

ABSTRACT OF CAPSTONE

Christine B. Boyd & Amy J. Staton

The Graduate School

Morehead State University

December 29, 2013

INTERACTIVE VIRTUAL SUTURING SIMULATIONS:
ENHANCEMENT OF STUDENT LEARNING IN VETERINARY MEDICINE

Abstract of capstone

A capstone submitted in partial fulfillment of the
Requirements for the degree of Doctor of Education in the
College of Education
At Morehead State University

By

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December 29, 2013

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This capstone addresses an instructional gap in the Morehead State University Veterinary Technology Program and in other similar programs around the globe. Students do not retain the knowledge needed to proficiently complete suture patterns nor do students receive sufficient instructional time during the year to master each suture pattern that is required of them. This is a common problem that is shared by other surgical training programs throughout the world. The Interactive Virtual Suturing Simulation (IVSS) is theorized to be a successful instructional tool at Morehead State University. The researchers project that this tool could be used as an instructional aid in several different veterinary training curriculums around the globe. The preliminary design processes leading up to the creation of an IVSS with a haptic add-on were completed. This project involved the review of collected data that established a need and basis for the design of the simulation. Extensive research was reviewed to determine the correct haptic add-on and instructional design. The expected outcome of this simulation is to aid as an additional learning tool and increase knowledge retention of suture patterns among all students.

KEYWORDS: veterinary education, simulations, haptics, 4C-ID, suture patterns

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DEDICATION

This capstone is dedicated to anyone who has found themselves in an unexpected place in life, but chooses to move forward in the journey against all odds. Choose joy.

Chris Boyd

This capstone is dedicated to my past, present, and future students. By learning from the past and working with the present we can all make the future brighter.

Amy Staton

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All my love goes to my foster parents, Barbara Bracy and Howard Neil, whose support, love, encouragement, and belief, has seen me through this process and my life's journey.

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Chapter One

Introduction

An instructional gap in the Morehead State University Veterinary Technology (MSU VT) Program has been found pertaining to suturing patterns and techniques. Students do not retain the knowledge needed to proficiently complete suture patterns nor do students receive sufficient instructional time during the year to master each suture pattern that is required of them. The MSU VT student survey results showed a significant learning gap in suturing technique retention and proficiency. Survey results (See Appendix A and Appendix B) revealed several areas of improvement that could be addressed through better instruction and time management. These results prompted the researchers to assess what was being done in the current curriculum and to investigate solutions that would promote the desired results. What is an alternative to current training techniques that may improve the suture patterns and techniques of the students in the MSU VT program and other similar programs around the globe? This capstone project includes processes of instructional design framework, storyboarding, and suturing videos for the Novice Level of the Interactive Virtual Suturing Simulation (IVSS) that will act as an alternative training tool within the MSU VT Program. The major goal of the IVSS is to provide MSU VT students with the opportunity to build upon and complement their classroom experience related to suturing in a way that heretofore has not been available to them.

The IVSS was designed for the MSU VT Program, but once produced could be used globally. Dependent on field testing of suturing technique competence by

MSU VT students, it is anticipated that the use of this IVSS could be used in programs outside the MSU VT Program. Initial measures of student competence related to IVSS may include in-class quizzes, laboratory assignments, and the Veterinary Technician National Examination (VTNE). Additionally, the impact of the IVSS on other veterinary programs could be impacted by the successes realized by the MSU VT students using the IVSS and awareness of the IVSS by professionals in other veterinary training programs.

Need

The MSU VT program identified suture patterns and techniques as a learning gap in the current curricula through student exams, surveys, and instructor observations, faculty and students. A survey was created, conducted, and compiled by the researchers to provide insight into current instructional practices along with common beliefs and opinions currently held by MSU VT students. The feedback from students in the MSU VT Program and questions posted by instructors of the MSU VT Program suggested that students do not receive sufficient one-on-one time with the instructor or sufficient time to master each suture pattern that is required of them (See Appendix A and Appendix B). Additional studies by Goff et al. (2001), Walsh, Osburn, and Schumache (2002), Dubrowski and MacRae (2006), Baillie (2007), Sutton (2007), and May and Head (2010), also revealed that suture patterns and techniques are a problem shared by other surgical training programs around the globe.

Accredited by the American Veterinary Medical Association (AVMA) since 1977, the MSU VT Program is located on a fully functional 350 acre farm known as the Derrickson Agricultural Complex. The faculty and staff include three full-time veterinarians and three full-time veterinary technologists. Morehead State University offers both an Associate and Bachelor degree in Veterinary Technology. Graduates of the MSU VT Program are eligible to take the VTNE for state licensure as a Licensed Veterinary Technician.

Currently, the MSU VT Program has only one instructor teaching the two-week suturing module. A review of class size from 2009–2013 in which suturing is taught indicates that the student-to-instructor ratio for laboratory periods average 15:1. The professional opinion of the instructor indicates that the two weeks allowed for this module is an inadequate amount of time for students to produce proficient suturing techniques. Additionally, the researchers theorize that the lack of practice and the condensed time frame provided to teach the suturing skills results in decreased comprehension and performance of each pattern. According to Hambrick et al. (2013), working memory is enhanced by practice. Proficiency demands dedication and the intensive honing of skills through hours of practice. In surgical fields the value of practice reveals itself through saving the lives of their patients. Once the IVSS is fully operational, it will allow for an assessment of this hypothesis.

An assessment is completed at the end of the current suturing module measuring the technical skill and knowledge of each student. The required suturing patterns which the students are tested over include simple continuous, simple

interrupted, ford interlocking, continuous horizontal mattress, horizontal mattress, vertical mattress, and cruciate. A portion of the assessment requires students to randomly complete one suture pattern on a phantom limb pictured in Figure 1.



Figure 1. Photograph of items currently used to teach suturing techniques. These items include thumb forceps, general surgical scissors, needle holders, suture material, and the phantom limb.

While the phantom limbs have been a regular part of instruction, they have outlived their usage. They are constructed of foam and a chamois cloth attached by duct tape. This tool deteriorates quickly with multiple uses. Faculty members in the MSU VT program have used phantom limbs for at least 12 years. These educational tools are unrealistic in that they neither look nor feel like animal skin or animal tissue. As noted previously, it is a goal to design an IVSS to increase students' suturing skills as compared to the skill level realized using the unrealistic phantom limbs.

Medical simulations, in general, aim to imitate real patients, anatomic regions, or clinical tasks and/or to mirror the real life circumstances in which medical services are rendered (Scalese, Obeso, & Issenberg, 2007). At Colorado State University College of Veterinary Medicine and Biomedical Sciences veterinarians have created a

product with synthetic body parts that look, feel and even bleed like real skin, muscles and vessels called “The Body Wall” (Krebsbach, 2011). Cornell University is using robotic pet simulators to expand training and reduce harmful animal use with sophisticated rescue mannequins and software programs (Cole, 2013). The Pulsating Organ Perfusion Trainer is a surgical simulator developed at the University of Arkansas that dispenses colored liquids into the veins and arteries of cadavers to offer a realistic alternative to live surgery (Aboud, Suarez, Al-Mefty, & Yasargil, 2004). These are a few examples of realistic simulations that are being used in the field of veterinary medicine that promote authentic experiences for students.

Since the MSU VT program uses fetal pig cadavers when available, it was important to research the benefits or non-benefits of cadaver use. Could the use of the IVSS eliminate any need for cadaver use? Cadavers have been used in veterinary educational facilities for many years because of the close to authentic experience provided through real flesh, but there are several limitations to their use. Because the specimens are dead, the tissue becomes more difficult to advance the needle through.

Students have limited time to work on cadavers. Unlike multimedia sources, where students could have access to the media at any given time, cadavers can only be used during normal facility hours in the MSU VT program. Students cannot remove the cadavers from the laboratory setting. This constraint limits the amount of time that students have to train on cadavers. With the use of a multimedia source such as an interactive DVD, students would have the opportunity to work with the specimen as much as needed and desired.

The cost of cadavers is comparable to the simulations that have been researched for this project. Cadavers that would be used in the VET 213 laboratory can range from \$30.00 to \$130.00 per cadaver depending on the desired species (Carolina Biological Supply Company, 2013). This is a cost that would be incurred on an annual basis to allow students access to cadaver usage.

When working with cadavers it is also important to store the animals properly to prevent decomposition. Because of the preservatives used, cadavers do not fully mimic that of a live body. If decomposition occurs, the practice of suturing becomes more unrealistic for the student. The suturing needle is difficult to advance and the tissue becomes dry and brittle.

Formaldehyde is the primary choice for cadaver preservation and this can provide problems for the VT student. There are several toxic effects that one may encounter when working with and around formaldehyde. Some of the effects include but may not be limited to irritation of the mucous membrane, contact dermatitis, allergic reactions, dry or sore nose and throat, running or congested nose, unusual thirst, itching of the eyes, redness of the eyes, excessive ocular drainage, nausea, headache, fainting, dizziness, tiredness, blurred vision, and respiratory distress (Dixit, Athavia, & Pathak, 2005, p. 209).

Formaldehyde is classified as a known human carcinogen by the International Agency for Research on Cancer and a probable carcinogen by the United States Environmental Protection Agency (Formaldehyde and Cancer Risk, 2011). Studies that have been conducted suggest an association between exposure of formaldehyde

and certain cancers, including nasopharyngeal cancer and leukemia (Formaldehyde and Cancer Risk, 2011). Due to the potential effects formaldehyde can have on students, the MSU VT program prefers not to use preserved cadavers. MSU VT instructors continue to look for new innovative instructional tools that do not put the students' health at risk. Even though ethically sourced cadavers are acceptable at most veterinary training facilities, most students and teachers prefer methodology that simulates the realness of a live animal and does not endanger or subject any of their students to harmful effects during their years of study.

Advanced technology can be an alternative to the elimination of cadaver usage. Technology allows instruction that can utilize three dimensional views of a specimen that almost seem touchable. Rather than working with the same species and scenarios, technology allows students to work with a large array of species, anatomical areas, and scenarios. With the use of an IVSS students should receive the same authentic experience with each session regardless of the species or scenario. These reasons clearly show that the IVSS would provide a safe and authentic alternative to the cadaver experience that the MSU VT program currently offers.

Along with the advanced technology that can be used to eliminate cadaver use, new and better methods have come about to avoid the use of live animals for training purposes. There is an increasing demand from both students and teachers to avoid methods of teaching and training that harm live animals (Martinsen & Jukes, 2005). To eliminate the over usage and harming of live patients, plastic models and life-like mannequins have been developed to provide veterinary students with clinical

skills training. These items help promote mastery of skill and give students valuable practice time in a stress-reduced environment. One of the aims of veterinary education is to create the best quality education while ensuring that animals are not used harmfully, and that respect for life is engendered within the student (Martinsen & Jukes, 2005).

In 2003, nearly every veterinary school in the United States was cited by the Department of Agriculture for failing to fully comply with the Animal Welfare Act (Nolen, 2004). The MSU VT Program was not one of the institutions that were cited. The Animal Welfare Act became law in 1966 and regulates how animals may be used in a variety of fields, including veterinary training programs (Animal Welfare Act, 1966). A 1985 amendment to the Act requires the principal investigator at veterinary institutions and other regulated entities to decrease animal suffering—when possible—by using alternatives to procedures "that may cause more than momentary or slight pain or distress to animals" (Nolen, 2004). The MSU Vet Tech Department works hard to comply with this amendment and stay updated to the latest procedures being used in the field of veterinary medicine. By doing so, the lives of animals are respected and the ethical principles of preserving life are instilled in the practices of MSU VT students.

MSU instructors constantly search for updated realistic alternatives to provide their students with authentic experiences while maintaining humane and ethical practices for their animals. Some updated alternatives implemented in the last five years include the purchase of Rescue Critter suturing arms (Valliyate, Robinson, &

Goddman, 2012), a Suturing Simulator (Smeak, 1989), and a Hollow Organ Simulator (Smeak, Hill, Beck, Shaffer, & Birchard, 1994). All of the alternatives used in the last five years have not proved to be of benefit for student learning based on limited use and lack of realism. The phantom limbs that are currently being used provide the same experience as these costly alternative simulations.

Student Proficiency Using Current Techniques

As previously noted, the MSU VT Program has identified a gap in instruction related to suturing patterns and techniques. As shown in Table 1, the MSU VT Program is competitive with the national average on the VTNE. However, the MSU VT Program strives for excellence and intends for their students to score beyond the VTNE national average.

Table 1

Comparison of MSU VTNE Surgical Nursing Scores Against National VTNE Surgical Nursing Scores

	2003	2004	2005	2006	2007	2008
MSU VTNE Score	514 (N=13)	535 (N=24)	492 (N=19)	482 (N=22)	521 (N=18)	535 (N=15)
US VTNE Score	543 (N=2771)	529 (N=3254)	493 (N=2690)	469 (N=4685)	494 (N=2051)	491 (N=4855)
Difference	-29	+6	-1	+13	+27	+44
	2009	2010	2011	2012	AVG	
MSU VTNE Score	484 (N=25)	480 (N=7)	527 (N=21)	458 (N=21)	502 (N=19)	

US VTNE Score	489 (N=5101)	500 (N=4873)	526 (N=4731)	494 (N=5369)	503 (N=4038)
Difference	-5	-20	+1	-36	-1

(Morehead State University, 2013)

Suturing as a surgical skill is a small section of the VTNE. This portion of the test also examines areas of asepsis, pre-operative and post-operative care, anesthesia, and surgical personnel responsibilities. Specific to the MSU VT program and objectives of the AVMA accreditation, the researchers looked closer at student knowledge in the form of student surveys and student assessment (See Appendix A). This survey asked MSU VT students how they felt about VET 213 and the current instructional methods that were used. Students were also asked about their experience with technology, simulations, and how they would perceive the implementation of simulation into the VET 213 module. The survey is given to each class at the end of the two-week suturing module.

Table 2 provides a detailed look at each suture pattern and retention of knowledge by each class. The data collected are one year post-instruction. As shown, students are not retaining the knowledge or skills to perform four of the seven patterns. The years 2009 and 2010 had a total number of three students that were tested over the suture patterns. When research began on this project students were asked to voluntarily take the exam but were not required resulting in low numbers.

Table 2

Percentage of Second Year Students Passing Suturing Pattern Tests One Year after First Year Instruction.

	2009 (N=3)	2010 (N=3)	2011 (N=16)	2012 (N=16)
Simple Interrupted	100% (3)	100% (3)	88% (14)	100% (16)
Simple Continuous	67% (2)	100% (3)	100% (16)	75% (12)
Ford Interlocking	0% (0)	67% (2)	69% (11)	69% (11)
Cruciate	0% (0)	100% (3)	38% (6)	50% (8)
Vertical Mattress	0% (0)	0% (0)	1% (1)	13% (2)
Horizontal Mattress	0% (0)	0% (0)	1% (1)	13% (2)
Continuous Horizontal	0% (N/A)	0% (N/A)	0% (N/A)	25% (4)

A review of the suturing exams given to first year MSU VT students indicates there was evidence for a need for change. In 2009, 19 MSU VT students participated in the suturing lesson and exam. Of those 19 students, 13 students did not meet the proficiency established by the instructor. Twenty-one students in 2010 participated in the suturing lesson and exam with 10 not attaining the instructor's desired skill level. In 2011, 19 students participated in the suturing lesson and exam. Upon examination, six students could not proficiently complete the suture pattern that was randomly assigned to them. In 2012, 19 students participated in the suturing lesson and exam. Upon examination, five students could not proficiently complete the suture pattern that was randomly assigned to them.

Since suturing proficiency is expected in veterinary practice, the suturing skills of students are a part of their final exam. Table 3 illustrates the struggle that some students in the MSU VT Program have with suturing technique by the assessing instructors on the final exam. The total number of students from each year differs in Table 2 and Table 3. Data from Table 1 was collected from second year MSU VT students. Data from Table 3 was collected from first year MSU VT students. Not all students were successful in the program from year one to year two. Students that did not perform at a 'C' or better could not continue in the program and therefore statistics varied. Data analysis from Table 2 and Tables 3 were created and conducted by the researcher.

Table 3

Assessment of First Year Student Skills Related no Suturing on the Final Exam

	2009 (N=19)	2010 (N=21)	2011 (N=19)	2012 (N=19)
Acceptable	32% (6)	52% (11)	68% (13)	74% (14)
Non-Acceptable	68% (13)	48% (10)	32% (6)	26% (5)

Comparison of Current with Planned Program

Currently, MSU VT students review a multimedia presentation, watch a live demonstration on a phantom limb, complete suture patterns on a phantom limb and on ethically sourced cadavers when available, and complete each pattern for review. The planned IVSS will provide an alternative to the use of cadavers and phantom limbs. Since the IVSS allows for on-going practice sessions it is anticipated that student suturing skills will be enhanced. Table 4 provides a comparison of current practices

and planned practices once the IVSS is implemented. The development of the IVSS ensures that no animals will be harmed in the process of suture practice. This alternative learning tool replaces harmful animal use and complements existing humane education.

Table 4

Comparison of Current Instructional Model to Proposed Instructional Model Using the IVSS.

Current Instructional Model	Proposed Instructional Model
Multimedia presentation	Multimedia presentation
Live demonstration by instructor	Live demonstration by instructor
Practice on phantom limbs	IVSS
Practice on cadaver pigs when available	
Exam	Exam

Description of the Project

The IVSS Novice Level will be delivered via interactive DVD with a haptic add-on. A haptic device makes it possible for users to touch and manipulate virtual objects (Sensable, 2013). The Haptic Cow (Baillie, Mellor, Brewster, & Reid, 2005), the Haptic Cat, a feline abdominal palpation simulator (Parkes, Forrest, & Baillie, 2009), the Glasgow Horse Ovary Palpation Simulator (Crossan et al., 2000), and the Core Skills Trainer (Baillie, Forrest, & Kinnison, 2010) are examples of haptic devices used in veterinary training. Because suturing requires the use of several skills at the same time (e.g., hand/eye coordination, knowledge of various types of suturing, and how tissue responds to suture needles), the content of the storyboards and

instructional framework will follow the guidelines found with the Four Component Instructional Design (4C/ID) model. The 4C/ID model, discussed further in Chapter 2, provides a framework for scaffolding practice and just-in-time information that addresses Cognitive Load Theory with a complex technical skill.

The IVSS will require students to determine what suture, instruments, and pattern to use that will result in the best outcome for the patient. The IVSS Novice Level will provide the students with opportunities to work with different scenarios and respond to situations that involve suturing on real animals. Students will be presented with different scenarios needing surgical assistance with the intention of promoting critical thinking and problem-solving skills. Different levels of difficulty will be provided to develop student skills needed for the simple to more complex suturing situations. Students will have the opportunity to make both correct and incorrect decisions in a safe environment designed to increase the skills required of competent veterinary technicians. The haptic add-on will allow students the feel of suturing depth and tissue resistance providing realistic practice without the use of live animal tissue.

IVSS is an alternative to current training techniques that may improve the suture patterns and techniques of the students in the MSU VT program and other similar programs around the globe. Based on the survey results of participating students of the MSU VT Program, the IVSS is expected to be an engaging educational tool. It is hypothesized that continued practice within the IVSS will

promote higher suturing proficiency and will be a successful training alternative for any learner that uses it.

Chapter Two

Review of Literature

Introduction

New training techniques are needed to develop veterinary technology student efficacy in the vital skill of suturing. When introducing a new teaching process or tool into the curricula, there needs to be an investigation of the various aspects of the pedagogy, application, and the science behind this new process. Research into simulations and haptics, cognitive thinking and learning process, and instructional design methods were logical choices towards investigating new training techniques that would produce effective results towards better suturing proficiency. This research supports the design of a framework for an IVSS instructional tool which is the key goal of this capstone.

Simulations

Technological advances over the past ten years have opened up many different venues for surgical teaching (Marina Del Rey, 2004). Satava (2009) shares that technological advances are touching every aspect of medical education.

The introduction of simulations and virtual reality in training provides a place to gain surgical experience without putting patients at risk. Patow (2005) stated that hands-on applications are indispensable; however, the safety of the patients outweighs the risks of learning. While refining skills, simulation allows the learner to gain confidence when performing skills on actual patients (Bailey, Johnson-Russell, & Lupien, 2010). In the medical field, simulation education advocates that students

learn procedures and treatment protocols before working with real patients (Aggarwal et al., 2010). In medical fields such as veterinary medicine there is no room for error when working with real patients so practice is a priority. Early practice during the course of training provides more opportunity to refine skills and to correct mistakes made in a safe simulation environment.

In his research, Patow (2005) indicated that exposing students to common medical cases early in their training leads to a quicker learning curve. A simulation environment “allows students and providers to learn, practice, and repeat procedures as often as necessary in order to correct mistakes, fine-tune their skills, and optimize clinical outcomes” (Patow, 2005, p. 1). In a clinical simulation students and residents can gain experience with various types of patients and cases that they might not encounter during their rotations and shifts. IVSS allows for this type of clinical environment. VT students using IVSS will have multiple opportunities to practice and repeat procedures in order to both correct mistakes as well as to gain skill and confidence in completing suturing techniques.

Ever increasing technological advances allow for more and more realistic simulations of real-life events. In research conducted by Issenberg and Scalese (2008), it was noted that computer simulations can be incorporated into curricula to prepare students before performing tasks on real patients. Simulations can help students plan, gain tactical skill, confidence, and knowledge of the procedure prior to working on live patients rather than requiring students to work under the extreme pressures of learning a task for the first time on real patients (Durham & Alden,

2008). Satava (2009) concludes that the power of simulations is that they give permission to fail in a safe environment (the laboratory setting) so students learn from their mistakes.

Simulations provide a learning model to complement traditional learning in medicine. Exposure to simulations can ensure that medical residents have exposure to emergencies, even if they are only simulated scenarios. For the implementation of procedures, it has been shown that the volume of experience decreases patient complication rates (Florea, Talu, & Talu, 2009). Simulators do allow for the development of experience prior to performance of these procedures on patients (Lateef, 2008, p. 3). Studies by Spinello and Fischbach (2008), Shapiro et al. (2004), Lateef (2008), and Gupta et al. (2008), support the effectiveness of a simulation, and the positive reinforcement it can have to the traditional classroom lecture. The intended use of the IVSS is to compliment traditional classroom lecture and provide an opportunity for repeat practice. Practice does not have to be done during classroom time and can be done in a simulation that is accessible to the student when and where it is convenient for them. The following study showed that there was no significant difference in the performance of the students who practiced in a regular classroom environment and for those students who practiced in an interactive simulation.

In the Wahlgren, Edelbring, Fors, Hindbeck, and Stahle, (2006) study completed by the medical program at Karolinska Institutet, an interactive simulation was created to provide virtual patients for the medical students. The simulation

provided authentic cases with images, medical history, examinations, investigations, and diagnosis. Students were placed into two groups; one group used the traditional classroom and the second group used the traditional classroom with the simulation as a supplemental learning tool. Students completed an examination at the end of the course. Results indicate that those students participating in the regular classroom produced a lower average percentage of 87.3% versus 88.8% for students participating in the interactive simulation (Wahlgren et al., 2006, p. 6). This study showed that there was no significant difference in the performance of the students, thus there was no real difference between regular classroom participation and participation in an interactive simulation.

Repeated opportunities for practice that promotes proficiency prepares students for unexpected events, developing communication skills, increase in confidence and improved performance. These are all positive outcomes that have been found when using simulation as a supplemental learning tool (Lateef, 2010). Simulation training reinforces fastidious attention to detail (Patow, 2005). In order to have a successful learning environment for any type of medical student, the cases must be relevant, realistic, engaging, challenging, and instructional. According to a study by Huwendiek et al. (2009) “interactive virtual simulations of patients must provide feedback, different levels of difficulty, multiple learning strategies, clinical variation, defined outcomes, and must be used within a controlled environment” (p. 581).

Simulators are tools for surgery, critical care, and some clinical skills practice. Simulators range from suture trainers and surgery practice devices to computerized patients (Jukes & Martinsen, 2007). Simulations significantly improved practitioner performance (Colt, Crawford, & Galbraith, 2001) and were superior to traditional training methods in the acquisition of procedural skills. Simulators in their current form have been demonstrated to improve the operating room performance of surgical residents (Roberts, Bell, & Duffy, 2006). Objective scores and trainee self-ratings suggest that a structured curriculum using simulator training allows junior medical students to achieve proficiency in basic surgical skills (Naylor et al., 2009).

Authentic experiences. A goal of the IVSS is the incorporation of authentic experiences so VT students can transfer the suturing skills learned in their training program to real world, clinical environments. It is important to provide access to a variety of species and anatomical body parts for practice within the simulation. It is also essential to use non-animal methods of training to demonstrate known facts or teach skills to maintain a respect for life. Since VT students will be able to use the IVSS for an unlimited amount of time, the researchers hypothesize that these students will gain the same benefits as the Gruber and Dewhurst (2004) study. This study focused on the success of computer simulations in student preparation before performing tasks on real patients. Results of this study revealed no significant evidence between students who trained on simulations were less capable or qualified than students that trained on real specimens.

According to Jacobson et al. (2009), using virtual patients enhance integration and student learning. When virtual patients, whether human or animal, are added to the curricula of medical students, the instructor allows students to prepare themselves before they begin their experiences with actual patients in clinical settings. Students build awareness and confidence while working in a risk free environment.

“Simulation has also begun to change much of the ways in which medicine is taught and how trainees and junior doctors obtain their relevant skills” (Lateef, 2010, p. 348).

Simulations allow the user to experiment with different scenarios, crises, and life- threatening issues all while allowing users to feel submerged in the experience firsthand without all the risks. “It is a technique (not a technology) to replace and amplify real experiences with guided ones, often immersive in nature, that evoke or replicate substantial aspects of the real world in a fully interactive fashion” (Lateef, 2010, p. 349). Learners can experiment with different responses, whether incorrect or correct, and understand what happens with each response. According to Kilmon, Brown, Ghosh, and Mikitiuk (2010) this experimentation is unacceptable in an actual clinical setting, but could provide a valuable learning experience in the virtual environment where there is no risk of injury or death.

The studies summarized above suggest that virtual patients in a simulation allow students to better prepare themselves for actual patients in clinical settings as compared to learning environments which do not provide a more realistic learning environment. The IVSS will provide a venue for experimentation and practice that is

synonymous with critical thinking and problem-solving. VT students are required to use critical thinking and problem solving on a daily basis. It is important for students to not only understand how to perform certain procedures, but the logic and reasoning behind that procedure. Students must know how to perform, but also know why they are performing particular procedures.

The Novice Level that is a part of this capstone will include eight different case scenarios with a variety of problems. It is anticipated that the completed IVSS will have as many as 24 different case scenarios with a variety of species and anatomical parts. The Kilmon et al., (2010) study concludes that a variety of case scenarios expose students to authentic experiences that could not be replicated on a campus setting, but could be presented in a real-life clinic.

Enhancement of instruction. “The simulated environment allows learning and re-learning as often as required to correct mistakes, allowing the trainee to perfect steps and fine-tune skills to optimize clinical outcomes” (Shapiro et al., 2004, p. 420). The IVSS as a virtual training environment would allow the learner to undertake a well-defined task of suturing at a set difficulty level with opportunities for repetition and correction of errors.

A simulation provides a learning model to complement traditional learning in medicine. Exposure to simulations can ensure that medical residents have exposure to emergencies, even if they are only simulated scenarios. Simulators do allow for the development of experience prior to performance of these procedures on patients. (Lateef, 2008, p. 3). Studies by Spinello and Fischbach (2008), Shapiro et al. (2004),

Lateef (2008), and Gupta et al. (2008) all support the effectiveness of a simulation, and the positive reinforcement it can have to the traditional classroom lecture.

According to Aldrich (2009) student testing is as much about evaluating methodology as it is about the understanding of content. It is an ongoing challenge to create interactive environments that measure timing, balance, judgment, and critical thinking. There are many approaches to assessment that revolve around the core learning goals and program goals (Aldrich, 2009). Many suggest that simulation-based learning enhances efficiency of the learning process in a controlled and safe environment (Grantcharov et al., 2004). Students who go through simulation experiences seem to understand concepts extremely well, so evaluations providing students the ability to determine what to do may be a better measure of what is taught (Aldrich, 2009).

Principles of virtual patient simulation. A study by Huwendiek et al. (2009) examined what students perceived as the ideal features of VP design in order to promote learning. Ten principles of VP simulation design emerged from the analysis.

A VP simulation should be relevant, of an appropriate level of difficulty, highly interactive, provide specific feedback, make optimal use of media, help students focus on relevant learning points, offer recapitulation of key learning points, provide an authentic web-based interface and student tasks, and include questions and explanations tailored to the clinical reasoning process. (Huwendiek et al., 2009, p. 583)

These guidelines help in the decision-making process of choosing an instructional design model. They narrow the selection of theories and models that promote authentic experiences and deal with the components of teaching a complex skill. The IVSS must have these components throughout the design as they focus on each suturing pattern. These guidelines suggest methods to use to attain the goals of the IVSS.

Feedback is important in any field of study and will be an essential component of the IVSS. Recognizing and correcting mistakes is crucial to any learning process (Shepard, 2000). When working in the medical field, it is fundamental not to repeat mistakes due to the risk of death. When using virtual patients, students can practice and build on their skills and prevent making life or death mistakes. This allows students to visualize their strengths and weaknesses and not be afraid of making mistakes.

Post-test study results by Beal, Johnson, Dabrowski, and Wu (2005) indicated that feedback led to stronger learning outcomes. MSU VT students will be using IVSS on their own without the benefit of instructor input or feedback. It is essential that student practice is correct and that students are provided with corrective feedback when students make errors in completing assigned tasks. Feedback necessary for learning needs to be built into the program and carefully constructed. The goal is to improve skill, but feedback can also be an important indicator of the IVSS fulfilling its intended purpose.

According to Schmidt and Wulf (1997), feedback is usually a powerful variable for facilitating performance while it is being presented. Immediate feedback has been shown to keep the learning process efficient (Mathan & Koedinger, 2003).

Research by Rieber (1996) revealed that “subjects learned more tacit knowledge when provided with animated graphical feedback, than in textual feedback, although gains in explicit understanding of these scientific principles did not depend on the way feedback was represented” (p. 5). The Clark and Dwyer (1998) study examined the effects of different types of computer-assisted feedback strategies. Their findings indicated that there was a positive correlation between achievement and response confidence when feedback strategies were applied. This underscores the importance that the instructional design of the IVSS contains sufficient elements of guidance and feedback to the student.

Gordon (2003) stated “that many opportunities in medical education are wasted if they are not accompanied by feedback” (p. 543). In the setting of clinical medical education, feedback refers to information describing students’ performance in a given activity that is intended to guide their future performance in the same or in a related activity (Ende, 1983). Without feedback mistakes go uncorrected, good performance is not reinforced and proficiency would not be achieved. Feedback becomes important when students get insight into what was done correctly as well as what was done in error (Stiggins, Arter, Chappuis, & Chappuis, 2004).

A study by Bearnson and Wiker (2005) at Brigham Young University used a human patient simulator (HPS) that would mimic several different human clinical

experiences. In the classroom, students learned about different effects and responses they might encounter when working with individual patients and medical conditions. When using the HPS, students could work on patients with varying health conditions and use different medications to evaluate the effectiveness of each drug on each patient scenario.

At the end of the study students were given a brief survey using a four point Likert-scale of 1 (strongly disagree) to 4 (strongly agree) to determine students' perceptions of the learning experience. Students in the study indicated that their confidence in skills increased, a better understanding of the importance of performing a thorough assessment, recognizing abnormal findings, and critical thinking improved after the simulation activity. Students also indicated that they liked being able to hear and recognize heart murmurs, abnormal breath sounds, and other findings not always present in a live healthy patient. This study showed that the human patient simulator offers a new medium for feedback, with safe and effective experimental learning (Bearnson & Wiker, 2005).

Suturing skills. Suturing requires many technical skills including eye hand coordination, reaction time, manual dexterity, and depth perception. Simulation is an important model to stimulate cognitive and perceptual motor skill learning (Stanney, Hale, Nahmens, & Kennedy, 2003). In suturing, there is a high degree of eye hand coordination that must be done with automaticity. Simulation has proven to be effective when developing hand eye coordination and ambidextrous maneuvers (Patow, 2005). Simulation is essential in developing skills in procedures that require

eye–hand coordination and in those that call for ambidextrous maneuvers (Gupta et al., 2008).

These studies point out that the design for practice must promote hand-eye coordination throughout each suturing module. Each suturing pattern has its own unique management of suture needle, with regard to angles and advancement. It demands the use of two hands, an ambidextrous maneuver, when using the hemostat and forceps. This movement continues with the gentle handling of tissue while performing suturing closure.

Haptic Technology

Initially haptic research was focused largely on the problem of sensory substitution, converting imagery or speech information into electric or vibratory stimulations on the skin, but today, haptics are thought of as an add-on to the user interface (SINC, 2011). Haptic interfaces are devices that enable manual interactions with virtual environments (Srinvasan, 1995). They are used in video games with force-feedback joysticks, the buzz of our cell phones, and devices that are helping doctors conduct surgeries. People have formed reliable mental models of how certain software interfaces should work such as keyboards and mice, touchpads, and touch screens (SINC, 2011).

Haptics is sensing and manipulating through touch (Srinivasan, 1995). For the purposes of the IVSS aspects of computer haptics need to be employed. Computer haptics is concerned with algorithms and software associated with generating and rendering the touch and feel of virtual objects (McLaughlin,

Hespanha, & Sukhatme, 2002). Multiple disciplines from biomechanics, neuroscience, psychophysics, robot design and control, mathematical modeling, and simulation and software engineering converge to support haptics (Srinivason, 1995).

Since the early twentieth century students have been exposed to the arrival of digital technology. Various forms of technology have completely transformed the way they learn. Children who have grown up with technology are known as digital natives because they have spent their entire lives surrounded by and using computers, videogames, digital music players, video cams, cell phones, and all the other toys and tools of the digital age. Today average college grads spent less than 5,000 hours of their lives reading, but over 10,000 hours playing video games and computer games, email, the Internet, cell phones, and instant messaging are integral parts of their lives. (Prensky, 2004, p. 1)

Through the use of technology, digital natives receive information quickly and have little tolerance for delays. They also prefer games to serious work and like to receive instant gratification and frequent rewards (Smith & Caruso, 2010). A report by Rosser et al. (2004) suggests that because of the type of dexterity required in some video games, as a whole video game players may be better laparoscopic surgeons than non-gamers.

According to Hamza-Lup and Stanescu (2010), a study performed at Richmond Hill High School in Richmond, Georgia introduced students to a haptic simulator in a physics course in 2007 and 2008. Eighty-four students at the school were divided into four classes. Half of the students used the simulation and the other

students used classroom lecture and homework. Survey results indicated that 94% of 42 students who used the simulation with a 3D game had a strong interest in using more simulations as a learning tool for other physics models. Test scores indicated that students using the simulation had better test scores and a higher level of engagement than students strictly using the traditional classroom.

Since haptics is the science of merging tactile sensations with computer applications, educators who facilitate learning for students in the health professions can use this technique to promote deep and applied learning required for providing patient care in today's complex health care settings (Kheddar, Gourishankar, & Evrard, 2008).

Competence for technical tasks has become an important issue within the medical profession in recent years. A benefit of virtual simulation training is to enhance surgical proficiency of novice surgeons from "pure novice" to "pre-trained novice" (Park et al., 2011).

Virtual reality technology provides the user with different kinds of technology (visual, haptic, auditory, etc.) to create a sense of presence in the virtual world (Seth, Su, & Vance, 2005). Because most students in the MSU VT program are digital natives and have used technology to complete tasks throughout their lives the researchers of this capstone predict that the presence of auditory, visual, and sensory information through a simulation and increased opportunity for practice will lead to the further enhancement of suturing skills that are used in veterinary clinics throughout the country. These studies also make clear to the researchers that game

play promotes a practice venue for ambidextrous movement, a skill that would seem to prove beneficial when suturing. Gamers use two hand manipulations with game play and so this maneuverability becomes automatic with time (Patow, 2005).

A randomized, double-blind study in the United Kingdom showed the use of virtual reality surgical simulation to reach specific target criteria significantly improved the operating room performance of residents during laparoscopic cholecystectomy. This documentation of transfer of training skills from virtual reality to the operating room sets the stage for more sophisticated uses of virtual reality in assessment, training, error reduction, and certification of surgeons (Seymour et al., 2002).

A haptic interface transmits forces to a person's hand or fingers in a way that mimics the sensation of touching real objects (Rassmus-Gröhn, 2008). Haptic devices provide capacity for both input and output capabilities, in contrast to keyboards which provide dedicated input capacity, or visual displays, which provide only, output capacity (Proctor, Tan, Vu, Gray, & Spence, 2005). Many commercial haptic devices reside with the desktop.

Two haptic desktop model devices that are popular and least expensive come from SensAble. They include the PHANToM Omni and PHANToM Desktop collections. The PHANToM interface permits users to feel the forces of interaction they would encounter while touching objects with the end of a stylus or the tip of their finger (Jarillo-Silva, Ramírez, Vega, & Oliver, 2009). SensAble has worked with over 22 universities to create successful haptic training devices in a number of

curricular fields. The researchers chose the PHANToM Omni to interface with the IVSS due to cost and mechanical specifications.

The purpose of practicing on models and simulations is to prepare students for live-animal surgery and practice. Lian and Chen (2006) verified that human and animal figures could be accurately generated by simulating the muscle action and resulting forces propelling the figure. Manual dexterity and surgical proficiency can be mastered on inanimate objects with the pressure and anxiety felt during the live animal laboratories (Greenfield et al., 1994).

Many medical applications require motor-skill training that traces a path. A successful haptic interface requires several essential components to make it successful. It needs a real-time function that will bring the user back to the right path, the effect of the path's curvature on tracing and the amount of haptic force needed for guiding the user properly (Zarei-nia, Yang, Irani, & Sepehri, 2009). Motor skill learning requires motivation, practice, learning strategies, and guidance techniques (Zarei-nia et al., 2009). The physical guidance is of the utmost importance because if a learner is unable to trace and stay on a path, he or she will not learn the properties of the trajectory.

Research by Greenfield et al. (1994) and Zarei-nia et al. (2009) underscore the importance of providing feedback. This is essential in the creation of the IVSS. As part of the scaffolding practice, visual and audio cues will be available to the student as they attempt to master the correct suturing path on wound closures. This will occur with distance between individual throws, known as bite spacing. Each

completed suture pattern should have an appropriate amount of space between each throw of the suture material. This amount of space between each thrown should be equal to the distance from the incision line to the bite. With continued mastery, the scaffolding will be diminished, until the student can finally perform the suture pattern correctly without any form of support or guidance. Students will experience a real-time feedback in order to correct bad techniques that could develop from self-practice.

Doyle, Gauthier, Ramanathan, and Okamura (2008) state that virtual reality simulators have proven highly effective in developing laparoscopic minimally invasive surgery (MIS) skills. The EyeSi, from VR Magic, Inc. is a haptic surgical device that helps train surgeons with cataract surgery. The haptic device serves as a practice tool. It is not exact, since the eye is a delicate organ to replicate graphically, but the practice and concepts of how to move the tools within the eye and how the tissue responds to force remain the same as a true surgery would be.

Research by Gillespie et al. (2008) showed the importance of simulation in the training of open suturing. Most suturing simulations have been low-tech models, but simulations have evolved to have features including data logging, display of concurrent and summary performance feedback, and playback for review and debriefing.

The literature provides no firm consensus on the importance of haptic feedback in performing minimally invasive surgery (Van der Meijden & Schijven, 2009). Some generalized results were assessed according to the level of evidence

through the Oxford Centre of Evidence-based Medicine Levels of Evidence.

According to Van der Meijden and Schijven (2009) although a majority showed positive assessment with the benefit of force feedback, overall results were ambivalent and not unanimous.

However, there are some research studies that do point to improved training results using haptic devices. Results from Strom et al. (2006) and Lamata et al. (2006), suggest that the addition of haptic feedback in an early training phase may improve the trainee's performance by enhancing the trainees' sensory perception capabilities and thus facilitating transfer of skill from simulation to the operating room.

A concern of the IVSS is to provide appropriate and realistic feedback to the student through visual, auditory, and haptic means. Knot-tying is a skill that is taught as a part of the suturing module. In a study by Van der Meijden and Schijven (2009) they discussed strategies to assess knot-tying when using haptic devices. They noted:

The haptic feedback during knot-tying was supplied in the form of a visual color on a bar scale, which changed colors when different forces were applied. The use of visual and auditory feedback of force levels combined has been found to improve consistency of applied forces during the knot-tying, even more consistent than those being hand-tied. (p. 1185)

According to Baran, Johnson, and Kehler (2009), "The animal research community faces a shortage of surgical training opportunities along with an increasing demand for expertise in surgical techniques" (p. 311). There are very few

published reports on simulations in veterinary medicine. Baillie, Crossan, Brewster, May, and Mellor (2010), Smeak (2007), Baillie (2007), Van der Meijden & Schijven (2009), and Baillie et al. (2005) are noted authors who published studies of simulations in veterinary medicine contrasted with the many hundreds of articles in the human medical education literature dealing with various applications of these modalities for teaching and learning (Scalese & Issenberg, 2005).

Veterinary medical education is a much smaller enterprise than its' human counterpart. Veterinary medical education is broken into two areas of veterinary schools and veterinary technician programs. Graduates of a college of veterinary medicine complete with a Doctorate of Veterinary Medicine (DVM). Students from a Veterinary Technology program may complete with a two year or four year degree, which allows them to assist a veterinarian in the performance of animal health care. There are 126 US and 16 Canadian medical schools compared to 30 US, four Canadian veterinary schools. Of the 218 Vet Tech programs across the nation, only 22 offer a four year Vet Tech degree. These training facilities in veterinary medicine have a lower faculty ration than their human medicine counterparts and correspondingly less funding. Although there are countless simulations used in human medical training, there are not many animal simulators designed specifically for use in veterinary education (Scalese & Issenberg, 2005). The following examples below give insight into current simulations with haptic that are being used in the field of veterinary medicine.

Smeak and his colleagues at the Ohio State University College of Veterinary Medicine did some of the earliest work with simulators for teaching surgical skills (Smeak, Beck, Shaffer & Gregg, 1991). Educators employed by the Royal Veterinary College, Herefordshire, United Kingdom, have been doing extensive research and development in the field of haptic technology (Baillie, 2007). The University of Glasgow Veterinary School has developed alternatives to invasive examinations on animals with their horse ovary palpation (Crossan, Brewster, Mellor, & Reid, 2003) and haptic cow simulators (Baillie et al., 2005).

The Inwound Trainer was one of the first of its kind as a human medical suturing simulator. The device was comprised of a control and computer display with support for an electrically activated needle-holder and a simulated tissue pack that could be mounted on a mannequin-type arm (Holbrey, 2005). A study using this device (Salvendy & Pilitsis, 1980) tested the device with 36 novice medical students. Salvendy and Pilitis (1980) concluded that the results should encourage the use of the Inwound Trainer as an inexpensive and effective training instrument.

The Boston Dynamics Incorporated Surgical Anastomosis Simulator allows users to practice the task of suturing tube-like organs together (Raibert, 1998). It incorporates two PHANTOM devices that hold real surgical tools promoting bimanual interaction. The user can have an instrumented needle holder in one hand and forceps in the other. Through the VR, the user can grasp and stabilize a tube using the forceps while puncturing the tube with the needle held in the jaws of the needle holder. The user sutures the vessels using standard curved needle technique.

The force-feedback gives the user the feel of the surgery while the visual images of the interaction are displayed through the 3D computer graphics. Writings by Reznick (1999) provided an editorial on the results of tests done using the Boston Dynamics Incorporated Surgical Anastomosis Simulator that were less than conclusive. The development of this simulator has been suspended (Holbrey, 2005).

The Computer and Mathematics Department of Millersville University and Penn State's Hershey Medical Center collaborated on the development a haptic suturing simulation. The goal of this joint research was to develop software for use in simulating a suite of surgical procedures. Medical students and surgeons would be able to test their skills using a virtual reality surgical simulator that provides sensitive touch feedback along with realistic 3D imagery. Needle holders were attached to the haptic device as the graphics of the needle-holder; needle, sutures, and virtual skin are displayed and updated in real time. The simulator incorporates several components such as real-time modeling of deformable skin, tissue and suture material and real-time recording of state of activity during the task using a finite state model (Webster, Zimmerman, Mohler, Melkonian, & Haluck, 2001).

The Inwound Trainer (Holbrey, 2005) introduced a concept similar to haptics. The use of a control and computer display paved the way for more innovative ideas involving tissue and a realistic environment. The Boston Dynamics Incorporated Surgical Anastomosis Simulator proved that the incorporation of PHANToM devices could give the user the feel of surgery while visual images were displayed through a

computer program. These human medical training devices share the same conceptual ideals that the IVSS hopes to accomplish.

Tzafestas, Birbas, Koumpouros, and Christopoulos (2008) note that the design of a successful suturing simulation rests on the inclusion of a 3D workstation containing 3D graphics rendering dynamic re-meshing, collision detection and response and contact with deformation modeling. This connects the haptic device (PHANTOM desktop) to a haptic control library and the ability to display force computation algorithms (Tzafestas et al., 2008). The simulation was considered to be realistic by the experienced group. The group one users agreed that the simulation helped acquire the basic skills needed and enhanced their performance. Statistical analysis of the results showed that the VR-based simulator was a reliable assessment for the clinical skills needed based on objectives metrics and performance scores automatically generated by the system. The presence of the haptic display improved the learning rate for the novice users. “The activation of haptic display had a statistically significant effect on skill assessment performance of the system as deduced by a comparative analysis of the scores obtained between novice and experienced users” (Tzafestas et al., 2008, pp. 215-216).

