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EXAMINING THE IMPACT OF A VIDEO REVIEW GUIDE ON ROBOTIC SURGICAL SKILL IMPROVEMENT

by

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A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Education
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in the College of Community Innovation and Education
at the University of Central Florida
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ABSTRACT

Surgical education has the arduous task of providing effective and efficient methods of surgical skill acquisition and clinical judgment while staying abreast with the latest surgical technologies within an ever-changing field. Robotic surgery is one such technology. Many surgeons in practice today were either never taught or were not effectively taught robotic surgery during training, leaving them to navigate the robotic learning curve and reach mastery independently. This dissertation examines the impact of a video review guide on improving robotic surgical skills. Using Kolb's Experiential Learning Theory as a framework, the literature review argues that video review can be used as a catalyst for reflection, which can deepen learning and improve self-assessment. Reflection, however, is not an innate skill but must be explicitly taught or guided. The researcher argues that a written video review guide can help novice surgeons develop reflective practice, resulting in improved surgical skills and a shorter robotic learning curve. A between-group quasi-random experiment was conducted to test this theory. The participants performed a pre-test technical simulation, conducted an independent video review, and then repeated the same simulation as a post-test. The intervention group received a surgical video review guide created by the researcher using Gibb's Reflective Cycle and additional evidence-based strategies during the video review. The participants also completed an exit survey measuring the perceived usefulness of video review guides. Data analysis found that overall, both groups significantly improved their surgical skills; however, there was no statistical difference between the two groups. The participants perceived both the surgical video review guide and video review guides in general as useful. Implications for practice and recommendations for future research were discussed. This research underscores the potential of reflective guides as a low-cost and independent method to develop reflective practitioners further and improve surgical practice.

"Trust in the Lord with all your heart and lean not on your own understanding; in all your ways acknowledge Him, and He shall direct your paths." Proverbs 3:5-6

To my parents, Drs. Marcus and Mervat Mansour, Ph.Ds. It is an honor to follow in your footsteps.

To my sister, Nermine, who taught me the meaning of resilience.

To my kids, Lydia and Silas. No learning curve is longer or more rewarding than that of parenthood. Thank you for your patience and love as Mommy worked on her big paper.

To my husband, Mark, whose obsession with video review and growth mindset inspired this topic. You are the greatest blessing in my life, and I thank God every day for you. 143.

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TABLE OF CONTENTS

LIST OF FIGURES x

LIST OF TABLES xi

LIST OF ABBREVIATIONS xii

CHAPTER ONE: INTRODUCTION 1

Background 1

Robotic Surgery 1

Benefits 1

Robotic Learning Curve 2

Robotic Skill Acquisition 4

Problem Statement 6

Significance 8

Purpose of the Study 9

Research Questions 9

Theoretical Framework 10

Definitions of Key Terms 14

CHAPTER TWO: LITERATURE REVIEW 16

Reflective Practice 16

Background 16

Reflection in Healthcare 18

Self-Assessment 19

Debriefing 20

Self-Debriefing 24

Video in Surgery 24

Instructional Videos 25

Video-Based Assessment 26
Video Review 29
Expert Video Review 32
Benchmark Videos 34
Video Review Guides 34
Perceived Usefulness 36
Summary 36
CHAPTER THREE: METHODOLOGY 38
Research Questions 38
Research Design 38
Sample and Recruitment 39
Site One 40
Site Two 41
Intervention 42
Instrumentation 44
Demographic Survey 45
Robotic Simulator 45
Exit Surveys 47
Data Collection Procedures 48
Data Analysis 52
Threats to Validity 52
Summary 56
CHAPTER FOUR: FINDINGS 57
Introduction 57
Research Questions 57
Participants 58