Authors Issenberg, McGaghie, Petrusa, David, and Scalese (2005) wrote a detailed systematic, review of the literature in the Best Evidence Medical Education (BEME) Collaboration, (spanning 34 years and 670 peer-reviewed journal articles) identified 10 features and uses of high-fidelity medical simulations that lead to effective learning They are:

1. Feedback is provided during the learning experience
2. Learners engage in repetitive practice
3. The simulator is integrated into the medical curriculum
4. Learners practice with increasing levels of difficulty
5. The simulator is adaptable to multiple learning strategies
6. The simulator provides clinical variation
7. The simulator is embedded in a controlled environment
8. The simulator allows for individualized learning
9. Outcome measures are expressed clearly
10. The simulator is a valid high fidelity approximation to clinical practice (p. 26)

These guidelines are important to the creation of a successful IVSS. As researchers looking for meaningful training experiences for MSU VT it is important to note that successful veterinary computer simulation should always be complemented by non-harmful practical experience with “live animals, so that technology is kept as a powerful tool, not an alternative to reality” (Martisen & Jukes, 2005, p. 459).

Current Veterinary Technology Instructional Practices

With the rise of concerns – ethics, expense, and availability – over the use of cadavers in veterinary medicine, there is a need to move towards the use of the 3Rs: reduce, replace, and refine (Kinnison, Forrest, Freat, & Baillie, 2009). Yet the effective real-time training of veterinary technicians and doctors in invasive

procedures is critical. Assessing the acquisition of the dexterity and skills required to safely perform such operations is difficult to perform objectively and reliably (Tzafestas et al., 2008). Simulation-based medical education can be a platform for “learning to mitigate ethical tensions and resolve practical dilemmas” (Lateef, 2010, p. 348). According to Valliyate et al. (2012) “veterinary programs throughout the world have moved away from the traditional classroom towards the combination of the traditional classroom and computer simulations, haptic trainers, video demonstrations, virtual reality, plastic models, manikins, ethically sourced cadavers and plastic specimens” (p. 326).

Ethically sourced cadavers are defined as those animals that have been euthanized for pre-existing medical conditions or have died of natural causes (Knight, 2008; Knight, 1999). Using live animals or cadavers can be a great experience for the student, but does not allow for sufficient repetition to allow the student to become proficient and confident in a given task without using a large number of animals. The use of simulations, plastic models, and video demonstrations in instructional methods is being used to not only supplement traditional learning but reduce and replace the use of animals (Valliyate et al., 2012). According to Greenfield et al. (1994) the “advantages of models over the live animal include the availability of models at all times; that all students can perform each procedure (rather than being surgeon, assistant surgeon, or anesthetist as is currently done in live-animal laboratories); and that procedures can be repetitively practiced until an acceptable level of proficiency has been reached (p.5).

Knight (1999) reviewed work at Murdoch University and found that “Between 1994 - 1997, Murdoch University used 2,952 animals in teaching experiments and among those 2,952 animals an average of 1,814 died” (p. 968).

Incorporating humane teaching practices not only save a tremendous number of animal lives, but also increases legislative compliance to minimize the harmful use of animals, improve teaching efficacy, decrease economic pressures, decrease dangers of legal liability and negative publicity, increase empathy of the students toward animals, and increase positive attitudes toward animal welfare (Knight, 1999; Knight, 2008). According to Wood, Hart, and Weng (2005) studies at many veterinary schools over the past 30 years, has led to improvements in instructional methods, reducing the use of live animals or cadavers, while conserving a high-quality learning environment for each new wave of veterinary students.

Bauer (1993) designed a questionnaire to gather information regarding the use of live animals, cadavers, inanimate models, and other innovative methods to teach veterinary surgery. It was mailed to individuals in the surgery sections of all 31 veterinary schools in the United States and Canada. This 1993 study received completed and returned forms from 27 of the universities mailed. Although live animal use is still a practice at these institutions the survey results indicated a growing trend towards the use of simulations, models, and ethically resourced cadavers.

As a general rule, surgical courses within veterinary schools are commonly comprised of several stages. Students begin by learning the basic suturing skill and instrument handling using knot-tying boards such as carpet pads, plastic organs, and

other similar products (Knight, 2008). After students grasp the basic concepts they move on to a cadaver model. Lastly, students observe, assist, and perform the necessary surgical procedure on an anesthetized patient under direct supervision (Knight, 1999).

Current Simulations in Veterinary Medicine

There are a number of different suturing simulations on the market today that allow repetitive practice, but do not provide a variety in species, anatomical parts, or scenario. This section of the literature review is dedicated to simulations that are currently being used in veterinary medical programs to eliminate the use of animals. Although these simulations eliminate the use of animals and allow students to learn and practice at their own pace, many do not provide immediate feedback to promote student performance.

Colorado State University (CSU) has developed an artificial tissue that closely resembles skin, connective tissue, muscle, and blood vessels of an equine abdomen (Colorado State University, 2010). This new artificial tissue is composed of multiple layers of silicone with realistic blood vessels (Colorado State University, 2010). The blood vessels are strategically placed, sized, and connected to an artificial blood source, giving the suturing experience a realistic component.

When using simulations such as the artificial tissue created by CSU, student stress levels drastically decrease. Students can improve their technique, dexterity, and confidence by using the simulations before operating on someone's live pet (Colorado State University, 2010). The added benefit of the artificial blood vessels

makes this simulation increasingly attractive, because of the realism. The artificial blood vessels provide students with the experience of hemostasis that they could not receive with other simulations that are on the market. The unfortunate side to this simulation is that learners have the same simulation every time the student practices on the abdominal wall. Students do not have the opportunity to work with different scenarios or anatomical parts of the body. Students do not receive any form of immediate feedback. The artificial tissue lifespan is limited. Students in the initial stages of learning are more likely to apply too much tension and tear through the silicone with their instruments and suture material. Once a blood vessel is incised and ligated by suture, that area is unusable. A new incision will need to be made to provide an additional learning experience.

With this limited use of the artificial tissue comes a financial burden. The cost of the artificial tissue, with blood vessels, is \$140 per 20 x 25cm simulation (SurgiReal, 2013). To allow the student ample practice time the cost is considered per student. With a total of 20 students in each of the two laboratories this would cost the MSU VT Program on average of \$5,600 per year.

Students at Ohio State University (OSU) learn suture patterns on a variety of items. During the students' second year of veterinary medicine they begin learning and practicing suture patterns, techniques, and instrument handling on the Skin and Suture Pattern Simulator created by Dr. Daniel Smeak (Smeak et al., 1994). This simulator is a flat laminated urethane polymer top layer that mimics the dermis and a subcutaneous tissue layer composed of foam (Norecopa, 2012a).

Students also have the option during this time to work with the Hollow Organ to gain additional experience. Much like the Skin and Suture Pattern Simulator, the Hollow Organ is laminated polyurethane designed to mimic the stomach (Norecopa, 2012b). Both simulators are reusable for a limited time. Handling the polyurethane tissue too roughly or applying too much tension will rip suture material through the simulator and that area can no longer be used. During the student fourth-year of veterinary school they work with local shelters to gain hands-on experience with live animals (Smeak et al., 1994). This set-up of teaching student suture patterns is quite similar to the current method of instruction within the MSU VT Program.

The drawback to the Smeak simulations is similar to those with the CSU artificial tissue. Students experience the same simulation every time with no difference in species or anatomical parts. If students take the simulators home to practice, they will receive no immediate feedback. The lack of experience leads to tearing of the urethane polymer and additional incisions lead to limited use.

The cost of the Skin and Suture Pattern Simulator is \$55 per simulation (Norecopa, 2012a). The cost of the Hollow Organ is \$60 per simulation (Norecopa, 2012b). With a total of 20 students in each of the two laboratories and to give each student experience with both simulators this would cost the MSU VT Program on average of \$4,600 per year.

VET Effects has created the Spay Neuter K9 Manikins that feature realistic skin, organs, fat tissue and blood, and allows limited repetitive practice for individual students (Vet Effects, n.d.). The cost of is nearly \$1900 per manikin (Vet Effects,

n.d.). Saw Bones created a virtual reality system called Mayo Endoscopy Simulated Image (MESI) that is used to demonstrate limited gastroscopy, colonoscopy, cystoscopy, and laparoscopic procedures (Sawbones, 2013). The cost for each MESI model is \$3125 (Sawbones, 2013).

Rescue Critters offers a suturing arm that mimics the dermis, adipose tissue, and muscle tissue that can be used repeatedly (Valliyate et al., 2012). The cost of the suturing arms is \$80.00 per model (Rescue Critters, 2013). In recent years the MSU VT Program purchased these models with the hope of providing a higher quality learning experience for the students. Unfortunately, the results indicated that the arm material was unrealistic and did not stand up to repeated use by inexperienced students. These models are limited to the number of times they can be reused.

The use of animals in veterinary education has been reduced over time due to the use of new resources along with changes in curriculum. The Royal Veterinary College revamped their Haptic Cow to become an automated (or self-teaching) version (Baillie et al., 2010). An examination performed by an expert was recorded. When a student first uses the simulator, the PHANToM haptic device moves the student's hand along the expert's path, one step at a time. Each step is accompanied by a recorded audio explanation. After this part of the training is completed, the student can explore the abdominal cavity and access the HELP button when needed. One of the advantages of the automated version is that students can use the simulator on their own and at times that are convenient to them.

There is a growing trend for veterinary students to be introduced to laboratory experiences that replicate real life. The Haptic Cow is currently being used to teach third year students the basic skills, such as identifying pelvic landmarks. In the final year of rotations, the Haptic Cow is being used in a laboratory experience called the Virtual Farm Visit (a simulated fertility visit) involving role playing experiences. The instructor is the farmer and the students are the vets. Students have to think on their feet, practice good communication skills, make diagnoses, and decide on a treatment or action plan. The simulator is an important part of the scenario and represents a safe, trial and error learning experience.

The University of Illinois created the use of artificial organs for surgical use to enhance essential learning and skills (Greenfield, Johnson, Arends, & Wroblewski, 1993). The University of California, Davis, created a software system that provided instructional materials, including interactive software of the virtual heart and videotapes to replace the use of animals (Wood, Hart, & Weng, 2005). To eliminate the unnecessary use of animals, many veterinary schools have shifted to spay/neuter programs for humane societies and local shelters to meet both budgetary and social demands.

The Dog Abdominal Surrogate for Instructional Exercises (DAISE) was developed by Dr. David L. Holmberg and redesigned by Bridgitte A. Brisson (DASIE, n. d.). DASIE is composed of laminated polyurethane foam rubber and red strings housed internally to mimic blood vessels (DASIE, n.d.). The cost of DASIE is \$30.00 per model (DASIE, n.d.). This model provides students with the opportunity

to learn and practice abdominal draping, aseptic technique, and tissue handling without the use of live animals (Hart, Wood, & Weng, 2005).

Colorado State University (CSU) has developed a Virtual Canine Anatomy (VCA) DVD to teach anatomy in conjunction with cadaver dissection. The cost of the Virtual Canine Anatomy is \$46.00 per DVD (VetText, 2013).

Prior to introducing the VCA, CSU instructors found that most of their time was spent identifying basic structures for students. In turn, the students spend a large amount of time waiting for assistance from the instructor and relied heavily on textbooks. Students that were absent from class were at a disadvantage because the lesson could not be repeated. After the implementation of VCA, student became self-directed, learned at their own pace, and new questions were now more practical. The DVD allowed students to repeat the dissection as needed to become confident and proficient. Students that worked with the VCA DVD could study alone or in groups, inside the classroom or at a time that was most convenient for them. The use of the DVD can also decrease the number of cadavers that are needed for a given lesson (Valliyate et al., 2012).

Purdue University replaced animal dissections with prosections (Provo & Lamar, 1995). Prosections allow the instructor to dissect one cadaver and students observe, rather than having students completing the dissection of multiple cadavers. An assessment of effectiveness was conducted on prosections and dissections with results indicating that student errors were similar with either application (Wood et al., 2005).

High fidelity simulations have the capability to replace live animals or cadavers. These simulations provide immediate feedback, real scenarios, and opportunities for the students to make mistakes. Over the next several decades the researchers foresee the increased use of high fidelity simulations and a decreased use of low fidelity and live animal lessons (Valliyate et al., 2012).

Cognitive Load Theory (CLT)

With a simulation there is no risk to the patient or time constraints on teaching, so comprehensive learning objectives from cognitive theory can be addressed (Wilson & Cole, 1996). By incorporating educational principles into surgical simulators the researchers believe MSU VT students should be able to see speeded growth towards expertise and improve the way they learn through a carefully constructed IVSS.

Surgical simulators will never replace the expert teacher or the reality of surgery within a real environment, but they will be able to teach more expertise outside the operating room where real patients are at risk (Issenberg, Gordon, M, Gordon, D, Safford, & Hart, 2001). When stumbling blocks like cognitive load and expert error are taken into consideration, successful simulations can be built around sound educational goals (Card, Moran, & Newell 1983). With this in mind, designers can create virtual learning environments that will prepare the novice surgeon for refinement of skills with the expert in the operating room.

According to Kirschner (2002) when designing instruction for simulations, it is important to take into consideration the severely “limited working memory with

partly independent processing units for visual/spatial and auditory/verbal information which interacts with a comparatively unlimited long-term memory” (p. 2). In a surgical simulation, there can be text, animation, audio, and moving images embedded into the simulator, often resulting in cognitive overload to the learner and this in turn impedes knowledge transfer. The learners’ attention is split among these media and it requires more mental work to integrate the information from many of these different sources (Satava, 1993). The goal of using technology needs to be a lowering of the cognitive load, focusing attention on only essential, goal-relevant information (Marina Del Rey, 2004). Examples of cognitive principles necessary in the development of simulators are: utilization of narrative in media displays rather than text, and the elimination of extraneous words, sounds (e.g. music), and pictures.

An understanding of the principles of cognitive load promotes a better understanding of the instructional design need to meet the objectives of the IVSS. A design goal must be to reduce unnecessary cognitive load (Paas, Renkl, & Sweller, 2003a). The researchers of this capstone believe that understanding how individuals think and learn is one of the first steps in designing a successful IVSS. The development of the IVSS must take cognitive load as a serious consideration in the design of its’ multimedia simulation. By understanding all of these principles, a successful product can be created.

There are three types of cognitive load: intrinsic, extraneous, and germane (DeLeeuw & Mayer, 2008). Intrinsic refers to the direct function of performing the task and the number of elements that must be simultaneously processed in the

working memory to make that task happen. Intrinsic load is affected by expertise, because more expert learners combine multiple elements into one element that can be processed in working memory (van Merriënboer & Sweller, 2005). It is managed by organizing the learning tasks in the simple-to-complex task classes. “For learning tasks within a simpler task class there is less element interactivity in that fewer elements and fewer interactions between the elements need to be processed simultaneously in working memory” (van Merriënboer, 1997, p. 5).

As tasks become more complex, the number of elements and interactions increases. Extraneous load is the extra load beyond the intrinsic load (Paas, Tuovinen, Tabbers, & VanGerven, 2003b). It is all the extra stuff that can assist us with the task at hand, but we don’t have to remember until we become more proficient with the task. This supportive information is better served before the learners start working, so that it can be constructed in long-term memory. This will be activated later in the working memory during the task performance. Germane load is related to processes that directly contribute to learning (van Merriënboer & Ayres, 2005). This is where the designer can connect information with what is already known to the user.

It is important to understand CLT so that an instructional designer can relate the theories that surround learning and put them into practice. Complex learning activities, such as suturing, demand a great deal of cognitive load as a complex skill (Kahol, Vankipuram, & Smith, 2009). Since the suturing unit is two-weeks long, the learner has a short amount of time to learn the technique. It involves a lot of existing

schemas, such as aseptic technique, pre-operative procedures, surgical tools, suturing materials and needles, post-operative procedures and the new information of the suturing patterns themselves.

The number and variety of required tasks when suturing, is sometimes difficult to process in working memory. The design model should provide experiences assisting in diminishing the load the working memory to allow for the collection of new information (van Merriënboer, 1997). Instructional designers can manipulate the extraneous and germane loads through their design (Paas et al., 2003a). Ideally, the instruction design for the IVSS can limit extraneous load by supplying just-in-time information and promote germane load with readily accessible support information and step-by-step guidance in the task. Understanding CLT is especially important when constructing a design for the novice learner, such as first year VT students.

One change that was not considered in cognitive load was the change that occurs with the increasing level of a learner's expertise. There is strong evidence that as levels of expertise increases, it is appropriate to decrease instructor control and increase learner control (Paas et al., 2003a). This new research led to the question, how should instructional design be altered as a learner's knowledge increases?

An article by van Merriënboer, Kirschner, and Kester (2003), addresses this issue with the premise that learners should be presented realistic tasks, despite the fact that, when dealing with complex areas, realistic tasks presented to novices with only limited schematic knowledge are likely to impose a heavy cognitive load (p. 6). van

Merriënboer, Kirschner, and Kester (2003) suggest two forms of scaffolding; simple-to-complex sequencing, and then followed by completion problems and then full problems. It was also suggested that the timing of essential information presented to students can be critical from a cognitive load perspective. Supporting information can be presented first, so that learners can construct a schema to be used throughout the task. These became parts of the four-component instruction design model (Sweller, 2003). This research is extremely relevant for the successful design for the IVSS.

Instructional Design Models

Instructional designers add to the process of learning because they know how people learn and understand how to design instruction to maximize on learning (Mayer, 2002). An effective instructional designer can make learning activities engaging and design ways to make practice closer to real-life skills.

An instructional designer must work with the content specialists to identify what students need to learn. Once that is accomplished objectives/tasks need to be developed to ensure that the content matches those objectives/tasks. It is essential to structure content and activities to maximize student learning (Driscoll, 2006). The selection of media to support learning needs to be chosen and instructional materials need to be adapted from face-to-face learning to DVD in this case. Assessments need to be developed in a variety of forms to accommodate different learning styles and be inclusive with all audiences.

Instructional design needs to be effective, efficient, and engaging (Merrill, 2008). In order to select the correct design model for the specific learning required by the IVSS it is essential to understand the principles behind instructional design theory so that learning can be enhanced in the best way. Since the IVSS replicates real-world suturing performances it is important to look at theories and designs that produce education that leads to performance. Many experts in the field of instructional design have opinions regarding the best methods of instruction for real-world applications. According to Charles Reigeluth (1999), there are three purposes to instructional design theory:

Instructional-design theory is design-oriented (focusing on means to attain given goals for learning or development), rather than description oriented (focusing on the results of given events). The goal is to enhance learning for any performance we want to teach. Instructional-design theory identifies methods of instruction (ways to support and facilitate learning) and the situations in which those methods should and should not be used (p. 5).

According to Perkins and Unger (1999), the primary goal of instructional theory is the cultivation of understanding as a performance capability. “Understanding a topic is a matter of being able to think and act creatively and competently with what one knows about the topic” (Reigeluth, 1999, p. 6). Perkins and Unger (1999) argue that mental and physical representations support understanding by providing learners with structured problem spaces that support the kinds of thinking they have to do to

display understanding. These thought demanding activities are called understanding performances or performances of understanding.

Teaching for Understanding uses a constructivist view of learning and uses a four-part framework for designing and delivering instruction. Teaching for Understanding continues to evolve as more research is done in educational practices. New technologies influence designers to evaluate ever changing contexts. Harvard professor Stone Wiske (2005) believes that a fifth component should be added to the traditional Teaching for Understanding framework due to the emerging technologies being used in the world. Since learning is not an isolated event, she proposes adding supportive learning communities to the framework.

Understanding by Design is a framework for instruction that leads students to deep understanding of the content (Wiggins & McTighe, 2005). It is more commonly known as the Backwards Design. The process begins at the end, and the desired result of learning must be determined at the beginning. This could be a state standard, a skill, or a product. The teacher will determine what will be the proof that the desired learning has taken place. Once the Big Idea and the proof have been established, then lessons and activities are designed that lead the student to the end result (Wiggins & McTighe, 2005). Understanding by Design is a three-stage backward design for building a coherent curriculum, spiraling around big ideas, essential questions, and core assessment (Wiggins & McTighe, 2005).

Instructional designers, Roger Schank, Tamara Berman, and Kimberli Macpherson (1999) promote an instructional design called Learning by Doing. The

primary goal of this theory is to promote skill development and learn the factual information in the context of how it will be used.

Learning that occurs in the context of a goal that is relevant, meaningful, and interesting to the student will have value. Content knowledge that is learned in the context of relevant tasks, closely related to how students will use it outside the learning environment will be of the upmost value. (Schank, Berman, & Macpherson, 1999, p. 163)

Learning by Doing uses goal-based scenarios for teaching and learning. A goal-based scenario is a learn-by-doing simulation in which learners pursue goals by practicing target skills and using prior content knowledge to help them achieve their goals. Throughout the simulation, learners are coached with just in time information, and this feedback allows them to remember what they were previously taught.

The goal-based scenarios design starts with a very clear idea of what students are to learn. These learning goals are divided into two categories: process knowledge and content knowledge. Process knowledge is the knowledge of “how to practice skills that contribute to goal achievement,” while content knowledge is the information that achievement of a goal requires (Schank, Berman, & Macpherson, 1999, p. 173). So when designers begin their approach they focus in on the skill set they want students to practice and the content knowledge that they want students to find.

It is no longer enough for surgeons to master the tools of the trade during their studies and then apply and perfect them throughout their careers. Competent

surgeons today (and tomorrow) need to master complex skills and competencies during their studies and never stop learning throughout their careers (van Merriënboer & Kirschner, 2013).

Complex learning involves integrating “knowledge, skills, and attitudes, coordinating qualitatively different constituent skills, and often transferring” of what is learned in the school or training setting to daily life and work setting (Reigeluth, 1999, p. 182). There are many popular educational approaches such as inquire, guided discovery, and project-based learning that foster complex learning. Even though these approaches differ in many ways, they have one thing in common, which is their focus on learning tasks that are based on real-life authentic tasks. The basic idea behind each of the above theories and models is that such tasks help learners integrate knowledge, skills, and attitudes, stimulate learning to coordinate constituent skills, and facilitate transfer of what is learned to new problem situations (Merrill, 2002; van Merriënboer, 2007; van Merriënboer & Kirschner, 2001).

According to Pellegrino (2006) students have difficulties combining all the things they learn into an integrated knowledge base and employing this knowledge base to perform real-life tasks and solve practical work-related problems once they have graduated. They do not achieve the required transfer of learning or training. Design theory must support the development of training programs for students who need to learn and transfer professional competencies of complex cognitive skills acquired in their study to an increasingly varied set of real-world contexts and settings.

Reigeluth (1999) noted that “The purpose of the Elaboration Theory is to provide guidance for making scope and sequence decisions that support much more holistic approaches to learning” (p. 452). According to Elaboration Theory, the instruction should be organized in order of complexity for optimal learning.

This layering has a sequencing approach that goes from simple to complex and repeated general to specific. The Elaboration Theory of instruction was developed to provide a holistic alternative “to the parts-to-whole sequencing and superficial coverage of content that have been so typical of both education and training over the past five to ten decades” (Reigeluth, 1999, p. 434).

“Open Learning Environments (OLEs) provide a theory for situations where divergent thinking and multiple perspectives are valued over a single ‘correct’ perspective” (Hannafin, Land, & Oliver, 1999, p. 120). OLEs attempt to break down skills and knowledge into smaller parts. Learners enjoy a hands-on approach with concrete experiences that are real and relevant. The learning is self-directed and the learner has a lot of autonomy in the methodology that they use to solve problems. They are provided with a variety of tools and resource to aid their efforts at learning. Learners are exposed to multiple perspectives and divergent thinking in while exploring ill-defined and ill-structured problems (Hannafin, 1999).

According to Merrill, Kowallis, and Wilson (1981), research in cognitive psychology has continued to shed light on relevant processes of learning and instruction. The information age means a change in the way we teach and the way we design instruction. Technological and societal developments have changed the way

we view education. Methods of instruction continue to change with the diversity of learners' needs. Researchers continue to study how learning occurs and why certain designs work better with others. Instructional designers must focus on methods of instruction that facilitate learning. Different learners have different learning needs. As students change, so do their learning styles, interests, motivations, and attitudes.

Educators must be agents of these learning changes. "Methods of instruction are varied, and we must create learning environments that are rich with guidance, empowerment and support, self-direction and structure" (Reigeluth, 1999, pg. 21).

Suturing is a complex cognitive skill that needs to be learned through whole-task performance. It demands complex learning which involves integrating knowledge, skills, and attitudes; coordinating qualitatively different constituent skills, and transferring what is learned in school to a work setting (van Merriënboer, 1997). Suturing is a skill that requires high organization and is a serial skill that is performed in order. Motor skills are complex, and the intricacies of suturing requires dexterity, coordination, and manipulation. Lim and Reiser (2006) found that the benefits of the whole-task performance proved more effective over the breakdown of a skill to smaller parts. The 4C/ID model manages cognitive load in the whole-task situation (van Merriënboer & Kester, 2005).

4C/ID Model

The four-component instructional design model (4C/ID model) views authentic learning tasks that are based on real-life tasks as the driving force for learning and thus the first component in a well-designed environment for complex

learning (van Merriënboer & Kester, 2005). In this model, the intrinsic cognitive load, a load inherent to the learned material is sequenced in a simple (full support) to complex (diminished scaffolding) approach. The extraneous cognitive load is minimized through the structure of the learning tasks. Support and modeling are provided, and completion is required within each task with decreasing support. The just-in-time information helps eliminate the need to search for answers. They are provided right when the learner needs them. The germane cognitive load is controlled by the layout of the learning tasks as they are presented in various contexts.

While the 4C/ID model is not specifically developed for the design of multimedia environments for learning, it has important implications for the selection of – a mix of – suitable educational media as well as the presentation of information and arrangement of practice and feedback through these media. (van Merriënboer & Kirschner, 2005, p. 2)

The medium must allow learners to work on those tasks in a real or simulated task environment. In multimedia learning, the heart of the learning environment will usually consist of a computer-simulated task environment. Although the necessary multimedia technology to implement optimal instructional methods is not always available, there are many programs offering the opportunity to perform learning tasks that are based on real-life tasks.

For real life tasks, there are many interactions between the different aspects of task performance and their related objectives. Objectives should include aiming to

perform each aspect of the complex task in isolation, but also pay attention to the ability to coordinate these different aspects in the real-life task performance.

“The 4C/ID model provides an organizing framework for instructional methods, including multimedia principles” (van Merriënboer & Kirschner, 2005, p. 13).

The basic premise of the 4C/ID model is to start with a task class where the learning tasks can be solved on the basis of a simple domain model and to continue with task classes where the supportive information pertains to increasingly more complex and elaborated domain models (van Merriënboer, Kirschner, & Kester, 2003). The task classes for the IVSS are the eight different suturing patterns. Each will be addressed as a separate module with supportive information that is specific to its’ own pattern.

Van Merriënboer & Kirschner (2005) noted, “The individualization principle takes the differences between learners into account by selecting learning tasks in such a way that the task difficulty and/or the available level of support are adjusted to the learner” (p. 8). This fits perfectly in the 4C/ID model, because with each learning task, the performance needs to be assessed in order to give cognitive feedback to the learner. The assessment can also give information that can be used to select a new task.

If performance is low, an equivalent task with a higher level of support will be selected from the same task class or, in the worst case, an easier task will be selected from a previous task class. If performance is high, an equivalent task with a lower level of support will be selected from the same task class, or, if all performance

criteria have been reached, the learner is allowed to move on to the next task class from which a more difficult task with a high level of support is selected (van Merriënboer & Kirschner, 2005, p.8).

One way to help novice learners is to provide either process-oriented worked examples that show an expert who is performing the task (Van Gog, Paas, & van Merriënboer, 2004), or to give process worksheets that ask leading questions that guide the learners step-by-step through the process.

The completion strategy (van Merriënboer, 1990; van Merriënboer, Clark & De Croock, 2002) starts with worked examples that must be studied by the learners, continues with completion tasks that present partial solutions that must be completed by the learners, and ends with conventional tasks for which the learners must independently generate whole solutions. Novices benefit more from studying worked examples, but experienced learners profit more from solving the problems.

In the 4C/ID model the completion-strategy principle is included as one way to decrease support for learning tasks within one task class. In the beginning of a task class, high support may be provided by the use of worked examples, the, increasingly lesser support is provided for which the learners have to provide for a larger part of the solution. It finally concludes with the completion of the whole task with no support at all (van Merriënboer & Kirschner, 2005).

The supportive information for each new task class is always an addition to, or embellishment or, information that has been presented for previous task classes. The link between new information and previous information can be pointed out, but

constantly repeating the information could cause the negative effect of redundancy. “The 4C/ID model relates the finding that the presentation of redundant information may seriously hamper learning primarily to the distribution of supportive information over task classes” (van Merriënboer & Kirschner, 2005, p10).

The self-pacing principle gives learners control over the pace of the instruction. This may facilitate elaboration and the deep processing of information. Mayer and Moreno (2003) report higher transfer test performance if information is presented in learner-controlled segments rather than as one continuous unit and example the self-pacing principle they called the “segmentation effect” (p. 3). In the 4C/ID-model, streaming information will often refer to case studies (e.g., an animation illustrating a particular dynamic domain model) and modeling examples (e.g., a video of an expert modeling a particular process). It is important to give learners the option to control the pace in which information is presented to them (van Merriënboer & Kirschner, 2005). The self-pacing principle allows them to stop and pause to better reflect on new information.

Mayer and Moreno (2003) refer to the temporal split-attention principle as the ‘temporal contiguity effect’ and reviewed several studies that report higher transfer test performance for the simultaneous presentation of mutually referring pictures and text than for their consecutive presentation. This principle is particularly important for the presentation of procedural information, like how-to instructions for performing the routine aspects of the learning task. “If this information is presented

“just in time” when the learner needs it, and then the practice occurs, it was found beneficial on transfer test performance” (van Merriënboer & Kirschner, 2005, p. 11).

Procedural information should be presented in such a way that it is optimally integrated with the learning tasks and the task environment. All information should be presented in one place, so it’s easy and consistent for the learner to find.

When necessary, the computer is probably the most suitable medium because it can make drill effective and appealing through giving procedural support; compressing simulated time so that more exercises can be done with in real time; giving knowledge of results and immediate feedback on errors, and using multiple representations, gaming elements, sound effects and so on. (van Merriënboer & Kirschner, 2005, p. 12)

Lastly, the component-fluency principle indicates that drill and practice on one or more routine aspects of a task may have positive effects on learning and performing the whole task (van Merriënboer & Kirschner, 2005). Strengthening produces a high level of automaticity for routine aspects, which frees up cognitive capacity to be given to the non-routine, problem-solving and reasoning aspects of the whole task performance.

According to Corbalan, Kester, and van Merriënboer (2008) and Salden, Paas, and van Merriënboer (2006), this type of individualized program will typically yield higher learning outcomes and better transfer performance than the one-size-fits-all. In an individualized program, a high ability student may move quickly from simple learning tasks to complex ones and need little support, whereas, a lower ability

learner may want to make use of many learning tasks, progress more slowly or work on tasks with a greater deal of support before the support is faded (van Merriënboer, 2013).

Research indicates that effective instructional methods for practicing simple tasks differ from effective methods for complex tasks. According to van Merriënboer and Ayres (2005) learning tasks should always be combined with methods that induce germane cognitive load such as high variability and limited guidance or feedback. For novices, such as MSU VT students this can only be realized by decreasing intrinsic load early by manipulating the learning tasks.

4C/ID design focuses on task specific skills rather than on knowledge types, context or presentation-delivery media (Kirschner, Kester, & Corbalan, 2011). Learners complete the task by finishing a complete model. Supportive information and Just-In-Time information is distinguishable. Supportive information is general information that learners need all the time while Just-In-Time information is only necessary when learners have to complete specific task. This information can vary. The 4C/ID model uses a mix of part-task practice or while task practice as needed. Part-task practice is issued to support complex whole-task learning. This makes 4C/ID model the perfect design for the IVSS.

Chapter Three

Methodology

Chapter 3 is dedicated to the description of methods used to address the suturing learning gap that has been identified in the MSU VT Program. The instructor for this module indicated that the two weeks allowed for this module was an inadequate amount of time for students to produce proficient suturing techniques. Additionally, the researchers theorize that the lack of practice and the condensed time frame provided to teach the suturing skills has resulted in decreased comprehension and performance of each pattern. The current phantom limbs that are being used as instructional tools, composed of a foam pad and a chamois cloth adhered with duct tape, have been found to be unrealistic in that they neither look nor feel like animal skin or animal tissue.

An analyses framework based on Lee and Owens (2004) multimedia design proposal was selected in this capstone project to address the current problem experienced by the MSU VT Program. Each analysis is described and a brief explanation of why each analysis was used is provided in this chapter.

Before deciding to use the Lee and Owens (2004) design, other assessment models were explored to determine which would best fit the needs of this particular project. One of the models that was considered for this project was the Kaufman Organizational Element Model. This form of assessment has five elements: inputs, processes, products, outputs, and outcomes (Kaufman, Rojas, & Mayer, 1993). Kaufman's Organizational Elements Model addresses the correlation between every

result's focus: societal, organizational, small group and individual (Kaufman, Oakley-Browne, Watkins, & Leigh, 2003). Kaufman's reverse approach to planning and implementation provides findings that can be applied to data-based decision making (Kaufman et al., 2003).

Another needs assessment model that was explored was the Witkin & Altschuld Three-Phase Model. This model consists of an analysis, assessment, and action plan framework incorporated into one system which occurs over three phases: pre-assessment, assessment, and post-assessment (Altschuld & Lepicki, 2010). The focus of the Witkin & Altschuld model is process improvement and the achievement of the organization's goals (Altschuld & Lepicki, 2010).

The Kaufman Organizational Element Model and the Witkin & Altschuld Three-Phase Model are both sufficient methods of completing a needs assessment. Neither of these models appeared to be as easy-to-follow and beginner friendly such as the Lee and Owens (2004) model. Both provided too much extraneous data to comprehend. Because of this the researchers felt more comfortable using the Lee and Owens (2004) needs assessment model and front-end analysis.

The Lee and Owens (2004) format is intended for both instructional designers that are beginning their first multimedia project and the experienced designers of larger projects. Lee and Owens (2004) provided an easy-to-follow step/action handbook that included a CD-ROM with critical information, and templates associated with the steps of completing a successful project. The chapters are broken down into sections that provide six step-by-step processes of completing the needs

assessment. Each step is explained in terms that the user can comprehend and complete.

Needs Analysis

A needs analysis involves the identification and evaluation of needs within a defined population. Witkin and Altschuld (1995) describe the needs analysis as a gap between what is and what should be. The problem and possible solution are identified under the needs analysis. When conducting a needs analysis the focus should be on what should be done rather than what has been done (Titcomb, 2000). Specific to this capstone, a needs analysis was conducted using the Lee & Owens (2004) method to identify the gap in student learning and to design curricula that would promote student learning. Lee and Owens (2004) provide a six step process for conducting a needs analysis that includes determining the present condition, defining the task expected of the students, goals of the project, discrepancies that may occur, and positive areas of the current instruction. Current needs and desired needs of VET 213 were defined. This information was gathered from the VET 213 instructor, MSU VT admissions coordinator, and the student surveys (See Appendix A & Appendix B).

Front End Analyses

A front end analysis can be referred to as the blueprint for creating instruction. If done correctly the front end analysis can save valuable time and money. Precise requirements at the beginning of a project will usually produce an excellent final product. The front end analysis is completed to obtain more detailed information

that will provide the researchers with a deeper understanding of the project. Those involved in the front end analysis include the subject matter expert, instructional designer, students, and instructors. The front end analysis outlined for this project including a needs analysis, audience analysis, critical incident analysis, situational analysis, objective analysis, media analysis, and a cost-benefit analysis.

Audience Analysis

Understanding the intended audience is an important element of promoting effective learning. An audience analysis can provide valuable insight about students. The instructional designer will use this valuable information to develop an applicable method of instruction. It can also promote creative lesson plans that are tailored to the intended audience, with appropriate tone, style, language and content.

An audience analysis identified the background, learning characteristics, and pre-requisite skills of the audience (Lee & Owens, 2004). This analysis has enabled the researchers to determine and design a curriculum that is appropriate for the intended audience. The four steps that were involved in the audience analysis included: analyze audience demographics and special needs, determine the attitudes toward the required content, analyze the language skills of the audience, and documentation of the results (Lee & Owens, 2004). Information obtained for this analysis was compiled through the MSU VT admissions coordinator, the VET Student Survey (See Appendix A and Appendix B), and the 2011-2012 Morehead State University Undergraduate Catalog (Morehead State University Graduate and

Undergraduate Catalog, 2013). The undergraduate catalog was used to provide detailed information relating to the admission criteria of the MSU VT Program.

Critical Incident Analysis

A Critical Incident Analysis provides a method to structuring the process of reflexing on current practices and the development of a solution. A critical incident analysis was performed during this project to allow the researchers to determine what tasks should and should not be taught, as well as what was and was not effective in VET 213 (Lee & Owens, 2004). This analysis provided a means of eliminating unneeded material from the curricula and provided a learning environment that will be most beneficial to the students. Determination of essential and non-essential tasks was identified in this analysis using the four-step Lee and Owens (2004) process. The researchers looked at the current method of instruction and the instructor determined what skills were critical and those that were not. Once these skills were identified the researchers were able to determine what tasks to eliminate from the current instruction. The elimination of the phantom limbs and cadavers and introduction of an IVSS is expected to not only improve student performance but improve overall scores in VET 213 and the VTNE.

Situational Analysis

A situational analysis identifies and prioritizes problem situations affecting the intended audience. Internal and external environmental factors are examined in order to understand the goals, objectives, and needs of the intended audience. A situational analysis was performed to gather information about possible physical or

environmental factors that have an effect on the project (Lee & Owens, 2004). The project environment and delivery environment were examined using the Lee and Owens (2004) three step process. This process included the examination of the current environment that the students work in, the performance that is impacted, and factors that can influence learning.

Objective Analysis

The instructional designer must write clear, measurable objectives to develop an effective solution (Lee & Owens, 2004). It was essential to look at what was being done currently and where in the five domains the learning occurred, by evaluating all of the evidence to date. These five learning domains are the foundation of an objective analysis. This project uses the objective analysis tool developed by Gagné, Briggs, and Wagner (1992) to determine where the five domains of learning occurred in previous instruction. This in-depth analysis provides a more comprehensive understanding of the current program and practices and provides a baseline from which to write new objectives. The four- step process provided by Lee and Owens (2004) involved examining the different domains and deciding on a level within each domain, writing a goal statement, and writing performance objectives.

Media Analysis

The media analysis reviewed multiple media outlets to determine the best approach to a successful instructional solution. Different types of media were reviewed to determine the best possible presentation format for this project. To accomplish this, the eight step process from Lee and Owens (2004) was used. The

analysis involved rating media factors, determining the advantages and disadvantages of the media, determining the most appropriate form of media, and matching that media to the objectives.

The content is the message and through this process determined which medium or media would be the best delivery system. A systematic and careful media selection decision is essential to successful and cost-effective resolution of problems (Lee & Owens, 2004). It was important to look at the different types of media delivery available to determine the best solution for this project.

Cost-Benefit Analysis

A cost-benefit analysis estimates and totals the cost of a project in relation to the value of a project and its benefits. This analysis was conducted to determine if IVSS would be worthwhile for the MSU VT Program. The anticipated positive effects that the finished product will have on the program are directly compared to the cost of producing the product (Lee & Owens, 2004). The total cost of the project is calculated along with the anticipated benefit of the product. The anticipated benefit is then divided by the total cost. Justification is provided to all stakeholders to demonstrate that the project will have a positive effect on the organization and to ensure continued support is provided to complete the project.

Development of Scripts, Storyboards, and Videos

The subject matter expert and the instructional designer created different veterinary surgical scripts, storyboards, and videos for this project. Scripts were created to familiarize the student with common issues that will be seen in a clinical

setting. The majority of the scripts created were based on past experiences of the subject matter expert.

Each script was created to mimic an actual medical case. The student will follow the case from the time the animal is presented until the animal is discharged from veterinary care. A brief explanation of the case that includes why the patient is being presented, patient history, and any laboratory testing results that may have been completed are provided during the script. Once the case has been explained the student will virtually work through each case as they would a live patient; giving injectable anesthesia, placing an intravenous catheter, intubating the patient if needed, preparing the surgical site, and scrubbing in for surgery. The veterinarian completes the surgery with the assistance of the veterinary technician. The skin closure is the sole responsibility of the veterinary technician.

The subject matter expert created a storyboard for each of the seven suture patterns that can be used for skin closure. The veterinary technology student will be responsible for completing the virtual skin closure of each case. Each storyboard provides a detailed illustration of the step-by-step process of correctly completing each suture pattern.

The subject matter expert and the instructional designer created three to five minute videos of each of the seven suture patterns. The purpose of this creation was to provide the student with a video tutorial as they worked through each virtual case. Each video provides a close-up, high definition view with audio explanation of how each suture pattern was completed. The instructional designer filmed while the

subject matter expert used a phantom limb, suture material, and suturing tools to complete each pattern and provide audio explanation. After filming was complete, the subject matter expert used video editing software to incorporate text, detailed information on each video and audio narration.

Chapter Four

Findings

This chapter focuses on the findings of the instructional analyses, as well as the instructional modules that have been created for this project. A description of the process for developing the instructional modules is provided along with a brief overview of each of the instructional modules that will be used in the MSU VT suturing curricula. The purpose of the instructional modules is to assist students in becoming more proficient in suturing patterns. A needs analysis was conducted to determine the gap between the current instruction and the desired instruction of VET 213. A front end analysis was completed to close the instructional gap by determining the best possible solutions that were required for curricula improvement.

Needs Analysis

A needs analysis was performed to analyze the current needs and the desired needs of the MSU VT Program suturing curricula and develop a technology-enhanced interactive simulation with a haptic add-on with the completion of student surveys (See Appendix A). Students in the MSU VT Program are expected to proficiently perform sutures. Without the use of phantom limbs or cadavers in the current curricula, students do not have the opportunity to practice and refine their suturing techniques. The lack of using a scenario that mimics real-life results in an achievement gap of suture patterns.

All students in the MSU VT Program are expected to proficiently perform suturing patterns. Suturing is an important component to any VT program because

improper suturing can create a variety of medical complications for the patients and could potentially result in death. It is because of this importance that all students in the MSU VT program are expected to proficiently perform various suturing patterns. The need is especially critical because the AVMA requires that students be proficient at suture patterns upon graduation (CVTEA, 2013). Students are provided instruction over a two-week period that includes a multimedia presentation and live demonstration by the instructor of suture patterns on a phantom limb. Cadaver pigs are used to provide a more authentic experience when available. Beyond the regular class time the instructor also has an open door policy for all students and provides additional guidance and one-on-one instruction as needed. An IVSS is being created to provide a more authentic experience that provides immediate feedback because of the unrealistic nature of these phantom limbs. The phantom limbs used by MSU VT students do not provide a realism of animal tissue therefore preventing students from fully understanding the skill and technique needed for each suture pattern. Students will have access to a realistic environment with multiple patient species and scenarios by using the IVSS. This simulation will allow students to practice their skills and techniques at a time that is most beneficial to them.

The need for students to be able to have more practice time in developing the suturing skills is evident by examining the student surveys from 2009-2012 (See Appendix A and Appendix B). A student survey was given to each student preceding the suturing lesson. The survey consisted of 23 questions pertaining to the current method of instruction and the implementation of an IVSS.

Results showed that students did not feel that the use of the phantom limbs provided a realistic experience (See Table 5). Students were very receptive to the introduction of an IVSS learning environment and felt that an IVSS would encourage and enable student proficiency (See Table 6). Table 7 provided the needs analysis that was conducted for this project.

Table 5

Question 7. The Phantom Limb Provides a Life-Like and Useful Experience

	2009 (N=9)	2010 (N=18)	2011 (N=18)	2012 (N=16)
Excellent	0% (0)	0% (0)	6% (1)	0% (0)
Good	22% (2)	22% (4)	28% (5)	6% (1)
Average	44% (4)	33% (6)	44% (8)	38% (6)
Poor	33% (3)	22% (4)	17% (3)	44% (7)
Very Poor	0% (0)	22% (4)	0% (0)	13% (2)

Table 6

Question 23. Would an IVSS Encourage and Enable Students to Gain Proficiency

	2009 (N=9)	2010 (N=18)	2011 (N=18)	2012 (N=16)
Definitely	100% (9)	67% (12)	83% (15)	88% (14)
Probably	0% (0)	33% (6)	11% (2)	13% (2)
Unsure	0% (0)	0% (0)	6% (1)	0% (0)

Table 7

Needs Analysis

Needs Analysis	
Present Condition	<ul style="list-style-type: none"> • MSU VT faculty and students have identified suture patterns and techniques as a learning gap in the current curricula used in VET 213. • A “C” or better in VET 112 is a prerequisite of VET 213. • Students must understand the instrumentation, material, and types of suture patterns that are taught. • Prior to this two week module students have no prior experience with suture patterns and techniques. • Feedback is limited to the laboratory period and the open door policy of the instructor. The instructor is generally not available after hours.
Description of the Job	<ul style="list-style-type: none"> • One instructor teaches the two week module. • MSU VT students review a multimedia presentation, watch a live demonstration on a phantom limb, complete suture patterns on a phantom limb, and complete each pattern for review. • Upon availability, ethically sourced cadaver pigs are used to provide a more authentic experience. • At the end of the two week module students take an exam with both written and physical components. • Students need to understand the instrumentation, material, and types of suture patterns that are taught. • The IVSS is not intended to replace the lecture and laboratory sessions. • The IVSS will be implemented as an additional instructional tool eliminating the use of phantom limbs and cadavers. • Implementation of the IVSS will provide immediate feedback to all students at any time. • Practice with the IVSS can occur whenever is most convenient for the student
Goals	<ul style="list-style-type: none"> • Students will have an enhanced understand the suture patterns and techniques using the IVSS, increase practice time, and reach proficiency of each pattern. • The IVSS will stimulate student involvement and learning.

	<ul style="list-style-type: none"> • Students will determine what steps to take in order to complete the pattern correctly • The IVSS will provide immediate feedback to students at all times. • Students will be able to practice at their convenience. They are not placed on time constraints to practice their techniques. • The IVSS will provide the students with eight different case scenarios to work with. The case scenarios will promote critical thinking.
Discrepancies	<ul style="list-style-type: none"> • Students will be required to have access to high-speed internet. • Purchase of the IVSS interactive DVD and rental fee of the haptic devices will be required. • Phantom limbs and cadavers will be eliminated with the implementation of IVSS.
Positive Areas	<ul style="list-style-type: none"> • Traditional classroom and laboratory settings. • One-on-one instruction as needed. • Student involvement. • Final exam with written and physical components.

Front End Analysis

The purpose of this capstone was to analyze the needs of the MSU VT Program and design a framework for a virtual simulation alternative that could replace the currently used phantom limbs and cadavers to teach suturing techniques. A front end analysis was completed to determine if there were any instructional gaps in the instructional techniques currently used. The front end analysis of this project included an audience analysis, critical incident analysis, situational analysis, objective analysis, media analysis, and cost-benefit analysis. A front end analysis was completed to determine the instructional gap that currently exists between instruction and student in VET 213 and possible solutions to improve student achievement

surrounding suturing (Lee & Owens, 2004). Based on this analysis, possible solutions to improve student achievement for MSU VT students were explored. As part of the front end analysis, a media analysis was performed and dedicated to the gathering and organizing of information to provide a delivery method that will best meet the needs of the students.

Audience Analysis

The audience consists of MSU VT students of various age groups, ethnic populations, and regions in the United States. The age of students ranged from 18-60 years old. The majority of the applicants were Caucasian. English was the primary language. There was an average of 100 applicants for the MSU VT Program each year between the years of 2009-2012 with an average of 29 accepted into the program annually.

There were a total of 19 first year students during spring 2012. Lecture and laboratory sessions were conducted at the MSU VT facility. The students were split into a laboratory group of 10 and a laboratory group of nine. One laboratory group met on Mondays and the other met on Wednesdays for two hours. The two groups of students consisted of nineteen Caucasian students; eighteen females and one male participant in the age group of 19-60.

Survey results (See Appendix A and Appendix B), show student perceptions of the potential use of a virtual simulation as an additional learning tool. As shown in Table 8, depending on the year of the survey, anywhere from 89% to 100% of the respondents would stimulate students to practice more. The total number of students

differs each year from first year assessment due to student success within the entire MSU VT Program. If students did not perform at the minimum grade level of a “C” they could not continue in the program and therefore statistics were unavailable.

Table 9 provides the audience analysis that was conducted. Information was obtained through the VET 213 instructor, MSU VT admissions coordinator, and student surveys (See Appendix A and Appendix B).

Table 8

Question 15. Would an IVSS Stimulate Students to Practice More?

	2009 (N=9)	2010 (N=18)	2011 (N=18)	2012 (N=16)
Yes	100% (9)	89% (16)	89% (16)	100% (16)
No	0% 0	5% (1)	0% (0)	0% (0)
Unsure	0% 0	5% (1)	1% (2)	0% 0

Table 9

Audience Analysis

Audience Analysis	
Audience Demographics and Special Requirements	<ul style="list-style-type: none"> • The IVSS will provide the students with eight different case scenarios to work with. Currently, students are not exposed to case scenarios only the suture patterns. The case scenarios will promote critical thinking. Students will have to determine what steps to take in order to complete the pattern correctly. • The audience consists of MSU VT students of various age groups, ethnic populations, and regions in the United States. The age of students ranged from 18-60 years old. The majority of the applicants were Caucasian. English was the primary language.

	<ul style="list-style-type: none"> • There was an average of 100 applicants for the MSU VT Program each year between the years of 2009-2012 with an average of 29 accepted into the program annually. The maximum number of students that can be accepted each year is 40. The total number of students per lab section cannot exceed 20. • The audience consists of MSU VT students of various age groups, ethnic populations, and regions in the United States. The age of students ranged from 18-60 years old with the majority of students in their early to mid-twenties. The majority of the applicants were Caucasian. English was the primary language. The MSU VT Program meets all requirements mandated by the university to meet the needs of any disabled student. • Students will be required to have access to high-speed internet outside the classroom and laboratory. Purchase of the IVSS interactive DVD and rental fee of the haptic devices will be required. • The IVSS will provide immediate feedback to students at all times. Students are not placed on time constraints to practice their techniques. They will be able to practice at their convenience.
<p>Attitude Toward Content</p>	<ul style="list-style-type: none"> • Students have a negative perception toward the current phantom limbs used for instruction. Students suggest that the phantom limbs that are currently used are unrealistic. • Incorporating a new method of instruction will require the instructor to provide clear instructions and objectives for using the IVSS. • Student surveys (See Appendix A and Appendix B) indicate that students have a positive perception of the introduction to IVSS. • Proper terminology of instruments, patterns, and material is required. With English being the native language there is no language barrier to be concerned with.
<p>Language Skill</p>	<ul style="list-style-type: none"> • The primary spoken and written language of all MSU VT students between the years of 2009-2012 was English. • All students with reading deficiencies are required

	to remediate during their first year of college. All remediation is completed prior to entering the MSU VT Program.
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Critical Incident Analysis

The AVMA requires that students must understand the specific uses and differentiate between each type of suturing material, needle, and instruments. Students must understand a large array of procedures before graduating an accredited AVMA VT Program. As part of this requirement students must learn each of the most common types of suture patterns that will be seen in veterinary medicine and be able to complete them successfully. The more common suture patterns used in veterinary medicine today include interrupted and continuous patterns such as the Simple Interrupted and the Ford Interlocking patterns. These patterns are used in both small and large animals based on the anatomical area and circumstance. Patient lives are put at risk if the critical tasks associated with suturing are not understood and accomplished. Students that do not complete and meet the requirements of the instructor and the AVMA will be required to repeat the course.

Based on the academic progress statement of the MSU VT Program, found in the 2012-2013 Undergraduate Academic Catalog, students must maintain adequate academic progress. Adequate progress means that if a student receives a grade less than a “C” in any VET course then it must be repeated prior to advancing in the program. The course that was not successfully completed by any student will have to be retaken the following year. A student will be dismissed from the program by

earning two or more grades less than a “C”. Once dismissed from the program the student must gain readmission by reapplying. Readmission requires that the student start the program over from the beginning.

Students will continue to work for proficiency with the suturing patterns that the AVMA requires. The use of the phantom limbs and cadavers will be eliminated when the IVSS is introduced. Using an interactive virtual learning environment will allow students to visualize the anatomical areas, work under different scenarios, and receive immediate feedback pertaining to their knowledge and technique. The positive benefits to eliminating phantom limbs and cadavers and introducing an IVSS is expected to not only improve student performance but overall grades in VET 213 and the VTNE. Table 10 provides the critical analysis that was conducted.

Table 10

Critical Incident Analysis

Critical Incident Analysis	
Critical Tasks	<ul style="list-style-type: none"> • The AVMA requires that students must understand the specific uses and differentiate between each type of suturing material, needle, and instruments. Students that do not complete and meet the requirements of the instructor and the AVMA will be required to repeat the course. • Proper knot tying • Completion of seven suture patterns used in veterinary medicine • What instruments are used to perform suture patterns • Understanding the different types of suture material
Important but Nonessential Tasks	<ul style="list-style-type: none"> • Determining what type of suture material to use in different species and case scenarios. This is determined by the veterinarian.

Eliminated Tasks	<ul style="list-style-type: none">• Use of phantom limbs and cadavers
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Situational Analysis

A gap was determined for MSU VT students in suturing proficiency as noted in the needs analysis. The gap in the MSU VT program was identified through student test scores, general observations by the instructor, and student surveys. Students are not performing suture patterns and retaining knowledge about these patterns as they should. This is a major concern due to the requirement set by the AVMA. Students should know how to complete the most common suture patterns prior to graduating from an AVMA accredited program. Researchers can only hypothesize about the successfulness of the IVSS in congruence with the research they have presented. There are several strengths and weaknesses to consider before implementing the IVSS for prototype testing. Two of the major concerns are funding opportunities and the type of haptic device that would be best suited for this project.

The constraints of funding are a main consideration. Neither researcher has the capability for graphic design or computer code, so the framework must be sent to a professional computer graphic designer for the production. Based on similar items in the market, it is estimated that the haptic devices alone could cost up to \$200,000 presenting another financial hurdle. One possible solution to cover part of the costs involves students renting the haptic devices from the MSU Vet Tech office.

However, at a rate affordable to most students would take years to recoup the initial

costs. Maintenance of the haptic device is an additional cost as the researchers anticipate high volume usage.

After researching a variety of haptic devices, the SensAble Technologies PHANToM product line seemed the best fit to accompany the IVSS project. Two of the additional devices the researchers reviewed were the Novint Falcon and the Force Dimension Omega 6. The Novint Falcon was found to be the cheapest of the haptic devices with a cost of \$250 (Novint Falcon, 2012). This device only works with the Microsoft Windows platform. This device has a ball grip design rather than the stylus pen an uneven friction of the mechanical arms which makes it unsuitable for this application.

The Force Dimension Omega 6 works with Microsoft and Apple platforms. The Omega 6 uses the stylus pen which is desired for this application and designed for demanding applications where performance and reliability are critical. Although the Omega 6 does meet the specification needs of this application and are recommended for medical simulations, the cost was considered the deciding factor. The cost for the Force Dimension Omega 6 is \$30,000. This cost is not feasible for this capstone project.

Several medical simulations involving suturing techniques have been developed utilizing SensAble haptic devices, but nothing specific to an IVSS for veterinary application has been created. After investigating several applications with suturing in human medicine, it was determined that the PHANToM product line

could meet the needs of our virtual simulation. SensAble has been a quality manufacturer of PHANToM haptic (force-feedback) devices since 1993. With over 20 years of experience in designing haptic applications and manufacturing these devices in volume, it seems that SensAble can provide the expertise and resources to help deliver a high-quality, cost-effective haptic solution for the IVSS. SensAble offers nine haptic devices that can be used on a broad range of applications ranging from \$2,400 to \$79,500. The PHANToM Omni (\$2,400) would be our most cost-efficient choice for MSU VT students. The PHANToM Desktop (\$13,000) delivers higher fidelity, stronger forces, and lower friction, but could be cost-prohibitive for the capstone project. To off-set these initial start-up costs, the researchers plan to explore grant funding and business sponsorship.

Students will be able to purchase the IVSS in DVD format through the University bookstore. The haptic add-ons will be available for check out through the Morehead State University Vet Tech office. Student computers will need high speed broadband access to stream high-quality videos and graphics and to download the haptic software. On-campus computers have high speed Internet and wireless Internet access. Currently, there is no similar product or application in veterinary medicine that resembles the IVSS. Table 11 provides the situational analysis that was conducted.

Table 11

Situational Analysis

Situational Analysis	
Job Environment	<p style="text-align: center;">Current environmental concerns</p> <ul style="list-style-type: none"> • Noise – animal noise in the facilities and student vocalization is of a concerned and controlled. • Room temperature – room temperature has always a big concern. Meeting the environmental temperature for all students is nearly impossible. • Lighting – ample amount of light is provided in the lecture and laboratory periods. • Seating – adequate seating is available although it may not be comfortable for all students. • Space – lecture and laboratory spacing is adequate for student performance. • Ventilation • Feedback – students receive immediate feedback during lecture and laboratory periods. • Mentoring – the instructor has an open door policy. The instructor works one-on-one with each student as needed. <p>IVSS environmental concerns</p> <ul style="list-style-type: none"> • All environmental concerns for the IVSS are left in the hands of the students. • The instructor is under the assumption that the student is practicing with the IVSS in an environment that best suits the individual’s needs. • IVSS is accessible from student computers 24/7. • Instructor is available via phone or internet communication for issues that may arise. • Students are required to have access to high-speed internet. • Purchase of the IVSS interactive DVD and rental fee of the haptic devices will be required.

Objective Analysis

The course objectives and performance objectives are set by the AVMA and the Morehead State University Veterinary Technology Program. To achieve a well-blended learning system all factors of learning need to be taken into consideration. The instructional designer must understand the system that the content specialist is using in order for it all to work successfully. It gives designers and subject-matter experts a clear understanding of the intended level of training and the objectives that are developed concurrently. Once there is an understanding of what is being done, the creators of the IVSS will have a direction in which to proceed. The current content of the suturing modules were evaluated to determine the learning domains and the level within the domain of each task (See Table 12).

Table 12

Objective Analysis

Student	
Review multimedia presentation	<p>Cognitive</p> <ul style="list-style-type: none"> • Discriminations/Concrete Concept/Defined Concept/Rule
Receive a guided tour of VS	<p>Cognitive</p> <ul style="list-style-type: none"> • Concrete Concept/Defined Concept/Rule • Problem-solving/Cognitive Strategies <p>Motor</p> <ul style="list-style-type: none"> • Reflex/Basic/Perceptual
Demonstrate knowledge of suture patterns, materials and instruments	<p>Cognitive</p> <ul style="list-style-type: none"> • Concrete/Rule/Cognitive Strategies <p>Motor</p> <ul style="list-style-type: none"> • Reflex/Basic/ Perceptual: Tactile discrimination • Visual and Kinesthetic discrimination • Coordinated abilities
Student practice and master suture technique	<p>Cognitive</p> <ul style="list-style-type: none"> • Discriminations/Concrete/Rule/ • Cognitive Strategies/Problem-Solving <p>Motor</p> <ul style="list-style-type: none"> • Reflex/Basic/ Perceptual: Tactile discrimination • Visual discrimination/Kinesthetic discrimination • Coordinated abilities <p>Metacognitive</p> <ul style="list-style-type: none"> • Have the student verbally/physically rehearse the steps without error

Assessment	<p>Cognitive</p> <ul style="list-style-type: none"> • Problem-solving • Cognitive strategies/Verbal information <p>Metacognitive</p> <ul style="list-style-type: none"> • Student can explain approach, verbalize and show each step • Explain the desired approach, demonstrate approach • Have students practice with simulated materials • Have students practice with actual materials
Instructor	<p>Metacognitive</p> <ul style="list-style-type: none"> • Explain the desired approach • Demonstrate technique/purpose/tools • Observe student performing the task • Encourage questions before, during, and after the demonstration • Have students verbally rehearse the steps • Have students practice with simulate materials • Evaluate scores on IVS to form individual lesson plans • Evaluate student performing with actual materials

Media Analysis

A systematic and careful media selection process is essential for the delivery of the IVSS. It is important to determine through this process the medium where learning can be best achieved. There are many types of media to be considered in making the correct selection. VET 213 lecture and laboratory are instructor led courses. The goal of the IVSS is to complement the traditional classroom, so the best method of delivery needs to be a blended solution.

The content specialist and the instructional designer used the Lee and Owens (2004) media procedure guide to select the best method of delivery for the IVSS. This media analysis was chosen on its high degree of validity and reliability. “Its validity comes from a team of twelve highly experienced instructional designers who used consensus to arrive at the factors and associated media” (Lee & Owens, 2004, p. 68).

Various types of delivery media were looked at and evaluated through this system. The focus centralized around current technology and ranged from computer-based applications, audiotapes, and video teleconferencing. Web-based applications, satellite broadcasting, performance support systems and electronic performance support systems were also considered in the analysis.

Any form of delivery involving the use of a computer was known as being computer-based. These options clearly supported the use of an interactive simulation with a haptic add-on. Options included computer-assisted instruction which also supported printed materials or instructor, or totally computer-based instruction, where all content is presented by the computer. Each factor related to the user, the cost, or the content. Each factor was rated on a scale of one to five regarding the importance to the issue. A rating of five meant the factor was very important and a rating of one indicated the factor was not important at all. A rating of three would signify a neutral rating, indicating no real difference one way or another. The project team rated the factors for media on the Media Analysis Rating form (See Table 13).

Table 13

Media Analysis Form

Rating Scale

- 5 = Very Important Consideration
- 4 = Important Consideration
- 3 = Neutral Consideration
- 2 = Unimportant Consideration
- 1 = Not a Consideration

The circled items are the chosen results selected by the researchers.

Factors	Considerations	Suggested Media
1 2 3 (4) 5 Content requires interactivity (computer)	Does the content involve computer software, simulation, or practice? Computer-based training simulations can facilitate learning.	Computer-based Web-based
1 2 3 (4) 5 Unintended learning may occur	Do you need to control for participants learning positive habits, eliminating or avoiding undesirable habits? Are learning attitudes important?	Instructor-led Satellite broadcast Video teleconference
1 (2) 3 4 5 Collaborative learning is desired	Do group learning experiences, including opportunities to build relationships or share information, need to occur?	Instructor-led Satellite broadcast Video teleconference Web-based
1 2 (3) 4 5 Content requires interactivity (human)	Will participants gain interpersonal and communication skills from immediate feedback from an observer about their performance? To what extent does the learner need to use or demonstrate interpersonal or communication skills such as presentation, teamwork, leadership, or facilitation?	Instructor-led Satellite broadcast Video teleconference
1 2 (3) 4 5 Audience requires motivation	How motivated are the learners? <i>Note:</i> Self-instruction or distance education requires higher intrinsic motivation for successful learning.	Instructor-led Videotapes Web-based Satellite broadcast

<p>1 2 3 (4) 5</p> <p>Audience requires convenience, training at or near the work site</p>	<p>Is time away from work not possible because of work schedules, project requirements, variable shifts, or time-sensitive performance? Are participants dispersed and require decentralized training?</p>	<p>Computer-based Video teleconference Performance support Web-based Audio teleconference</p>
<p>(1) 2 3 4 5</p> <p>Audience has limited access to required technology</p>	<p>What technology is available? Is there a barrier to technology?</p>	<p>Audio teleconference Instructor-led Computer-based</p>
<p>(1) 2 3 4 5</p> <p>Audience has limited access to required expertise</p>	<p>Is there limited expertise that must be leveraged across the organization?</p>	<p>Computer-based Satellite broadcast Videotapes Web-based Video teleconference</p>
<p>(1) 2 3 4 5</p> <p>Students resistant to new media</p>	<p>How receptive is the audience to using a new medium? To what extent does attitude toward lecture style help or hinder learning? <i>Note: Learners often enjoy instructor-led training because it allows them to be with other learners. Although they enjoy it, they may learn less. They may fear technology, have only experienced mainframe CBT, or not want to spend more time at a computer screen. Take that fear into account and move toward a technology solution whenever possible.</i></p>	<p>Instructor-led</p>
<p>1 2 3 (4) 5</p> <p>Employees must review the information frequently</p>	<p>Will reference materials be required? Is there a need for “look-up” capabilities?</p>	<p>Performance support Web-based</p>
<p>1 2 3 4 (5)</p> <p>There is an immediate need for application of</p>	<p>How critical are the knowledge or skills to the performance of job-related tasks?</p>	<p>Performance support</p>

<p>expertise to the job</p> <p>1 2 3 4 (5)</p> <p>Wide variation in entry level background knowledge</p>	<p>How wide is the gap in entry level knowledge?</p> <p><i>Note:</i> CBT provides the ability to branch users to different levels of training.</p>	<p>Computer-based</p>
<p>(1) 2 3 4 5</p> <p>Content has a short shelf life or is changing rapidly</p>	<p>Is the content stable? Is it still under construction or development?</p> <p>How does the stability of the content affect the frequency of revisions?</p> <p>How difficult is it to make revisions using this medium?</p> <p>Revisions to audiotapes, videotapes, and CBT are time-consuming and expensive.</p>	<p>Video teleconference</p> <p>Audio teleconference</p> <p>Web-based</p> <p>Satellite broadcast</p> <p>Instructor-led</p>
<p>1 2 (3) 4 5</p> <p>Global audience multiple cultures or languages</p>	<p>Will reading, hearing, or understanding English be difficult for audience members?</p> <p>Are there varying levels and types of information need?</p> <p><i>Note:</i> A variety of non-print media can deliver text, graphics, sound, and motion allowing for learner control.</p>	<p>Computer-based</p> <p>Satellite broadcast</p> <p>Videotapes</p>
<p>1 2 3 4 (5)</p> <p>Materials must be available in a variety of formats</p>	<p>Do you need to re-purpose materials?</p> <p><i>Note:</i> Video can be reused in a variety of media.</p> <p>Electronic media can be delivered in a variety of formats.</p>	<p>Videotapes</p> <p>Satellite broadcast</p> <p>Video teleconference</p> <p>Computer-based</p>
<p>(1) 2 3 4 5</p> <p>Fewer than two hundred per year need training/ performance support</p>	<p>How many learners are in the target audience? What is the size of the audience over the expected shelf life of the training?</p>	<p>Performance support</p> <p>Instructor-led</p> <p>Video teleconference</p> <p>Audio teleconference</p>

1 2 3 4 (5) More than two thousand per year need training/performance support	How many learners are in the target audience? What is the size of the audience over the expected shelf life of the training?	Satellite broadcast Computer-based Videotapes Audiotapes
1 (2) 3 4 5 Must train large numbers of employees quickly	How quickly must the intervention be developed? How much time is available to build, buy, or revise products? For shortened time frames, consider buying or revising existing products.	Video teleconference Audio teleconference Audiotapes Instructor-led Satellite broadcast
1 2 3 4 (5) Requires compression of training time	Is it important to reduce the time participants spend in training? <i>Note:</i> CBT has typical training compression ratios of 50 to 70 percent.	Performance support Computer-based Satellite broadcast Self-paced workbook
1 2 3 4 5 Keep development cost per hour of instruction low	What is the cost per learner for developing or acquiring this medium?	Video teleconference Audio teleconference Satellite broadcast
1 2 3 4 (5) Keep travel expenses low	Is travel a barrier due to budgets, distance, and business considerations? How can you reduce travel expenses?	Performance support Computer-based Web-based Satellite broadcast Self-paced workbook Video teleconference Audio teleconference Videotapes Audiotapes
1 (2) 3 4 5 Keep Implementation, delivery, maintenance cost low	What are means of distribution? How will changes be accomplished? Can they be made quickly and easily? Will changes make previous distributions obsolete?	Performance support Video teleconference Audio teleconference Self-paced workbook
1 2 3 4 (5)	Can the assessment be self-scored? Is certification necessary?	Self-paced workbook Computer-based

Testing, evaluation, or tracking of student performance is necessary	<i>Note:</i> Assessment of interpersonal and communication skills requires observation. Some observation requires a trained expert.	Satellite broadcast Instructor-led
1 2 3 4 (5) Tracking course completion necessary	Can media assess course completion?	Computer-based Satellite broadcast Instructor-led

After the media analysis, the team concurred on a blended system of instruction-led content in the traditional classroom and the IVSS available on a DVD for MSU VT students use at their convenience.

Cost-Benefit Analysis

The anticipated positive effects that the finished product would have on the program are directly compared to the cost of producing the product (Lee & Owens, 2004). Justification needs to be provided to all stakeholders to demonstrate that the project would have a positive effect on the organization and to ensure continued support was provided to complete the project.

An expert in simulation design and graphics will need to be secured to complete the IVSS Novice Level. The framework, storyboards, and modules will be sent to the developer to be implemented into the IVSS Novice Level. A high percentage of the developing cost will be relative to hours on the project. The more information and detailing the creators of the IVSS can give to the developing team, should result in the lessening of hours to complete the project.

Additional costs would pertain to production expenses. Since there was narration with the scenarios, the rental of equipment and a sound studio would be a cost factor. All other production should be done in-house. There should be no administrative costs.

Table 14 shows cost projections on the creation of the project and the potential revenue opportunities. Revenue projections begin with the intended use of the IVSS as it pertains to MSU VT students. If the IVSS proves to be a successful instructional tool, sales will be extended to accredited veterinary school students across the United States and internationally. Market penetration will include U.S. and international veterinary technology school students and continuing CEU credits for graduated professionals. There are unlimited possibilities of revenue extending to veterinary clinics, zoos, and veterinarian supply companies who want their clients to perfect their suturing skills using their company products. Table 14 displays the potential for a return on investment within the first year of extended sales outside of the Morehead application.

Table 14

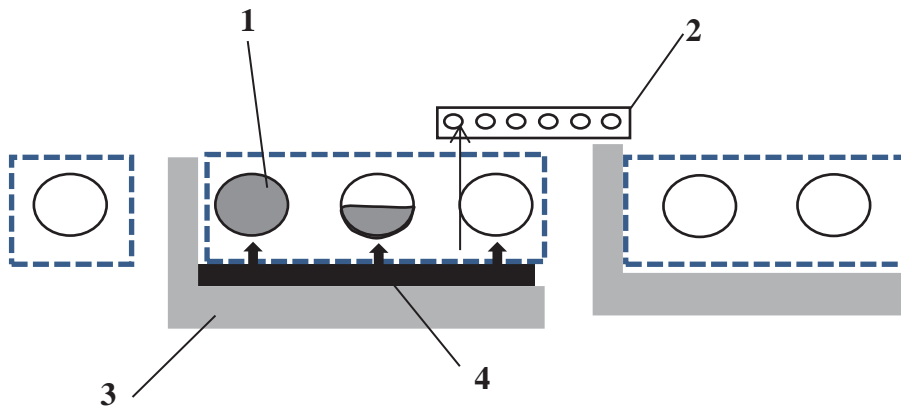
Cost Benefit Analysis

IVSS Novice Level Project Budget	
Expenses	
Instructional Tool Simulation Development	
Project Management	\$4,640.00
Voiceover Audio, Recording and Editing	\$1,766.25
Graphic Design, Animation and Editing	
Custom Background and Item Illustration	\$4,000.00
Graphic Design and Photo Editing	\$1,750.00
Flash Design and Development	
Audio Timing and Lip-syncing	\$1,375.00
Programming Development	\$14,875.00
Video Editing	\$5,000.00
Revisions and Quality Assurance	
Quality Assurance	\$1,375.00
Instructional Design Revisions	\$920.00
Production Revisions	\$5,375.00
One Time Project Expenses	
Character Design and Animation	\$3,750.00
Animal Design and Animation	\$8,000.00
Template Design and Programming	\$3,000.00
Haptic Device Purchases for Morehead (80 @ \$2500 each)	\$200,000.00
Haptic Device Interface Toolkit Design Development	\$25,000.00
Instructional Tool (DVD) Production (40 @\$10 each)	\$400.00
Total Costs	\$281,226.25
Revenue	
Morehead University	
DVD Purchases by 40 Students @ \$25 each	\$1,000.00
Haptic Device Rentals by 40 students @ \$40 per set	\$1,600.00
Total Morehead University	\$2,600.00
Other Sources (Sales of DVD @ \$25 to:)	
AVMA* Accredited Veterinary School Students	
US-28 Schools with 100 Students Annually @ 25% Market Penetration	\$17,500.00

International-18 Schools with 100 Students Annually @ 5% Market Penetration	\$4,500.00
US Accredited Veterinary Technology School Students	
200 Schools with 100 Students @ 25% Market Penetration	\$125,000.00
US Veterinary Clinics	
30,000 and Growing @ 25% Market Penetration	\$187,500.00
Others (Zoos, CEUs for Professionals) 500 @ 25% Market Penetration	\$2,500.00
Total Other Sources	\$337,000.00
Total Revenue	\$339,600.00
NET	\$58,373.75

4C/ID Model

The 4C/ID model becomes the ideal framework for the IVSS because it concentrates on the whole skill of suturing with emphasis on one specific pattern choice at a time. This design uses a visual design language that uses basic forms and shapes that represent learning tasks (circles), supportive information (L-shapes), procedural information (arrows) and part-task practice (boxed series of circles). These components are represented by drawn objects as seen in Figure 2.



- 1 – Learning Task
- 2 – Part Task Practice
- 3 - Supportive Information
- 4 – Procedural Information often called Just-In-Time Information

Figure 2. The main features of the Four-component (4C/ID model) A visual depiction of the four main features of 4C/ID adapted from van Merriënboer, J.J.G. (1997).

Training complex cognitive skills. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

A learning task is one of the components and includes different skills in our simulated/real task environment to practice complex learning tasks. In keeping with the heart of the 4C/ID model base, it is necessary to confront learners with all skills necessary for the whole task at the same time.

Each circle stands for one specific learning task. All learning tasks are connected to the task-class (in this case: simple interrupted suture), but they can differ. There can be whole tasks (carry out the complete simple interrupted suture pattern on the canine with varying degrees of support) or part- task (only practice on the knot tying between each stitch). The learning tasks are differing from simple to complex, and that is made visible with the shadow in the circle

The supportive information helps the student learn to perform non-routine aspects of the learning task that often involve problem solving, decision making, and reasoning (such as information on the different surgical tools and information on the

pattern). This information is available before the task starts and throughout the entire class task.

The procedural information or just-in-time information enables students learn to perform routine aspects of the learning tasks, that which are always performed in the same way (the step-by-step instruction of how to do the suture pattern).

Finally, the part-task practice pertains to additional practice of routine aspects that learners need to develop a very high level of automaticity (van Merriënboer, 2013, p. 446). This could be represented by the difficulty of performing the square knot accurately so that the knot is visibly flat to the skin surface. This skill takes practice to perfect, so it could be isolated in a practice session where the student could have more time to perfect the technique.

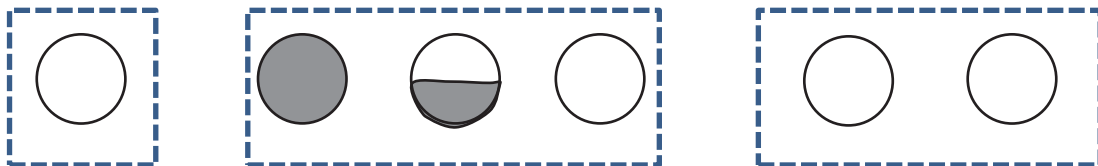
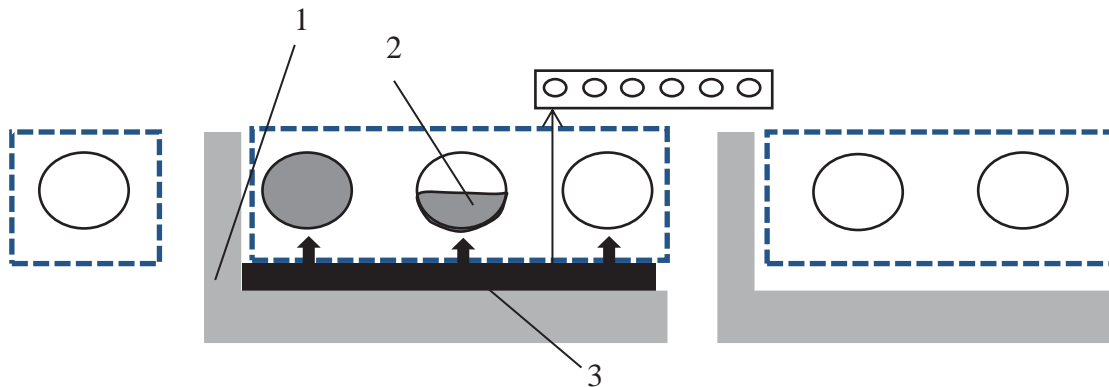


Figure 3. Completion Strategy. Schematic blueprint of the support and guidance that diminishes in the process of scaffolding as learners acquire more expertise – known as the completion strategy (van Merriënboer & de Croock, 1992). adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

A lot of shadow in the first circle in the first class stands for a task with a lot of support. A white circle stands for a task without learner support. The half shadowed circle stands for a degree of support. A learner becomes more self-assured and self-sufficient through this supported assistance and increases his or her degree of expertise. In the IVSS, there are many degrees of support. For example a pedagogical agent could be helping during the practice, but the learner is still doing the full suture pattern on their own, so the circle is half filled with shadow.

Supportive information is important to those constituent skills that are classified as non-recurrent. Supportive information is relevant to all learning tasks within the same task class, so usually it is presented before learners start to work on a new task class and it is kept available for them during their work on the task class. Learners can discover relationships between newly presented information and their prior knowledge. Learners can get information about the main subject in front of the task class and during it; hence the L is formed (See Figure 4).

The learners can go back to this information when completing part-tasks or whole tasks anytime that they need it. It is the basis of learning tasks. Supportive information for the IVSS is the Power Points on each particular suture pattern, the videos, handouts, and textbooks required for the class.



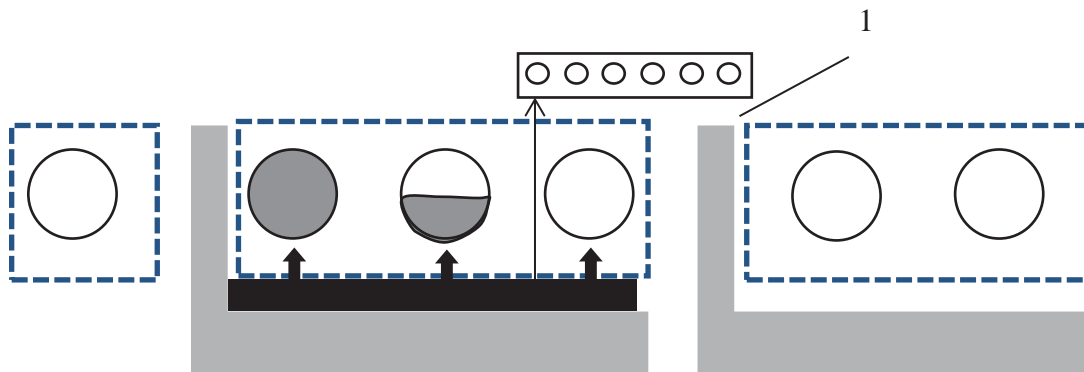
- 1 – Supportive Information
- 2 – Degree of Support
- 3 – Procedure Information (also called Just-In-Time Information)

Figure 4. All degrees of supportive information as viewed in the visual symbols used in the 4C/ID model adapted from van Merriënboer, J.J.G., Kirschner, P.A., and Kester, L. (2003). Taking the load of a learners' mind: Instructional design for complex learning. *Educational Psychologist*, 38(1), 5–13.

Procedure information or just-in-time information is primarily important for those constituent skills that have been classified as recurrent. Procedural information specifies for learners how to perform the routine aspects of the learning tasks and usually takes the form of a step-by-step instruction. It is best presented to learners exactly when they first need it to perform a task, also known as just-in-time information. This information will fade for subsequent learning tasks.

Procedural information is information that is meant to support the learner when completing part-tasks. In this model, you can see the procedural information is

a small black beam with arrows pointing at the learning tasks. Each arrow points at a specific learning task (See Figure 5). This means the information given at this point is only useful for this specific learning task. The information fades away as the learner gains more expertise. In our case, an example of JIT information could be the cueing that accompanies the pattern, or the pedagogical agent assisting with angle and depth of stitch. JIT information can be provided as rules, or the pedagogical agent can play a role by providing information while learners are completing tasks.



1. Part-task practice

Figure 5. Schematic training blueprint for part-task practice. The part-task visual symbol used in the 4C/ID model adapted from van Merriënboer, J.J.G. (1997).

Training complex cognitive skills. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

There are situations where part-task practice might be necessary, especially if a high level of automaticity is desired for a particular recurrent aspect of a task. Part-time practice for a particular recurrent aspect of a task can only begin after it has been

introduced in a meaningful whole learning task. This process for repetition is known as strengthening.

Part-task practice can be dependent or independent. Dependent part-task practice is when the teacher explicitly provides the practice for a selected to-be-automated recurrent aspect after this aspect has been introduced in the context of whole, meaningful learning tasks (van Merriënboer, 2013). In the IVSS, the content specialist wanted difficult sections of each pattern to be practiced. The instructor knows the difficulty at specific points of the suture pattern that will prove to be difficult for the learner, so these areas of the pattern were taken into part-task practice so that the learner could take the time to become more proficient and more automatic with their technique at these specific trouble areas.

Independent part-task practice is when the learner decides which routine aspects of the learning tasks will receive additional practice and when they will be practiced (van Merriënboer, 2013). Learners should be able to identify routines that may help them improve their whole-task performance and must also be able to find opportunities for part-task practice.

The 4C/ID model adds for highly individualized and flexible types of learning by using the training blueprint as an organizing framework which allows for the dynamic selection of learning tasks that take the learning needs of the individual learner into account (van Merriënboer, 2013). Dynamic task selection makes it

possible to offer individual learners a sequence of learning tasks that are optimally adjusted to their individual and specific learning needs.

Instructional Design

The 4C/ID model for training complex cognitive skills was recommended for the instructional design because it met the need of the whole-task approach. The 4C/ID model is based on a learner's performing increasingly complex skills as a whole-task with part-task practice only on the recurrent skills. The 4C/ID model was primarily formulated for ID professionals who are involved in the design and development of computer-based or simulation-based training programs for complex skills in technical domains (van Merriënboer, 1997). Suturing is a complex cognitive skill that requires the ability to remember information while performing a mental operation. Suturing requires doing two things at once and it requires a student to attend to incoming information that can be observed and broken down into a variety of sub-skills and improved through properly coordinated training (van Merriënboer, Jelsma & Paas, 1992).

In the book *Outliers*, Gladwell (2008) documented a theory that it takes 10,000 hours or roughly around 10 years to achieve an expert status in most disciplines. The features of 4C/ID model allow for the individualization of the learning program and continual application. With system control, the instructor and the IVSS will assess if the standards for acceptable performance have been met.

The 4C/ID model supports complex skill learning through four interrelated components. Beginning learners work on a complete and meaningful task, in a simple and very much supported form. It begins with a basic unit, a task class, comprising of several learning tasks of equal complexity and diversity, to be performed by the learner. These tasks are put in order of decreasing scaffolding. The learner will get less and less support to complete the task.

The supportive information belongs to one complete task-class and is usually provided before starting the task and is readily available through-out the complete task. Procedural information is basically about rule-based information and it is specific to how to perform the routine aspects of the tasks. It can be provided for each task in the form of Just-in-Time information, which acts like a job aid. This information fades away as the learner gains more expertise. Lastly, each learner can use some part-task practice separately from the complete tasks. The main goal of practice with these tasks is to reach a very high level of automaticity.

The 4C/ID model was used to divide the seven suture patterns into eight learning modules or task classes lasting approximately 25-45 minutes. The focus will be suture pattern practice, suturing material and tool selection in a whole-task environment. This environment requires prior knowledge from VET 213 lecture and laboratory with supporting information and just in time information, throughout each task class. Immediate feedback will be provided throughout all learning tasks. This will be done through the pedagogical agent, the haptic bar scale, various visual and

audio cues, and computer data display. The assessment of the task class will be available to the learner through a computer display in the final learning task. The student will take a screen shot of this display at the completion of the last learning task and then give this picture to the instructor for final evaluation. Criteria for determining the best method in the novice level will be accuracy.

The IVSS Novice Level is a suturing practice supplement to the classroom and laboratory experience. It is to be used in conjunction with instructor expertise and feedback and not meant to be a standalone option for MSU VT students. The IVSS Novice Level will contain eight suturing modules that include numerous practice scenarios with decreasingly available help. Each module will be developed with MSU VT general course outlines, the Essential Skill Rubric, and the AVMA guidelines in surgical nursing. The IVSS Novice Level will represent a higher level of interactivity by providing numerous realistic scenarios with suture pattern practice tasks (each with decreasingly available help), within each module, that teach, reinforce, and assess the students' ability to identify suturing surgical tools, identify appropriate suturing materials, and demonstrate correct suture spacing and pattern.

The eight suturing pattern modules are:

Module 1 – Simple Interrupted Suture Pattern - Canine

Module 2 – Simple Continuous Suture Pattern - Swine

Module 3 – Ford Interlocking Suture Pattern – Equine

Module 4 – Ford Interlocking Suture Pattern - Bovine

Module 5 – Cruciate Suture Pattern - Feline

Module 6 – Vertical Mattress Suture Pattern – Avian

Module 7 – Horizontal Mattress Suture Pattern – Rabbit

Module 8 –Continuous Horizontal Suture Pattern - Mouse

Scripts, Storyboards, and Videos

Scripts, storyboards and videos were developed by the subject matter expert and the instructional designer for the IVSS. The instructional design model (See Appendix C) drove the storyboard and script creation (See Appendix D and E). Hours of edits and revisions were put in by the subject matter expert and instructional designer to create each module to replicate the authenticity of the real surgical experience. The subject matter expert provided knowledge and experience to create the scripts, storyboards, and videos. It was important to the subject matter expert to provide the veterinary technology students with a realistic experience using scenarios and animals that will be seen in the veterinary profession post-graduation. Exposing the students to a large array of species provide them with the experience, understanding, and knowledge to better prepare them for the workforce in any area of veterinary medicine.

The scripts that were used for this project were some of the most common scenarios that the subject matter expert was involved in while working in private practice. Although the main focus was on each individual suture pattern, a script was created for each species beginning with the primary reason for medical attention and

ending with discharge instructions post-operation. Providing a detailed scenario gave students additional experience that may not have otherwise been discussed in the curriculum. The additional exposure to the entire case will better educate the student and prepare them for the professional workforce.

The main focus of this project is the seven suture patterns. A story board was created that provides an extremely detailed look at each pattern. The subject matter expert hand drew each of the storyboards that provide the desired detail of each pattern.

Each video provides a close-up, high definition view with audio explanation of how each suture pattern was completed. The instructional designer filmed while the subject matter expert used a phantom limb, suture material, and suturing tools to complete each pattern and provide audio explanation. After filming was completed the subject matter expert used video editing software to incorporate text, detailed information about each video, and audio narration. Unnecessary scenes were deleted to decrease video length. Fundamental scenes of the video were slowed down to allow the students to view and absorb the technique of each pattern such as knot tying and directional change of the needle. Part-time tasks were created for the purpose of reaching a very high level of automaticity. Audio narration was provided and synced with the video to provide verbal instruction of the proper steps for pattern completion. Many hours were put into this portion of the project to product the best quality video that would be most beneficial to the student learning outcome. Each

video that was created has been implemented into the current VET 213 curriculum as an additional instructional aid. Videos are provided to all students via internet access. This access allows students to have additional form of instruction outside the classroom as needed prior to the completion of the IVSS. The addition of the suturing videos is thought to have a positive impact on the current curriculum.

Each of the final scripts, storyboards, and videos will be submitted to the developer for review and will be used to develop the final IVSS product. The completion of each will lessen the work load of the developer and decrease the financial burden on the instructional designer and subject matter expert.

Module One – Simple Interrupted Suture Pattern - Canine

The simple interrupted pattern is the first pattern that MSU VT students learn. This pattern is the most basic pattern used in veterinary medicine and is used frequently on a variety of species. The pattern uses the basic square knot to close the incision line.

Two objectives for Module One come from the American Veterinary Medical Association (AVMA) Surgical Nursing section of the Veterinary Technology Student Essential and Recommended Skills List (CVTEA, accreditation policies and procedures, 2011). AVMA Standard 1.1 focuses on the performance of basic suturing techniques. AVMA Standard 1.2 requires that students identify and know proper use for instruments and identify common suture materials, types, and sizes. The MSU VT Program has two standards as well. MSU Standard 1.1 states that

students will become proficient in suture patterns, material and instrument usage. MSU 1.2 states that students will explore and develop skills that will enhance successful completion of suture patterns and techniques that can be applied in the workforce. Essential Skill Standard (E 1.1) indicates that students will correctly identify common surgical instruments, know the appropriate terminology for each, and demonstrate knowledge of their proper uses.

The task class in this module is the simple interrupted suture pattern. The learning tasks are embedded in a canine castration scenario, so each learning task is the simple interrupted suturing pattern on a canine castration. The first learning task (1.1) is fully supported with full assistance ranging from visual suture pattern lines and spacing to verbal cueing from a pedagogical agent giving step-by-step instruction on the suturing procedure. Tool selection is required in all learning tasks, but decreases from a short tray to a full tray. Incorrect tools will not move over. The suture material choice will be supplied in the Novice Level.

Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient. Tips and guidance will sound throughout the first learning task. Just-in-time information will give the student audio beeps and a colored visual line when they are off the placed pattern. The haptic color bar will change colors when different forces are applied during the suturing technique. Too little tension will show a yellow color and too much tension will show red. If the student maintains a green color throughout the procedure, that will indicate the

perfect suture tension. An auditory beep will sound if depth penetration of the dermas is too deep.

Support information is available with the click of the resource button. A multimedia presentation on simple interrupted, an instructional video of simple interrupted suture pattern on the rescue critter with step-by-step procedural information, and a video on the square knot is available at any time. This supportive information is available before the first learning task and throughout all of the task class, except for the final Learning task 1.6.

Learning tasks 1.2 through 1.5 are put in order of decreasing scaffolding. Each learning task is of equal complexity and diversity. The learner will get less and less support to complete the task. The suture pattern line will decrease in visibility. Lines and bite spacing will be shown with dotted lines periodically throughout the wound, instead of a solid bold line.

Part-task practice will be available starting with learning task 1.2 through 1.5. Video on the square knot is mandatory when the first part-task practice is initiated (See Appendix C). After the first part-task practice, the video is optional on subsequent tasks.

The IVSS will provide feedback after the completion of each learning task. The IVSS will count the number of clicks to correctly identify tools and suture material. It will record the number of times the learner goes out of the pattern line, if

suture depth penetration is too deep, and the number of time placement of bite spacing is incorrect.

The haptic assessment will reveal if the haptic tension was too tight or too loose by the haptic color bar. If tension is too little for a period of two throws, the suture will unravel and the task will automatically stop. The student will have to start the task over. If the tension is too tight for a period of two throws the suture will tear and the task will automatically end. Students will need to start the task over.

The final assessment takes place on the last learning task within the task class. The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. There will be no visible lines or bite spacing, and audio cueing will be unavailable. The learner will have one opportunity to do the suture pattern correctly.