Data Cleaning 58
Demographics 59
Sub-Question One 61
Descriptive Statistics 62
Tests of Assumptions 62
Inferential Statistics 63
Additional Insights 66
Power Analysis 70
Sub-Question Two 71
Data Analysis 71
Instrument Reliability 73
Central Research Question 73
Summary 74
CHAPTER FIVE: DISCUSSION 75
Introduction 75
Summary of the Study 75
Discussion of Sub-Question One 76
Discussion of Sub-Question Two 81
Discussion of Central Research Question 83
Limitations 85
Implications for Practice 88
Recommendations for Future Research 89
Conclusion 90
APPENDIX A: PERMISSION TO REPRINT SHARP DEBRIEFING TOOL 92
APPENDIX B: SURGICAL VIDEO REVIEW GUIDE 95
APPENDIX C: INFORMED CONSENT & DEMOGRAPHIC SURVEY 97

APPENDIX D: PERMISSION TO PRINT SIMULATOR IMAGES 106

APPENDIX E: SAMPLE SIMULATION REPORT 108

APPENDIX F: EXIT SURVEYS 110

APPENDIX G: IRB APPROVAL 120

LIST OF REFERENCES 124

LIST OF FIGURES

Figure 1 *Example of a Multi-Phasic Robotic Learning Curve* 4
Figure 2 *Example of a Surgeon's Progress Through Kolb's Experiential Learning Cycle* 11
Figure 3 *Gibb's Reflective Cycle Overlaid on Kolb's Experiential Learning Cycle* 13
Figure 4 *SHARP Debriefing Tool for Surgery (Ahmed et al., 2013)* 23
Figure 5 *The Role of Intraoperative Videos in Surgical Education* 36
Figure 6 *Three-Phase Development Process* 43
Figure 7 *Images from the SimNow Combo Exercise* 46
Figure 8 *Flowchart of Study Procedures* 51
Figure 9 *Count of Participants Operating in Each State* 59
Figure 10 *Scatterplot of the Score Difference Between the Baseline and Post Simulation Test* 65
Figure 11 *Scatterplot of the Relationship Between the Baseline and Post Simulation Scores* 67
Figure 12 *Box and Whisker Plot Comparison of Baseline Simulation Performance* 69
Figure 13 *Box and Whisker Plot Comparison of Post-Simulation Performance* 70

LIST OF TABLES

Table 1 *Stratified Random Sampling of Participants in Each Group* 42

Table 2 *Threats to Validity* 53

Table 3 *Demographic Characteristics of Participants* 60

Table 4 *Robotic & Video Review Experience* 61

Table 5 *Descriptive Statistics for Intervention Group (n = 20) and Control Group (n = 21)* 62

Table 6 *Homogeneity of Variance Test* 63

Table 7 *Shapiro-Wilk Test for Normality* 63

Table 8 *Repeated Measures ANOVA* 64

Table 9 *Correlation Matrix of the Score Difference and Demographic Characteristics* 66

Table 10 *Linear Regression for Intervention Group* 68

Table 11 *Linear Regression for Control Group* 68

Table 12 *Descriptive Statistics of Perceived Usefulness of VRGs* 72

Table 13 *Descriptive Statistics of Perceived Usefulness of the SVRG (n=21)* 72

Table 14 *Internal Reliability of Perceived Usefulness Scales* 73

LIST OF ABBREVIATIONS

ABS	American Board of Surgery
ACGME	Accreditation Council for Graduate Medical Education
APDCRS	Association of Program Directors for Colon and Rectal Surgery
CAT	Competency Assessment Tool
CRQ	Central Research Question
C-SATS	Crowd-Sourced Assessment of Technical Skills
CUSUM	Cumulative Sum
EPAs	Entrustable Professional Activities
FDA	Food and Drug Administration
GEARS	Global Evaluative Assessment of Robotic Skills
GOALS	Global Operative Assessment of Laparoscopic Skills
M&M	Morbidity and Mortality Conference
MSQC	Michigan Surgical Quality Collaborative
OCC	Orlando Colorectal Congress
OSATS	Objective Structured Assessment of Technical Skill
SHARP	Feedback and Debriefing Tool for Surgeons
SQ1	Sub-Question One