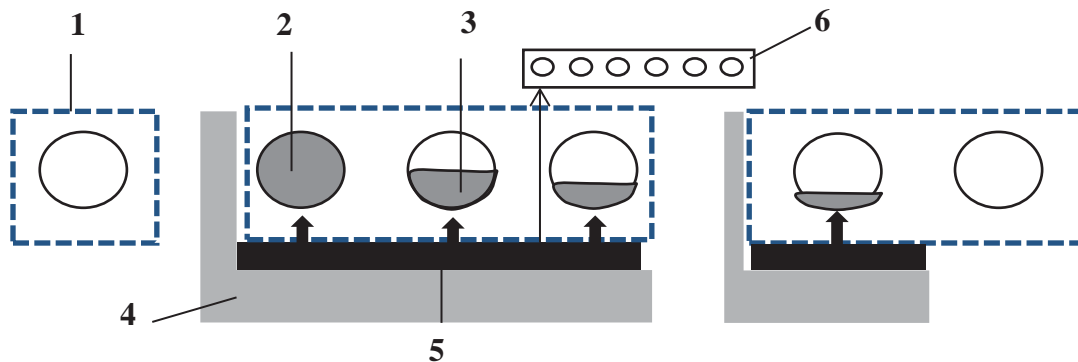
Upon completion the colored visual line will appear to give the student immediate feedback on the correctness of the suture pattern line and bite spacing. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (See Appendix C), in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET 213 laboratory, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. Proficiency will be based on the identification of tools and suture material to be used, the accuracy of distance between bites and each suture, and the accuracy

of the square knot.

Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with learning task 1.6 with any feedback options to check their proficiency with the pattern or return to any other practice within the task class.

The 4C/ID uses a visual design language that uses basic forms and shapes that represent learning tasks (circles), supportive information (L-shapes), procedural information (just-in-time) (arrows) and part-task practice (boxed series of circles).

These components are represented by drawn objects in Figure 6.



1. Task Class: Simple Interrupted Suture Pattern
2. Learning Task: Simple Interrupted Canine Castration (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: multimedia presentation slides on simple interrupted suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library – canine closure wound with simple interrupted suture pattern, Video segment of simple interrupted suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall and Peter (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*.

Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials

5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension after two throws, the suture material will break, and the student will have to start the task over. If too little tension is applied after two throws, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button
Step by step procedural information available by Pedagogical agent upon request (talking head)
6. Part-task practice: Square knot practice

Figure 6. 4C/ID model for the Simple Interrupted. A visual depiction of the six main features of 4C/ID-model for the Simple Interrupted suture pattern scenario used in the IVSS; adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Module 2 – Simple Continuous Suture Pattern - Swine

The simple continuous suture pattern is the second pattern that MSU VT students will learn. This pattern is also a very common pattern to be used in veterinary medicine. The species used in this case scenario is the minipig, but this pattern can be and is used in all species.

Two objectives for Module One come from the American Veterinary Medical Association (AVMA) Surgical Nursing section. AVMA Standard 1.1 focuses on the performance of basic suturing techniques. AVMA Standard 1.2 requires that students

identify and know proper use for instruments and identify common suture materials, types, and sizes. Morehead State University Veterinary Technology Program has two standards as well. MSU 1.1 states that students will become proficient in suture patterns, material and instrument usage. MSU 1.2 states that students will explore and develop skills that will enhance successful completion of suture patterns and techniques that can be applied in the workforce. Essential Skill Standard (E 1.1) indicates that students will correctly identify common surgical instruments, know the appropriate terminology for each and demonstrate knowledge of their proper uses.

The task class in this module is the simple continuous suture pattern. The learning tasks are embedded in a swine laceration scenario, so each learning task is the simple continuous suturing pattern on a minipig laceration. The first learning task (1.1) is fully supported with full assistance ranging from visual suture pattern lines and spacing to verbal cueing from a pedagogical agent giving step-by-step instruction on the suturing procedure. Tool selection is required in all learning tasks, but decreases from a short tray to a full tray. Incorrect tools will not move over. The suture material will be a given.

Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient. Tips and guidance will sound throughout the first learning task. Just-in-time information will give the student audio beeps and a colored visual line when they are off the placed pattern. The haptic color bar will change colors when different forces are applied during the suturing technique. Too

little tension will show a yellow color and too much tension will show red. If the student maintains a green color throughout the procedure, that will indicate the perfect suture tension. An auditory beep will sound if depth penetration of the dermas is too deep.

Support information is available with the click of the resource button. A multimedia presentation on simple continuous, an instructional video of simple continuous suture pattern on the rescue critter with step-by-step procedural information, and a video on the square knot is available at any time. This supportive information is available before the first learning task and throughout all of the task class, except for the final Learning task 1.6.

Learning tasks 1.2 through 1.5 are put in order of decreasing scaffolding. Each learning task is of equal complexity and diversity. The learner will get less and less support to complete the task. The suture pattern line will decrease in visibility. Lines and bite spacing will be shown with dotted lines periodically throughout the wound, instead of a solid bold line.

Part-task practice will be available starting with learning task 1.2 through 1.5. Video on the square knot is mandatory when the first part-task practice is initiated (See Appendix C). After the first part-task practice, the video is optional on subsequent tasks.

The IVSS will also provide feedback after the completion of each learning task. The IVSS will count the number of clicks to correctly identify tools and suture

material. It will record the number of times the learner goes out of the pattern line, if suture depth penetration is too deep, and the number of time placement of bite spacing is incorrect.

The haptic assessment will reveal if the haptic tension was too tight or too loose by the haptic color bar. If tension is too little for a period of two throws, the suture will unravel and the task will automatically stop. The student will have to start the task over. If the tension is too tight for a period of two throws the suture will tear and the task will automatically end. Students will need to start the task over.

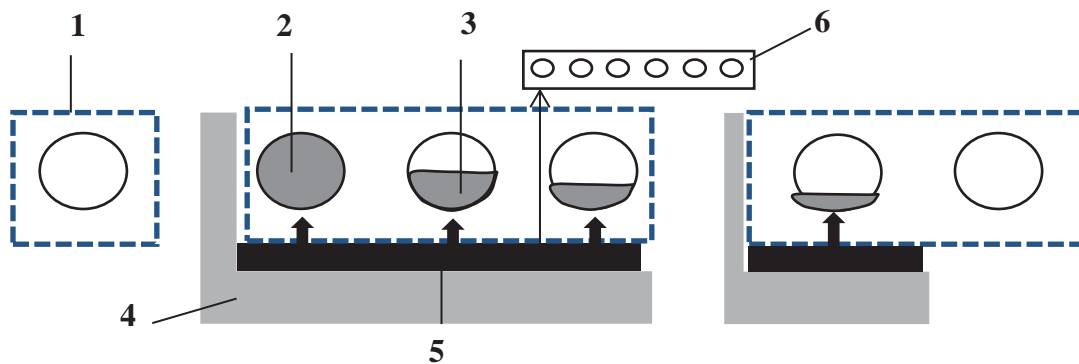
The final assessment takes place on the last learning task within the task class. The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. There will be no visible lines or bite spacing, and audio cueing will be unavailable. The learner will have one opportunity to do the suture pattern correctly.

Upon completion the colored visual line will appear to give the student immediate feedback on the correctness of the suture pattern line and bite spacing. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described previously in the preliminary content), in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET 213 laboratory, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. Proficiency will be based on

the identification of tools and suture material to be used, the accuracy of distance between bites and each suture, and the accuracy of the square knot.

Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with learning task 1.6 with any feedback options to check their proficiency with the pattern or return to any other practice within the task class. Students may also revisit any task class in Modules 1.

The 4C/ID uses a visual design language that uses basic forms and shapes that represent learning tasks (circles), supportive information (L-shapes), procedural information (arrows) and part-task practice (boxed series of circles). These components are represented by drawn objects in Figure 7.



1. Task Class: Simple Continuous suture Pattern
2. Learning Task: Simple Continuous Suture on a minipig (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: multimedia presentation slides on simple interrupted suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library – minipig closure wound with simple continuous suture pattern, Video segment of simple continuous suture pattern on rescue critter with step-

by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall and Peter (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials

5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension applied after two throws, the suture material will break, and the student will have to start the task over. If too little tension is applied after two throws, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head)
6. Part-task practice: Square knot practice

Figure 7. 4C/ID model of Simple Continuous Suture Pattern A visual depiction of the six main features of 4C/ID model for the Simple Continuous suture pattern scenario used in the IVSS; adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Module 3 – Ford Interlocking Suture Pattern - Equine

The ford interlocking suture pattern will follow the simple continuous in class instruction. This pattern is more difficult to learn and takes more time for each student to complete correctly. Although this pattern can be used with any species it is commonly performed on large animals due to the consistency of tension throughout the pattern. The species used in this module will be the horse.

The task class in this module is the ford interlocking suture pattern. The learning tasks are embedded in an equine caslick scenario, so each learning task is the ford suturing pattern on an equine caslick. The first learning task (1.1) is fully supported with full assistance ranging from visual suture pattern lines and spacing to verbal cueing from a pedagogical agent giving step-by-step instruction on the suturing procedure. Tool selection is required in all learning tasks, but decreases from a short tray to a full tray. Incorrect tools will not move over. The suture material will be a given.

Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient. Tips and guidance will sound throughout the first learning task. Just-in-time information will give the student audio beeps and a colored visual line when they are off the placed pattern. The haptic color bar will change colors when different forces are applied during the suturing technique. Too little tension will show a yellow color and too much tension will show red. If the student maintains a green color throughout the procedure, that will indicate the perfect suture tension. Tension is of particular importance in this procedure and will be monitored closely. An auditory beep will sound if depth penetration of the dermas is too deep.

Support information is available with the click of the resource button. A multimedia presentation on ford interlocking, an instructional video of ford interlocking suture pattern on the rescue critter with step-by-step procedural

information, and a video on the square knot is available at any time. This supportive information is available before the first learning task and throughout all of the task class, except for the final Learning task 1.6.

Learning tasks 1.2 through 1.5 are put in order of decreasing scaffolding. Each learning task is of equal complexity and diversity. The learner will get less and less support to complete the task. The suture pattern line will decrease in visibility. Lines and bite spacing will be shown with dotted lines periodically throughout the wound, instead of a solid bold line.

Part-task practice will be available starting with learning task 1.2 through 1.5. Video on procedural steps 25-28 will be mandatory when the first part-task practice is initiated. A special focus will be on the needle (See Appendix C). After the needle exits the tissue it should be directed through the loop of the suture material and pulled snug. After the first part-task practice, the video is optional on subsequent tasks.

The IVSS will also provide feedback after the completion of each learning task. The IVSS will count the number of clicks to correctly identify tools and suture material. It will record the number of times the learner goes out of the pattern line, if suture depth penetration is too deep, and the number of time placement of bite spacing is incorrect.

The haptic assessment will reveal if the haptic tension was too tight or too loose by the haptic color bar. If tension is too little for a period of two throws, the suture will unravel and the task will automatically stop. The student will have to start

the task over. If the tension is too tight for a period of two throws the suture will tear and the task will automatically end. Students will need to start the task over.

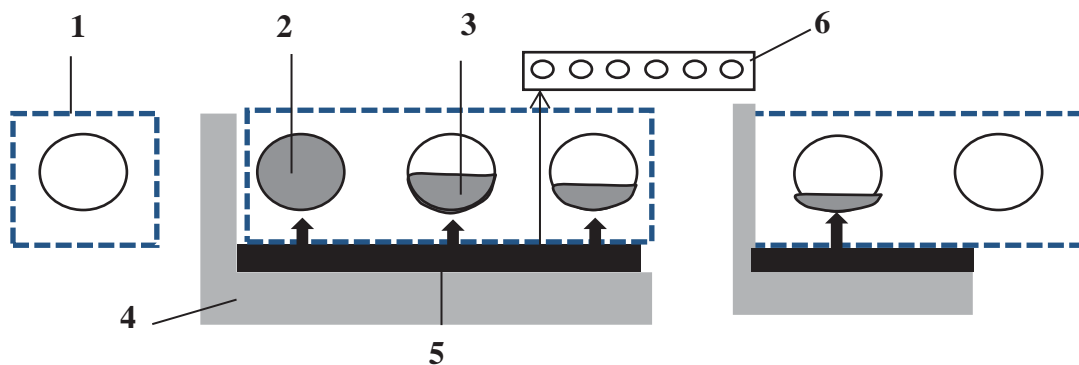
The final assessment takes place on the last learning task (1.6) within the task class. The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. There will be no visible lines or bite spacing, and audio cueing will be unavailable. The learner will have one opportunity to do the suture pattern correctly.

Upon completion the colored visual line will appear to give the student immediate feedback on the correctness of the suture pattern line and bite spacing. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described previously in the preliminary content), in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET 213 laboratory, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. Proficiency will be based on the identification of tools and suture material to be used, the accuracy of distance between bites and each suture, and the accuracy of the square knot.

Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with learning task 1.6 with any feedback options to check their proficiency with the pattern

or return to any other practice within the task class. Students may also revisit any task class in Modules 1-2.

The 4C/ID uses a visual design language that uses basic forms and shapes that represent learning tasks (circles), supportive information (L-shapes), procedural information (arrows) and part-task practice (boxed series of circles). These components are represented by drawn objects in Figure 8.



1. Task Class: Ford Interlocking Suture Pattern
2. Learning Task: Ford Interlocking Equine Caslick (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: multimedia presentation slides on Ford Interlocking suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library – equine Caslick with Ford Interlocking suture pattern, Video segment of Ford Interlocking suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall and Peter (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press. Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension after two throws, the suture material will break, and the student will have to start the task over. If too little tension is

applied after two throws, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head)

6. Part-task practice: procedural steps 25-28 of Ford Interlocking suture pattern

Figure 8. 4C/ID model for the Ford Interlocking suture pattern (Equine). A visual depiction of the six main features of 4C/ID-model for the Ford Interlocking suture pattern equine scenario used in the IVSS; adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Module 4 – Ford Interlocking Suture Pattern - Bovine

A second ford interlocking pattern simulation is given to MSU VT students so that they are exposed to the two most common large animal species they will work with in real life situations. The same technique concerns hold true when working on the cow. Students must be cognizant to the tension throughout the pattern. Since there is no real change to the pattern itself, the instructor anticipates a faster learning curve on the bovine, since it was previously performed on the horse. The number of tasks will remain the same due to the special emphasis on wrist supination (See Appendix B).

The task class in this module is ford interlocking suture pattern. The learning tasks are embedded in a bovine C-section scenario, so each learning task is the ford interlocking suturing pattern on a cow C-section. The first learning task (1.1) is fully supported with full assistance ranging from visual suture pattern lines and spacing to verbal cueing from a pedagogical agent giving step-by-step instruction on the suturing procedure. Tool selection is required in all learning tasks, but decreases from a short tray to a full tray. Incorrect tools will not move over. The suture material will be a given.

Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient. Tips and guidance will sound throughout the first learning task. Just-in-time information will give the student audio beeps and a colored visual line when they are off the placed pattern. The haptic color bar will change colors when different forces are applied during the suturing technique. Too little tension will show a yellow color and too much tension will show red. If the student maintains a green color throughout the procedure, that will indicate the perfect suture tension. An auditory beep will sound if depth penetration of the dermas is too deep.

Support information is available with the click of the resource button. A multimedia presentation on ford interlocking, an instructional video of ford interlocking suture pattern on the rescue critter with step-by-step procedural information, and a video on the square knot is available at any time. This supportive

information is available before the first learning task and throughout all of the task class, except for the final Learning task 1.6.

Learning tasks 1.2 through 1.5 are put in order of decreasing scaffolding. Each learning task is of equal complexity and diversity. The learner will get less and less support to complete the task. The suture pattern line will decrease in visibility. Lines and bite spacing will be shown with dotted lines periodically throughout the wound, instead of a solid bold line.

Part-task practice will be available starting with learning task 1.2 through 1.5. Video on the ford interlocking procedure steps 26-30 is mandatory when the first part-task practice is initiated. Special attention is to be given to wrist supination when advancing the needle through the skin (See Appendix C). After the first part-task practice, the video is optional on subsequent tasks.

The IVSS will also provide feedback after the completion of each learning task. The IVSS will count the number of clicks to correctly identify tools and suture material. It will record the number of times the learner goes out of the pattern line, if suture depth penetration is too deep, and the number of time placement of bite spacing is incorrect.

The haptic assessment will reveal if the haptic tension was too tight or too loose by the haptic color bar. If tension is too little for a period of two throws, the suture will unravel and the task will automatically stop. The student will have to start

the task over. If the tension is too tight for a period of two throws the suture will tear and the task will automatically end. Students will need to start the task over.

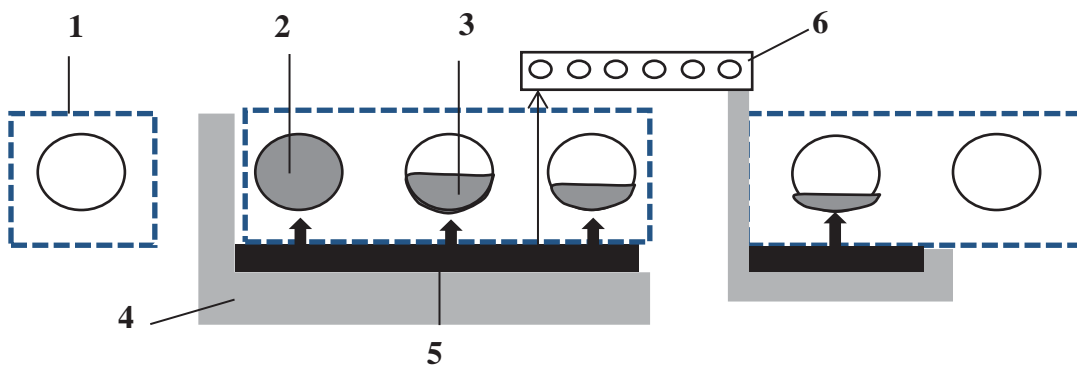
The final assessment takes place on the last learning task (1.6) within the task class. The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. There will be no visible lines or bite spacing, and audio cueing will be unavailable. The learner will have one opportunity to do the suture pattern correctly.

Upon completion the colored visual line will appear to give the student immediate feedback on the correctness of the suture pattern line and bite spacing. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described previously in the preliminary content), in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET 213 laboratory, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. Proficiency will be based on the identification of tools and suture material to be used, the accuracy of distance between bites and each suture, and the accuracy of the square knot.

Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with learning task 1.6 with any feedback options to check their proficiency with the pattern

or return to any other practice within the task class. Students may also revisit any task class in Modules 1-3.

The 4C/ID uses a visual design language that uses basic forms and shapes that represent learning tasks (circles), supportive information (L-shapes), procedural information (arrows) and part-task practice (boxed series of circles). These components are represented by drawn objects in Figure 9.



1. Task Class: Ford Interlocking Suture Pattern
2. Learning Task: Ford Interlocking Bovine C-section (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: multimedia presentation slides on Ford Interlocking suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library – canine closure wound with simple interrupted suture pattern, Video segment of ford interlocking suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall and Peter (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension applied after two throws, the suture material will break, and the student will have to start the task over. If too little

tension is applied after two throws, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head).

6. Part-task practice: Square knot practice and Specialized practice on procedural steps 26-30 of Ford Interlocking suture pattern

Figure 9. 4C/ID model Ford Interlocking suture pattern (Bovine)

A visual depiction of the six main features of 4C/ID model for the Ford Interlocking suture pattern bovine scenario used in the IVSS; adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Module 5 – Cruciate Suture Pattern - Feline

The next pattern taught is the cruciate suture pattern. This is an interrupted pattern that is less frequently used than the simple interrupted and slightly more difficult to learn by the student. Students seemingly cannot remember the pattern based on the direction of the needle insertion (See Appendix B). The species chosen for this simulation was the cat, but the pattern can be used on any species.

The task class in this module is the cruciate suture pattern. The learning tasks are embedded in a feline cystotomy case scenario, so each learning task is the cruciate suturing pattern on a cat cystotomy. The first learning task (1.1) is fully supported with full assistance ranging from visual suture pattern lines and spacing to verbal

cueing from a pedagogical agent giving step-by-step instruction on the suturing procedure. Tool selection is required in all learning tasks, but decreases from a short tray to a full tray. Incorrect tools will not move over. The suture material will be a given.

Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient. Tips and guidance will sound throughout the first learning task. Just-in-time information will give the student audio beeps and a colored visual line when they are off the placed pattern. The haptic color bar will change colors when different forces are applied during the suturing technique. Too little tension will show a yellow color and too much tension will show red. If the student maintains a green color throughout the procedure, that will indicate the perfect suture tension. An auditory beep will sound if depth penetration of the dermas is too deep.

Support information is available with the click of the resource button. A multimedia presentation on cruciate suturing, an instructional video of the cruciate suture pattern on the rescue critter with step-by-step procedural information, and a video on the square knot is available at any time. This supportive information is available before the first learning task and throughout all of the task class, except for the final Learning task 1.6.

Learning tasks 1.2 through 1.5 are put in order of decreasing scaffolding. Each learning task is of equal complexity and diversity. The learner will get less and less

support to complete the task. The suture pattern line will decrease in visibility. Lines and bite spacing will be shown with dotted lines periodically throughout the wound, instead of a solid bold line.

Part-task practice will be available starting with learning task 1.2 through 1.5. Video on the cruciate suture pattern procedural steps 10-14 is mandatory when the first part-task practice is initiated. Special attention is again with wrist supination and with the insertion of the needle (See Appendix C). After the first part-task practice, the video is optional on subsequent tasks.

The IVSS will also provide feedback after the completion of each learning task. The IVSS will count the number of clicks to correctly identify tools and suture material. It will record the number of times the learner goes out of the pattern line, if suture depth penetration is too deep, and the number of time placement of bite spacing is incorrect.

The haptic assessment will reveal if the haptic tension was too tight or too loose by the haptic color bar. If tension is too little for a period of two throws, the suture will unravel and the task will automatically stop. The student will have to start the task over. If the tension is too tight for a period of two throws the suture will tear and the task will automatically end. Students will need to start the task over.

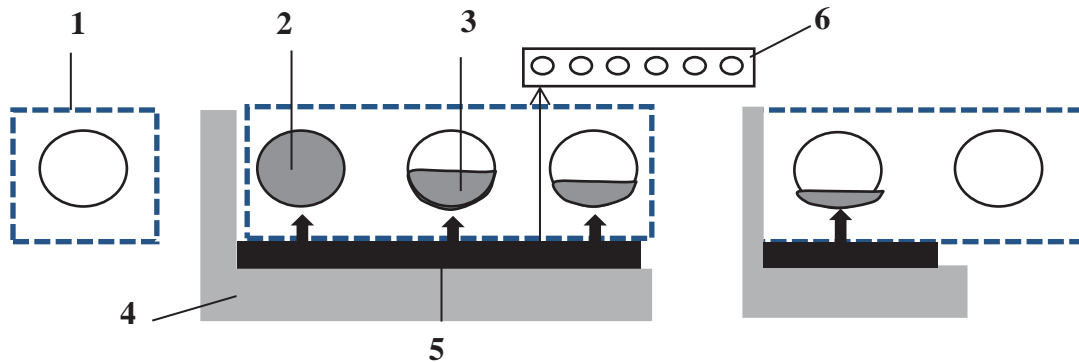
The final assessment takes place on the last learning task within the task class. The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be

unavailable. There will be no visible lines or bite spacing, and audio cueing will be unavailable. The learner will have one opportunity to do the suture pattern correctly.

Upon completion the colored visual line will appear to give the student immediate feedback on the correctness of the suture pattern line and bite spacing. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described previously in the preliminary content), in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET 213 laboratory, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. Proficiency will be based on the identification of tools and suture material to be used, the accuracy of distance between bites and each suture, and the accuracy of the square knot.

Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with learning task 1.6 with any feedback options to check their proficiency with the pattern or return to any other practice within the task class. Students may also revisit any task class in Modules 1-4.

The 4C/ID uses a visual design language that uses basic forms and shapes that represent learning tasks (circles), supportive information (L-shapes), procedural information (arrows) and part-task practice (boxed series of circles). These components are represented by drawn objects in Figure 10.



1. Task Class: Cruciate Suture Pattern
2. Learning Task: Feline Cystotomy cruciate suture pattern (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: multimedia presentation slides on simple interrupted suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library –feline cystotomy with cruciate suture pattern, Video segment of cruciate suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall and Peter (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension applied after two throws, the suture material will break, and the student will have to start the task over. If too little tension is applied after two throws, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermis is too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head)
6. Part-task practice: Square knot practice and specialized practice on Procedural steps 10-14 on cruciate suture pattern

Figure 10. 4C/ID model Cruciate suture pattern. A visual depiction of the six main features of 4C/ID model for the Cruciate suture pattern scenario used in the IVSS; adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Module 6 – Vertical Mattress Suture Pattern - Avian

The vertical mattress suture pattern is the one that the majority of MSU VT students struggle with (See Table 3). The thought behind this lack of proficiency is the repositioning of the needle (See Appendix C). It is not a commonly used pattern, but it is still essential for the students to learn. A bird is the patient for this simulation.

The task class in this module is the vertical mattress suture pattern. The learning tasks are embedded in an avian lipoma case scenario, so each learning task is the vertical mattress suturing pattern on a bird's lipoma. The first learning task (1.1) is fully supported with full assistance ranging from visual suture pattern lines and spacing to verbal cueing from a pedagogical agent giving step-by-step instruction on the suturing procedure. Tool selection is required in all learning tasks, but decreases from a short tray to a full tray. Incorrect tools will not move over. The suture material will be a given.

Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient. Tips and guidance will sound throughout the

first learning task. Just-in-time information will give the student audio beeps and a colored visual line when they are off the placed pattern. The haptic color bar will change colors when different forces are applied during the suturing technique. Too little tension will show a yellow color and too much tension will show red. If the student maintains a green color throughout the procedure, that will indicate the perfect suture tension. An auditory beep will sound if depth penetration of the dermas is too deep.

Support information is available with the click of the resource button. A multimedia presentation on vertical mattress, an instructional video of vertical mattress suture pattern on the rescue critter with step-by-step procedural information, and a video on the square knot is available at any time. This supportive information is available before the first learning task and throughout all of the task class, except for the final Learning task 1.6.

Learning tasks 1.2 through 1.7 are put in order of decreasing scaffolding. Each learning task is of equal complexity and diversity. The learner will get less and less support to complete the task. The suture pattern line will decrease in visibility. Lines and bite spacing will be shown with dotted lines periodically throughout the wound, instead of a solid bold line.

Part-task practice will be available starting with learning task 1.2 through 1.7. Video on procedural steps 5-11 with vertical mattress suture pattern is mandatory when the first part-task practice is initiated (See Appendix B). The repositioning of

the needle in the needle holders is a point to be reinforced with the isolated practice. After the first part-task practice, the video is optional on subsequent tasks.

The IVSS will also provide feedback after the completion of each learning task. The IVSS will count the number of clicks to correctly identify tools and suture material. It will record the number of times the learner goes out of the pattern line, if suture depth penetration is too deep, and the number of time placement of bite spacing is incorrect.

The haptic assessment will reveal if the haptic tension was too tight or too loose by the haptic color bar. If tension is too little for a period of two throws, the suture will unravel and the task will automatically stop. The student will have to start the task over. If the tension is too tight for a period of two throws the suture will tear and the task will automatically end. Students will need to start the task over.

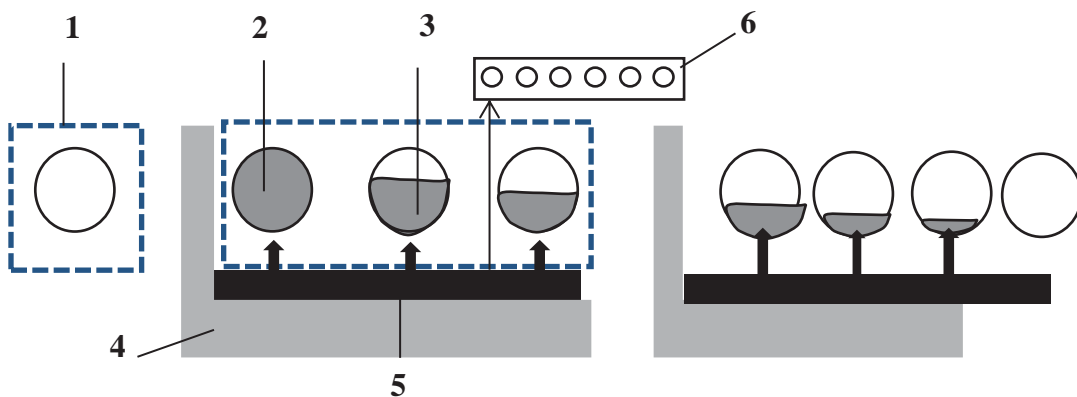
The final assessment takes place on the last learning task (1.8) within the task class. The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. There will be no visible lines or bite spacing, and audio cueing will be unavailable. The learner will have one opportunity to do the suture pattern correctly.

Upon completion the colored visual line will appear to give the student immediate feedback on the correctness of the suture pattern line and bite spacing. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described previously

in the preliminary content), in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET 213 laboratory, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. Proficiency will be based on the identification of tools and suture material to be used, the accuracy of distance between bites and each suture, and the accuracy of the square knot.

Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with learning task 1.8 with any feedback options to check their proficiency with the pattern or return to any other practice within the task class. Students may also revisit any task class in Modules 1-5.

The 4C/ID model uses a visual design language that uses basic forms and shapes that represent learning tasks (circles), supportive information (L-shapes), procedural information (arrows) and part-task practice (boxed series of circles). These components are represented by drawn objects in Figure 11.



1. Task Class: Vertical Mattress Suture Pattern
2. Learning Task: Horizontal Mattress Suture on an avian lipoma (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: multimedia presentation slides on vertical mattress suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library –avian lipoma vertical mattress suture pattern, Video segment of vertical mattress suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall and Peter (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension applied after two throws, the suture material will break, and the student will have to start the task over. If too little tension is applied after two throws, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head)
6. Part-task practice: Procedural steps 5-11 on horizontal mattress suture pattern

Figure 11. 4C/ID model Vertical Mattress suture pattern. A visual depiction of the six main features of 4C/ID model for the Vertical Mattress suture pattern scenario used in the IVSS; adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Module 7 – Horizontal Mattress Suture Pattern - Rabbit

The horizontal mattress is another pattern that students struggle with (See Table 3). Students have a hard time remembering to reposition the needle within the needle holders (See Appendix C). The part-task practice will focus heavily on this skill to help promote automaticity. Although this pattern is not commonly used, it is still vital for the MSU VT student to learn.

The task class in this module is the horizontal mattress suture pattern. The learning tasks are embedded in a rabbit ovariohysterectomy case scenario, so each learning task is the horizontal mattress suturing pattern on a rabbit ovariohysterectomy. The first learning task (1.1) is fully supported with full assistance ranging from visual suture pattern lines and spacing to verbal cueing from a pedagogical agent giving step-by-step instruction on the suturing procedure. Tool selection is required in all learning tasks, but decreases from a short tray to a full tray. Incorrect tools will not move over. The suture material will be a given.

Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient. Tips and guidance will sound throughout the first learning task. Just-in-time information will give the student audio beeps and a colored visual line when they are off the placed pattern. The haptic color bar will change colors when different forces are applied during the suturing technique. Too little tension will show a yellow color and too much tension will show red. If the student maintains a green color throughout the procedure, that will indicate the

perfect suture tension. An auditory beep will sound if depth penetration of the dermas is too deep.

Support information is available with the click of the resource button. A multimedia presentation on horizontal mattress, an instructional video of horizontal mattress suture pattern on the rescue critter with step-by-step procedural information, and a video on the square knot is available at any time. This supportive information is available before the first learning task and throughout all of the task class, except for the final Learning task 1.8.

Learning tasks 1.2 through 1.7 are put in order of decreasing scaffolding. Each learning task is of equal complexity and diversity. The learner will get less and less support to complete the task. The suture pattern line will decrease in visibility. Lines and bite spacing will be shown with dotted lines periodically throughout the wound, instead of a solid bold line.

Part-task practice will be available starting with learning task 1.2 through 1.7. Video of the procedure steps 6-10 with the horizontal mattress suture pattern is mandatory when the first part-task practice is initiated. Special attention needs to be taken with this pattern. This pattern requires a reversing of the order while suturing. The needle needs to enter the same side that was just exited (See Appendix B). Another part-task practice will be available to students to practice the square knot again, since it has been eliminated from several of the previous simulations. It can be

used as a refresher if the students selects. After the first part-task practice, the video is optional on subsequent tasks.

The IVSS will also provide feedback after the completion of each learning task. The IVSS will count the number of clicks to correctly identify tools and suture material. It will record the number of times the learner goes out of the pattern line, if suture depth penetration is too deep, and the number of time placement of bite spacing is incorrect.

The haptic assessment will reveal if the haptic tension was too tight or too loose by the haptic color bar. If tension is too little for a period of two throws, the suture will unravel and the task will automatically stop. The student will have to start the task over. If the tension is too tight for a period of two throws the suture will tear and the task will automatically end. Students will need to start the task over.

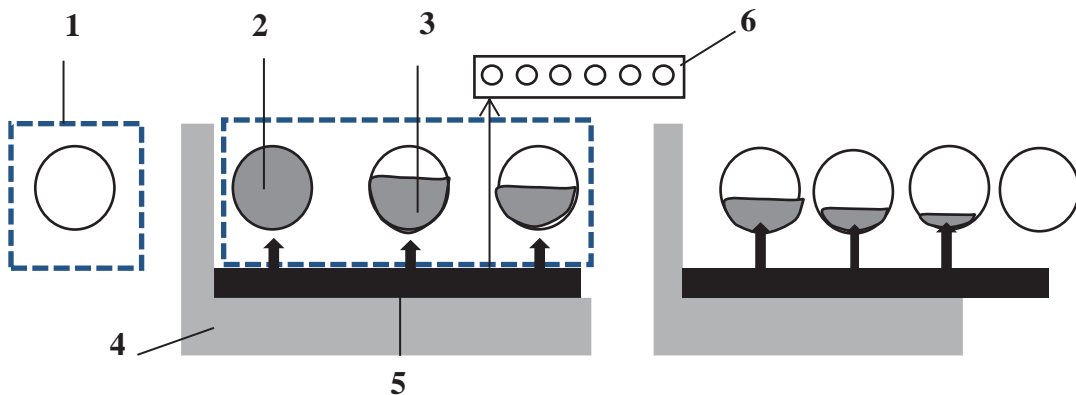
The final assessment takes place on the last learning task (1.8) within the task class. The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. There will be no visible lines or bite spacing, and audio cueing will be unavailable. The learner will have one opportunity to do the suture pattern correctly.

Upon completion the colored visual line will appear to give the student immediate feedback on the correctness of the suture pattern line and bite spacing. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described previously

in the preliminary content), in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET 213 laboratory, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. Proficiency will be based on the identification of tools and suture material to be used, the accuracy of distance between bites and each suture, and the accuracy of the square knot.

Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with learning task 1.6 with any feedback options to check their proficiency with the pattern or return to any other practice within the task class. Students may revisit any task within any of the Modules 1-6.

The 4C/ID model uses a visual design language that uses basic forms and shapes that represent learning tasks (circles), supportive information (L-shapes), procedural information (arrows) and part-task practice (boxed series of circles). These components are represented by drawn objects in Figure 12.



1. Task Class: Horizontal Mattress Suture Pattern

2. Learning Task: Horizontal Mattress Suture on a rabbit ovariohysterectomy (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: multimedia presentation slides on horizontal mattress suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library –rabbit ovariohysterectomy mattress suture pattern, Video segment of horizontal mattress suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall and Peter (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension applied after two throws, the suture material will break, and the student will have to start the task over. If too little tension is applied after two throws, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head)
6. Part-task practice: Square knot practice and procedural steps 5-11 on horizontal mattress suture pattern

Figure 12. 4C/ID model Horizontal Mattress suture pattern. A visual depiction of the six main features of 4C/ID model for the Horizontal Mattress suture pattern scenario used in the IVSS; adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Module 8 –Continuous Horizontal Suture Pattern - Mouse

The last pattern the students learn is the continuous horizontal suture pattern

The continuous horizontal is another pattern that students struggle with (See Table 3). Students continue to have a hard time remembering to reposition the needle within the needle holders. The part-task practice will focus heavily on this skill to help promote automaticity (See Appendix C). Although this pattern is not commonly used, it is still vital for the MSU VT student to learn.

The task class in this module is the continuous horizontal suture pattern. The learning tasks are embedded in a rodent ovariohysterectomy case scenario, so each learning task is the continuous horizontal suturing pattern on a mouse ovariohysterectomy. The first learning task (1.1) is fully supported with full assistance ranging from visual suture pattern lines and spacing to verbal cueing from a pedagogical agent giving step-by-step instruction on the suturing procedure. Tool selection is required in all learning tasks, but decreases from a short tray to a full tray. Incorrect tools will not move over. The suture material will be a given.

Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient. Tips and guidance will sound throughout the first learning task. Just-in-time information will give the student audio beeps and a colored visual line when they are off the placed pattern. The haptic color bar will change colors when different forces are applied during the suturing technique. Too little tension will show a yellow color and too much tension will show red. If the student maintains a green color throughout the procedure, that will indicate the

perfect suture tension. An auditory beep will sound if depth penetration of the dermas is too deep.

Support information is available with the click of the resource button. A multimedia presentation on continuous horizontal, an instructional video of continuous horizontal suture pattern on the rescue critter with step-by-step procedural information, and a video on the square knot is available at any time. This supportive information is available before the first learning task and throughout all of the task class, except for the final Learning task 1.8.

Learning tasks 1.2 through 1.7 are put in order of decreasing scaffolding. Each learning task is of equal complexity and diversity. The learner will get less and less support to complete the task. The suture pattern line will decrease in visibility. Lines and bite spacing will be shown with dotted lines periodically throughout the wound, instead of a solid bold line.

Part-task practice will be available starting with learning task 1.2 through 1.7. Video of the procedure steps 6-10 with the continuous horizontal suture pattern is mandatory when the first part-task practice is initiated. Special attention needs to be taken with this pattern. This pattern requires a reversing of the order while suturing. The needle needs to enter the same side that was just exited (See Appendix C). Another part-task practice will be available to students to practice the square knot again, since it has been eliminated from several of the previous simulations. It can be

used as a refresher if the students selects. After the first part-task practice, the video is optional on subsequent tasks.

The IVSS will also provide feedback after the completion of each learning task. The IVSS will count the number of clicks to correctly identify tools and suture material. It will record the number of times the learner goes out of the pattern line, if suture depth penetration is too deep, and the number of time placement of bite spacing is incorrect.

The haptic assessment will reveal if the haptic tension was too tight or too loose by the haptic color bar. If tension is too little for a period of two throws, the suture will unravel and the task will automatically stop. The student will have to start the task over. If the tension is too tight for a period of two throws the suture will tear and the task will automatically end. Students will need to start the task over.

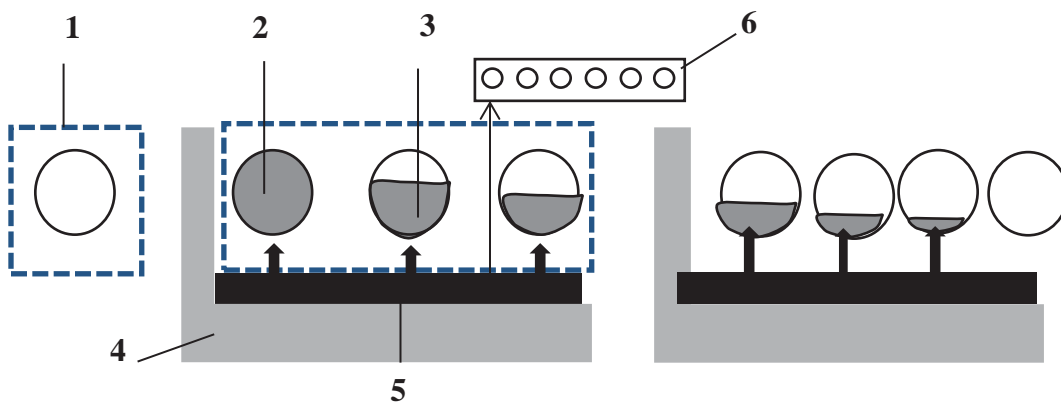
The final assessment takes place on the last learning task (1.8) within the task class. The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. There will be no visible lines or bite spacing, and audio cueing will be unavailable. The learner will have one opportunity to do the suture pattern correctly.

Upon completion the colored visual line will appear to give the student immediate feedback on the correctness of the suture pattern line and bite spacing. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described previously

in the preliminary content), in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET 213 laboratory, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. Proficiency will be based on the identification of tools and suture material to be used, the accuracy of distance between bites and each suture, and the accuracy of the square knot.

Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with learning task 1.6 with any feedback options to check their proficiency with the pattern or return to any other practice within the task class. Students may revisit any task within any of the Modules.

The 4C/ID model uses a visual design language that uses basic forms and shapes that represent learning tasks (circles), supportive information (L-shapes), procedural information (arrows) and part-task practice (boxed series of circles). These components are represented by drawn objects in Figure 13.



1. Task Class: Continuous Horizontal Suture Pattern
2. Learning Task: Continuous Horizontal Suture on a rodent ovariohysterectomy (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: multimedia presentation slides on continuous horizontal mattress suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library –rodent ovariohysterectomy mattress suture pattern, Video segment of continuous horizontal mattress suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall and Peter (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension after two throws, the suture material will break, and the student will have to start the task over. If too little tension is applied after two throws, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head)
6. Part-task practice: Procedural Steps 6-10 of the horizontal continuous suture pattern

Figure 13. 4C/ID model Continuous Horizontal Mattress suture pattern. A visual depiction of the six main features of 4C/ID model for the Continuous Horizontal Mattress suture pattern scenario used in the IVSS; adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Chapter Five

Conclusions

Faculty and students have identified suture patterns and techniques as a learning gap in the MSU VT Program. The researchers theorized that the lack of practice and the condensed time frame provided to teach the suturing skills results in decreased comprehension and performance of each pattern. The goal of this capstone was to complete the framework for an alternate training technique that will improve the suture patterns and techniques of the students in the MSU VT Program. The IVSS will provide MSU VT students with a safe interactive real-world simulation in which to practice suturing patterns. The purpose of developing the IVSS is to provide MSU VT students an alternative tool that may be used in developing suturing techniques. The IVSS Novice Level will provide the practice venue for students to become more proficient in the selection of surgical tools, suture materials, and pattern selection. The simulation will be available on a DVD and the haptic interface will allow PHANTOM Omni devices to interact with the simulation.

Next Steps of the IVSS Project

The IVSS Novice Level will provide a high level of interactivity by providing numerous realistic scenarios with suture pattern practice tasks (each with decreasingly available help). Within each instructional module, previously taught skills are reinforced and assessed in order to determine the students' ability to identify suturing

surgical tools, identify appropriate suturing materials, and demonstrate correct suture spacing and pattern.

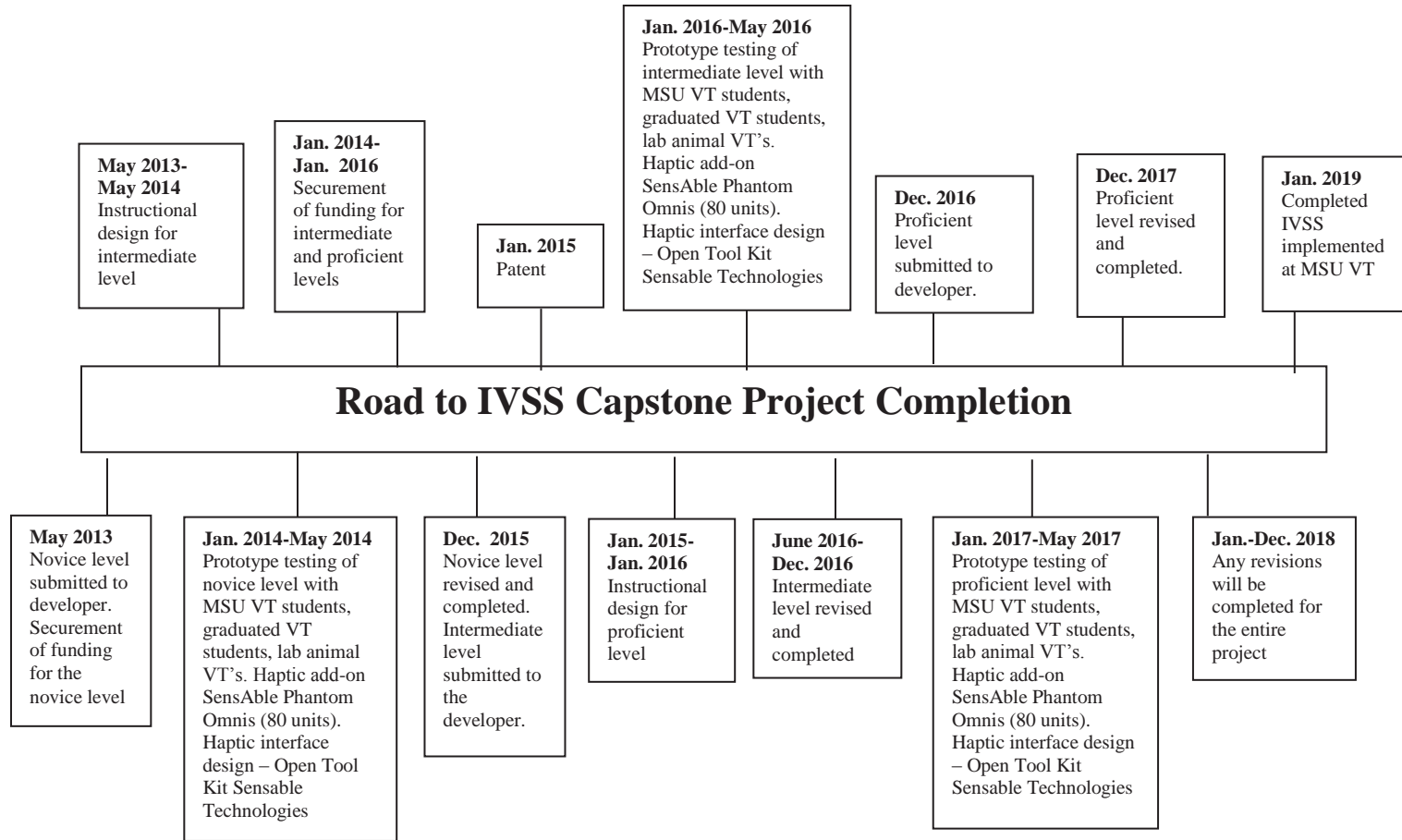
The development of a timeline (See Figure 14) enabled the creators of the IVSS to set goals for design and implementation. As shown below, the timeline identifies a number of essential steps leading to the successful development of IVSS and an approximate amount of time for each step. Figure 14 shows the complete project time frame starting with the Novice Level and ending with the Proficient Level.