SQ2	Sub-Question Two
SVRG	Surgical Video Review Guide
VAD	Video-Assisted Debriefing
VBA	Video-Based Assessment
VRG	Video Review Guides
VRO	Video Review Only

CHAPTER ONE: INTRODUCTION

Background

Robotic Surgery

The growth of robotic surgery has been exponential over the past fifteen years. The first robotic-assisted device created by Intuitive Surgical Inc. received FDA clearance in the year 2000. Seventeen years later, the leading surgical robotic system on the market reached a milestone of five million procedures performed. Only four years later, in 2021, this number doubled, with 10 million procedures performed and 55,000 trained robotic surgeons across the globe (Intuitive Surgical Inc., 2021). The latest published data found that robotic procedures increased from 1.8% of total operations to 15.1% from 2012 to 2018 within the Michigan Surgical Quality Collaborative (MSQC), which documents 90% of all surgical procedures in Michigan (Sheetz et al., 2020).

Robotic-assisted devices, otherwise known as robotic surgery, are the latest minimally invasive technology in the field of surgery (Marino et al., 2018). A robotic surgical system consists of multiple parts, including a surgeon console, a patient cart (robotic arms), a camera system, and computer software. A surgeon sits at the surgeon console and uses their hands and feet to control multiple robotic arms, which are inserted into the patient through 8–12 mm incisions. The camera system offers the surgeon high-definition three-dimensional (3D) video with magnification, while the sophisticated computer software translates the surgeon's movements into precise robotic actions. In addition, the computer software provides data analytic feedback such as operative time and economy of motion to inform the surgeons of their robotic performance.

Benefits

The benefits of robotic surgery are numerous. When compared to open surgery, robotic procedures require significantly smaller incisions, which results in less pain, lower instances of infection, and quicker recovery time. While the monetary cost of performing a robotic procedure is initially higher than an open procedure, shorter hospital stays and reduced complication rates can translate into overall cost savings (Chiu et al., 2019). When compared to conventional minimally invasive laparoscopic surgical instruments, robotic instrumentation offer a 180-degree range of motion, thereby not being limited by the human wrist. Robotic platforms offer three-dimensional (3D) imaging to assist in depth perception, and the ability for a single surgeon to control multiple arms, advanced tremor filtration, and the ability for the surgeon to fix instruments in space, all thereby reducing the need for a surgical assistant. Additionally, performance and kinematic motion feedback through the robot's onboard computer software allows the surgeon to track their surgical skill improvement and plan for future operations (Rivero-Moreno et al., 2023). Finally, the surgeon console offers improved ergonomics over traditional surgical modalities that require the surgeon to stand for multiple hours, often hunched over, resulting in poor posture and long-term adverse health effects (Wee et al., 2020).

Robotic Learning Curve

Though the benefits are numerous, robotic surgery presents significant challenges. Since the surgical instruments are controlled remotely and do not provide haptic feedback to the surgeon, the entire procedure relies on visual cues to gauge the required force for achieving the desired tissue effect. This can be particularly difficult, especially for novice surgeons (Patel et al., 2022). In addition, robotic surgery requires more equipment and more time to set up the patient in the operating room correctly compared to other modalities, and the actual operations typically take longer for surgeons to complete while they are in their learning curve compared to laparoscopic surgery, often with similar outcomes (Solaini et al., 2022). For these reasons, it is common for novice robotic surgeons to abandon robotic surgery after a few initial attempts.

The robotic learning curve is measured using a cumulative sum (CUSUM) score, the measure of variance in operative time over time (Pernar et al., 2017). The learning curve for robotic surgeons can be precarious to measure as there are several confounding variables, including surgeon-related, patient-related, procedure-related, and institution-related factors such as the frequency and complexity of operations and the presence and support of expert robotic surgeons for proctoring and guidance (Kassite et al., 2019; Wong & Crowe, 2022). However, surgeons who perform complex robotic abdominal cases generally have been found to progress through a multi-phasic learning curve (Figure 1). Surgeons typically choose simple operative procedures during the initial learning curve while gaining comfort with the robot's mechanics. Their operative times decrease as they progress and then plateau between cases 25–33. The challenging phase is accompanied by an initial increase in operative time due to the surgeon attempting more complex operative cases before once again decreasing and plateauing around case 75. While most surgeons plateau here, some robotic surgeons enter an expert phase, characterized by an additional bell curve, plateauing after approximately 128 cases.