Development of the IVSS Project

The research on simulations provided the project team intrinsic and integral components needed to produce one type of effective simulation instructional tools. An understanding of simulation as an instructional tool combined with the identification and selection of the appropriate content were critical in the development of the IVSS. Attention to detail, design, and implementation is essential for a successful product.

The next phase of the project will be to hire an expert in simulation design and implementation to create the graphics and simulation product. The IVSS development will involve elaborate detailing to the storyboarding and instructional design created by the researchers. For the IVSS to advance in its development, it is vital to find a company that will suit the IVSS design needs and budget constraints.

Figure 14. Timeline for the IVSS



The biggest component for cost consideration in the development of the IVSS is time. Most costs are relative to hours on the project, so it is necessary for the creators of the IVSS to provide the developing company with as much framework as possible. The developing company must provide attention to detail, such as the refinement of script writing, visuals that drive the script, and embedding the videos within the appropriate sections of the IVSS. Another production cost includes the development of media and audio. Rental costs for a sound studio and rental equipment must be considered. To minimize the time and costs associated with narration the designers will have extensive detailing and specifics in their framework.

Selection of a company to produce the IVSS involves identifying the scope of the work, the ease and ability of the project developers to contact and interact with the company personnel, and the ability of the company to work within the time and financial constraints required by the project developers. A track record of producing other, similar products also will guide the selection of the company.

An example of a development company is Clearly Trained, a company based out of Louisville, Kentucky. Clearly Trained are experts in the field of simulation design and implementation. Their area of expertise lies in interactive surgical simulations designed for the web. The creators of the IVSS want to use a company like Clearly Trained because of their proven successes, their dedication to the needs and desires of the client, and the fact that all of their production, except for the audio, is done in-house.

Other training modules produced by Clearly Trained contain actual surgical videos and realistic procedures designed to take the intimidation out of the surgery. A participant can complete simulations of liposuction, tonsillectomies, dental procedures, and other medical procedures. Their designs take a participant through pre-op instructions and the beneficial details of the surgery, the actual procedure with tool selection and protocol, and post-op information that is beneficial to the patient. The researchers began to visualize this application serving a purpose for MSU VT students, substituting animals instead of human patients. The generalized project is estimated at over \$100,000. This estimated cost including the haptic add-on can reach upwards of \$300,000.

Implementation of the IVSS Project

The Novice Level will be submitted for development and completed during 2013-2014. A total of 80 PHANToM Omnis will be purchased for checkout purposes by MSU VT students to be interfaced with the IVSS. The researchers will be working with SensAble OpenTool Kit and SensAble haptic designers to blend the simulation design with the tool.

The Intermediate Level of the IVSS will be created by December 2015. Testing of the revised intermediate level prototype will continue throughout January to May, 2016. The Proficient Level will be in draft and design with completion slated for December 2016. Final testing and revision will run through January to May, 2017.

It is expected that the complete IVSS will be available for implementation for MSU VT students by 2019 and will be an integrated part of the curriculum.

The IVSS will serve as a companion piece to suture products, a continuing education piece, and an ethical alternative in veterinary practices. It can be used as a teaching tool, a refresher course, a continuing education credit, and a profitable practice tool to further proficiency in a life-saving practice. The researchers of the IVSS foresee its' use in all veterinary teaching colleges and universities across this country and abroad. Private industries that supply suturing products can use the IVSS as a supplement to their product line. Practitioners in independent clinics, emergency animal hospitals, and private practices can use the IVSS as a refresher course.

Evaluation of the IVSS Project

Testing of the Novice Level prototype will begin in January 2015, funding permitted. MSU VT students will be randomly divided into two test groups. One group will use the IVSS in addition to a multimedia presentation and instructor demonstration. The second group will continue the suturing lesson in its current form with the multimedia presentation, instructor demonstration, and phantom limb. Results will be assessed from student surveys, IVSS practice results from computer feedback and captured screen shots, and face-to-face proficiency testing in the laboratory.

All students will complete an exam at the end of the suturing unit that includes both written and physical components. This exam will assess content knowledge and

student physical ability to link content with tactile skill. Both test group scores will be compared in content knowledge and skill proficiency.

After the suturing module is complete, all MSU VT students will have an opportunity to experiment with the simulation and give constructive feedback on the design, implementation, and an over-all critique. The simulation will also be shared with MSU VT graduates in clinical practice, lab animal research, and educational settings. Feedback will come through survey questionnaires.

Prototype testing will continue on the remaining two levels of the IVSS through May 2017. The Intermediate Level prototype will be reviewed by and revisions will be completed by the designer and developer by August of 2017. The Proficient Level prototype will be reviewed by and revisions will be completed by August 2018. The IVSS finished product will be completed and ready for full implementation by 2019.

Current research by Lateef (2010) and McGaghie, Issenberg, Petrusa, and Scalese (2010) that examines simulations to teach doctors of human patients, suggests that simulations improve clinical skills such as suturing. Suture patterns are universal, so if human medical doctors' skills improve by using simulation, it seems that a logical conclusion would be that veterinary technician skills will improve as well.

Limitations of the Project

A number of limitations have been identified for this project including funding, time constraints, uncertainty of impact as an instructional tool, and reluctance of university professors to adopt simulation as an instructional tool. The major limitations in this project are the time and funds necessary to continue to study and improve the product and the future development of subsequent generations of the product. The approximate cost to produce the IVSS with haptic devices range from \$161,000- \$200,000. This cost lies far outside of the MSU VT Departments budget allotment. It will also take many years to recoup the initial startup costs through student book and rental fees.

Grant searches and alternative funding sources will be explored to meet the cost projections of the IVSS. Monies available to veterinarian practices are not as available as human medicine funding. The creators of the IVSS will seek new and creative resourcing to fund the project.

Not knowing the impact of IVSS on student learning is another limitation. As with any new project, one should always be cognizant of the need to continuously improve the product, to identify unintended consequences that may interfere with the intended results of the product, and the possibility of the need to refine the product to increase the effective operation even more efficient ways. This information will come from follow-up studies and interviews with students and faculty using the product to verify learning and teaching improvements. Such findings provide

important information that can be used to improve the project if need be. Another possibility is that while the product may be defined as a success at a given point, there is a need to continue the work to meet more demands as users become familiar with the product and request expansion of the product's abilities and uses

On a larger scale another limitation is persuading teachers to use interactive simulations in their classroom. Given the scarcity of simulation tools in veterinary training, it's unlikely that the university instructor was trained using simulation tools. Some university teachers may find it unacceptable to diverge from the methods with which they were taught and have always used to teach.

Conclusions

Current research suggests that practice in an interactive virtual simulation can improve clinical skills such as suturing. (Scalese, Obeso, & Issenberg, 2007; MacDonald, Williams, & Rogers, 2003; and Porte, Xeroulis, Rezneck, & Dubrowski, 2007). It is believed that veterinary technician skills will benefit from the same results. The IVSS will provide veterinary technicians with a low stress environment to work in and a venue for practice; the ability to repeat procedures without patient consequence. If the IVSS works as intended, MSU VT students will graduate with higher confidence and better proficiency in suturing skills which will transfer to safer procedures and longer life for the animals they treat.

The IVSS was designed for the MSU VT Program, but once produced could be used globally. Dependent on field testing of suturing technique competence by

MSU VT students, it is anticipated that the use of this IVSS could be used in programs outside the MSU VT Program. Initial measures of student competence related to IVSS may include in-class quizzes, laboratory assignments, and the Veterinary Technician National Examination (VTNE). Additionally, the impact of the IVSS on other veterinary programs could be impacted by the successes realized by the MSU VT students using the IVSS and awareness of the IVSS by professionals in other veterinary training programs. Once the IVSS is fully operational, it will allow for an assessment of this hypothesis.

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- Zarei-Nia, K., Yang, X. D., Irani, P., & Sepehri, N. (2009). Evaluating factors that influence path tracing with passive haptic guidance. In *Haptic and Audio Interaction Design* (pp. 21-30). Springer Berlin Heidelberg.

Appendix A

VET 213 Surgical Nursing – Student Survey

Please answer the following questions to the best of your ability. Your answers are extremely important in the improvement of instruction methods of this class. By falsely answering questions you hinder the improvement and success of the class.

1. Please rate your level of interest in suturing material, patterns, and techniques.
 - a. Very high
 - b. High
 - c. Average
 - d. Low
 - e. Very low
 - f. Unsure

2. Please rate the quality of the learning material used while working on suturing material, patterns, and techniques.
 - a. Excellent
 - b. Good
 - c. Average
 - d. Poor
 - e. Very poor
 - f. Unsure

3. Please rate the relevance of the learning material to the overall goals during your Second-Year small animal rotation.
 - a. Excellent
 - b. Good
 - c. Average
 - d. Poor
 - e. Very poor
 - f. Unsure

4. Please rate the learning material used while working on suturing material, patterns, and techniques on its ability to engage you.
 - a. Excellent
 - b. Good
 - c. Average
 - d. Poor
 - e. Very poor
 - f. Unsure

5. The PowerPoint presentation pertaining to suture material, needles, and patterns was helpful in my understanding of the topic

- a. Excellent
- b. Good
- c. Average
- d. Poor
- e. Very poor
- f. Unsure

6. The live demonstration the instructor provided of suture patterns was helpful in my understanding of suturing technique.

- a. Excellent
- b. Good
- c. Average
- d. Poor
- e. Very poor
- f. Unsure

7. The phantom limb that was provided was very life like and useful.

- a. Excellent
- b. Good
- c. Average
- d. Poor
- e. Very poor
- f. Unsure

8. The amount of time that was given for practice met my expectations.

- a. Excellent
- b. Good
- c. Average
- d. Poor
- e. Very poor
- f. Unsure

9. Have or do you use a joystick or additional device to enhance your gaming experience?

- a. Yes
- b. No
- c. Unsure

10. Have you ever used interactive virtual simulation as a form of entertainment?

- a. Yes
- b. No
- c. Unsure

11. Have you ever used interactive virtual simulation as learning tool?

- a. Yes
- b. No
- c. Unsure

12. Are you involved in an interactive virtual environment in your free time?

- a. Yes
- b. No
- c. Unsure

13. Are you involved in an interactive virtual environment for any classes or assignments?

- a. Yes
- b. No
- c. Unsure

14. Would an interactive virtual simulation that would allow you to simulate suture patterns be of benefit? This technology would give different scenarios and species to practice with.

- a. Yes
- b. No
- c. Unsure

15. Do you think using an interactive virtual simulation would stimulate you to practice your technique more?

- a. Yes
- b. No
- c. Unsure

16. Please rate the clearness of objectives while working on suture material, patterns, and techniques.

- a. Excellent
- b. Good
- c. Average
- d. Poor
- e. Very Poor
- f. Unsure

17. Please rate the class on meeting its objectives.
- Excellent
 - Good
 - Average
 - Poor
 - Very Poor
 - Unsure
18. Compared to your other experiences at MSU VT, were suture material, patterns, and techniques:
- Far better
 - Somewhat better
 - Average
 - Somewhat worse
 - Far worse
 - Unsure
19. Please rate suture material, patterns, and techniques based only on its content and material.
- Excellent
 - Good
 - Average
 - Poor
 - Very poor
 - Unsure
20. Please rate the instructor on preparing for suture material, patterns, and techniques.
- Excellent
 - Good
 - Average
 - Poor
 - Very poor
 - Unsure
21. Please rate the ability of the instructor to effectively answer questions.
- Excellent
 - Good
 - Average
 - Poor
 - Very poor
 - Unsure

22. Please rate the ability of the instructor to encourage participation.

- a. Excellent
- b. Good
- c. Average
- d. Poor
- e. Very poor
- f. Unsure

23. Do you think have an interactive virtual simulation of suture, patterns, and techniques would encourage and enable students to become more proficient at suturing techniques?

- a. Definitely
- b. Probably
- c. Maybe
- d. Probably not
- e. Definitely not
- f. Unsure

Appendix B

Student Survey Responses

Question #	2009	2010	2011	2012	Answer
1	3	7	5	1	very high
	5	9	7	12	high
	0	2	3	3	average
	1	0	3	0	low
2	1	1	0	1	excellent
	3	6	10	1	good
	5	7	7	9	average
	0	4	1	5	poor
3	1	3	3	2	excellent
	7	11	7	9	good
	1	3	5	5	average
	0	1	0	0	poor
	0	0	1	0	very poor
	0	0	2	0	unsure
4	0	1	3	4	excellent
	8	10	4	2	good
	1	6	9	7	average
	0	0	2	3	poor
	0	1	0	0	very poor
5	0	0	3	2	excellent
	5	7	5	10	good
	4	7	7	4	average
	0	4	2	0	poor
	0	0	1	0	very poor
6	3	9	10	8	excellent
	6	5	7	8	good
	0	4	1	0	average

Question#	2009	2010	2011	2012	Answer
7	0	0	1	0	excellent
	2	4	5	1	good
	4	6	8	6	average
	3	4	3	7	poor
	0	4	0	2	very poor
8	2	1	1	2	excellent
	5	10	11	8	good
	1	7	4	6	average
	1	0	2	0	poor
9	3	3	7	6	yes
	5	13	11	8	no
	1	2	0	2	not sure
10	6	11	7	10	yes
	2	7	11	4	no
	1	1	0	2	not sure
11	5	4	3	6	yes
	4	14	14	10	no
	0	0	1	1	not sure
12	3	2	4	1	yes
	6	15	14	13	no
	0	1	0	2	not sure
13	6	1	0	0	yes
	8	16	17	14	no
	1	1	1	2	not sure
14	9	17	16	16	yes
	0	1	0	0	no
	0	0	2	0	not sure

Question#	2009	2010	2011	2012	Answer
15	9	16	16	16	yes
	0	1	0	0	no
	0	1	2	0	not sure
16	2	2	0	4	excellent
	7	9	15	7	good
	0	7	1	5	average
	0	0	2	0	poor
17	3	3	2	3	excellent
	6	10	14	13	good
	0	4	1	0	average
	0	1	0	0	poor
	0	0	1	0	not sure
18	1	1	0	0	far better
	3	5	5	10	somewhat better
	5	10	10	5	average
			3	1	somewhat worse
	0	2	0	0	not sure
19	1	1	0	1	excellent
	3	12	10	10	good
	5	5	8	5	average
20	7	7	10	6	excellent
	2	8	7	7	good
	0	3	1	3	average
21	9	6	13	10	excellent
	0	10	5	6	good
	0	2	0	0	average
22	8	10	13	9	excellent
	1	4	5	5	good
	0	4	0	2	average
23	9	12	15	14	definitely
	0	6	2	2	probably
	0	0	1	0	maybe

Appendix C

Instructional Design Modules

Simple Interrupted – Canine

The Simple Interrupted pattern is the first pattern that the students learn. This is the most basic pattern used in veterinary medicine yet used quite frequently. The pattern uses the basic square knot to close the incision line. The species used for this simulation is the dog although this pattern is commonly used on all species.

Module 1 – Simple Interrupted

Learning Focus

AVMA *Surgical Nursing*: (AVMA 1.1) Perform basic suturing techniques

***Procedural management*: (AVMA 1.2)** Identify and know proper use for instruments and identify common suture materials, types, and sizes AVMA. (2012). Accreditation Policies and Procedures of the AVMA Committee on Veterinary Technician Education and Activities (CVTEA). (Appendix I: 9-10).

MSU (MSU 1.1) Students will become proficient in suture patterns, material and instrument usage.

(MSU 1.2) Students will explore and develop skills that will enhance successful completion of suture patterns and techniques that can be applied in the workforce (MSU VET 213 Animal Care Techniques Surgical Nursing Syllabus).

Essential Skill (E 1.1) Students correctly identify common surgical instruments, knows the appropriate terminology for each and demonstrates knowledge of their proper uses according to Buell, L. & Sturtz, R. (2008). *Assessing essential skills of veterinary technology students*. 2nd ed. Deer Park, NY.

References

Multimedia presentation on simple interrupted suture pattern

Class Textbooks

Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.

Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.

Materials

Handout on suture materials – provided by instructor

Canine Case Scenario/Storyboard with procedural information on the steps to follow for correct simple interrupted suturing

Professional video library – canine closure wound with simple interrupted suture pattern

Video segment of simple interrupted suture pattern on rescue critter with step-by-step procedural information

Video on the square knot with step-by-step procedural information

Canine Castration Scenario

Jake is a six month old Labrador Retriever weighing 45 pounds and is in the veterinary clinic for a routine castration. All pre-anesthetic blood work has been completed and reviewed. He has been fasted for 12 hours and ready for pre meds. Jake is brought into the surgery prep area. He receives 0.20 ml of Butorphanol and 0.57 ml of Dexmedetomidine as a cocktail. This cocktail is given intramuscular in the right SM/ST. After the sedatives are given the vet tech places the intravenous (IV) catheter in the right cephalic vein. Once the IV catheter is secure, the vet tech administers Propofol IV until Jake loses all jaw tone. The vet tech should not need more than 5.32 ml. Once all jaw tone is lost the vet tech intubates the patient and connects him to the anesthesia machine where he is given Isoflurane to maintain his depth of anesthesia. He is now ready to be prepped for surgery.

Jake is placed in dorsal recumbancy and an area from the scrotum to mid abdomen is shaved with a #40 clipper blade. Once shaved and hair is removed via vacuum, the surgical scrub is performed. Three rotations of Chlorohexidine scrub and Isopropyl alcohol is applied. Once prepped, Jake is transferred into the surgery room.

All personal in the surgery room are wearing caps, masks, and booties. The surgical assistant and surgeon are aseptically gowned and gloved after they scrub in using Chlorohexidine. Jake is placed in dorsal recumbancy on the surgery table with all limbs secured. All monitoring equipment is connected and working properly.

In the surgery room, a sterile scrub is completed with Chlorohexidine scrub and Isopropyl alcohol and a final prep of Betadine is applied and left on the area.

The surgical site is draped aseptically using the four corner towel technique.

During the castration the vet tech assists with passing needed surgical instruments, gauze, and suture material. The veterinary technician will complete the skin closure by using a non-absorbable 2-0 Maxon suture material with a conventional cutting needle. Once the incision is closed Jake is taken off Isoflurane and given pure oxygen for the next five minutes. After five minutes the oxygen is turned off all monitoring equipment is removed and Jake is taken to recovery. Once Jake has a swallowing reflex the endotracheal tube is deflated and removed. Jake will need to return in seven to 10 days for suture removal. He will need to stay confined with restricted activity for the next seven to 10 days with no running or jumping.

Overview of Module 1: Canine Scenario with Simple Interrupted Suture Pattern

Objectives	Preliminary Content
	<p>Introduction of real-life case: Canine Scenario – Simple Interrupted Suture on Jake</p> <p>Learner is required to complete each task in order until they submit their final task for assessment by instructor. After the final task has been completed for final assessment with 80% accuracy, the user may revisit any task of their choosing for additional practice.</p> <p>The scenario sets the scene for the surgery (castration). Pedagogical agent reviews procedure and vet tech responsibilities pre-op/procedure/post-op. After the veterinarian has completed the castration, the vet tech is left to complete the surgery by closing the skin tissue with the simple interrupted suture pattern.</p>
<p>AVMA 1.2 MSU 1.1 E1.1</p>	<p>The vet tech must identify the tools and suture material needed to complete the closure. (Olsen Hegar Needle Holders, Adson Brown or Adson Tissue Forceps, conventional cutting needle, non-absorbable 2-0 Maxon).</p>

<p>AVMA 1.1 MSU 1.1 MSU 1.2 E 1.1</p>	<p>Vet tech will demonstrate Simple Interrupted suture pattern on Jake’s skin closure</p> <p>Vet tech will have several opportunities to practice with diminishing support and assistance. Feedback on this task will be provided with audio and visual cueing. A beep will sound if they get outside of the pattern lines or their spacing is off. A colored visual line will appear at the completion of each pattern. This line will reveal accuracy or if the vet tech got outside of the pattern lines.</p>
	<p>Assistance will be available with support materials upon request by selecting the resource button:</p> <ul style="list-style-type: none"> • Procedural information on the steps to follow for correct Simple Interrupted suturing • Professional video library – canine closure wound with Simple Interrupted suture pattern • Video segment of Simple Interrupted suture pattern on rescue critter with step-by-step procedural information • Video on the square knot with step-by-step procedural information <p>Assistance will be available with just in time information upon request by selecting the help_button:</p> <ul style="list-style-type: none"> • Pedagogical agent will appear with verbal just in time information pertaining to different points in the procedure (tips and guidance)
	<p>Areas for error:</p> <ul style="list-style-type: none"> • Unequal bite size • Leaving cut suture too long – tissue reaction • Pattern outside of line • Haptic tension too tight or too loose • Suture depth penetration
	<p>Proficiency based on:</p> <ul style="list-style-type: none"> • Identification of tools and suture material to be used • Accuracy of distance between bites and each suture • Accuracy of square knot
	<p>Final Assessment:</p> <p>In Learning task 1.6 the vet tech must identify tools, suture material and perform simple interrupted suture pattern without any form of assistance. The last task will have all supportive and just-in-time information unavailable for use. No part-task practice will be permitted, and the pedagogical agent will be</p>

	<p>unavailable. Upon completion the colored visual line will appear to give them immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment below in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p>
	<p>Assessment done by computer:</p> <ul style="list-style-type: none"> • Number of clicks to correctly identify tools • Number of clicks to correctly identify suture material • Number of times learner goes outside of pattern line • Number of times placement of bite spacing is wrong • Haptic feedback on angle of needle penetration - depth (audio) • Accuracy of square knot – direction of manipulation (alternating throws and a visual on the flatness of the knot) – Haptic color bar will signal too much or too little • Haptic feedback on angle of needle penetration - depth (audio) • Haptic feedback on tension applied to suture material – Haptic color bar will signal too much or too little • If tension is too little suture will unravel and the task will automatically stop. Student must start the task over • If tension is too tight the suture will tear and/or strangulation of tissue may occur. The task will automatically end and the student must start the task over.
	<p>Assessment to be done by instructor:</p> <ul style="list-style-type: none"> • Review of computer assessment and screen shot visual of pattern

Module 1: Simple Interrupted Suture Pattern: Canine Castration Scenario

Task Class	Simple Interrupted Suture Pattern
<p>Learning task 1.1 Simple Interrupted Suture Pattern with full support</p>	<p>Case scenario introduction: Canine castration</p> <ul style="list-style-type: none"> • Learners will be required to watch the professional video of Simple Interrupted suture pattern of an actual castration on a canine patient. Upon completion, they will be returned to the interactive virtual environment where they will begin their required procedure of completing the surgery with simple interrupted suture pattern with full support. They will select the tools and suture material necessary to perform the task.

	<ul style="list-style-type: none"> • Tools and suture material are provided as they glow on the tray for easy identification. Learners will click on tools and materials to identify them and enter them into the environment. Learners will perform the pattern with full assistance; lines are solid and easy to follow and spacing dots are set. Verbal cueing from pedagogical agent giving step-by-step instruction on the procedure of simple interrupted suturing. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button: Multimedia presentation on Simple Interrupted, Video segment of simple interrupted suture pattern, on rescue critter with step-by-step procedural information, and video on the square knot with step-by-step procedural information. • Part-task practice is available before the next task practice for square knot practice. • Video on square knot is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance if needed.
<p>Learning task 1.2 Simple Interrupted Suture Pattern with diminishing support in suture pattern</p>	<p>(Part-task practice is available before beginning of this task practice for square knot practice if desired by learner.)</p> <ul style="list-style-type: none"> • Video on square knot is required when part-task practice is initiated. • Pedagogical agent is available for step by step guidance. • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.) • Suture material is provided by glowing presence

	<ul style="list-style-type: none"> • Suture pattern is not complete – shown with dotted lines periodically throughout the wound. • Spacing is completely visible. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Just in time information will give learner audio beeps when they are off of the pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. An auditory beep will sound if depth penetration in derma layers is too deep. • Step by step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.3 Simple Interrupted Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>(Part-task practice is available before beginning this task practice for square knot practice if desired by learner.)</p> <ul style="list-style-type: none"> • Video on square knot is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • Broken dotted lines provided for suture pattern formation and spacing is eliminated to every other one. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic

	<p>tension. An auditory beep will sound if depth penetration of dermas is too deep.</p> <ul style="list-style-type: none"> • Step by step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.4 Simple Interrupted Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>(Part-task practice is available before beginning this task practice for square knot practice if desired by learner.)</p> <ul style="list-style-type: none"> • Video on square knot is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance. • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • Learners will suture with the haptic force feedback device No suture pattern line to follow. Spacing eliminated to every third one • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. • If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. • If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. • Step by step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.5 Simple Interrupted Suture Pattern with diminishing support in suture pattern</p>	<p>(Part-task practice is available before beginning this task practice for square knot practice if desired by learner.)</p> <ul style="list-style-type: none"> • Video on square knot is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance. • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.)

<p>and spacing</p>	<ul style="list-style-type: none"> • Learners will suture with the haptic force feedback. • No lines or spacing is provided – immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern. • The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. • Just in time information will give learner audio beeps when they are off of pattern. • Support information available with a click of the resource button.
<p>Learning task 1.6 Simple Interrupted Suture Pattern with no support</p> <p>Final Exam component to be submitted to the instructor</p>	<ul style="list-style-type: none"> • Tool selection is required from the full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not pull over.) • No lines or spacing or audio cueing. Learner gets one opportunity to the suture pattern correctly. • The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give the student immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described in the preliminary content) in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. <p>Learners do not have to follow the scope and sequence after successful completion and may continue to practice an unlimited amount of times with Learning task 1.6 with visual feedback to check their proficiency.</p>

Supportive Information

- Multimedia presentation on Simple Interrupted suture pattern.
- Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.
- Professional video library – canine closure wound with Simple Interrupted suture pattern.
- Video segment of Simple Interrupted suture pattern on rescue critter with step-by-step procedural information.
- Video on the square knot with step-by-step procedural information.
- Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.
- Handouts will be provided on suture materials.

Just In Time Information

- Audio beeps sound if the learner gets out of the suture pattern lines or spacing becomes incorrect.
- Visual colored lines appear as to the correctness of the pattern.
- Pedagogical agent appears to help the learner upon request.
- The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too

information, Marshall, G. and Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials

5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button
Step by step procedural information available by Pedagogical agent upon request (talking head)
6. Part-task practice: Square knot practice

Figure C1. 4C/ID model for Simple Interrupted Suture Pattern. Adapted from van Merriënboer, J.J.G. (1997). Training complex cognitive skills. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Simple Continuous – Swine

The Simple Continuous pattern is the second pattern that the students will learn. This pattern is also a very common pattern used in veterinary medicine. The species used in this simulation is the pig although this pattern can and is used in all species.

Module 2 – Simple Continuous

Learning Focus

AVMA Surgical Nursing: (AVMA 1.1) Perform basic suturing techniques

Procedural management: (AVMA 1.2) Identify and know proper use for instruments and identify common suture materials, types, and sizes AVMA. (2012). Accreditation Policies and Procedures of the AVMA Committee on Veterinary Technician Education and Activities (CVTEA). Appendix I: (9-10).

MSU (MSU 1.1) Students will become proficient in suture patterns, material and instrument usage.

(MSU 1.2) Students will explore and develop skills that will enhance successful completion of suture patterns and techniques that can be applied in the workforce (MSU VET 213 Animal Care Techniques Surgical Nursing Syllabus).

Essential Skill (E 1.1) Students correctly identify common surgical instruments, knows the appropriate terminology for each and demonstrates knowledge of their proper uses according to Buell, L. & Sturtz, R. (2008). *Assessing essential skills of veterinary technology students*. 2nd ed. Deer Park, NY.

References

Multimedia presentation on Simple Continuous suture pattern

Class Textbooks

Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.

Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*.

Lakewood, Co. American Animal Hospital Association Press.

Materials

Handout on suture materials – provided by instructor

Swine Case Scenario/Storyboard with procedural information on the steps to follow for correct Simple Continuous suturing

Professional video library – Minipig closure wound with Simple Continuous suture pattern

Video segment of Simple Continuous suture pattern on rescue critter with step-by-step procedural information

Video on the square knot with step-by-step procedural information

Swine Laceration Scenario

It is the beginning of the workday. The animal care staff has started off their day by feeding all of the Sinclair Minipigs their morning feed. Since these animals are gregarious, they are housed in pairs. The animal care staff has to be mindful and watch the animals as they eat, so as to make sure that each animal gets fed the appropriate amount of food. In the past, these particular minipigs have been aggressive towards one another during their twice a day feedings and snack times. Unfortunately today is one of those days. One of the minipigs has attacked his cage mate over an apple slice and now the injured animal has a wound on his right lateral

abdomen. Upon evaluation, the wound only involves the dermis and epidermis so no internal organs have been hit. Hemostasis has occurred, but the wound will need to be shaved, cleaned/flushed and sutured. The vet tech contacts the veterinarian in charge of these animals to report the issue and gain approval for treatment.

Your pre-medications include a cocktail of Ketamine 10mg/kg and Midazolam 0.4 mg/kg given intramuscularly in the neck. After the pre-medications have taken affect, tracheal intubation is preformed and the animal is maintained on Isoflurane/oxygen throughout the entire process. The animal is placed in left lateral recumbancy. The vet tech shaves the hair around the wound using a #40 blade. The vet tech adds topical Lidocaine so the surface tissues are numb. Once the area has been shaved, the vet tech cleans the surface of the wound with Isopropyl alcohol and Chlorhexidine scrub. A Nolvasan dilution is flushed through the dermis and epidermis to clean the internal areas. A non-fenestrated drape is placed over the area. The animal is now ready for the debridement of the dermis, and the suture to be placed. The vet tech will complete the skin closure by using a Simple Continuous suture pattern with 2-0 synthetic, non-absorbable, monofilament with a conventional cutting needle. The area will need to be kept bandaged to avoid the introduction of any pathogens after wound has been closed. Suture will have to be removed in, approximately 10-14 days.

Overview of Module 2: Minipig Scenario with Simple Continuous Suture

Pattern

Objectives	Preliminary Content
	<p>Introduction of Real-life case: Swine Scenario – Simple Continuous Suture on a minipig</p> <p>Learner is required to complete each task in order until they submit their final task for assessment by instructor. After the final task has been completed for final assessment with 80% accuracy, the user may revisit any task of their choosing for additional practice.</p> <p>Sets the scene for the surgery (laceration).</p> <p>Pedagogical agent reviews procedure and vet tech responsibilities pre-op/procedure/post-op. After the veterinarian has completed the castration, the vet tech is left to complete the surgery by closing the skin tissue with the simple continuous suture pattern.</p>
<p>AVMA 1.2 MSU 1.1 E1.1</p>	<p>The vet tech must identify the tools and suture material needed to complete the closure. (Mayo Hegar or Olsen Hegar Needle Holders, Adson Brown or Adson Tissue Forceps, conventional cutting needle, non-absorbable 2-0 Maxon).</p>
<p>AVMA 1.1 MSU 1.1 MSU 1.2 E 1.1</p>	<p>Vet tech will demonstrate Simple Continuous suture on the minipigs laceration.</p> <p>Vet tech will have several opportunities to practice with diminishing support and assistance. Feedback on this task will be provided with audio and visual cueing. A beep will sound if they get outside of the pattern lines or their spacing is off. A colored visual line will appear at the completion of each pattern. This line will reveal accuracy or if the vet tech got outside of the pattern lines.</p>
	<p>Assistance will be available with support materials upon request by selecting the resource button:</p> <ul style="list-style-type: none"> • Procedural information on the steps to follow for correct Simple Continuous suture pattern • Professional video library – canine closure wound with Simple Continuous suture pattern • Video segment of Simple Continuous suture pattern on rescue critter with step-by-step procedural information • Video on the square knot with step-by-step procedural information <p>Assistance will be available with just in time information upon request by selecting the help button:</p> <ul style="list-style-type: none"> • Pedagogical agent will appear with verbal just in time

	information pertaining to different points in the procedure (tips and guidance)
	<p>Areas for error:</p> <ul style="list-style-type: none"> • Unequal bite size • Leaving cut suture too long – tissue reaction • Pattern outside of line • Haptic tension too tight or too loose • Suture depth penetration
	<p>Proficiency based on:</p> <ul style="list-style-type: none"> • Identification of tools and suture material to be used • Accuracy of distance between bites and each suture • Accuracy of square knot
	<p>Final Assessment:</p> <p>In Learning task 1.6 the vet tech must identify tools, suture material and perform simple interrupted suture pattern without any form of assistance. The last task will have all supportive and just-in-time information unavailable for use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give them immediate feedback on the skill. Learners will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment below in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p>
	<p>Assessment done by computer:</p> <ul style="list-style-type: none"> • Number of clicks to correctly identify tools • Number of clicks to correctly identify suture material • Number of times learner goes outside of pattern line • Number of times placement of spacing is wrong • Accuracy of square knot – (is the spatial movement correct)
	<p>Assessment to be done by instructor:</p> <ul style="list-style-type: none"> • Review of computer assessment and screen shot visual of pattern

Module 2: Simple Continuous Suture Pattern:

Task Class	Simple Continuous Suture Pattern
<p>Learning task 1.1 Simple Continuous Suture Pattern with full support</p>	<p>Case scenario introduction: Minipig laceration wound</p> <ul style="list-style-type: none"> • Learners will be required to watch the professional video of Simple Continuous suture pattern on the live minipig patient. Upon completion, they will be returned to the interactive virtual environment where they will begin their required procedure of completing the surgery with Simple Continuous suture pattern. They will select the tools and suture material necessary to perform the task. • Tools and suture material are provided as they glow on the tray for easy identification. Learners will click on tools and materials to identify them and enter them into the environment. Learners will perform the pattern with full assistance; lines are solid and easy to trace and spacing dots are set. Verbal cueing from pedagogical agent giving step-by-step instruction on the procedure of simple continuous suturing. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learners audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button: Multimedia presentation on Simple Continuous, Video segment of simple continuous suture pattern, on rescue critter with step-by-step procedural information, and video on the square knot with step-by-step procedural information. • Part-task practice is available before the next task

	<p>practice for square knot practice.</p> <ul style="list-style-type: none"> • Video on square knot is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance
<p>Learning task 1.2 Simple Continuous Suture Pattern with diminishing support in suture pattern</p>	<p>(Part-task practice is available before beginning this task practice for square knot practice if desired by learner.)</p> <ul style="list-style-type: none"> • Video on square knot is required when part-task practice is initiated. • Pedagogical agent is available for step by step guidance • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over). • Suture material provided by glowing presence. • Suture pattern is not complete – shown with dotted lines periodically throughout the wound. • Spacing is completely visible. • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. An auditory beep will sound if depth penetration in derma layers is too deep. • Step by step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.3 Simple Continuous Suture Pattern with diminishing support in</p>	<p>(Part-task practice is available before beginning this task practice for square knot practice if desired by learner.)</p> <ul style="list-style-type: none"> • Video on square knot is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance. • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct

<p>suture pattern and spacing</p>	<p>tool and given suture material into the environment – incorrect tools will not stay over.)</p> <ul style="list-style-type: none"> • Broken dotted lines provided for suture pattern formation and spacing is eliminated to every other one. • Just in time information will give learner audio beeps when learners are off of pattern and a visual colored line if learners get off the traced pattern. Support information available with a click of the resource button. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. An auditory beep will sound if depth penetration in derma layers is too deep. • Step by step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.4 Simple Continuous Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>(Part-task practice is available before beginning this task practice for square knot practice if desired by learner.)</p> <ul style="list-style-type: none"> • Video on square knot is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance. • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No suture pattern line to follow. • Spacing eliminated to every third suture. • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Just in time information will give learner audio beeps when learners are off of pattern and a visual colored line if learners get off the traced pattern. Support information available with a click of the resource button. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a

	<p>green color will indicate perfect haptic tension. An auditory beep will sound if depth penetration in derma layers is too deep.</p> <ul style="list-style-type: none"> • Step by step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.5 Simple Continuous Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>(Part-task practice is available before beginning this task practice for square knot practice if desired by learner.)</p> <ul style="list-style-type: none"> • Video on square knot is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance. • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No lines or spacing is provided – immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern. • The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. • Just in time information will give learner audio beeps when they are off of pattern. • Support information available with a click of the resource button.
<p>Learning task 1.6 Simple Continuous Suture Pattern with no support Final Exam</p>	<ul style="list-style-type: none"> • Tool selection is required from the full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not pull over.) • No lines or spacing or audio cueing. Learner gets one opportunity to the suture pattern correctly. • The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be

	<p>unavailable. Upon completion the colored visual line will appear to give the student immediate feedback on the skill. Learners will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described in the preliminary content) in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p> <p>Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with Learning task 1.6 with visual feedback to check their proficiency with the pattern or return to any other practice within the task class.</p>
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SUPPORTIVE INFORMATION

- Multimedia presentation on Simple Continuous suture pattern
- Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.
- Professional video library – minipig closure wound with Simple Continuous suture pattern
- Video segment of Simple Continuous suture pattern on rescue critter with step-by-step procedural information
- Video on the square knot with step-by-step procedural information
- Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*.

Lakewood, Co. American Animal Hospital Association Press.

- Handout on suture materials

JUST IN TIME INFORMATION

- Audio beeps if the learner gets out of the suture pattern lines or spacing becomes incorrect
- Visual colored line appear to the correctness of the pattern
- Pedagogical agent appears to help the learner upon request
- Pedagogical agent appears to help the learner upon request
- The Haptic Color bar will change colors when different forces are applied.

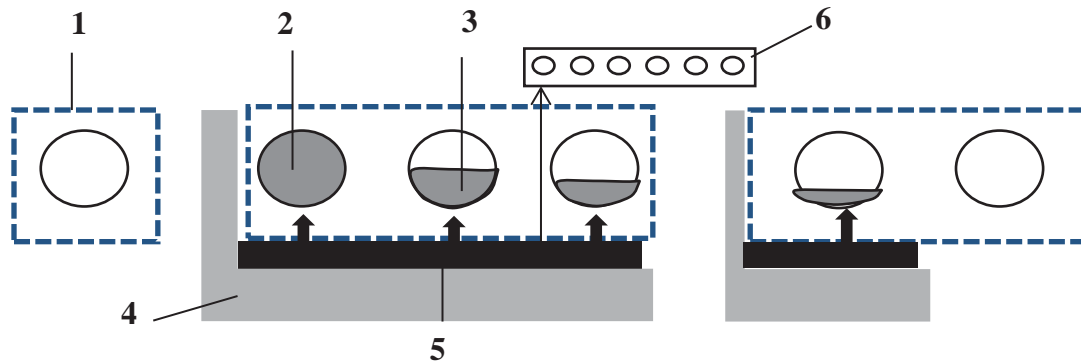
Too little tension will show yellow and too much tension will show red.

Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermas is too deep.

- The Rescue critter video with step by step instructions on simple continuous suture pattern is available on demand
- Step by Step procedure video on the square knot is available at any time and before part-task practice.

Part-task PRACTICE

- Specialized practice on the square knot



1. Task Class: Simple Continuous Suture Pattern
2. Learning Task: Simple Continuous Suture on a minipig (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: PowerPoint slides on Simple Continuous suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library – minipig closure wound with simple continuous suture pattern, Video segment of Simple Continuous suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound of depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Step by step procedural information is available by Pedagogical agent upon request (talking head).
6. Part-task practice: Square knot practice

Figure C2. 4C/ID model for Simple Continuous Suture Pattern. Adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Ford Interlocking – Equine

The Ford Interlocking suture pattern will follow the Simple Continuous suture pattern. This pattern is a little more difficult to learn and takes more time for each student to complete correctly. The species used in this simulation is the horse. Although this pattern can be used with any species it is more commonly performed in large animal due to the consistency of tension throughout the pattern.

Module 3 – Ford Interlocking - Equine

Learning Focus

AVMA Surgical Nursing: (AVMA 1.1) Perform basic suturing techniques

Procedural management: (AVMA 1.2) Identify and know proper use for instruments and identify common suture materials, types, and sizes AVMA. (2012). Accreditation Policies and Procedures of the AVMA Committee on Veterinary Technician Education and Activities (CVTEA). Appendix I: (9-10).

MSU (MSU 1.1) Students will become proficient in suture patterns, material and instrument usage.

(MSU 1.2) Students will explore and develop skills that will enhance successful completion of suture patterns and techniques that can be applied in the workforce (MSU VET 213 Animal Care Techniques Surgical Nursing Syllabus).

Essential Skill (E 1.1) Students correctly identify common surgical instruments, knows the appropriate terminology for each and demonstrates knowledge of their proper uses according to Buell, L. & Sturtz, R. (2008). *Assessing essential skills of veterinary technology students*. 2nd ed. Deer Park, NY.

References

Multimedia presentation on ford interlocking suture pattern

Class Textbooks

Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.

Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.

Materials

Handout on suture materials – provided by instructor

Equine Case Scenario/Storyboard with procedural information on the steps to follow for correct Ford Interlocking suturing

Professional video library – Equine closure wound with Ford Interlocking pattern

Video segment of Ford Interlocking suture pattern on Rescue Critter with step-by-step procedural information

Video on the square knot with step-by-step procedural information

Equine Caslick Scenario

Scarlett, a seven year old, 1000 pound female quarter horse, recently foaled and has developed a pneumovagina. Pneumovagina post foaling is caused by scar tissue formation, excessive stretching of tissue, and/or poor body condition. Scarlett has a body condition score of five and is in optimal health post foaling. Without

treatment, a pneumovagina can lead to chronic infection of the vagina and uterus and infertility. Today the veterinary team will be performing the Caslick procedure to form a seal and prevent aspiration of air and fecal material into the vaginal region.

Scarlett is placed in the stocks to prevent injury to both the mare and the veterinary staff. Pre-anesthetic blood work is completed and reviewed prior to sedation. Scarlett is given a cocktail of Xylazine 1.1mg/kg and Butorphanol 0.02mg/kg for sedation intravenously. Scarlett's tail is wrapped and the area of interest is cleaned with three or more (dependent on the cleanliness of the horse) rotations of Nolvasan and warm water. Everyone is aware that even though Scarlett is sedated she can still use her rear limbs to kick, so the vet tech will complete a local block of the labial margins using Lidocaine.

The vet tech will complete the last rotation of Nolvasan and warm water and finish with a Betadine spray on the affected area that will be left in place. After the Lidocaine block is effective the vet begins the Caslicks procedure.

The vet removes enough of the mucosa to create a vaginal seal. The ventral aspect of the vulva should be left as is. As the vet tech, it is your responsibility to make the closure using a ford interlocking pattern and O non-absorbable polypropylene suture with a reverse cutting needle.

After the procedure is completed Scarlett is placed in a stall until she gains her balance and can be loaded on the trailer. Once loaded, her owner can safely take her

home. Scarlett will return to the clinic in 10-12 days for stitch removal and re-evaluation of site.