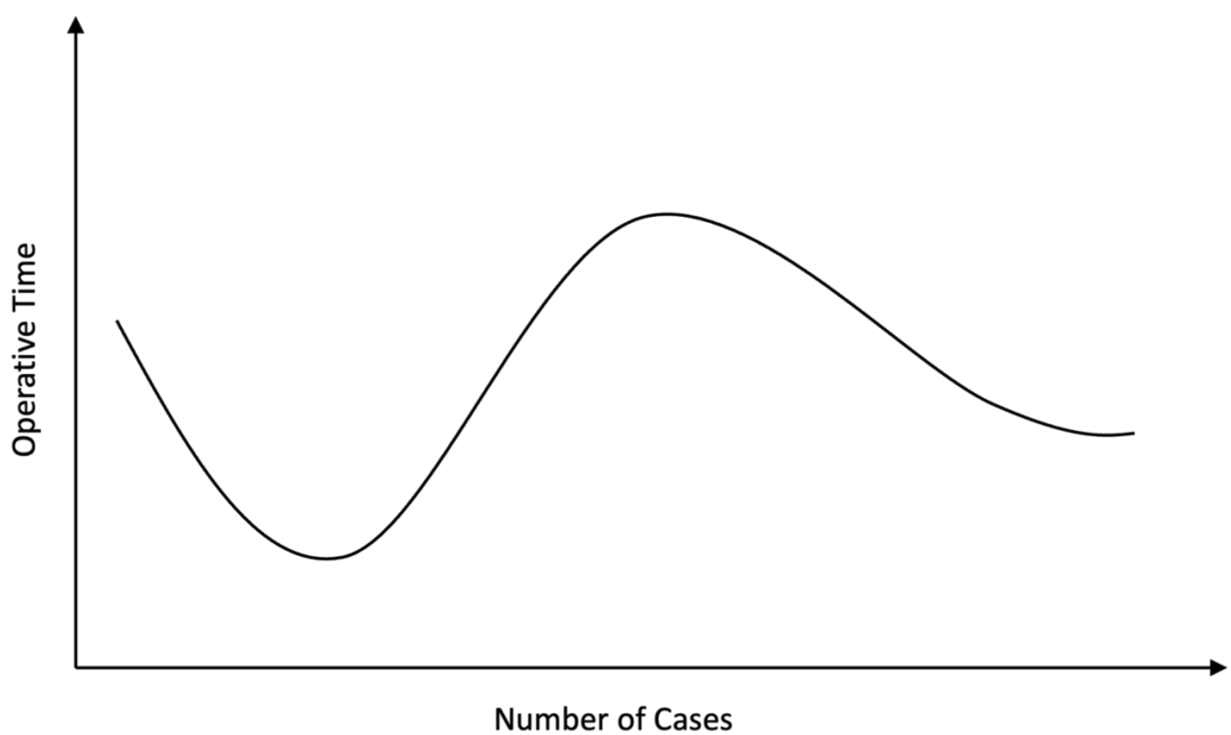

Figure 1

Example of a Multi-Phasic Robotic Learning Curve

Surgical education is primarily focused on shortening the learning curve for surgeons. A multi-surgeon, single-institution study by Guend et al. (2017) found that it took the first robotic surgeon 75 operative cases to overcome their learning curve and only 25 cases for subsequent surgeons who later joined the practice. This finding highlights the significance of having an expert robotic surgeon as a support and guide for novices.