Overview of Module 1: Canine Scenario with Simple Interrupted Suture

Pattern

Objectives	Preliminary Content
	<p>Introduction of Real-life case: Equine Caslick procedure – Ford Interlocking suture pattern on Scarlett, a seven year old horse. Learner is required to complete each task in order until they submit their final task for assessment by instructor. Learner is required to complete each task in order until they submit their final task for assessment by instructor. After the final task has been completed for final assessment with 80% accuracy, the learner may revisit any task of their choosing for additional practice. The scenario will set the scene for the surgery (Episioplasty – Caslick procedure). Pedagogical agent reviews procedure and vet tech responsibilities pre-op/procedure/post-op. After the veterinarian has completed the Caslick procedure, the vet tech is left to complete the surgery by closing the skin tissue with the Ford Interlocking suture pattern.</p>
<p>MSU 1.1 E1.1 AVMA 1.2</p>	<p>The vet tech must identify the tools and suture material needed to complete the closure. (Mayo Hegar or Olsen Hegar Needle Holders, Adson Brown or Adson Tissue Forceps, reverse cutting needle, non-absorbable 0 polypropylene suture material)</p>
<p>MSU 1.1 MSU 1.2 E 1.1 AVMA 1.1</p>	<p>Vet tech will demonstrate Ford Interlocking suture pattern on Scarlett. Vet tech will have several opportunities to practice with diminishing support and assistance. Feedback on this task will be provided with audio and visual cueing. A beep will sound if they get outside of the pattern lines or their spacing is off. A colored visual line will appear at the completion of each pattern. This line will reveal accuracy or if the vet tech got outside of the pattern lines.</p>
	<p>Assistance will be available with support materials upon request by selecting the resource button:</p> <ul style="list-style-type: none"> • Procedural information on the steps to follow for correct Ford Interlocking suture pattern. • Professional video library – equine Caslick procedure with Ford Interlocking suture pattern • Video segment of Ford Interlocking suture pattern on rescue

	<p>critter with step-by-step procedural information</p> <ul style="list-style-type: none"> • Video on the square knot with step-by-step procedural information <p>Assistance will be available with just in time information upon request by selecting the help button:</p> <ul style="list-style-type: none"> • Pedagogical agent will appear with verbal just in time information pertaining to different points in the procedure (tips and guidance).
	<p>Areas for error:</p> <ul style="list-style-type: none"> • Unequal bite size • Leaving cut suture too long – tissue reaction • Pattern outside of line • Haptic tension too tight or too loose • Suture depth penetration
	<p>Proficiency based on:</p> <ul style="list-style-type: none"> • Identification of tools and suture material to be used • Accuracy of distance between bites and each suture • Accuracy of square knot
	<p>Final Assessment:</p> <p>In Learning Task 1.6 the vet tech must identify tools, suture material and perform simple interrupted suture pattern without any form of assistance. The last task will have all supportive and just-in-time information unavailable for use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give them immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment below in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p>
	<p>Assessment done by computer:</p> <ul style="list-style-type: none"> • Number of clicks to correctly identify tools • Number of clicks to correctly identify suture material • Number of times learner goes outside of pattern line • Number of times placement of bite spacing is wrong • Haptic feedback on angle of needle penetration - depth (audio) • Accuracy of square knot – direction of manipulation (alternating throws and a visual on the flatness of the knot) –

	<p>Haptic color bar will signal too much or too little</p> <ul style="list-style-type: none"> • Haptic feedback on angle of needle penetration - depth (audio) • Haptic feedback on tension applied to suture material – Haptic color bar will signal too much or too little. • If tension is too little suture will unravel and the task will automatically stop and the student must start the task over. • If tension is too tight suture will tear and/or strangulation of tissue may occur. The task will automatically end and the student must start the task over. <p>Assessment to be done by instructor:</p> <ul style="list-style-type: none"> • Review of computer assessment and screen shot visual of pattern
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Module 3: Ford Interlocking Suture Pattern:

Task Class	Ford Interlocking Suture Pattern
<p>Learning task 1.1 Ford Interlocking Suture Pattern with full support</p>	<p>Case scenario introduction: Equine - Scarlett</p> <ul style="list-style-type: none"> • Learners will be required to watch the professional video of the Ford Interlocking suture pattern on the live equine patient. Upon completion, they will be returned to the interactive virtual environment where they will begin their required procedure of completing the surgery with Ford Interlocking suture pattern. They will select the tools and suture material necessary to perform the task. • Tools and suture material are provided as they glow on the tray for easy identification. Learners will click on tools and materials to identify them and enter them into the environment. Learners will perform the pattern with full assistance; lines are solid and easy to follow and spacing dots are set. Verbal cueing from pedagogical agent giving step-by-step instruction on the procedure of the Ford Interlocking suture pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when

	<p>different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information available with a click of the resource button: A multimedia presentation on Ford Interlocking suture pattern, video segment of Ford Interlocking suture pattern on the rescue critter with step-by-step procedural information, and a video on the square knot with step-by-step procedural information.</p> <ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 26-30 of the Ford Interlocking suture pattern on the Rescue Critter video. (These steps show a special emphasis on the needle exiting the tissue and how it should be directed through the loop of your suture material and pulled snug). <p>26. Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate))</p> <p>27. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p> <p>28. As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug</p> <p>29. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>30. Repeat this pattern until the incision is completely closed and always enter on the same side of incision.</p> <ul style="list-style-type: none"> • Pedagogical agent is available for step- by -step guidance
<p>Learning task 1.2 Ford Interlocking Suture Pattern with diminishing support in suture pattern</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 26-30 of the Ford Interlocking suture pattern from the Rescue Critter video. (These steps show a special emphasis on the needle exiting the tissue and how it should be directed through the loop of your suture material and pulled snug.)</p> <p>26. Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and</p>

out through the interior portion of wound while twisting your wrist (supinate)

27. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)

28. As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug

29. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides

30. Repeat this pattern until the incision is completely closed and always enter on the same side of incision.

- Video of the Ford Interlocking suture pattern on the Rescue Critter is required when part-task practice is initiated. Pedagogical agent is available for step- by-step guidance.
 - Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools. (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.)
 - Suture material provided by glowing presence.
 - Suture pattern is not complete – shown with dotted lines periodically throughout the wound.
 - Spacing is completely visible.
 - Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice.
 - Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Just in time information will give learners audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information is available with a click of the resource button. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. An
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	<p>auditory beep will sound if depth penetration in derma layers is too deep.</p> <ul style="list-style-type: none"> • Support information available with a click of the resource button • Step- by- step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.3 Ford Interlocking Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 26-30 of the Ford Interlocking suture pattern from the Rescue Critter video. (These steps show a special emphasis on the needle exiting the tissue and how it should be directed through the loop of your suture material and pulled snug.)</p> <p>26. Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate)</p> <p>27. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p> <p>28. As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug</p> <p>29. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>30. Repeat this pattern until the incision is completely closed and always enter on the same side of incision.</p> <ul style="list-style-type: none"> • Video on the Ford Interlocking on Rescue Critter is required when part-task practice is initiated. Pedagogical agent.is available for step- by -step guidance. • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • Broken dotted lines provided for suture pattern formation and spacing is eliminated to every other one. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Just in time information will give learner audio beeps

	<p>when they are off of pattern and a visual colored line if they get off the traced pattern. Support information is available with a click of the resource button. Just in time information will give learners audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information is available with a click of the resource button. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. An auditory beep will sound if depth penetration in derma layers is too deep.</p> <ul style="list-style-type: none"> • Support information is available with a click of the resource button • Step- by -step procedural information is available by Pedagogical agent upon request (talking head).
<p>Learning task 1.4 Ford Interlocking Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 26-30 of the Ford Interlocking suture pattern from the Rescue Critter video. (These steps show a special emphasis on the needle exiting the tissue and how it should be directed through the loop of your suture material and pulled snug.)</p> <p>26. Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate)</p> <p>27. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p> <p>28. As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug</p> <p>29. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>30. Repeat this pattern until the incision is completely closed and always enter on the same side of incision.</p> <ul style="list-style-type: none"> • Video of the Ford Interlocking suture pattern on the Rescue Critter is required when part-task practice is initiated. Pedagogical agent is available for step- by- step guidance.

	<ul style="list-style-type: none"> • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No suture pattern line to follow. • Spacing eliminated to every third suture throw. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Just in time information will give learners audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information is available with a click of the resource button. Just in time information will give learners audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information is available with a click of the resource button. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. An auditory beep will sound if depth penetration in derma layers is too deep. • Support information is available with a click of the resource button. • Step- by- step procedural information is available by Pedagogical agent upon request (talking head).
<p>Learning task 1.5 Ford Interlocking Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 26-30 of the Ford Interlocking suture pattern from the Rescue Critter video. (These steps show a special emphasis on the needle exiting the tissue and how it should be directed through the loop of your suture material and pulled snug.)</p> <p>26. Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate))</p> <p>27. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>

	<p>28. As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug</p> <p>29. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>30. Repeat this pattern until the incision is completely closed and always enter on the same side of incision.</p> <ul style="list-style-type: none"> • Video of the Ford Interlocking suture pattern on the Rescue Critter is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance. • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No lines or spacing is provided – immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information is available with a click of the resource button. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. An auditory beep will sound if depth penetration in derma layers is too deep. • Support information is available with a click of the resource button.
<p>Learning task 1.6 Ford Interlocking Suture Pattern with no support</p>	<ul style="list-style-type: none"> • Tool selection is required from the full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not pull over.) • No lines or spacing or audio cueing. Learner gets one opportunity to the suture pattern correctly. This last

Final Exam	<p>task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give the student immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described in the preliminary content) in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p> <p>Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with Learning task 1.6 with visual feedback to check their proficiency with the pattern or return to any other practice within the task class.</p> <p>Learners may continue to practice an unlimited amount of times with Learning task 1.6 or any part of Module 1 or 2 with visual feedback to check their proficiency with the pattern.</p>
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SUPPORTIVE INFORMATION

- Multimedia presentation on Ford Interlocking suture pattern
- Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.
- Professional video library – minipig closure wound with Ford Interlocking suture pattern
- Video segment of Ford Interlocking suture pattern on Rescue Critter with step-by-step procedural information
- Video on the square knot with step-by-step procedural information

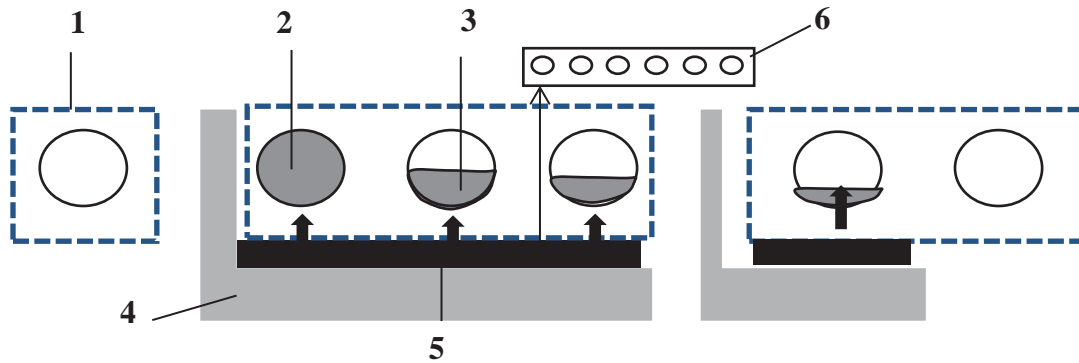
- Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.
- Handout on suture materials

JUST IN TIME INFORMATION

- Audio beeps if the learner gets out of the suture pattern lines or spacing becomes incorrect
- Visual colored line appear to the correctness of the pattern
- Pedagogical agent appears to help the learner upon request
- The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermas is too deep.

Part-task PRACTICE

- Specialized practice on the square knot
- Specialized video on procedural steps 26-30 of Ford Interlocking suture pattern on the Rescue Critter



1. Task Class: Ford Interlocking Suture Pattern
2. Learning Task: Ford Interlocking Equine Caslick (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: PowerPoint slides on Ford Interlocking suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library – equine Caslick with Ford Interlocking suture pattern, Video segment of Ford Interlocking suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermis is too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information

- available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head)
6. Part-task practice: procedural steps 25-28 of Ford Interlocking suture pattern

Figure C3. 4C/ID-model for Ford Interlocking Suture Pattern. Adapted from van Merriënboer, J.J.G. (1997). Training complex cognitive skills. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Ford Interlocking – Bovine

Two Ford Interlocking suture pattern simulation scenarios are provided to allow students to be exposed to the two most common large animal species. This pattern is a little more difficult to learn and takes more time for each student to complete correctly. The species used in this simulation is the cow. Although this pattern can be used with any species it is more commonly performed in large animal due to the consistency of tension throughout the pattern.

Module 4 – Ford Interlocking Suture Pattern

Learning Focus

AVMA Surgical Nursing: (AVMA 1.1) Perform basic suturing techniques

Procedural management: (AVMA 1.2) Identify and know proper use for instruments and identify common suture materials, types, and sizes AVMA. (2012). Accreditation Policies and Procedures of the AVMA Committee on Veterinary Technician Education and Activities (CVTEA). Appendix I: (9-10).

MSU (MSU 1.1) Students will become proficient in suture patterns, material and instrument usage.

(MSU 1.2) Students will explore and develop skills that will enhance successful completion of suture patterns and techniques that can be applied in the workforce (MSU VET 213 Animal Care Techniques Surgical Nursing Syllabus).

Essential Skill (E 1.1) Students correctly identify common surgical instruments, knows the appropriate terminology for each and demonstrates knowledge of their proper uses Buell, L. & Sturtz, R. (2008). *Assessing essential skills of veterinary technology students*. 2nd ed. Deer Park, NY.

References

Multimedia presentation on Ford Interlocking suture pattern

Class Textbooks

Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.

Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.

Materials

Handout on suture materials – provided by instructor

Bovine Case Scenario/Storyboard with procedural information on the steps to follow for correct Ford Interlocking suturing

Professional video library –Bovine C-section with Ford Interlocking suture pattern

Video segment of Ford Interlocking suture pattern on rescue critter with step-by-step procedural information

Video on the square knot with step-by-step procedural information

Specialized video on procedural steps 26-30 of Ford Interlocking suture pattern

Bovine C-Section Scenario

A client calls the veterinary clinic because one of his heifers is having trouble calving. Once the veterinarian finishes an exam on a dog he and the vet tech head out to the clients farm to examine the heifer. Upon arrival the veterinarian vaginally palpates the heifer and determines that a C-section will need to be performed in order to save the heifer and the calf.

The vet tech plugs in the clippers and starts shaving the side of the abdomen. Once a large rectangle is shaved the vet tech will clean the area with three rotations of Nolvasan and Isopropyl alcohol. Once cleaned, Iodine is applied to the area. After the heifer is prepped the vet tech completes a local Lidocaine block of the area and the surgery begins.

During the surgery the vet tech assists in passing instruments to the veterinarian. The veterinarian removes the calf successfully and the owner tends to it while the veterinarian and the vet tech finish working on the heifer.

After closure of all abdominal structures the vet tech is instructed to complete the skin closure. The vet tech will complete the skin closure by using a ford

interlocking suture pattern and non-absorbable 4 Monocryl with a reverse cutting needle.

The veterinarian and the vet tech will revisit the farm in 10-14 days to remove the sutures and re-evaluate the heifer and calf.

Overview of Module 4: Bovine C-section with the Ford Interlocking Suture

Pattern

Objectives	Preliminary Content
	<p>Introduction of Real-life case: Bovine C-section – Ford Interlocking Suture Pattern</p> <p>Learner is required to complete each task in order until they submit their final task for assessment by instructor.</p> <p>Learner is required to complete each task in order until they submit their final task for assessment by instructor. After the final task has been completed for final assessment with 80% accuracy, the user may revisit any task of their choosing for additional practice.</p> <p>Scenario sets the scene for the surgery (Cesarean section). A Pedagogical agent reviews procedure and vet tech responsibilities pre-op/procedure/post-op. After the veterinarian has completed the cesarean section, the vet tech is left to complete the surgery by closing the skin tissue with the Ford Interlocking suture pattern.</p>
<p>AVMA 1.2 MSU 1.1 E1.1</p>	<p>The vet tech must identify the tools and suture material needed to complete the closure. (Mayo Hegar or Olsen Hegar Needle Holders, Adson Brown or Adson Tissue Forceps, reverse cutting needle, non-absorbable 4 Monocryl suture material)</p>
<p>AVMA 1.1 MSU 1.1 MSU 1.2 E 1.1</p>	<p>Vet tech will demonstrate Ford Interlocking suture pattern on bovine.</p> <p>Vet tech will have several opportunities to practice with diminishing support and assistance. Feedback on this task will be provided with audio and visual cueing. A beep will sound if they get outside of the pattern lines or their spacing is off. A colored visual line will appear at the completion of each pattern. This line will reveal accuracy or if the vet tech got outside of the pattern lines.</p>

	<p>Assistance will be available with support materials upon request by selecting the resource button:</p> <ul style="list-style-type: none"> • Procedural information on the steps to follow for correct Ford Interlocking suture pattern • Professional video library – Bovine C-section with Ford Interlocking suture pattern • Video segment of Ford Interlocking suture pattern on Rescue Critter with step-by-step procedural information • Video on the square knot with step-by-step procedural information <p>Assistance will be available with just in time information upon request by selecting the help button:</p> <ul style="list-style-type: none"> • Pedagogical agent will appear with verbal just in time information pertaining to different points in the procedure (tips and guidance).
	<p>Areas for error:</p> <ul style="list-style-type: none"> • Unequal bite size • Leaving cut suture too long – tissue reaction • Pattern outside of line • Haptic tension too tight or too loose • Suture depth penetration
	<p>Proficiency based on:</p> <p>Identification of tools and suture material to be used Accuracy of distance between bites and each suture Accuracy of square knot</p>
	<p>Final Assessment:</p> <p>In Learning task 1.6 the vet tech must identify tools, suture material and perform simple interrupted suture pattern without any form of assistance. This last task will have all supportive and just-in-time information unavailable for use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give them immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment below in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p>
	<p>Assessment done by computer:</p>

	<ul style="list-style-type: none"> • Number of clicks to correctly identify tools • Number of clicks to correctly identify suture material • Number of times learner goes outside of pattern line • Number of times placement of bite spacing is wrong • Haptic feedback on angle of needle penetration - depth (audio) • Accuracy of square knot – direction of manipulation (alternating throws and a visual on the flatness of the knot) – Haptic color bar will signal too much or too little • Haptic feedback on angle of needle penetration - depth (audio) • Haptic feedback on tension applied to suture material – Haptic color bar will signal too much or too little • If tension is too little suture will unravel and the task will automatically stop and the student will need to start the task over. • If tension is too tight the suture will tear and/or strangulation of tissue may occur. The task will automatically end and the student must start the task over.
	<p>Assessment to be done by instructor:</p> <ul style="list-style-type: none"> • Review of computer assessment and screen shot visual of pattern

Module 4: Ford Interlocking Suture Pattern: Bovine Case Scenario

Task Class	Ford Interlocking Suture Pattern
<p>Learning task 1.1 Ford Interlocking Suture Pattern with full support</p>	<p>Case scenario introduction: Bovine C-section</p> <ul style="list-style-type: none"> • Learners have the option to watch the professional video of the Ford Interlocking suture pattern on a live bovine patient. Upon completion of the video or bypassing it, they will enter the interactive virtual environment where they will begin their required procedure of completing the surgery with the Ford Interlocking suture pattern. Learners will select the tools and suture material necessary to perform the task. • Tools and suture material are provided as they glow on the tray for easy identification. Learners will click on tools and materials to identify them and enter them into the environment. Learners will perform the pattern with full assistance; lines are solid and easy to trace

and spacing dots are set. Verbal cueing from the pedagogical agent giving step-by-step instruction on the procedure of Ford Interlocking suture pattern will be active.

- Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice.
- Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information available with a click of the resource button: Multimedia presentation on Ford Interlocking, Video segment of Ford Interlocking suture pattern on rescue critter with step-by-step procedural information, and video on the square knot with step-by-step procedural information. Video of square knot
- Part-task practice is available before the next task practice for Procedural Steps 26-30 of the Ford Interlocking suture pattern on the Rescue Critter with special focus on the following steps in the video:

26. Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate))

27. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)

28. As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug

29. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides

30. Repeat this pattern until the incision is completely closed

	<p>and always enter on the same side of incision.</p> <ul style="list-style-type: none"> • Pedagogical agent is available for step-by-step guidance
<p>Learning task 1.2 Ford Interlocking Suture Pattern with diminishing support in suture pattern</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Part-task practice is available before the next task practice for Procedural Steps 26-30 of the Ford Interlocking suture pattern on the Rescue Critter with special focus on the following steps in the video: 26. Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate) 27. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate) 28. As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug 29. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 30. Repeat this pattern until the incision is completely closed and always enter on the same side of incision. • Video Ford Interlocking on Rescue Critter is required when part-task practice is initiated. Pedagogical agent is available for step-by-step guidance. • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools. (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.) • Suture material provided by glowing presence • Suture pattern is not complete – shown with dotted lines periodically throughout the wound • Spacing is completely visible • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the

	<p>patient – they will follow the procedural information given to them during their first practice.</p> <ul style="list-style-type: none"> • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. • The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button • Step- by- step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.3 Ford Interlocking Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Part-task practice is available before the next task practice for Procedural Steps 26-30 of the Ford Interlocking suture pattern on the Rescue Critter with special focus on the following steps in the video: 26. Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate) 27. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate) 28. As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug 29. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 30. Repeat this pattern until the incision is completely closed and always enter on the same side of incision. • Video Ford Interlocking on Rescue Critter is required when part-task practice is initiated. Pedagogical agent is available for step- by- step guidance. • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment –

	<p>incorrect tools will not stay over.)</p> <ul style="list-style-type: none"> • Broken dotted lines provided for suture pattern formation and spacing is eliminated to every third suture. • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button • Step- by- step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.4 Ford Interlocking Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Part-task practice is available before the next task practice for Procedural Steps 26-30 of the Ford Interlocking suture pattern on the Rescue Critter with special focus on the following steps in the video: 26. Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate) 27. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate) 28. As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug 29. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides

	<p>30. Repeat this pattern until the incision is completely closed and always enter on the same side of incision.</p> <ul style="list-style-type: none"> • Video Ford Interlocking on Rescue Critter is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance. • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools. (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.) • No suture pattern line to follow • Spacing eliminated to every fourth suture • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information available with a click of the resource button • Step- by- step procedural information is available by a Pedagogical agent upon request (talking head).
<p>Learning task 1.5 Ford Interlocking Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Part-task practice is available before the next task practice for Procedural Steps 26-30 of the Ford Interlocking suture pattern on the Rescue Critter with special focus on the following steps in the video: <p>26. Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate)</p>

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27. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)
 28. As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug
 29. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides
 30. Repeat this pattern until the incision is completely closed and always enter on the same side of incision.
 - Video Ford Interlocking on Rescue Critter is required when part-task practice is initiated. Pedagogical agent is available for step by step guidance.
 - Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools. (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over).
 - No lines or spacing is provided – immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern.
 - Just in time information will give learner s audio beeps when they are off of pattern.
 - Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice.
 - Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep.
 - Support information is available with a click of the resource button.

<p>Learning task 1.6 Ford Interlocking Suture Pattern with no support</p> <p>Final Exam</p>	<ul style="list-style-type: none">• Tool selection is required from the full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not pull over.)• No lines or spacing or audio cueing. Learner gets one opportunity to do the suture pattern correctly.• The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give the student immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described in the preliminary content) in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. <p>Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with Learning task 1.6 with visual feedback to check their proficiency with the pattern or return to any other practice within the task class. Learners may also continue to practice with any part of Module 1, 2, or 3 with any feedback options to check their proficiency with the pattern.</p>
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SUPPORTIVE INFORMATION

- Multimedia presentation on Ford Interlocking suture pattern
- Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.
- Professional video library – Bovine C-section with Ford Interlocking suture pattern
- Video segment of Ford Interlocking suture pattern on rescue critter with step-by-step procedural information
- Video on the square knot with step-by-step procedural information
- Specialized video on procedural steps 26-30 of Ford Interlocking suture pattern
- Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.
- Handout on suture materials

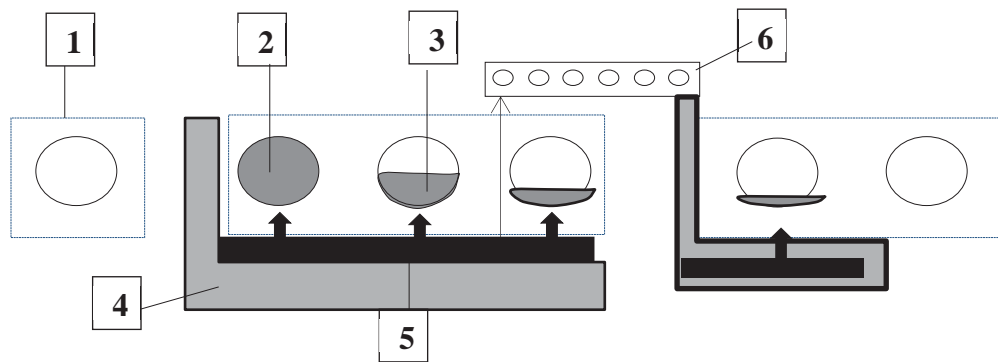
JUST IN TIME INFORMATION

- Audio beeps if the learner gets out of the suture pattern lines or spacing becomes incorrect
- Visual colored line appear to the correctness of the pattern
- Pedagogical agent appears to help the learner upon request

- The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermas is too deep.
- The Rescue Critter video with step by step instructions on the Ford Interlocking suture pattern
- Video on the square knot

Part-task Practice

- Specialized practice on the square knot
- Specialized practice on procedural steps 26-30 of Ford Interlocking suture pattern



1. Task Class: Ford Interlocking Suture Pattern
2. Learning Task: Ford Interlocking Bovine C-section (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: PowerPoint slides on Ford Interlocking suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library – canine closure wound with simple interrupted suture pattern, Video segment of ford interlocking suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermis is too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head)
6. Part-task practice: Square knot practice and Specialized practice on procedural steps 26-30 of Ford Interlocking suture pattern

Figure C4. 4C/ID-model for Ford Interlocking Suture Pattern. Adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Cruciate – Feline

The next pattern taught is the Cruciate suture pattern. This is an interrupted pattern that is less frequently used than the Simple Interrupted and slightly more difficult to learn by the student. The use of each pattern is based on tension of incision and personal preference. The species of choice for this simulation was the cat although the pattern can be used in any species.

Module 5 – Cruciate Suture Pattern

Learning Focus

AVMA *Surgical Nursing*: (AVMA 1.1) Perform basic suturing techniques

***Procedural management*: (AVMA 1.2)** Identify and know proper use for instruments and identify common suture materials, types, and sizes AVMA. (2012). Accreditation Policies and Procedures of the AVMA Committee on Veterinary Technician Education and Activities (CVTEA). Appendix I: (9-10).

MSU (MSU 1.1) Students will become proficient in suture patterns, material and instrument usage.

(MSU 1.2) Students will explore and develop skills that will enhance successful completion of suture patterns and techniques that can be applied in the workforce (MSU VET 213 Animal Care Techniques Surgical Nursing Syllabus).

Essential Skill (E 1.1) Students correctly identify common surgical instruments, knows the appropriate terminology for each and demonstrates knowledge of their proper uses according to Buell, L. & Sturtz, R. (2008). *Assessing essential skills of veterinary technology students*. 2nd ed. Deer Park, NY.

References

Multimedia presentation on Cruciate suture pattern

Class Textbooks

Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.

Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.

Materials

Handout on suture materials – provided by instructor

Feline Cystotomy Case Scenario/Storyboard with procedural information on the steps to follow for correct simple interrupted suturing

Professional video library – Feline cystotomy with Cruciate suture pattern

Video segment of cruciate suture pattern on Rescue Critter with step-by-step procedural information

Video on the square knot with step-by-step procedural information

Specialized practice video on Procedural steps 10-14 on Cruciate suture pattern

Feline Cystotomy Scenario

Tabby is a 10 year old female domestic shorthaired cat. The owner is complaining of blood in urine, painful urination, and is struggling to urinate. Upon examination, Tabby is extremely tender in her abdomen region. Radiographs and a urinalysis is ordered by the veterinarian. Urinalysis results are completed and reviewed. Radiographic findings determined a large amount of calculi in the bladder.

Tabby is hospitalized and added to the surgery schedule for the following day. Pre-anesthetic blood work was completed and reviewed. Tabby was fasted 12 hours prior to surgery.

She is given Butorphanol 0.225 mg/kg and Dexmedetomidine 250mcg/m² intramuscularly in the quadriceps. Once Tabby is sedated, her throat is swabbed with Lidocaine for numbing purposes. The endotracheal tube is passed and proper placement is determined. Tabby is placed on Isoflurane and oxygen to maintain anesthesia.

She is then placed in dorsal recumbancy and shaved with a #40 clipper blade from the costal arch to pubis. Once shaved and hair is removed via vacuum, the

surgical scrub is performed. Three rotations of Chlorohexidine scrub and Isopropyl alcohol are applied. Once prepped, Tabby is transferred into the surgery room.

All personal in the surgery room are wearing caps, masks, and booties. The surgical assistant and surgeon are aseptically gowned and gloved after they scrub in using Chlorohexidine. Tabby is placed in dorsal recumbancy on the surgery table with all limbs secured. All monitoring equipment is connected and working properly. A sterile scrub is completed with a Chlorohexidine scrub, Isopropyl alcohol and a final prep of Betadine is applied and left on the area. The bladder is emptied by means of cystocentesis using a 22 gauge needle. The surgical site is draped aseptically using the four corner towel technique.

The veterinarian begins the surgery and the vet techs' duty as the surgical assistant is to pass needed surgical instruments, gauze, and suture material. After all calculi is removed and all abdominal closures have been made the vet tech is instructed to make the skin closure. Skin closure is completed by using 3-0 polypropylene, a cruciate pattern, and conventional cutting needle. Tabby is hospitalized overnight to ensure proper urination occurs.

Calculi is sent to lab for further diagnostic testing and determine what diet Tabby should be on. Tabby will return to the clinic in 10 days for removal of all external sutures.

Overview of Module 5: Feline Cystotomy Case Scenario with Cruciate Suture Pattern

Objectives	Preliminary Content
	<p>Introduction of Real-life case: Feline Tabby, 10 year old DSH – Cruciate Suture Pattern</p> <p>Learner is required to complete each task in order until they submit their final task for assessment by instructor. After the final task has been completed for final assessment with 80% accuracy, the learner may revisit any task of their choosing for additional practice.</p> <p>The scenario sets the scene for the surgery (Cystotomy). Pedagogical agent reviews procedure and vet tech responsibilities pre-op/procedure/post-op. After the veterinarian has completed the procedure, the vet tech is left to complete the surgery by closing the skin tissue with Cruciate suture pattern.</p>
<p>AVMA 1.2 MSU 1.1 E1.1</p>	<p>The vet tech must identify the tools and suture material needed to complete the closure.</p> <p>(Mayo Hegar or Olsen Hegar Needle Holders, Adson Brown or Adson Tissue Forceps, conventional cutting needle, 3-0 polypropylene suture material)</p>
<p>AVMA 1.1 MSU 1.1 MSU 1.2 E 1.1</p>	<p>Vet tech will demonstrate Cruciate suture pattern on feline. Vet tech will have several opportunities to practice with diminishing support and assistance. Feedback on this task will be provided with audio and visual cueing. A beep will sound if the learner gets outside of the pattern lines or their spacing is off. A colored visual line will appear at the completion of each pattern. This line will reveal accuracy or if the vet tech got outside of the pattern lines.</p>
	<p>Assistance will be available with support materials upon request by selecting the resource button:</p> <ul style="list-style-type: none"> • Procedural information on the steps to follow for the correct Cruciate suture pattern • Professional video library –feline cystotomy with Cruciate suture pattern • Video segment of Cruciate suture pattern on Rescue Critter with step-by-step procedural information • Video on the square knot with step-by-step procedural information <p>Assistance will be available with just in time information upon request by selecting the help button:</p> <ul style="list-style-type: none"> • Pedagogical agent will appear with verbal just in time information pertaining to different points in the procedure (tips and guidance).
	<p>Areas for error:</p> <ul style="list-style-type: none"> • Unequal bite size

	<ul style="list-style-type: none"> • Leaving cut suture too long – tissue reaction • Pattern outside of line • Haptic tension too tight or too loose • Suture depth penetration
	<p>Proficiency based on:</p> <ul style="list-style-type: none"> • Identification of tools and suture material to be used • Accuracy of distance between bites and each suture • Accuracy of square knot
	<p>Final Assessment: In Learning task 1.6 the vet tech must identify tools, suture material and perform Cruciate suture pattern without any form of assistance. The last task will have all supportive and just-in-time information unavailable for use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give them immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment below in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p>
	<p>Assessment done by computer:</p> <ul style="list-style-type: none"> • Number of clicks to correctly identify tools • Number of clicks to correctly identify suture material • Number of times learner goes outside of pattern line • Number of times placement of bite spacing is wrong • Haptic feedback on angle of needle penetration - depth (audio) • Accuracy of square knot – direction of manipulation (alternating throws and a visual on the flatness of the knot) – Haptic color bar will signal too much or too little • Haptic feedback on angle of needle penetration - depth (audio) • Haptic feedback on tension applied to suture material – Haptic color bar will signal too much or too little • If tension is too little the suture will unravel and the task will automatically stop. Student will then need to start the task over. • If tension is too tight the suture will tear and/or strangulation of tissue may occur. The task will automatically end and the student must start the task over.
	<p>Assessment to be done by instructor:</p>

	<ul style="list-style-type: none"> • Review of computer assessment and screen shot visual of pattern
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Module 5: Cruciate Suture Pattern:

Task Class	Cruciate Suture Pattern
<p>Learning task 1.1 Cruciate Suture Pattern with full support</p>	<p>Case scenario introduction: Feline Cystotomy – Cruciate suture pattern</p> <ul style="list-style-type: none"> • Learners are required to watch the professional video of Cruciate suture pattern on the live feline patient. Upon completion of the video, learners will enter the interactive virtual suturing environment where they will begin their required procedure of completing the surgery with the Cruciate suture pattern. They will select the tools and suture material necessary to perform the task. • Tools and suture material are provided as they glow on the tray for easy identification. Learners will click on tools and materials to identify them and enter them into the environment. • Learners will perform the pattern with full assistance; lines are solid and easy to trace and spacing dots are set. Verbal cueing from pedagogical agent giving step-by-step instruction on the procedure of the Cruciate suture pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information available with a click of the resource button: PowerPoint slides on Cruciate suturing, video segment of Cruciate suture pattern on rescue critter with step-by-

	<p>step procedural information, and video on the square knot with step-by-step procedural information. Video of square knot</p> <ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 10-14 of the Cruciate suture pattern on the Rescue Critter video with special focus on: <ol style="list-style-type: none"> 10. Hold the skin edges with the tissue forceps 11. Advance the needle through the skin on the same side that was previously, first entered. Begin on healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate) 12. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate) 13. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 14. Tie the suture using a square knot carefully applying tension <ul style="list-style-type: none"> • Pedagogical agent is available for step- by- step guidance
<p>Learning task 1.2 Cruciate Suture Pattern with diminishing support in suture pattern</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 10-14 of the Cruciate suture pattern from the Rescue Critter video with special focus on: <ol style="list-style-type: none"> 10. Hold the skin edges with the tissue forceps 11. Advance the needle through the skin on the same side that was previously, first entered. Begin on healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate) 12. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate) 13. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 14. Tie the suture using a square knot carefully applying tension <ul style="list-style-type: none"> • Tool selection is required from a short stacked surgical

	<p>instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.)</p> <ul style="list-style-type: none"> • Suture material provided by glowing presence • Suture pattern is not complete – shown with dotted lines periodically throughout the wound • Spacing is completely visible • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information available with a click of the resource button • Step- by- step procedural information is available by Pedagogical agent upon request (talking head).
<p>Learning task 1.3 Cruciate Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 10-14 of the Cruciate suture pattern from the Rescue Critter video with special focus on: <ol style="list-style-type: none"> 10. Hold the skin edges with the tissue forceps 11. Advance the needle through the skin on the same side that was previously, first entered. Begin on healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate) 12. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate) 13. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 14. Tie the suture using a square knot carefully applying

	<p>tension</p> <ul style="list-style-type: none"> • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.) • Broken dotted lines provided for suture pattern formation and spacing is eliminated to every other suture. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button. • Step- by- step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.4 Cruciate Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 10-14 of the Cruciate suture pattern from the Rescue Critter video with special focus on: <ol style="list-style-type: none"> 10. Hold the skin edges with the tissue forceps 11. Advance the needle through the skin on the same side that was previously, first entered. Begin on healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate) 12. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate) 13. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides

	<p>14. Tie the suture using a square knot carefully applying tension</p> <ul style="list-style-type: none"> • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.) • No suture pattern line to follow • Spacing eliminated to every third suture • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button. • Step- by- step procedural information available by Pedagogical agent upon request (talking head)
<p>Learning task 1.5 Cruciate Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 10-14 of the Cruciate suture pattern from the Rescue Critter video with special focus on: <ol style="list-style-type: none"> 10. Hold the skin edges with the tissue forceps 11. Advance the needle through the skin on the same side that was previously, first entered. Begin on healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate) 12. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate) 13. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides

	<p>14. Tie the suture using a square knot carefully applying tension</p> <ul style="list-style-type: none"> • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.) • No lines or spacing is provided – immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button.
<p>Learning task 1.6 Cruciate Suture Pattern with no support Final Exam</p>	<ul style="list-style-type: none"> • Tool selection is required from the full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not pull over.) • No lines or spacing or audio cueing. Learner gets one opportunity to the suture pattern correctly. The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give the student immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described in the preliminary content) in a numerical

	<p>assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p> <p>Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with Learning task 1.6 with visual feedback to check their proficiency with the pattern or return to any other practice within the task class.</p> <p>Learners may continue to practice an unlimited amount of times with any part of Module 1, 2, 3, or 4 with any feedback options to check their proficiency with the pattern.</p>
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SUPPORTIVE INFORMATION

- Multimedia presentation on Cruciate suture pattern
- Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.
- Professional video library –feline cystotomy with Cruciate suture pattern
- Video segment of Cruciate suture pattern on rescue critter with step-by-step procedural information
- Video on the square knot with step-by-step procedural information
- Specialized practice video on Procedural steps 10-14 on Cruciate suture pattern
- Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*.

Lakewood, Co. American Animal Hospital Association Press.

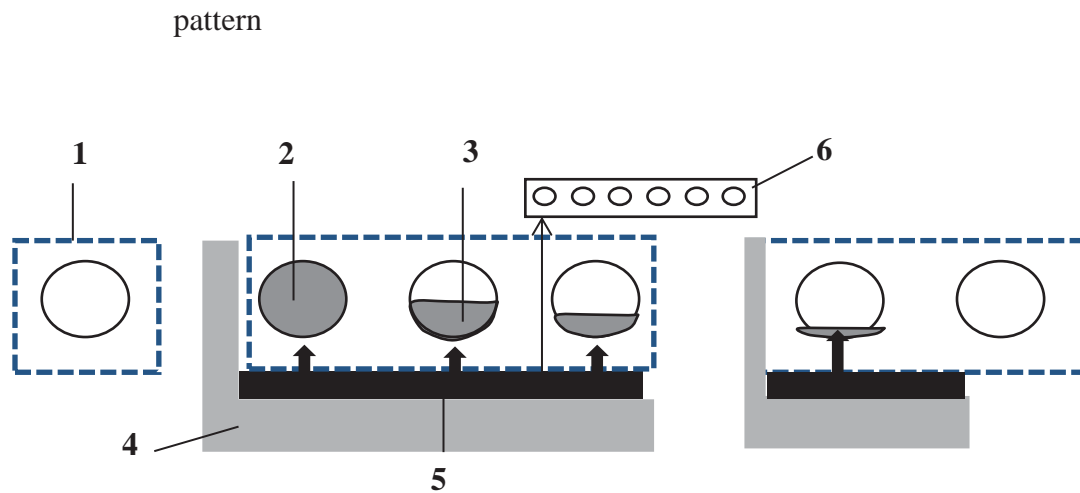
- Handout on suture materials

JUST IN TIME INFORMATION

- Audio beeps if the learner gets out of the suture pattern lines or spacing becomes incorrect
- Visual colored line appear to the correctness of the pattern
- Pedagogical agent appears to help the learner upon request
- The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermas is too deep.
- The Rescue Critter video with step by step instructions on Cruciate suture pattern
- Video on square knot

Part-task PRACTICE

- Specialized practice on the square knot if desired
- Specialized practice on Procedural steps 10-14 on Cruciate suture



1. Task Class: Cruciate Suture Pattern
2. Learning Task: Feline Cystotomy Cruciate suture pattern (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: PowerPoint slides on simple interrupted suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library –feline cystotomy with Cruciate suture pattern, Video segment of cruciate suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermis is too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head)

6. Part-task practice: Square knot practice and specialized practice on Procedural steps 10-14 on Cruciate suture pattern

Figure C5. 4C/ID-model for Cruciate Suture Pattern. Adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Vertical Mattress – Avian

The vertical mattress is a suture pattern that the students have difficulty learning. The thought behind this lack of proficiency is the reposition of the needle. This pattern is one of the less common used, but still a vital pattern to learn. The species of choice for this simulation was the bird.

Module 6 – Vertical Mattress Suturing Pattern

Learning Focus

AVMA *Surgical Nursing*: (AVMA 1.1) Perform basic suturing techniques

***Procedural management*: (AVMA 1.2)** Identify and know proper use for instruments and identify common suture materials, types, and sizes AVMA. (2012). Accreditation Policies and Procedures of the AVMA Committee on Veterinary Technician Education and Activities (CVTEA). Appendix I: (9-10).

MSU (MSU 1.1) Students will become proficient in suture patterns, material and instrument usage.

(MSU 1.2) Students will explore and develop skills that will enhance successful completion of suture patterns and techniques that can be applied in the workforce (MSU VET 213 Animal Care Techniques Surgical Nursing Syllabus).

Essential Skills (E 1.1) Students correctly identify common surgical instruments, knows the appropriate terminology for each and demonstrates knowledge of their proper uses according to Buell, L. & Sturtz, R. (2008). *Assessing essential skills of veterinary technology students*. 2nd ed. Deer Park, NY.

References

Multimedia presentation on vertical mattress pattern

Class Textbooks

Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.

Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.

Materials

Handout on suture materials – provided by instructor

Avian Case Scenario/Storyboard with procedural information on the steps to follow for correct Vertical Mattress suturing

Professional video library – Avian Lipoma with Vertical Mattress suture pattern

Video segment of Vertical Mattress suture pattern on Rescue Critter with step-by-step procedural information

Video on the square knot with step-by-step procedural information

Specialized practice video on Procedural steps 5-11 on Vertical Mattress suture pattern

Avian Lipoma Scenario

Charlie is a 10 year old Amazon Parrot who is presented with a lipoma on his sternum region. Lipomas in avian species involve the subcutaneous tissue around the sternum and caudal abdomen. Lipomas are generally well encapsulated and highly vascular.

Pre-anesthetic blood work is reviewed prior to sedation. Charlie is anesthetized by masking with Isoflurane and oxygen. Any feathers that impact the incision site are plucked and removed. The affected area is scrubbed with three rotations of Chlorohexidine and Isopropyl alcohol.

Once prepped, Charlie is transferred into the surgery room. All personal in the surgery room are wearing caps, masks, and booties. The surgical assistant and surgeon are aseptically gowned and gloved after they scrub in using Chlorohexidine. In the surgery room, Charlie is placed in dorsal recumbancy on the surgery table with all limbs secured. A sterile scrub is completed with Chlorohexidine scrub and Isopropyl alcohol and a final prep of Betadine is applied and left on the area. The surgical site is draped aseptically using a fenestrated drape. The vet completes the

removal of the lipoma as the vet tech assists in passing surgical instruments, gauze, and suture material as needed.

Upon removal of the lipoma it is the vet techs’ responsibility to make a skin closure using 4-0 non-absorbable Nylon with a conventional cutting needle and a vertical mattress suture pattern. After closure is complete, Isoflurane is turned off and fresh oxygen is supplied until he regains a blink reflex. After Charlie has recovered he stays in the clinic until the afternoon and his owner is called to pick him up. Charlie will need to return in seven to 10 days to have his stitches removed.

Overview of Module 6: Avian Lipoma with Vertical Mattress Suture Pattern

Objectives	Preliminary Content
	Introduction of Real-life case: Avian Charlie, 10 year old Amazon Parrot–Vertical Mattress Suture Pattern Learner is required to complete each task in order until they submit their final task for assessment by instructor. After the final task has been completed for final assessment with 80% accuracy, the user may revisit any task of their choosing for additional practice. The scenario sets the scene for the surgery (Avian Lipoma). Pedagogical agent reviews procedure and vet tech responsibilities pre-op/procedure/post-op. After the veterinarian has completed the successful removal of the lipoma, the vet tech is left to complete the surgery by closing the skin tissue with Vertical Mattress suture pattern.
AVMA 1.2 MSU 1.1 E1.1	The vet tech must identify the tools and suture material needed to complete the closure. (Mayo Hegar or Olsen Hegar Needle Holders, Adson Brown or Adson Tissue Forceps, conventional cutting needle, 4-0 non-absorbable Nylon)
AVMA 1.1 MSU 1.1 MSU 1.2 E 1.1	Vet tech will demonstrate Vertical Mattress suture pattern on Avian (Amazon Parrot) Vet tech will have several opportunities to practice with diminishing support and assistance. Feedback on this task will be provided with audio and visual cueing. A beep will sound if they get outside of the pattern lines or their spacing is off. A colored visual line will appear at the completion of each pattern. This line will reveal accuracy or if

	<p>the vet tech got outside of the pattern lines.</p>
	<p>Assistance will be available with support materials upon request by selecting the resource button:</p> <ul style="list-style-type: none"> • Procedural information on the steps to follow for correct Vertical Mattress suturing • Professional video library – avian lipoma with Vertical Mattress suture pattern • Video segment of Vertical Mattress suture pattern on Rescue Critter with step-by-step procedural information • Video on the square knot with step-by-step procedural information <p>Assistance will be available with just in time information upon request by selecting the help button:</p> <ul style="list-style-type: none"> • Pedagogical agent will appear with verbal just in time information pertaining to different points in the procedure (tips and guidance).
	<p>Areas for error:</p> <ul style="list-style-type: none"> • Unequal bite size • Leaving cut suture too long – tissue reaction • Pattern outside of line • Haptic tension too tight or too loose • Suture depth penetration
	<p>Proficiency based on:</p> <ul style="list-style-type: none"> • Identification of tools and suture material to be used • Accuracy of distance between bites and each suture • Accuracy of square knot
	<p>Final Assessment:</p> <p>In Learning task 1.8 the vet tech must identify tools, suture material and perform simple interrupted suture pattern without any form of assistance. The last task will have all supportive and just-in-time information unavailable for use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give them immediate feedback on the skill. Learners will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment below in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p>

	<p>Assessment done by computer:</p> <ul style="list-style-type: none"> • Number of clicks to correctly identify tools • Number of clicks to correctly identify suture material • Number of times learner goes outside of pattern line • Number of times placement of bite spacing is wrong • Haptic feedback on angle of needle penetration – depth (audio) • Accuracy of square knot – direction of manipulation (alternating throws and a visual on the flatness of the knot) – Haptic color bar will signal too much or too little • Haptic feedback on angle of needle penetration - depth (audio) • Haptic feedback on tension applied to suture material – Haptic color bar will signal too much or too little • If tension is too little suture will unravel and the task will automatically stop. Student must then start the task over. • If tension is too tight suture will tear and/or strangulation of tissue may occur. The task will automatically end and the student must start the task over.
	<p>Assessment to be done by instructor:</p> <ul style="list-style-type: none"> • Review of computer assessment and screen shot visual of pattern

Module 6: Vertical Mattress Suture Pattern:

Task Class	Vertical Mattress Suture Pattern
<p>Learning task 1.1 Vertical Mattress Suture Pattern with full support</p>	<p>Case scenario introduction: Avian lipoma</p> <ul style="list-style-type: none"> • Learners are required to watch the professional video of Vertical Mattress suture pattern on the live avian patient. Upon completion of the video, learners will enter the interactive virtual suturing environment where they will begin their required procedure of completing the surgery with the Vertical Mattress suture pattern. Learners will select the tools and suture material necessary to perform the task. • Tools and suture material are provided as they glow on the tray for easy identification. Learners will click on tools and materials to identify them and enter them into the environment. Learners will perform the pattern with full assistance; lines are solid and easy to trace and spacing dots are set. Verbal cueing from pedagogical agent giving step-by-step instruction on the procedure of Vertical Mattress suturing.

- Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice.
- Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied.
- Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information available with a click of the resource button: Multimedia presentation on Vertical Mattress suture pattern, video segment of vertical mattress suture pattern on rescue critter with step-by-step procedural information, and video on the square knot with step-by-step procedural information.
- Part-task practice is available before the next task practice for Procedural Steps 5-11 of the Vertical Mattress suture pattern on the Rescue Critter with special focus on:

5. Advance the needle through the skin on one healthy side of the wound 8-10mm from the tissue edge and out through the interior portion of wound while twisting your wrist (supinate)

6. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 8-10mm from the tissue edge while twisting your wrist (supinate)

7. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides

8. Reverse the order; repositioning your needle to enter the same side you just exited

9. Entrance should be between the 3-4mm from skin edge and out through the interior portion of wound while twisting your wrist (supinate)

10. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides

	<p>11.Tie the suture using a square knot carefully applying tension</p> <ul style="list-style-type: none"> • Pedagogical agent.is available for step –by- step guidance.
<p>Learning task 1.2 Vertical Mattress Suture Pattern with diminishing support in suture pattern</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 5-11 of the Vertical Mattress suture pattern on the Rescue Critter with special focus on: <p>5. Advance the needle through the skin on one healthy side of the wound 8-10mm from the tissue edge and out through the interior portion of wound while twisting your wrist (supinate)</p> <p>6.Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 8-10mm from the tissue edge while twisting your wrist (supinate)</p> <p>7.Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>8.Reverse the order; repositioning your needle to enter the same side you just exited</p> <p>9.Entrance should be between the 3-4mm from skin edge and out through the interior portion of wound while twisting your wrist (supinate)</p> <p>10.Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>11.Tie the suture using a square knot carefully applying tension</p> <ul style="list-style-type: none"> • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.) • Suture material provided by glowing presence • Suture pattern is not complete – shown with dotted lines periodically throughout the wound • Spacing is completely visible • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual

	<p>colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied.</p> <ul style="list-style-type: none"> • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information available with a click of the resource button • Step- by -step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.3 Vertical Mattress Suture Pattern with diminishing support in suture pattern</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 5-11 of the Vertical Mattress suture pattern on the Rescue Critter with special focus on: <ol style="list-style-type: none"> 5. Advance the needle through the skin on one healthy side of the wound 8-10mm from the tissue edge and out through the interior portion of wound while twisting your wrist (supinate) 6.Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 8-10mm from the tissue edge while twisting your wrist (supinate) 7.Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 8.Reverse the order; repositioning your needle to enter the same side you just exited 9.Entrance should be between the 3-4mm from skin edge and out through the interior portion of wound while twisting your wrist (supinate) 10.Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 11.Tie the suture using a square knot carefully applying tension <ul style="list-style-type: none"> • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.) • Broken dotted lines provided for suture pattern formation on one side of the wound and spacing is eliminated to every other suture.

	<ul style="list-style-type: none"> • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button. • Step- by- step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.4 Vertical Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 5-11 of the Vertical Mattress suture pattern on the Rescue Critter with special focus on: <ol style="list-style-type: none"> 5. Advance the needle through the skin on one healthy side of the wound 8-10mm from the tissue edge and out through the interior portion of wound while twisting your wrist (supinate) 6.Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 8-10mm from the tissue edge while twisting your wrist (supinate) 7.Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 8.Reverse the order; repositioning your needle to enter the same side you just exited 9.Entrance should be between the 3-4mm from skin edge and out through the interior portion of wound while twisting your wrist (supinate) 10.Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 11.Tie the suture using a square knot carefully applying tension <ul style="list-style-type: none"> • Tool selection is required from a short stacked surgical

	<p>instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.)</p> <ul style="list-style-type: none"> • No suture pattern line to follow on one side and a dotted line on the other side of the wound • Spacing eliminated to every third suture • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button • Step- by- step procedural information available by Pedagogical agent upon request (talking head).
<p>Learning task 1.5 Vertical Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 5-11 of the Vertical Mattress suture pattern on the Rescue Critter with special focus on: <ol style="list-style-type: none"> 5. Advance the needle through the skin on one healthy side of the wound 8-10mm from the tissue edge and out through the interior portion of wound while twisting your wrist (supinate) 6.Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 8-10mm from the tissue edge while twisting your wrist (supinate) 7.Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 8.Reverse the order; repositioning your needle to enter the same side you just exited 9.Entrance should be between the 3-4mm from skin edge and

	<p>out through the interior portion of wound while twisting your wrist (supinate)</p> <p>10. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>11. Tie the suture using a square knot carefully applying tension</p> <ul style="list-style-type: none"> • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.) • No lines on either side – spacing provided every fourth suture - immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern. Just in time information will give learner audio beeps when they are off of pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. • Support information is available with a click of the resource button.
<p>Learning task 1.6 Vertical Mattress Suture Pattern with diminishing support in suture pattern</p>	<ul style="list-style-type: none"> • Part-task practice is available before the next task practice for Procedural Steps 5-11 of the Vertical Mattress suture pattern on the Rescue Critter with special focus on: <p>5. Advance the needle through the skin on one healthy side of the wound 8-10mm from the tissue edge and out through the interior portion of wound while twisting your wrist (supinate)</p> <p>6. Reposition your thumb forceps over the second skin edge as</p>

<p>and spacing</p>	<p>you advance the needle through the interior portion of the wound and out through the healthy tissue 8-10mm from the tissue edge while twisting your wrist (supinate)</p> <p>7. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>8. Reverse the order; repositioning your needle to enter the same side you just exited</p> <p>9. Entrance should be between the 3-4mm from skin edge and out through the interior portion of wound while twisting your wrist (supinate)</p> <p>10. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>11. Tie the suture using a square knot carefully applying tension</p> <ul style="list-style-type: none"> • Tool selection is required from a short stacked surgical instrument tray – learner selects from a limited number of surgical tools (Learner will click and drag the correct tool into the environment – incorrect tools will not stay over.) • No lines or spacing. Immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button.
<p>Learning task</p>	<ul style="list-style-type: none"> • Tool selection is required from a full tray of surgical

<p>1.7 Vertical Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.)</p> <ul style="list-style-type: none"> • No lines or spacing. Upon completion learner will know how they did when the visual colored line is revealed with the completed pattern. • Just in time information will give learners audio beeps when they are off of pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. • Support information is available with a click of the resource button.
<p>Learning task 1.8 Vertical Mattress Suture Pattern with no support</p> <p>Final Exam</p>	<ul style="list-style-type: none"> • Tool selection is required from the full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not pull over.) • No lines or spacing or audio cueing. Learner gets one opportunity to the suture pattern correctly. <p>The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give the student immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described in the preliminary content) in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p>

	<p>Learners do not have to follow the scope and sequence after successful completion. Learners may continue to practice an unlimited amount of times with Learning task 1.8 with visual feedback to check their proficiency with the pattern or return to any other practice within the task class Learners may continue to practice an unlimited amount of times with any part of Module 1, 2, 3, 4 or 5 with any feedback option to check their proficiency with the pattern.</p>
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SUPPORTIVE INFORMATION

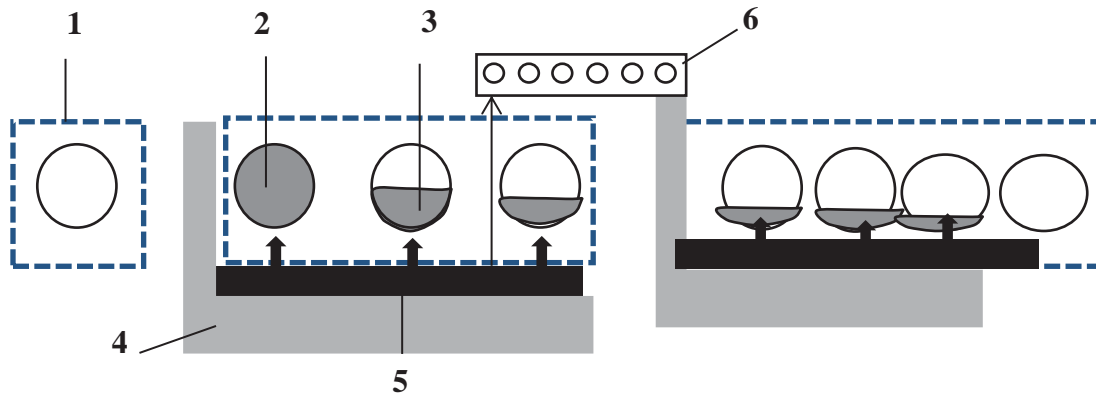
- Multimedia presentation on Vertical Mattress suture pattern
- Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.
- Professional video library –Avian lipoma with Vertical Mattress suture pattern
- Video segment of Vertical Mattress suture pattern on Rescue Critter with step-by-step procedural information
- Video on the square knot with step-by-step procedural information
- Specialized practice video on Procedural steps 5-11 on Vertical Mattress suture pattern
- Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.
- Handout on suture materials

JUST IN TIME INFORMATION

- Audio beeps if the learner gets out of the suture pattern lines or spacing becomes incorrect
- Visual colored line appear to the correctness of the pattern
- Pedagogical agent appears to help the learner upon request
- The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermas is too deep.
- The Rescue Critter video with step by step instructions on Vertical Mattress suture pattern is available on demand
- Step by step procedure video on the square knot is available at any time

Part-task PRACTICE

- Specialized practice on the square knot if desired
- Specialized practice on Procedural steps 5-11 on Vertical Mattress suture pattern



1. Task Class: Vertical Mattress Suture Pattern
2. Learning Task: Vertical Mattress Suture on an avian lipoma (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: PowerPoint slides on Vertical Mattress suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library –avian lipoma Vertical Mattress suture pattern, Video segment of Vertical Mattress suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information is available with a

click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head).

6. Part-task practice: Square knot practice and procedural steps 5-11 on Vertical Mattress suture pattern

Figure C6. 4C/ID-model on Vertical Mattress Suture Pattern. Adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Horizontal Mattress – Rabbit

The horizontal mattress is another difficult suture pattern that students have trouble learning. The thought behind this lack of proficiency is the reposition of the needle. This pattern is one of the less common used, but still a vital pattern to learn. The species of choice for this simulation was the rabbit.

Module 7 – Horizontal Mattress Suturing Pattern

Learning Focus

AVMA *Surgical Nursing*: (AVMA 1.1) Perform basic suturing techniques

***Procedural management*: (AVMA 1.2)** Identify and know proper use for instruments and identify common suture materials, types, and sizes AVMA. (2012). Accreditation Policies and Procedures of the AVMA Committee on Veterinary Technician Education and Activities (CVTEA). Appendix I: (9-10).

MSU (MSU 1.1) Students will become proficient in suture patterns, material and instrument usage.

(MSU 1.2) Students will explore and develop skills that will enhance successful completion of suture patterns and techniques that can be applied in the workforce (MSU VET 213 Animal Care Techniques Surgical Nursing Syllabus).

Essential Skill (E 1.1) Students correctly identify common surgical instruments, knows the appropriate terminology for each and demonstrates knowledge of their proper uses according to Buell, L. & Sturtz, R. (2008). *Assessing essential skills of veterinary technology students*. 2nd ed. Deer Park, NY.

References

Multimedia presentation on Horizontal Mattress suture pattern

Class Textbooks

Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.

Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.

Materials

Handout on suture materials – provided by instructor

Rabbit Case Scenario/Storyboard with procedural information on the steps to follow for correct Horizontal Mattress suturing

Professional video library – Rabbit Ovariohysterectomy with Horizontal Mattress suture pattern

Video segment of Horizontal Mattress suture pattern on Rescue Critter with step-by-step procedural information

Video on the square knot with step-by-step procedural information

Video on specialized practice for procedural steps 6-10 on Horizontal Mattress suture pattern

Rabbit Ovariohysterectomy Scenario

Daisy is an eight month old female Flemish Giant, weighing in at 13 pounds. She is scheduled for a routine spay today. Pre-anesthetic blood work is reviewed prior to sedation. Daisy is anesthetized using Xylazine 5mg/kg and Ketamine 35mg/kg intramuscularly. Once the sedatives have been given and Daisy drifts off, the vet tech will intubate and hook the patient up to Isoflurane and oxygen to maintain anesthesia. The rabbit is to be placed in dorsal recumbancy.

Before prepping the patient for surgery the vet tech must empty out the contents of the bladder by manual manipulation. The vet tech must also shave the abdominal area from the diaphragmatic arch to the pubis and remove all hair. Daisy is prepped with three rotations of Chlorohexidine and Isopropyl alcohol. Once prepped, Daisy is transferred into the surgery room.

All personal in the surgery room are wearing caps, masks, and booties. The surgical assistant and surgeon are aseptically gowned and gloved after they scrub in using Chlorohexidine. Daisy is placed in dorsal recumbancy on the surgery table with all limbs secured.

In the surgery room, a sterile scrub is completed with Chlorohexidine scrub and Isopropyl alcohol and a final prep of Betadine is applied and left on the area. All monitoring equipment is connected and working properly. The surgical site is draped aseptically using the four corner towel technique.

The veterinarian begins the ovariohysterectomy on Daisy. As the surgical assistant, the vet tech is responsible for passing needed instruments, gauze, and suture material. After closure of the abdominal wall the vet insists that the vet tech completes the skin closure. The vet tech will complete the skin closure by using 2-O PDS and a Horizontal Mattress pattern and conventional cutting needle.

Daisy is placed in recovery until she is able to set up on her own. The owner is called to pick up Daisy. Daisy is returned in seven to 10 days for suture removal. Close monitoring during this time is important to prevent chewing of skin closure.

Overview of Module 7: Rabbit Ovariohysterectomy Scenario with Horizontal Mattress Suture Pattern

Objectives	Preliminary Content
	<p>Introduction of Real-life case: Rabbit Ovariohysterectomy – Daisy, eight month old female, Flemish Giant, Horizontal Mattress Suture Pattern</p> <p>Learner is required to complete each task in order until they submit their final task for assessment by instructor. After the final task has been completed for final assessment with 80% accuracy, the user may revisit any task of their choosing for additional practice.</p> <p>The scenario sets the scene for the surgery (Rabbit Ovariohysterectomy).</p> <p>Pedagogical agent reviews procedure and vet tech responsibilities pre-op/procedure/post-op. After the veterinarian has completed the ovariohysterectomy, the vet tech is left to complete the surgery by closing the skin tissue with Horizontal Mattress suture pattern.</p>

<p>AVMA 1.2 MSU 1.1 E1.1</p>	<p>The vet tech must identify the tools and suture material needed to complete the closure. (Mayo Hegar or Olsen Hegar Needle Holders, Adson Brown or Adson Tissue Forceps, conventional cutting needle, 2-0 PDS)</p>
<p>AVMA 1.1 MSU 1.1 MSU 1.2 E 1.1</p>	<p>Vet tech will demonstrate Horizontal Mattress suture pattern on Daisy, the eight month old Flemish giant rabbit. Vet techs will have several opportunities to practice with diminishing support and assistance. Feedback on this task will be provided with audio and visual cueing. A beep will sound if they get outside of the pattern lines or their spacing is off. A colored visual line will appear at the completion of each pattern. This line will reveal accuracy or if the vet tech goes outside of the pattern lines.</p>
	<p>Assistance will be available with support materials upon request by selecting the resource button:</p> <ul style="list-style-type: none"> • Procedural information on the steps to follow for correct Horizontal Mattress suturing • Professional video library – rabbit closure wound with Horizontal Mattress suture pattern • Video segment of Horizontal Mattress suture pattern on Rescue Critter with step-by-step procedural information • Video on the square knot with step-by-step procedural information <p>Assistance will be available with just in time information upon request by selecting the help button:</p> <ul style="list-style-type: none"> • Pedagogical agent will appear with verbal just in time information pertaining to different points in the procedure (tips and guidance).
	<p>Areas for error:</p> <ul style="list-style-type: none"> • Unequal bite size • Leaving cut suture too long – tissue reaction • Pattern outside of line • Haptic tension too tight or too loose • Suture depth penetration
	<p>Proficiency based on:</p> <ul style="list-style-type: none"> • Identification of tools and suture material to be used • Accuracy of distance between bites and each suture • Accuracy of square knot
	<p>Final Assessment: In Learning task 1.8 the vet tech must identify tools, suture material and perform simple interrupted suture pattern without any form of assistance. The last task will have all supportive and just-in-time</p>

	<p>information unavailable for use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give them immediate feedback on the skill. Learners will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment below in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p>
	<p>Assessment done by computer:</p> <ul style="list-style-type: none"> • Number of clicks to correctly identify tools • Number of clicks to correctly identify suture material • Number of times learner goes outside of pattern line • Number of times placement of bite spacing is wrong • Haptic feedback on angle of needle penetration - depth (audio) • Accuracy of square knot – direction of manipulation (alternating throws and a visual on the flatness of the knot) – Haptic color bar will signal too much or too little • Haptic feedback on angle of needle penetration - depth (audio) • Haptic feedback on tension applied to suture material – Haptic color bar will signal too much or too little • If tension is too little the suture will unravel and the task will automatically stop. Learners must then start the task over. • If tension is too tight the suture will tear and/or strangulation of tissue may occur. The task will automatically end and the student must start the task over.
	<p>Assessment to be done by instructor:</p> <ul style="list-style-type: none"> • Review of computer assessment and screen shot visual of pattern

Module 7: Horizontal Mattress Suture Pattern:

Task Class	Horizontal Mattress Suture Pattern
<p>Learning task 1.1 Horizontal Mattress Suture Pattern with full support</p>	<p>Case scenario introduction: Rabbit Ovariohysterectomy</p> <ul style="list-style-type: none"> • Learners are required to watch the professional video of Horizontal Mattress suture pattern on the live rabbit patient. Upon completion of the video, learners will enter the interactive virtual suturing environment where they will begin their required procedure of completing the surgery with the Horizontal Mattress suture pattern. Learners will select the tools and suture material

	<p>necessary to perform the task.</p> <ul style="list-style-type: none"> • Tools and suture material are provided as they glow on the tray for easy identification. Learners will click on tools and materials to identify them and enter them into the environment. Learners will perform the pattern with full assistance; lines are solid and easy to trace and spacing dots are set. Verbal cueing from pedagogical agent giving step-by-step instruction on the procedure of horizontal mattress suturing. • Learner is to trace the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button: Multimedia presentation on Horizontal Mattress suture pattern, video segment of Horizontal Mattress suture pattern on Rescue Critter with step-by-step procedural information, and video on the square knot with step-by-step procedural information. <p>Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <ol style="list-style-type: none"> 6. Reverse the order; repositioning your needle to enter the same side you just exited 7. Entrance should be 6-8mm across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate)
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	<ol style="list-style-type: none"> 8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate) 9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 10. Tie the suture using a square knot carefully applying tension <ul style="list-style-type: none"> • Pedagogical agent is available for step by step guidance.
<p>Learning task 1.2 Horizontal Mattress Suture Pattern with diminishing support in suture pattern</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <ol style="list-style-type: none"> 6. Reverse the order; repositioning your needle to enter the same side you just exited 7. Entrance should be 6-8mm across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate) 8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate) 9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 10. Tie the suture using a square knot carefully applying tension <ul style="list-style-type: none"> • Pedagogical agent is available for step by step guidance • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • Suture material provided by glowing presence • Suture pattern is not complete – shown with dotted lines periodically throughout the wound

	<ul style="list-style-type: none"> • Spacing is completely visible • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button • Step- by- step procedural information is available by Pedagogical agent upon request (talking head).
<p>Learning task 1.3 Horizontal Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <ol style="list-style-type: none"> 6. Reverse the order; repositioning your needle to enter the same side you just exited 7. Entrance should be 6-8mm across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate) 8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate) 9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 10. Tie the suture using a square knot carefully applying tension <ul style="list-style-type: none"> • Pedagogical agent is available for step by step guidance

	<ul style="list-style-type: none"> • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • Broken dotted lines provided for suture pattern formation on one side of the wound and spacing is eliminated to every other one. • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button. • Step- by- step procedural information is available by Pedagogical agent upon request (talking head).
<p>Learning task 1.4 Horizontal Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <ol style="list-style-type: none"> 6. Reverse the order; repositioning your needle to enter the same side you just exited 7. Entrance should be 6-8mm across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate) 8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial

	<p>entrance site, while twisting your wrist (supinate)</p> <p>9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>10. Tie the suture using a square knot carefully applying tension</p> <ul style="list-style-type: none"> • Pedagogical agent is available for step by step guidance • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No suture pattern line to follow on one side and a dotted line on the other side of the wound • Spacing eliminated to every third suture • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button. • Step- by -step procedural information is available by Pedagogical agent upon request (talking head).
<p>Learning task 1.5 Horizontal Mattress Suture Pattern with diminishing</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <p>6. Reverse the order; repositioning your needle to enter the same side you just exited</p> <p>7. Entrance should be 6-8mm across from the point of</p>

<p>support in suture pattern and spacing</p>	<p>exit and out through the interior portion of wound while twisting your wrist (supinate)</p> <ol style="list-style-type: none"> 8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate) 9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 10. Tie the suture using a square knot carefully applying tension <ul style="list-style-type: none"> • Pedagogical agent is available for step by step guidance • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No lines on either side – spacing provided every fourth one - immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern. • Just in time information will give learner audio beeps when they are off of pattern Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. <p>Support information is available with a click of the</p>
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<p>Learning task 1.6 Horizontal Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>resource button.</p> <p>Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <ol style="list-style-type: none"> 6. Reverse the order; repositioning your needle to enter the same side you just exited 7. Entrance should be 6-8mm across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate) 8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate) 9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 10. Tie the suture using a square knot carefully applying tension <ul style="list-style-type: none"> • Pedagogical agent is available for step by step guidance • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No lines or spacing. Immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern. • Just in time information will give learner audio beeps when they are off of pattern. Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when
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	<p>different forces are applied.</p> <ul style="list-style-type: none"> • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. • Support information is available with a click of the resource button.
<p>Learning task 1.7 Horizontal Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Tool selection is required from a full tray of surgical instruments (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No lines or spacing. Upon completion learner will know how they did when the visual colored line is revealed with the completed pattern. Just in time information will give learner audio beeps when they are off of pattern. • Support information is available with a click of the resource button.
<p>Learning task 1.8 Horizontal Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Tool selection is required from the full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not pull over.) • No lines or spacing or audio cueing. Learner gets one opportunity to the suture pattern correctly. Learning task 1.8 screen shot will be submitted to the instructor for evaluation. • Immediate feedback –The learner will see their pattern matched up against the colored visual line showing correct spacing and pattern. <p>The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give the student immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described in the preliminary content) in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. Learners do not have to follow the scope and sequence after</p>

successful completion. Learners may continue to practice an unlimited amount of times with all feedback options to check their proficiency with the pattern or return to any other practice within the task class Learners may continue to practice an unlimited amount of times with any part of Module 1, 2, 3, 4, 5, or 6 with all feedback options to check their proficiency with the pattern.

SUPPORTIVE INFORMATION

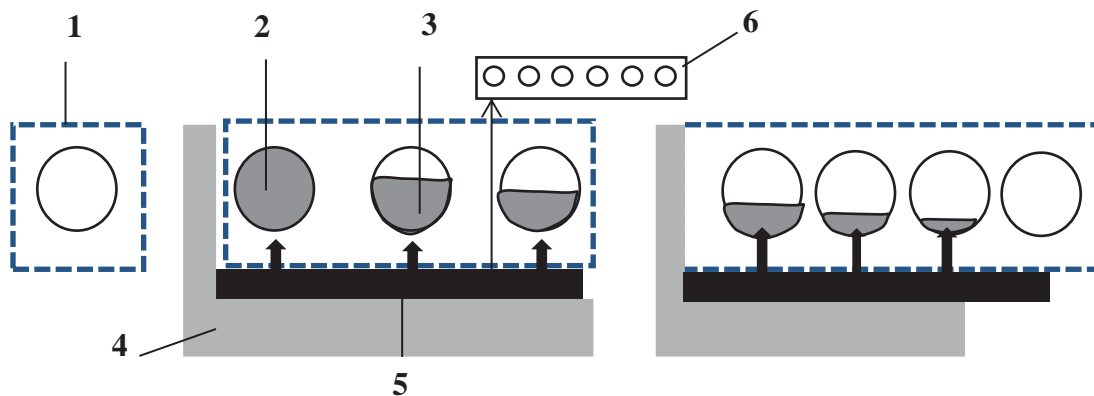
- Multimedia presentation on Horizontal Mattress suture pattern
- Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.
- Professional video library –Rabbit ovariohysterectomy with Horizontal Mattress suture pattern
- Video segment of Horizontal Mattress suture pattern on Rescue Critter with step-by-step procedural information
- Video on the square knot with step-by-step procedural information
- Specialized practice video on Procedural steps 6-10 on Horizontal Mattress suture pattern
- Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.
- Handout on suture materials

JUST IN TIME INFORMATION

- Audio beeps if the learner gets out of the suture pattern lines or spacing becomes incorrect
- Visual colored line appear to the correctness of the pattern
- Pedagogical agent appears to help the learner upon request
- The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermas is too deep.
- Rescue Critter video with step by step instructions on vertical mattress suture pattern
- Step by Step procedure video on the square knot

Part-task Practice

- Specialized practice on the square knot if desired
- Specialized practice on Procedural steps 6-10 on Horizontal Mattress suture pattern



1. Task Class: Horizontal Mattress Suture Pattern
2. Learning Task: Horizontal Mattress Suture on a rabbit ovariohysterectomy (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: Multimedia presentation on Horizontal Mattress suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library –rabbit ovariohysterectomy- Horizontal Mattress suture pattern, Video segment of Horizontal Mattress suture pattern on Rescue Critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermis is too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information is available with a click of the resource button. Step by step procedural information is available by Pedagogical agent upon request (talking head).

6. Part-task practice: Square knot practice and procedural steps 5-11 on Horizontal Mattress suture pattern

Figure C7. 4C/ID model for Horizontal Mattress Suture Pattern. Adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*. Englewood Cliffs, NJ: Educational Technology Publications, Inc.

Continuous Horizontal Mattress – Mouse

The last pattern the students learn is the continuous horizontal pattern. This pattern is also very difficult for the students to learn and become proficient at completing. The thought behind this lack of proficiency is the reposition of the needle. This pattern is one of the less common used but still a vital pattern to learn. The species of choice for this simulation was the mouse.

Module 8 –Continuous Horizontal Suture Pattern

Learning Focus

AVMA *Surgical Nursing*: (AVMA 1.1) Perform basic suturing techniques

***Procedural management*: (AVMA 1.2)** Identify and know proper use for instruments and identify common suture materials, types, and sizes AVMA. (2012). Accreditation Policies and Procedures of the AVMA Committee on Veterinary Technician Education and Activities (CVTEA). Appendix I: (9-10).

MSU (MSU 1.1) Students will become proficient in suture patterns, material and instrument usage.

(MSU 1.2) Students will explore and develop skills that will enhance successful completion of suture patterns and techniques that can be applied in the workforce (MSU VET 213 Animal Care Techniques Surgical Nursing Syllabus).

Essential Skill (E 1.1) Students correctly identify common surgical instruments, knows the appropriate terminology for each and demonstrates knowledge of their proper uses according to Buell, L. & Sturtz, R. (2008). *Assessing essential skills of veterinary technology students*. 2nd ed. Deer Park, NY.

References:

Multimedia presentation on Continuous Horizontal Mattress suture pattern

Class Textbooks

Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.

Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.

Materials

Handout on suture materials – provided by instructor

Rodent Case Scenario/Storyboard with procedural information on the steps to follow for correct continuous horizontal suturing pattern

Professional video library – Rodent with Continuous Horizontal Mattress suture pattern

Video segment of Continuous Horizontal Mattress suture pattern on Rescue Critter with step-by-step procedural information

Video on the square knot with step-by-step procedural information

Specialized practice video on Procedural steps 6-10 on Continuous Horizontal Mattress suture pattern

Mouse Ovariohysterectomy Scenario

The College of Dermatology has just named a new Dean. He is set to arrive with his entire research department, including 500 mice. Upon arrival the vet techs will spay all female mice. Each mouse is placed, individually in an induction chamber that is quickly filled with a mixture of Isoflurane and Oxygen for induction.

After each animal has been anesthetized it is removed and placed in dorsal recumbancy. Her nose is placed the anesthesia machine's nose cone with a mixture of Isoflurane and Oxygen for maintenance. The abdominal area is shaved from the costal arch to the pubis with a #40 blade. The area is then aseptically prepared by swabbing with a surgical scrub of Chlorhexidine and Isopropyl alcohol using three rotations.

The vet tech is properly prepped to perform the surgery. Since this is rodent surgery, the procedure does not need to be performed in a surgical operating room, but rather in an aseptic way on a dedicated rodent surgical table top.

The vet begins the surgical procedure and the vet tech aids as the surgical assistant passing any needed surgical instruments, gauze, and suture material. Once

the surgical procedure is completed and all internal structures are closed you are required to make the skin closure.

The vet tech will complete the skin closure by using a Continuous Horizontal Mattress suture pattern, 8-O Polybuster, and a conventional cutting needle. The animal is then placed into a recovery cage on a heated water blanket until completely recovered from anesthesia

The animals are returned to their respected rack placement when all surgical patients are able to exhibit normal ambulation. The sutures are removed in seven to 10 days post-surgery.

Overview of Module 8: Rodent Ovariohysterectomy with Continuous Horizontal Mattress Suture Pattern

Objectives	Preliminary Content
	Introduction of Real-life case: Rodent Ovariohysterectomy – Continuous Horizontal Mattress Suture Pattern Learner is required to complete each task in order until they submit their final task for assessment by instructor. After the final task has been completed for final assessment with 80% accuracy, the user may revisit any task of their choosing for additional practice. The scenario sets the scene for the surgery (Rodent Ovariohysterectomy). Pedagogical agent reviews procedure and vet tech responsibilities pre-op/procedure/post-op. After the veterinarian has completed the ovariohysterectomy, the vet tech is left to complete the surgery by closing the skin tissue with Continuous Horizontal Mattress suture pattern.
AVMA 1.2 MSU 1.1 E1.1	The vet tech must identify the tools and suture material needed to complete the closure. (Mayo Hegar or Olsen Hegar Needle Holders, Adson Brown or Adson Tissue Forceps, conventional cutting needle, 2-0 PDS)

<p>AVMA 1.1 MSU 1.1 MSU 1.2 E 1.1</p>	<p>Vet tech will demonstrate Continuous Horizontal Mattress suture pattern on a mouse.</p> <p>Vet tech will have several opportunities to practice with diminishing support and assistance. Feedback on this task will be provided with audio and visual cueing. A beep will sound if they get outside of the pattern lines or their spacing is off. A colored visual line will appear at the completion of each pattern. This line will reveal accuracy or if the vet tech got outside of the pattern lines.</p>
	<p>Assistance will be available with support materials upon request by selecting the resource button:</p> <ul style="list-style-type: none"> • Procedural information on the steps to follow for correct Continuous Horizontal Mattress suture pattern • Professional video library – rodent ovariohysterectomy with Continuous Horizontal Mattress suture pattern • Video segment of Continuous Horizontal Mattress suture pattern on Rescue Critter with step-by-step procedural information • Video on the square knot with step-by-step procedural information <p>Assistance will be available with just in time information upon request by selecting the help button:</p> <ul style="list-style-type: none"> • Pedagogical agent will appear with verbal just in time information pertaining to different points in the procedure (tips and guidance).
	<p>Areas for error:</p> <ul style="list-style-type: none"> • Unequal bite size • Leaving cut suture too long – tissue reaction • Pattern outside of line • Haptic tension too tight or too loose • Suture depth penetration
	<p>Proficiency based on:</p> <ul style="list-style-type: none"> • Identification of tools and suture material to be used • Accuracy of distance between bites and each suture • Accuracy of square knot
	<p>Final Assessment:</p> <p>In Learning task 1.8 the vet tech must identify tools, suture material and perform Continuous Horizontal Mattress suture pattern without any form of assistance. The last task will have all supportive and just-in-time information unavailable for use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will</p>

	<p>appear to give them immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment below in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy.</p>
	<p>Assessment done by computer:</p> <ul style="list-style-type: none"> • Number of clicks to correctly identify tools • Number of clicks to correctly identify suture material • Number of times learner goes outside of pattern line • Number of times placement of bite spacing is wrong • Haptic feedback on angle of needle penetration - depth (audio) • Accuracy of square knot – direction of manipulation (alternating throws and a visual on the flatness of the knot) – Haptic color bar will signal too much or too little • Haptic feedback on angle of needle penetration - depth (audio) <p>Haptic feedback on tension applied to suture material – Haptic color bar will signal too much or too little</p> <ul style="list-style-type: none"> • If tension is too little suture will unravel and the task will automatically stop. Student must start the task over • If tension is too tight suture will tear and/or strangulation of tissue may occur. The task will automatically end and the student must start the task over
	<p>Assessment to be done by instructor:</p> <ul style="list-style-type: none"> • Review of computer assessment and screen shot visual of pattern

Module 8: Continuous Horizontal Mattress Suture Pattern:

<p>Task Class</p>	<p>Continuous Horizontal Mattress Suture Pattern</p>
<p>Learning task 1.1 Continuous Horizontal Mattress Suture Pattern with full support</p>	<p>Case scenario introduction: Mouse Ovariohysterectomy</p> <ul style="list-style-type: none"> • Learners are required to watch the professional video of Continuous Horizontal Mattress suture pattern on the live rodent patient. Upon completion of the video, learners will enter the interactive virtual suturing environment where they will begin their required procedure of completing the surgery with the continuous horizontal suture pattern. Learners will select the tools and suture material necessary to perform the task.

- Tools and suture material are provided as they glow on the tray for easy identification. Learners will click on tools and materials to identify them and enter them into the environment. Learners will perform the pattern with full assistance; lines are solid and easy to trace and spacing dots are set. Verbal cueing from pedagogical agent giving step-by-step instruction on the procedure of Continuous Horizontal Mattress suturing.
- Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice.
- Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button: Multimedia presentation on Continuous Horizontal Mattress suture pattern, video segment of Continuous Horizontal Mattress suture pattern on Rescue Critter with step-by-step procedural information, and video on the square knot with step-by-step procedural information.

Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Continuous Horizontal Mattress suture pattern on the Rescue Critter with special focus on:

6. Reverse the order; repositioning your needle to enter the same side you just exited
7. Entrance should be 6-8mm across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate)
8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the

	<p>healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate)</p> <ol style="list-style-type: none"> 9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 10. Repeat this pattern until the incision is completely closed always enter on the same side of incision. <ul style="list-style-type: none"> • Pedagogical agent is available for step by step guidance.
<p>Learning task 1.2 Continuous Horizontal Mattress Suture Pattern with diminishing support in suture pattern</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Continuous Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <ol style="list-style-type: none"> 6. Reverse the order; repositioning your needle to enter the same side you just exited 7. Entrance should be 6-8mm across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate) 8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate) 9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 10. Repeat this pattern until the incision is completely closed always enter on the same side of incision. <ul style="list-style-type: none"> • Pedagogical agent is available for step- by- step guidance. • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • Suture material provided by glowing presence • Suture pattern is not complete – shown with dotted lines periodically throughout the wound • Spacing is completely visible • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if

	<p>they get off the traced pattern. Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice.</p> <ul style="list-style-type: none"> • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button. • Step by step procedural information is available by Pedagogical agent upon request (talking head).
<p>Learning task 1.3 Continuous Horizontal Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>Procedural Steps 6-10 of the Continuous Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <ol style="list-style-type: none"> 6. Reverse the order; repositioning your needle to enter the same side you just exited 7. Entrance should be 6-8mm across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate) 8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate) 9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 10. Repeat this pattern until the incision is completely closed always enter on the same side of incision.
<p>Learning task 1.4 Continuous Horizontal Mattress Suture Pattern with</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Continuous Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <ol style="list-style-type: none"> 6. Reverse the order; repositioning your needle to enter the same side you just exited 7. Entrance should be 6-8mm across from the point of

<p>diminishing support in suture pattern and spacing</p>	<p>exit and out through the interior portion of wound while twisting your wrist (supinate)</p> <p>8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate)</p> <p>9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p> <p>10. Repeat this pattern until the incision is completely closed always enter on the same side of incision.</p> <ul style="list-style-type: none"> • Pedagogical agent is available for step- by- step guidance. • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No suture pattern line to follow on one side and a dotted line on the other side of the wound • Spacing eliminated to every third suture • Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. Support information is available with a click of the resource button. • Step by step procedural information is available by Pedagogical agent upon request (talking head).
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<p>Learning task 1.5 Continuous Horizontal Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Continuous Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <ol style="list-style-type: none"> 6. Reverse the order; repositioning your needle to enter the same side you just exited 7. Entrance should be 6-8mm across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate) 8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate) 9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 10. Repeat this pattern until the incision is completely closed always enter on the same side of incision. <ul style="list-style-type: none"> • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No lines on either side – spacing provided every fourth one - immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern. • Just in time information will give learners audio beeps when they are off of pattern Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed
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	<p>pattern. The Haptic Color bar will change colors when different forces are applied.</p> <ul style="list-style-type: none"> • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. • Support information is available with a click of the resource button.
<p>Learning task 1.6 Continuous Horizontal Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<p>Part-task practice is available before the next task practice for Procedural Steps 6-10 of the Continuous Horizontal Mattress suture pattern on the Rescue Critter with special focus on:</p> <ol style="list-style-type: none"> 6. Reverse the order; repositioning your needle to enter the same side you just exited 7. Entrance should be 6-8mm across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate) 8. Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue 6-8mm across from the initial entrance site, while twisting your wrist (supinate) 9. Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides 10. Repeat this pattern until the incision is completely closed always enter on the same side of incision. <ul style="list-style-type: none"> • Tool selection is required from the full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not pull over.) • No lines or spacing. Immediate feedback with audio beeps if the learner gets out of the pattern or spacing too far. Upon completion lets learner know how they did when the visual colored line is revealed with the completed pattern. • Just in time information will give learner audio beeps when they are off of pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first

	<p>learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied.</p> <ul style="list-style-type: none"> • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. • Support information is available with a click of the resource button.
<p>Learning task 1.7 Continuous Horizontal Mattress Suture Pattern with diminishing support in suture pattern and spacing</p>	<ul style="list-style-type: none"> • Tool selection is required from a full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not stay over.) • No lines or spacing. Upon completion learner will know how they did when the visual colored line is revealed with the completed pattern. • Just in time information will give learner audio beeps when they are off of pattern. • Learners will suture with the haptic force feedback device by following the pattern as it is laid out on the patient – they will follow the procedural information given to them during their first practice. • Tips and guidance will sound throughout the first learning task. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line will disappear if they get off the placed pattern. The Haptic Color bar will change colors when different forces are applied. • Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect suture tension. An auditory beep will sound if depth penetration of dermas is too deep. • Support information is available with a click of the resource button.

<p>Learning task 1.8 Continuous Horizontal Mattress Suture Pattern with no support</p>	<ul style="list-style-type: none"> • Tool selection is required from the full tray of surgical instruments. (Learner will click and drag the correct tool and given suture material into the environment – incorrect tools will not pull over.) • No lines or spacing or audio cueing. Learners get one opportunity to do the suture pattern correctly. <p>The last task will have all supportive and just-in-time information locked out from use. No part-task practice will be permitted, and the pedagogical agent will be unavailable. Upon completion the colored visual line will appear to give the student immediate feedback on the skill. Students will take a screen shot of the final screen to submit to the instructor. The last screen of the task will also reveal the computer assessment (as described in the preliminary content) in a numerical assessment percentage in each requirement. Follow-up will be done with the instructor in VET213L, where one-on-one practice can be provided to each individual student. Successful completion of the final task will require 80% accuracy. They do not have to follow the scope and sequence after successful completion. They may continue to practice an unlimited amount of times with Learning task 1.8 with visual feedback to check their proficiency with the pattern or return to any other practice within the task class. Learners may now practice on any tasks within the IVSS Novice Level with any of the feedback options.</p>
<p>Final Exam</p>	

SUPPORTIVE INFORMATION

- Multimedia presentation on Continuous Horizontal Mattress suture pattern
- Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc.
- Professional video library –Rodent ovariohysterectomy with Continuous Horizontal Mattress suture pattern
- Video segment of Continuous Horizontal Mattress suture pattern on rescue critter with step-by-step procedural information

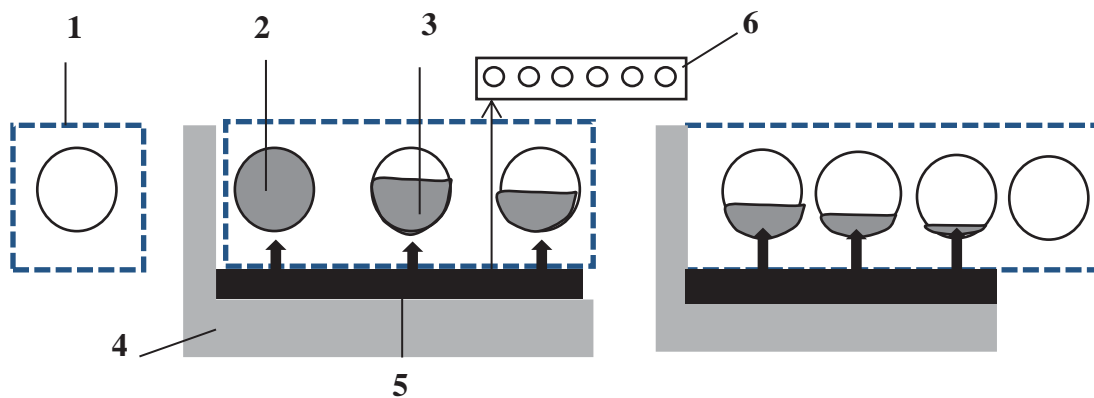
- Video on the square knot with step-by-step procedural information
- Specialized practice video on Procedural steps 6-10 on Continuous Horizontal Mattress suture pattern on Rescue Critter
- Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press.
- Handout on suture materials

JUST IN TIME INFORMATION

- Audio beeps if the learner gets out of the suture pattern lines or spacing becomes incorrect
- Visual colored line appear to the correctness of the pattern
- Pedagogical agent appears to help the learner upon request
- The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermas is too deep.
- Rescue critter video with step by step instructions on Continuous Horizontal Mattress suture pattern
- Step by Step procedure video on the square knot

Part-Task PRACTICE

- Specialized practice on the square knot if desired
- Specialized practice on Procedural steps 6-10 on Continuous Horizontal Mattress suture pattern



1. Task Class: Continuous Horizontal Mattress Suture Pattern
2. Learning Task: Continuous Horizontal Mattress Suture on a rodent ovariohysterectomy (fully supported)
3. Degree of Support: Pedagogical agent on request/broken line on pattern/spacing full support/Tools selected from a short tray
4. Supportive Information: PowerPoint slides on Continuous Horizontal Mattress suture pattern, Class Textbook: Tear, M (2012). *Small animal surgical nursing skills and concepts*. 2nd ed. St. Louis, MO. Mosby, Inc., Professional video library –rodent ovariohysterectomy mattress suture pattern, Video segment of Continuous Horizontal Mattress suture pattern on rescue critter with step-by-step procedural information, Video on the square knot with step-by-step procedural information, Marshall, G. & Peter, K. (2011). *Companion-animal dental and surgical instruments a reference for veterinary technicians and assistants*. Lakewood, Co. American Animal Hospital Association Press., Handout on suture materials
5. Just-In-Time Information: The Haptic Color bar will change colors when different forces are applied. Too little tension will show yellow and too much tension will show red. Maintaining a green color will indicate perfect haptic

tension. If there is too much tension during the throw, the suture material will break, and the student will have to start the task over. If too little tension is applied, the task will terminate and the student will have to start the task over. An auditory beep will sound if depth penetration of dermas are too deep. Just in time information will give learner audio beeps when they are off of pattern and a visual colored line if they get off the traced pattern. Support information is available with a click of the resource button. Step by step procedural information available by Pedagogical agent upon request (talking head)

6. Part-task practice: Square knot practice and Procedural Steps 6-10 of the Continuous Horizontal Mattress suture pattern

Figure C8. 4C/ID-model for Continuous Horizontal Mattress Suture Pattern.

Adapted from van Merriënboer, J.J.G. (1997). *Training complex cognitive skills*.

Englewood Cliffs, NJ: Educational Technology Publications, Inc.

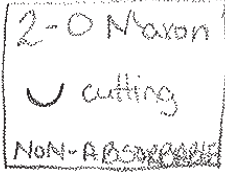
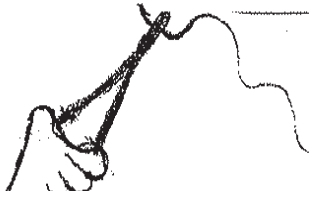





Appendix D

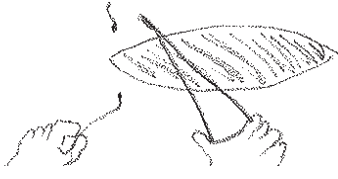



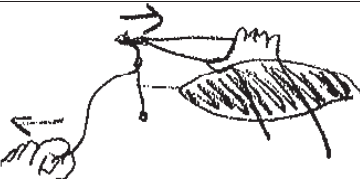

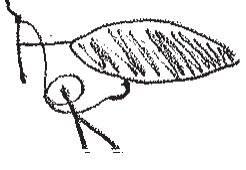
Instructional Module Storyboards and Scripts




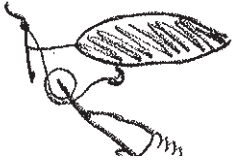



Canine Castration




- Jake, a six month old Labrador retriever weighing 45 lbs is in the animal clinic for a routine castration.
- All pre-anesthetic blood work has been completed and reviewed.
- He has been fasted for 12 hours and ready for his pre meds.
- Jake is brought into the surgery prep area. He receives 0.20 ml of Butorphanol and 0.57 ml of Dexmedetomidine as a cocktail.
- This cocktail is given in the right SM/ST, IM.
- After the sedatives are given you prep the right forelimb for IV catheter placement
- You place the IV catheter in the right cephalic vein.
- Once the IV catheter is secure you administer Propofol, IV until Jake loses all jaw tone. You should not need more than 5.32 ml.
- Once all jaw tone is lost you intubate your patient and connect him to the anesthesia machine where he is given Isoflurane and Oxygen to maintain his depth of anesthesia.
- Jake is now ready to be prepped for surgery.
- He is placed in dorsal recumbancy and an area from the scrotum to mid abdomen is shaved with a #40 clipper blade.
- Once shaved and hair is removed via vacuum and the surgical scrub is performed involving three rotations of Chlorohexidine scrub and Isopropyl alcohol.
- Once prepped, Jake is transferred into the surgery room.
- All personal in the surgery room are wearing caps, masks, and booties. The surgical assistant and surgeon are aseptically gowned and gloved after they scrub in using Chlorohexidine.
- He is placed in dorsal recumbency on the surgery table with all limbs secured
- All monitoring equipment is connected and working properly.
- A sterile scrub is completed with Chlorohexidine scrub and Isopropyl alcohol and a final prep of Betadine is applied and left on the area.
- The surgical site is draped aseptically using the four corner towel technique
- Now we are ready to begin the surgery.

- During the surgical procedure you assist with passing instruments, gauze, and suture material.
- The veterinarian insists that you to complete the skin closure using a non-absorbable 2-O Maxon suture material with a conventional cutting needle and a simple interrupted suture pattern.
- Once incision is completed, Jake is taken off Isoflurane and given pure oxygen for 5 minutes'.
- After 5 minutes all monitoring equipment is removed and he is taken to recovery.
- Once fully awake Jake's owners come to pick him up.
- He will need to return in 7-10 days for suture removal.
- Jake will need to stay confined with restricted activity for 7-10 days with no running or jumping.

<p>Choose the appropriate size suture, type of material, and needle</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on the healthy side farthest from you and out through the interior portion of wound while twisting your wrist (suprinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue nearest to you while twisting your wrist (suprinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	

<p>Hold needle holders in dominant hand and suture between index finger and thumb of opposite hand</p>	
<p>Keep the length of the free suture end less than two inches</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	

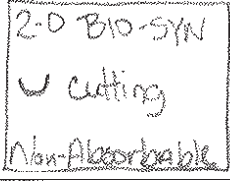
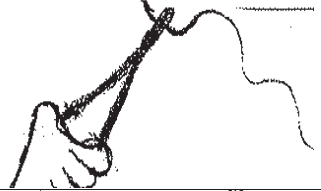
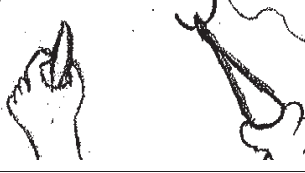

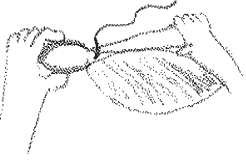



<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions causing tension</p>	
<p>Once knot is complete and secure, run the suture material within the slightly opened jaws of the General Surgical Scissors down to the knot, making sure that tips of the scissors are always visible to prevent cutting tissue</p>	






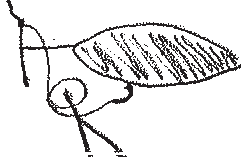

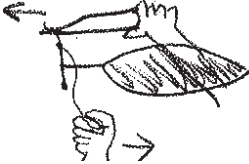
<p>Cut knot one fourth to one eighth of an inch from knot</p>	
<p>Continue all steps until wound is completely closed</p>	
<p>Distance between each suture should be equal to the bite distance from needle insertion into healthy tissue to incision/wound edge</p>	


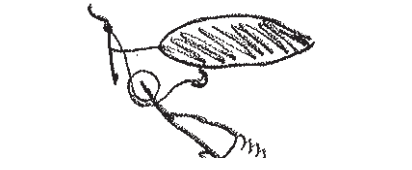





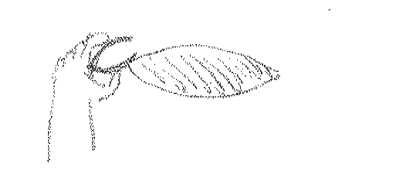
Swine Laceration

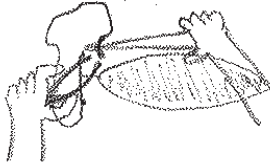
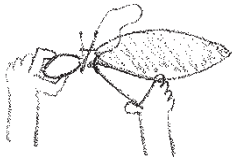

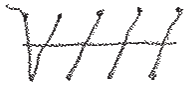
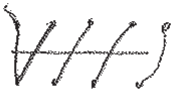


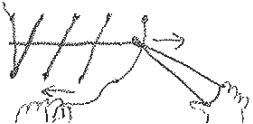
- It is the beginning of the workday.
- The animal care staff has started off their day by feeding all of the Sinclair Minipigs their morning feed.
- Since these animals are gregarious, they are housed in pairs.
- The animal care staff has to be mindful and watch the animals as they eat, so as to make sure that each animal gets fed the appropriate amount of food.
- In the past, these particular minipigs have been aggressive towards one another during their twice a day feedings and snack times.
- Unfortunately today is one of those days...
- One of the minipigs has attacked his cage mate over an apple slice and now the injured animal has a wound on his right lateral abdomen.
- Upon evaluation, the wound only involves the dermis and epidermis so no internal organs have been hit.
- Hemostasis has occurred, but the wound will need to be clipped, cleaned/flushed and sutured.
- You contact the Veterinarian in charge of these animals to report the issue and gain approval for treatment.
- Your premeds include a cocktail of Ketamine 10mg/kg and Midazolam 0.4 mg/kg IM.
- After the premeds have taken effect, tracheal intubation is preformed and the animal is maintained on inhaled Isoflurane/oxygen throughout the entire process.
- The animal is placed in left lateral recumbancy.
- You shave the hair around the wound using a #40 blade.
- You add topical Lidocaine so the surface tissues are numb.
- Once the area has been shaved, you clean the surface of the wound with three rotations of Isopropyl alcohol and Chlorhexidine scrub.
- A Nolvasan dilution is flushed through the dermis and epidermis to clean the internal areas.
- A non-fenestrated drape is placed over the area.
- The animal is now ready for the debridement of the dermis, and the suture to be placed.
- You debride the wound with a #20 scalpel blade and #4 Bard Parker Scalpel Handle. Debriding the wound edges promote tissue growth.

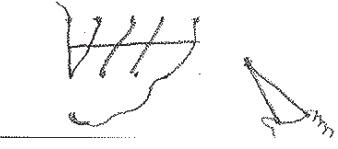

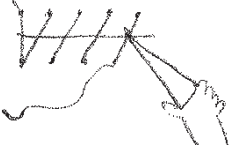
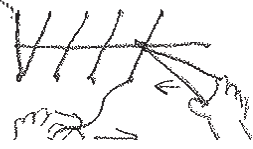
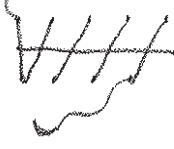
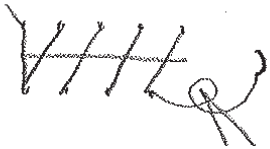
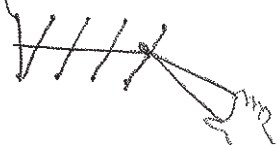
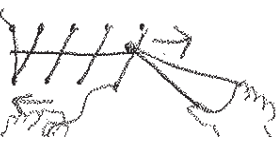
- You will complete the skin closure by using a simple continuous suture pattern with 2-0 synthetic, non-absorbable monofilament and a conventional cutting needle.
- The area will need to be kept bandaged to avoid the introduction of any pathogens.
- Suture will have to be removed in, approximately, 10-14 days.



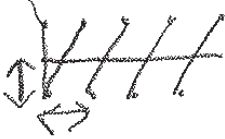
<p>Choose the appropriate size suture, type of material, and needle</p>	
<p>Grasp the needle one-third to one-half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on the healthy side farthest from you and out through the interior portion of wound while twisting your wrist (supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue nearest to you while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Hold needle holders in dominant hand and suture between index finger and thumb of opposite hand</p>	

<p>Keep the length of the free suture end less than two inches</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions causing tension</p>	

<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions causing tension</p>	
<p>Do not cut the suture at this point.</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	

<p>Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Repeat this pattern until the incision is completely closed always enter on the same side of incision.</p>	
<p>When incision is completely closed, take one more throw, leaving a loop in your suture. Do not pull tension.</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	

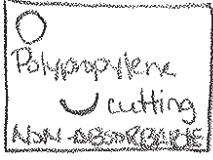
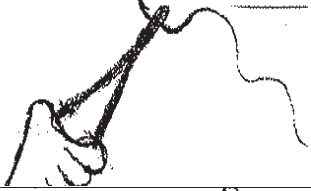
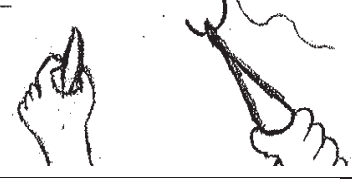





<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	










<p>Once knot is complete and secure, run the suture material within the slightly opened jaws of the General Surgical Scissors down to the knot, making sure that tips of the scissors are always visible to prevent cutting tissue</p>	
<p>Cut knot one fourth to one eighth of an inch from knot</p>	
<p>Distance between each suture should be equal to the bite distance from needle insertion into healthy tissue to incision/wound edge</p>	

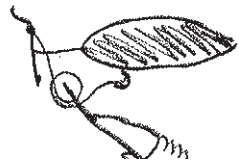




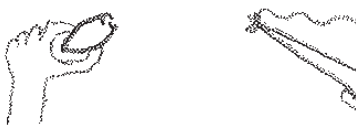


Equine Caslick


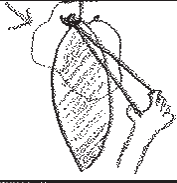

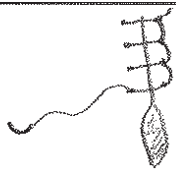

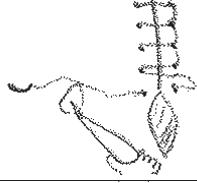
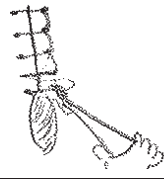
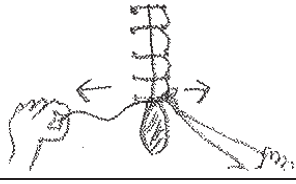
- Scarlett, a seven year old, 1000lb, female quarter horse, recently foaled and has developed a pneumovagina.
- Pneumovagina post foaling is caused by scar tissue formation, excessive stretching of tissue, and/or poor body condition.
- Scarlett has a body condition score of five and is in optimal health post foaling.
- Without treatment a pneumovagina can lead to chronic infection of the vagina and uterus and infertility.
- Today we will be performing the Caslick procedure to form a seal and prevent aspiration of air and fecal material into the vaginal region.
- Scarlett is placed in the stocks to prevent injury to both the mare and the veterinary staff.
- Pre-anesthetic bloodwork is completed and review prior to sedation.
- Scarlett is given a cocktail of Xylazine 1.1mg/kg and Butorphanol 0.02mg/kg for sedation IV.
- Scarlett's tail is wrapped and the area of interest is cleaned with three or more (dependent on the cleanliness of the horse) rotations of Nolvasan and warm water.
- Because we are aware that even though Scarlett is sedated she can still use her rear limbs to kick, we will complete a local block of the labial margins using Lidocaine.
- We will complete the last rotation of Nolvasan and warm water and finish with a Betadine spray that will be left in place.
- After the Lidocaine block is effective the vet begins the caslicks procedure.
- A four to eight millimeter strip of mucosa along the mucocutaneous junction is removed using our metzenbaum scissors on each labium and including the dorsal aspect of the vulva.
- He removes enough of the mucosa to create a vaginal seal.
- We simply want to remove and repair enough tissue to create a seal.
- The ventral aspect of the vulva should be left as is.
- As the veterinary technician it is your responsibility to make the closure using O non-absorbable, polypropylene suture with a reverse cutting needle.
- You will use a Ford Interlocking pattern to suture the site and create a seal.
- After the procedure is completed Scarlett is placed in a stall until she gains her balance and can be loaded on the trailer.

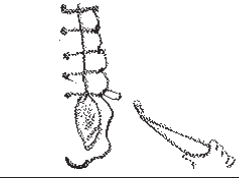
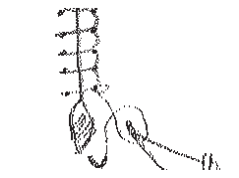
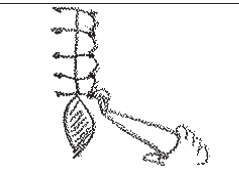
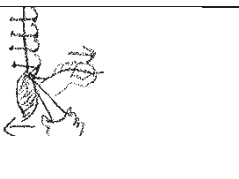
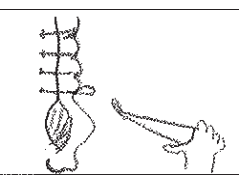
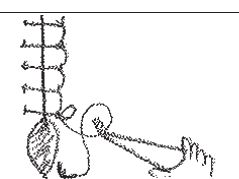
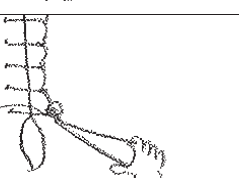
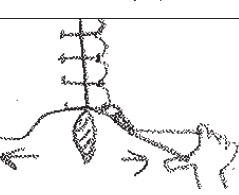
- Once loaded her owner can safely take her home.
- Scarlett will return to the clinic in 10-12 days for stitch removal and re-evaluation of site.




<p>Choose the appropriate size suture, type of material, and needle</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on one healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Hold needle holders in dominant hand and suture between index finger and thumb of opposite hand</p>	

<p>Keep the length of the free suture end less than two inches</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
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<p>Release the short end from the needle holders</p>	

<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	
<p>Do not cut the suture at this point.</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate))</p>	

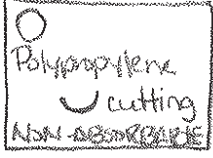
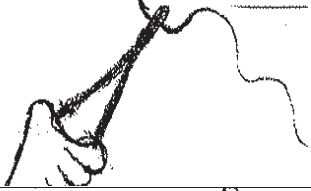
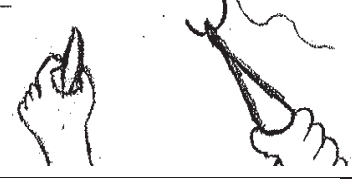





<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Repeat this pattern until the incision is completely closed always enter on the same side of incision.</p>	
<p>When incision is completely closed, take one more throw, leaving a loop in your suture. Do not pull tension.</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	










<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
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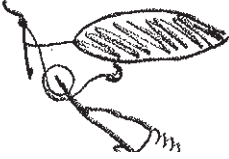


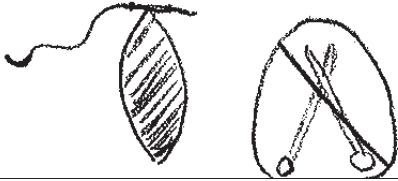



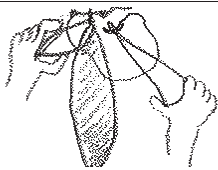
<p>Once knot is complete and secure, run the suture material within the slightly opened jaws of the General Surgical Scissors down to the knot, making sure that tips of the scissors are always visible to prevent cutting tissue</p>	
<p>Cut knot one fourth to one eighth of an inch from knot</p>	
<p>Distance between each suture should be equal to the bite distance from needle insertion into healthy tissue to incision/wound edge</p>	


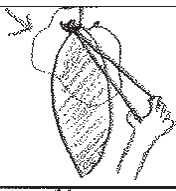

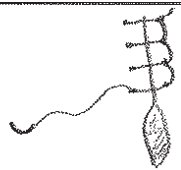

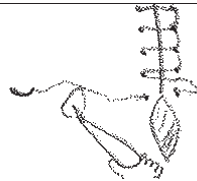
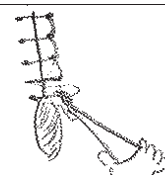
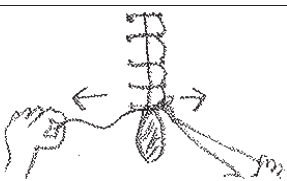
Bovine C-Section

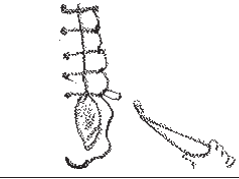
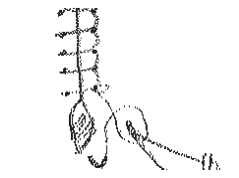
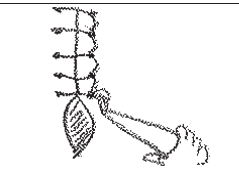
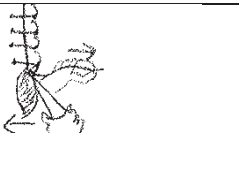
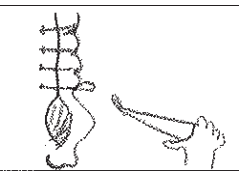
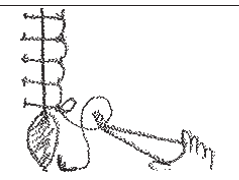
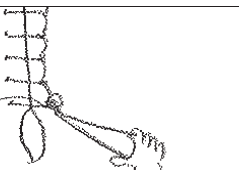
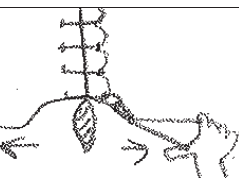
- A client calls the veterinary clinic because one of his heifers is having trouble calving.
- Once the veterinarian finishes an exam on a dog he and the vet tech head out to the clients farm to examine the heifer.
- Upon arrival the veterinarian vaginally palpates the heifer and determines that a C-section will need to be performed in order to save the heifer and the calf.
- The vet tech plugs in the clippers and starts shaving the side of the abdomen.
- Once a large rectangle is shaved Amy cleans the area with three rotations of Nolvasan and Isopropyl alcohol.
- Once cleaned, Iodine is applied to the area.
- After the heifer is prepped the vet tech completes a local Lidocaine block of the area and the surgery begins.
- During the surgery the vet tech assists in passing instruments to the veterinarian.
- The veterinarian removes the calf successfully and the owner tends to it while the veterinarian and the vet tech finish working on the heifer.
- After closure of all abdominal structures the vet tech is instructed to complete the skin closure.
- The vet tech will complete the skin closure by using a ford interlocking suture pattern and non-absorbable 4 Monocryl with a reverse cutting needle
- The client is instructed to keep the heifer and calf in the barn for the next 10-14 days.
- The veterinarian and vet tech will revisit the farm in 10-14 days to re-evaluate the heifer and calf and remove all sutures.




<p>Choose the appropriate size suture, type of material, and needle</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on one healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Hold needle holders in dominant hand and suture between index finger and thumb of opposite hand</p>	

<p>Keep the length of the free suture end less than two inches</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
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<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	
<p>Do not cut the suture at this point.</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate))</p>	

<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>As your needle exits the tissue it should be directed through the loop of your suture material and pulled snug</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Repeat this pattern until the incision is completely closed always enter on the same side of incision.</p>	
<p>When incision is completely closed, take one more throw, leaving a loop in your suture. Do not pull tension.</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	

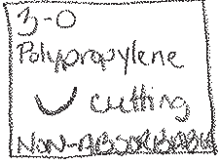
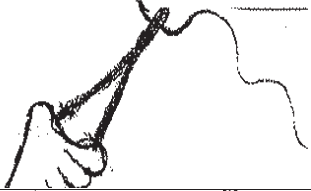


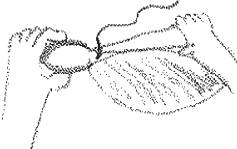



<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	



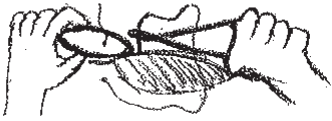

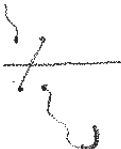


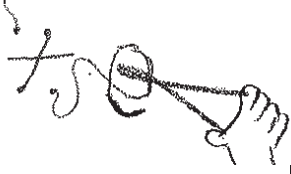
<p>Once knot is complete and secure, run the suture material within the slightly opened jaws of the General Surgical Scissors down to the knot, making sure that tips of the scissors are always visible to prevent cutting tissue</p>	
<p>Cut knot one fourth to one eighth of an inch from knot</p>	
<p>Distance between each suture should be equal to the bite distance from needle insertion into healthy tissue to incision/wound edge</p>	



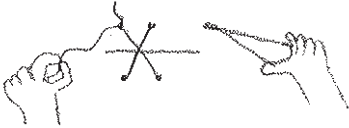
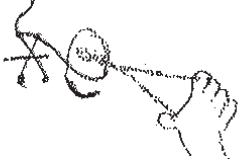


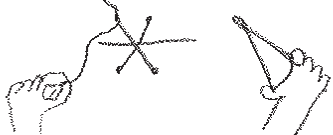
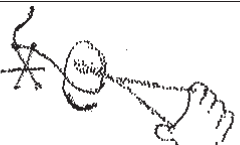
Feline Cystotomy

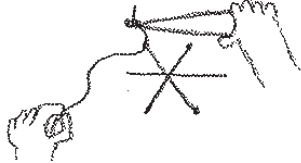





- Tabby is a 10 year old female domestic shorthaired feline.
- Owner is complaining of blood in urine, painful urination, difficulty urinating.
- Upon examination, Tabby is extremely tender in her abdomen region.
- Radiographs and urinalysis is ordered by the vet.
- Urinalysis results are completed and reviewed.
- Radiographic findings determined a large amount of calculi in the bladder.
- Tabby is hospitalized and added to the surgery schedule for the following day.
- Pre-anesthetic bloodwork was completed and reviewed.
- Tabby was fasted twelve hours prior to surgery.
- It is now Tabby's turn for surgery.
- She is given Butorphanol 0.225 mg/kg and Dexmedetomidine 250mcg/m² IM.
- Once Tabby is sedated her throat is swabbed with Lidocaine for numbing purposes.
- Endotracheal tube is passed and proper placement is determined.
- Tabby is placed on Isoflurane to maintain anesthesia.
- She is then placed in dorsal recumbency and shaved with a #40 clipper blade from the costal arch to pubis.
- Once shaved and hair is removed via vacuum, the surgical scrub is performed with three rotations of Chlorohexidine scrub and Isopropyl alcohol.
- Once prepped, Tabby is transferred into the surgery room.
- All personal in the surgery room are wearing caps, masks, and booties. The surgical assistant and surgeon are aseptically gowned and gloved after they scrub in using Chlorohexidine.
- He is placed in dorsal recumbency on the surgery table with all limbs secured
- All monitoring equipment is connected and working properly.
- A sterile scrub is completed with Chlorohexidine scrub and alcohol and a final prep of Betadine is applied and left on the area.
- The bladder is emptied by means of cystocentesis using a 22 gauge needle
- The surgical site is draped aseptically using the four corner towel technique
- Now we are ready to begin the surgery.
- After the abdominal closure is completed the veterinarian asked you to complete the skin closure by using 3-O polypropylene, a cruciate pattern, and conventional cutting needle.
- Tabby is hospitalized overnight to ensure proper urination occurs.

- Calculi are sent to lab for further diagnostic testing and determine what diet Tabby should be on.
- Tabby will return to the clinic in 10 days for removal of all external sutures.

<p>Choose the appropriate size suture, type of material, and needle</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on one healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	

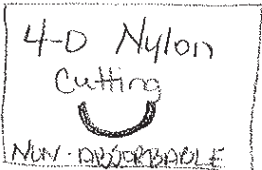
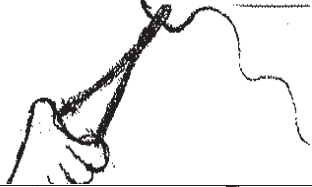






<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on the same side that was previously, first entered. (Healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate))</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Hold needle holders in dominant hand and suture between index finger and thumb of opposite hand</p>	
<p>Keep the length of the free suture end less than two inches</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	


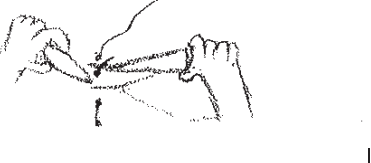



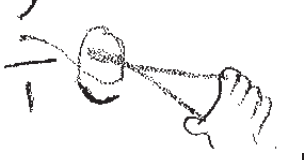


<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	

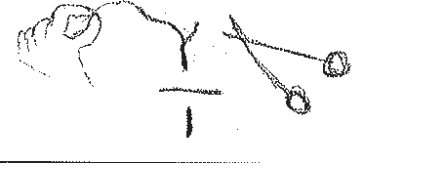


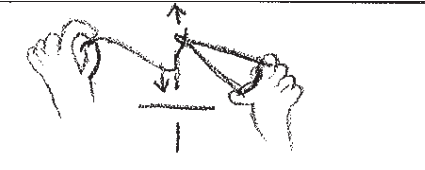
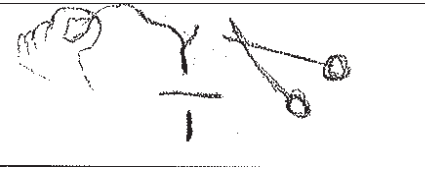
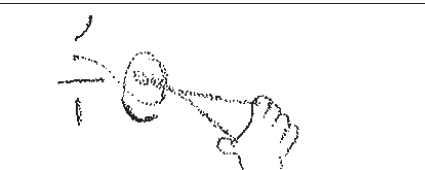

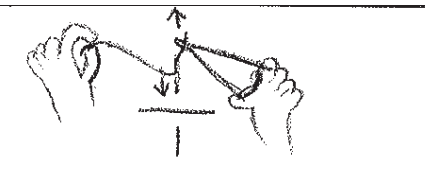
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	
<p>Once knot is complete and secure, run the suture material within the slightly opened jaws of the General Surgical Scissors down to the knot, making sure that tips of the scissors are always visible to prevent cutting tissue</p>	
<p>Cut knot one fourth to one eighth of an inch from knot</p>	
<p>Repeat this pattern until the incision is completely closed always enter on the same side of incision.</p>	
<p>Distance between each suture should be equal to the bite distance from needle insertion into healthy tissue to incision/wound edge</p>	




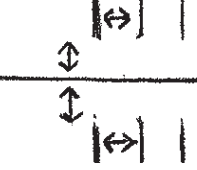
Avian Lipoma Removal

- Charlie, 10 year old Amazon Parrot who is presented with a lipoma on the sternum region.
- Lipomas in avian species involve the subcutaneous tissue around the sternum and caudal abdomen.
- Lipomas are generally well encapsulated and highly vascular.
- Pre-anesthetic bloodwork is reviewed prior to sedation.
- Charlie is anesthetized by masking with Isoflurane and oxygen.
- Any feathers that impact the incision site are plucked and removed.
- The affected area is scrubbed with three rotations of Chlorohexidine and Isopropyl alcohol.
- Once prepped, Charlie is transferred into the surgery room.
- All personal in the surgery room are wearing caps, masks, and booties. The surgical assistant and surgeon are aseptically gowned and gloved after they scrub in using Chlorohexidine.
- He is placed in dorsal recumbency on the surgery table with all limbs secured.
- In the surgery room, a sterile scrub is completed with Chlorohexidine scrub and Isopropyl alcohol and a final prep of Betadine is applied and left on the area.
- The surgical site is draped aseptically using a non-fenestrated drape.
- Now we are ready to begin the surgery.
- Once the veterinarian has removed the tumor and completed all subcuticular closures he asks you to complete the skin closure using 4-0 Nylon, conventional cutting needle and a vertical mattress pattern.
- The Isoflurane is turned off and fresh oxygen is supplied until he regains a blink reflex
- After Charlie has recovered he stays in the clinic until the afternoon and his owner is called to pick him up.
- Charlie will need to return in 7-10 days to have his stitches removed.

<p>Choose the appropriate size suture, type of material, and needle and open</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on the healthy side farthest from you and out through the interior portion of wound while twisting your wrist (supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue nearest to you while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Reverse the order; repositioning your needle to enter the same side you just exited</p>	

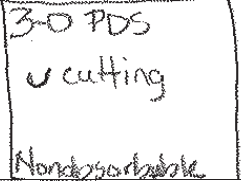
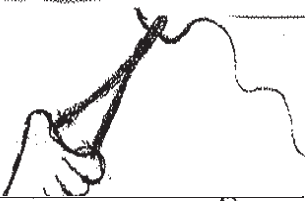
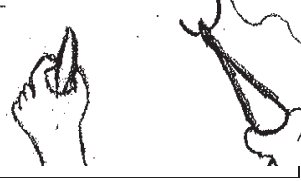




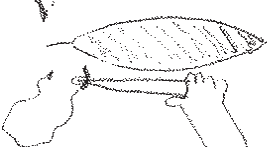
<p>Enter through the skin edge and out through the interior portion of wound while twisting your wrist (supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Hold needle holders in dominant hand and suture between index finger and thumb of opposite hand</p>	
<p>Keep the length of the free suture end less than two inches</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	



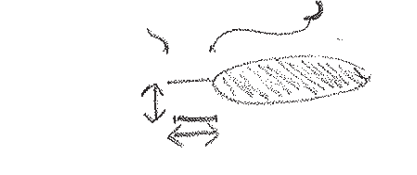

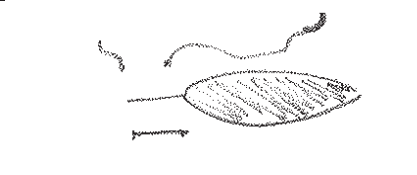
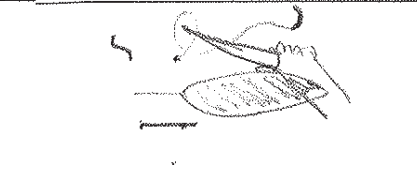

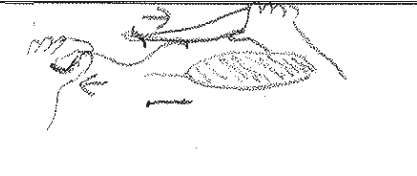
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	

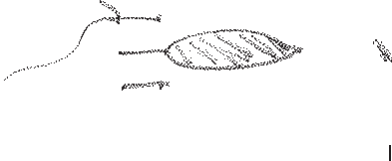



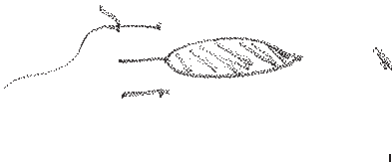



<p>Once knot is complete and secure, run the suture material within the slightly opened jaws of the General Surgical Scissors down to the knot, making sure that tips of the scissors are always visible to prevent cutting tissue</p>	
<p>Cut knot one fourth to one eighth of an inch from knot</p>	
<p>Continue all steps until wound is completely closed</p>	
<p>Distance between each suture should be equal to the bite distance from needle insertion into healthy tissue to incision/wound edge</p>	



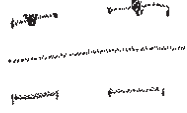
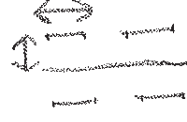
Rabbit Ovariohysterectomy

- Daisy, eight month old female Flemish giant, weighing in at 13lbs, is scheduled for a routine spay today.
- Pre-anesthetic bloodwork is reviewed prior to sedation.
- Daisy is anesthetized using Xylazine 5mg/kg and Ketamine 35mg/kg IM.
- Once the sedatives have been given and Daisy drifts off, you will intubate and hook the patient up to Isoflurane to maintain anesthesia.
- Place the rabbit in dorsal recumbency.
- Before prepping the patient for surgery you must empty out the contents of the bladder by manual manipulation.
- Shave the abdominal area from the diaphragmatic arch to the pubis and remove all hair using a #40 clipper blade.
- Daisy is prepped with three rotations of Chlorohexidine and Isopropyl alcohol
- Once prepped, Daisy is transferred into the surgery room.
- All personal in the surgery room are wearing caps, masks, and booties.
- The surgical assistant and surgeon are aseptically gowned and gloved after they scrub in using Chlorohexidine.
- She is placed in dorsal recumbency on the surgery table with all limbs secured.
- In the surgery room, a sterile scrub is completed with Chlorohexidine scrub and Isopropyl alcohol and a final prep of Betadine is applied and left on the area.
- All monitoring equipment is connected and working properly.
- The surgical site is draped aseptically using the four corner towel technique
- Now we are ready to begin the surgery.
- After the abdominal wall is closed the veterinarian asked you to complete the skin closure by using 3-O PDS, a horizontal mattress pattern, and conventional cutting needle.
- Once completed, the Isoflurane is turned off and fresh oxygen is supplied until she re-gains a blink reflex.
- Daisy is returned in 7-10 days for suture removal.
- Close monitoring during this time is important to prevent chewing of skin closure.

<p>Choose the appropriate size suture, type of material, and needle</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on one healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Reverse the order; repositioning your needle to enter the same side you just exited</p>	

<p>Enter across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Hold needle holders in dominant hand and suture between index finger and thumb of opposite hand</p>	
<p>Keep the length of the free suture end less than two inches</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	

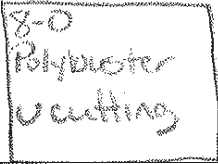
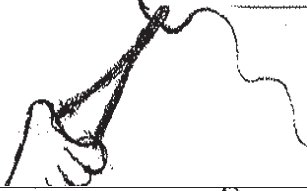






<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	




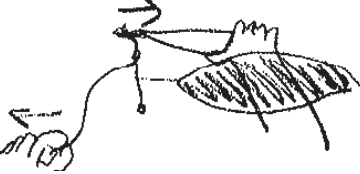

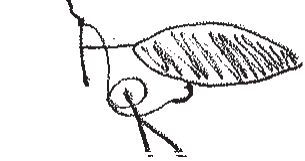


<p>Once knot is complete and secure, run the suture material within the slightly opened jaws of the General Surgical Scissors down to the knot, making sure that tips of the scissors are always visible to prevent cutting tissue</p>	
<p>Cut knot one fourth to one eighth of an inch from knot</p>	
<p>Continue all steps until wound is completely closed</p>	
<p>Distance between each suture should be equal to the bite distance from needle insertion into healthy tissue to incision/wound edge</p>	


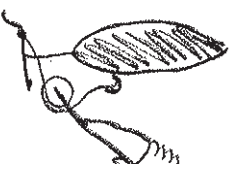
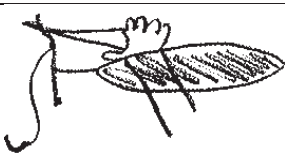

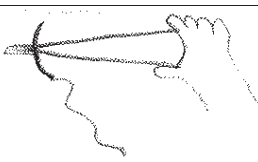
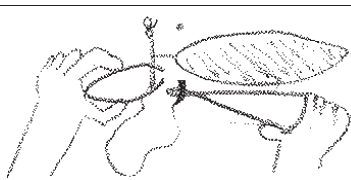
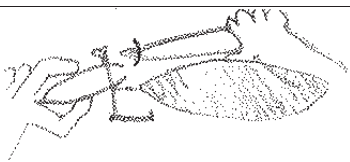
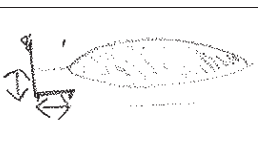
Mouse Ovariohystorectomy

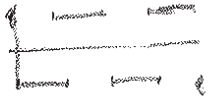
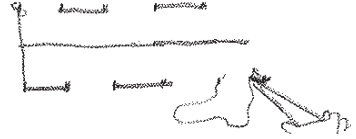
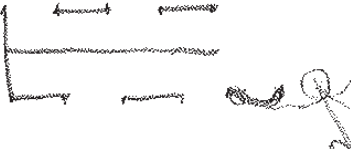
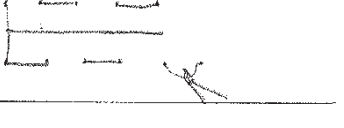

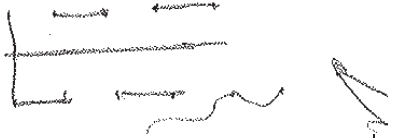

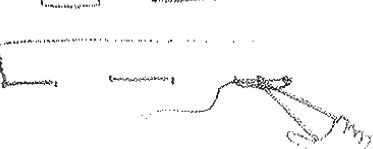
- The College of Dermatology has just named a new Dean. He is set to arrive with his entire research department, including 500 mice.
- Upon arrival we will spay all female mice.
- Each mouse is placed, individually in an induction chamber that is quickly filled with a mixture of Isoflurane and Oxygen for induction.
- After the animal has been anesthetized she is removed and placed in dorsal recumbency.
- Her nose is placed the anesthesia machine's nose cone with a mixture of Isoflurane and Oxygen for maintenance.
- The abdominal area is shaved from the costal arch to the pubis with a #40 blade.
- The area is then aseptically prepared by swabbing with a surgical scrub of Chlorhexidine and Isopropyl alcohol using three rotations.
- The Veterinary Technician is properly prepped to perform the surgery
- Since this is rodent surgery, the procedure does not need to be performed in a surgical operating room, but rather in an aseptic way on a dedicated rodent surgical table top.
- The veterinarian begins the surgical procedure as you assist in passing instruments, gauze, and suture material
- A 2-3 cm midline incision is made through the skin and muscle from the midpoint of the abdomen to a point anterior of the urethral opening exposing the peritoneal cavity using a #15 blade and #3 Bard Parker scalpel handle.
- The uterine horns and ovaries are located and freed from surrounding tissue.
- A single ligature is placed around the cervix using, 10-O absorbable, Monofilament, Polydioxanone (PDS) suture.
- Two throws are placed, each closed with a square knot.
- The cervix is cut anterior to the ligature and the uterine horns and ovaries are removed.
- The muscle wall of the abdomen is closed with 10-O absorbable, Monofilament, Polydioxanone (PDS) suture, with a tapered needle, in a continuous horizontal mattress pattern to allow the tissues to line up and promote healing.
- The veterinarian instructs you to complete the skin closure using a continuous horizontal, 8-O Polybuster, and a conventional needle

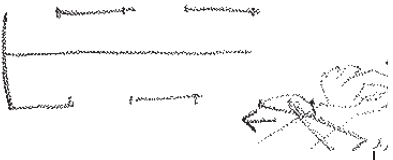
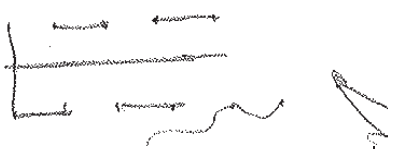

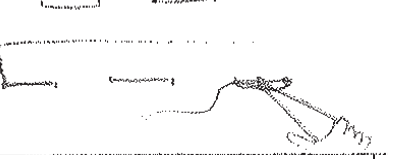
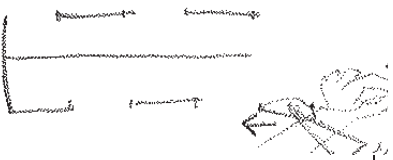


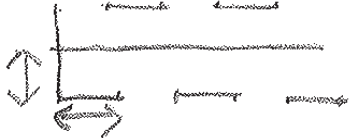
- The animal is then placed into a recovery cage on a heated water blanket until completely recovered from anesthesia
- The animals are returned to their respected rack placement when all surgical patients are able to exhibit normal ambulation.
- The staples are moved in 7-10 days post-surgery.

<p>Choose the appropriate size suture, type of material, and needle</p>	
<p>Grasp the needle one third to one half the distance from the swaged end to the point with the Mayo Hegar or Olsen Hegar Needle Holders (personal preference) in your dominant hand</p>	
<p>Hold the Adson Brown or Adson Tissue Forceps in opposite hand</p>	
<p>Hold the skin edges with the tissue forceps</p>	
<p>Advance the needle through the skin on one healthy side of the wound and out through the interior portion of wound while twisting your wrist (supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	
<p>Hold needle holders in dominant hand and suture between index finger and thumb of opposite hand</p>	

<p>Keep the length of the free suture end less than two inches</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	

<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the free suture end within the jaws of the needle holders</p>	
<p>Pull each suture end, both short and fixed ends, in opposite directions, causing tension</p>	
<p>Reverse the order; repositioning your needle to enter the same side you just exited</p>	
<p>Enter across from the point of exit and out through the interior portion of wound while twisting your wrist (supinate)</p>	
<p>Reposition your thumb forceps over the second skin edge as you advance the needle through the interior portion of the wound and out through the healthy tissue while twisting your wrist (supinate)</p>	
<p>Make sure that the distance and depth of the passage the needle is traveling from healthy tissue to interior wound is equal on both sides</p>	

<p>Repeat this pattern until the incision is completely closed always enter on the same side of incision.</p>	
<p>When incision is completely closed, take one more throw, leaving a loop in your suture. Do not pull tension.</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	

<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	
<p>Release the short end from the needle holders</p>	
<p>Wrap the fixed suture end OVER and around the needle holder jaws</p>	
<p>Clamp the top of the loop within the jaws of the needle holders</p>	
<p>Pull each suture end, both looped and fixed ends, in opposite directions, causing tension</p>	
<p>Once knot is complete and secure, run the suture material within the slightly opened jaws of the General Surgical Scissors down to the knot, making sure that tips of the scissors are always visible to prevent cutting tissue</p>	
<p>Cut knot one fourth to one eighth of an inch from knot</p>	
<p>Distance between each suture should be equal to the bite distance from needle insertion into healthy tissue to incision/wound edge</p>	

Appendix E

Suturing Videos on DVD

Simple Interrupted Suture Pattern

Simple Continuous Suture Pattern

Ford Interlocking Suture Pattern

Cruciate Suture Pattern

Vertical Mattress Suture Pattern

Horizontal Mattress Suture Pattern

Continuous Horizontal Suture Pattern

Appendix F

Delineation of Work

Amy Staton is a veterinary technologist at Morehead State University. She is the main instructor for the MSU VT program. She teaches the two-week suturing module in the surgical nursing section, and from this experience she noted a learning gap with her students and their proficiency at suturing skills. Amy shared this concern and passion to expedite change in a doctoral class that she shared with Chris, the co-creator of the IVSS.

Chris, on the other hand, had a daughter, Summer, who went through the MSU VT program in 2002. She shared the same concerns with her mother about the lack of practice, the ratio of instructor to student, and the unrealistic phantom limbs. So both co-creators of the IVSS were armed with a passion to make changes in the suturing module.

As the content specialist, Amy gathered information and data from her VT students. Amy provided essential amounts of general information about the MSU VT Program along with more in- depth information about VET 213. Her front-end analysis and needs analysis included information pertaining to student surveys, test scores, and current instructional methods and tools used in the curriculum. The main concern of the content specialist was the obvious learning gap that was present within the suturing patterns and techniques lesson. The lack of student practice time, and the

cadavers and unrealistic phantom limbs that are currently being used have been found to be major precursors to this learning gap.

Chris continued the research with an objective, media, and situational analysis. After a computer-based simulation was chosen, the research extended itself into what types of simulations would work best. Literature reviews from both co-creators of IVSS revealed that virtual simulations are successful in medical applications. It was determined that a virtual interactive suturing simulation with a haptic-add on would best suit the objectives the creators were looking for.

When Chris went to England for her summer residency, she went to the University of Bristol, in Bristol, England to meet with noted veterinarian and haptic designer Sarah Baillie, who designed many famous haptic applications being used in the field of veterinary medicine. Dr. Baillie is the creator of the Haptic Cow, Horse, and co-designer of the Core Skills Trainer. She continued to share her expertise and lets us participate in discussions about other simulations on NOVICE. NOVICE is an international collaboration of veterinarians and education specialists dedicated to improving the experiences of students in the field of veterinary medicine. So it was determined that a virtual interactive suturing simulation with a haptic-add on would best suit the objectives the creators were looking for.

As an instructional designer it is essential to ask how instruction can be made better. According to Merrill (2002a) it needs to be effective, efficient and engaging. Chris began researching how people learned and how that would apply to an

instructional design. The search began for an instructional design that focused on real-world applications. Since suturing is a complex learning skill it was essential to find a design that would assist the MSU VT students in learning through the whole-task process. The 4C/ID model became the perfect framework for the IVSS because it concentrates on the whole skill of suturing with emphasis on one specific pattern choice at a time. Students start with full support in the whole task and proceed through tasks with varying degrees of support until it finally diminishes to none.

Together the content specialist and the instructional designer created the necessary framework for the IVSS Novice Level. Amy and Chris created case scenarios for the real-world application of the design. Amy created storyboards and videos to be used in the simulation. Chris created the supportive instructional design details with extensive input from Amy and her daughter, Summer, and together they came up with eight different case scenarios fully supported in 4C/ID.

This project was a successful collaboration between the content specialist and the instructional designer. The project could not exist one without the other. Funding for the project and the procurement of a design developer lies ahead for the completion of the project. The creators of the IVSS plan on seeing this project through to completion. There are two more phases, Intermediate and Proficient, with full implementation in the MSU VT Program slated for 2020.

VITA

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Place of Birth: Youngstown, Ohio

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1975 Bachelor of Science
Morehead State University
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1995 - Present Secondary Educator
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Warsaw Community High School
Warsaw, Indiana

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Body by Boyd, Inc.
Warsaw, Indiana

1993-1997 Secondary Educator
Manchester High School
North Manchester, Indiana

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2011 - 2013	Codie Award Judge
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1992	Teacher of the Year – Lakeview Middle School

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2012 Kentucky Women in Agriculture Scholarship
 Kentucky Women in Agriculture

PUBLICATIONS

Peterson, K.M., Staton , A.J., & Hayne, M. (2009). Ventilation and the anesthetic patient. *National Association of Veterinary Technicians in America Journal*, 42-49.