Robotic Skill Acquisition

A licensed surgeon in the United States completes an Accreditation Council of Graduate Medical Education (ACGME) approved general surgical residency program (five to seven years) and then has the option to complete a surgical specialty fellowship (one to three years). Surgical residents and fellows primarily acquire surgical skills following Fitts and Posner's Three-Stage Theory of Skills Acquisition (Fitts & Posner, 1973). That is, residencies and fellowships typically follow a master-apprenticeship model in which surgical trainees observe, imitate, and practice surgical skills under the guidance of more experienced surgeons until they have reached a level of competence that no longer requires monitoring. Nearly all surgical residency programs today offer some form of robotic training, though the quality and consistency of training vary widely across the country (Madion et al., 2022; Zhao, Lam, et al., 2020).

Robotic surgery is still a relatively new modality; therefore, most surgeons who completed residency programs more than five years ago never received sufficient robotics training (Madion et al., 2022). Surgeons already in practice must become trained through a robotics company, such as Intuitive Surgical Inc., or by attending trainings hosted by surgical societies or healthcare institutions. The hands-on tissue training is typically completed in one to three days; therefore, surgeons must rely on additional methods of skill reinforcement such as simulator practice, surgical coaching, and instructional videos to reach mastery.

Simulators. The advent of dry-box simulations and virtual reality simulators have proven to be safe and effective ways for novices to improve their surgical skills outside of the operating theatre, especially for minimally invasive modalities, such as robotic surgery (Yang et al., 2017). Simulations allow surgeons to exercise deliberate practice, a purposeful and systematic form of practice that generally involves feedback and targeted strategies to improve a specific skill within a domain (Ericsson, 2011). Compared to an unstructured approach, deliberate practice on simulators allows novices to achieve expertise in a shorter period by focusing on specific robotic skills or steps of a procedure and allowing them to practice as many times as necessary without having actual patients.

Surgical Coaching. After residency/fellowship, surgeons operate independently, often with little or no support. Some surgeons, however, may determine that they would benefit from additional surgical coaching or mentorship post-residency, especially if they are learning a new surgical procedure, technique, or modality, such as robotics. A systematic review found that surgical coaching is a valuable means of continuing education by improving technical, leadership, and communication skills. In addition, virtual coaching is found to be as effective as in-person coaching (El-Gabri et al., 2020). Surgical coaching can be conducted through formal programs such as The Academy for Surgical Coaching, which connects surgeons with experts for a fee (https://surgicalcoaching.org/). Alternatively, surgeons can seek informal coaching by relying on partners in their surgical practice or by reaching out for surgical advice on social media such as private Facebook groups or SurgeOn – a networking app exclusively for surgeons. Additionally, many medical device companies maintain surgical networks to allow surgeons to connect with mentors and proctors.

Instructional Videos. Video-based learning is a popular and effective method of acquiring both procedural learning and operative skills (Larkins et al., 2023; Takagi et al., 2023). Watching surgical videos to prepare for upcoming surgeries is becoming a ubiquitous method of continuing education, with up to 98% of surgeons reporting watching surgical videos preoperatively (Mota et al., 2018).

Robotic surgery, in particular, has a robust library of surgical videos due to the ease of recording through the robotic console, allowing the viewer to watch everything the surgeon sees. By watching surgical videos ahead of time, surgeons can better anticipate and plan for challenges they may encounter during their operations.

The methods mentioned above provide surgical trainees pathways to learn, practice, and reinforce their robotic skills and shorten the length of their learning curve. One method that is often overlooked is the role of reflection in improving learning and skills. This dissertation will explore the role of video review as a catalyst for self-reflection and a mechanism for improving robotic surgical skills.

Problem Statement

Robotic-assisted devices are the latest minimally invasive technology in surgery (Marino et al., 2018). These devices provide surgeons with 3D visualization, 360-degree range of motion, data analytic feedback, and improved ergonomics over their predecessor, laparoscopic devices. Robotic surgery as a modality continues to experience exponential growth, rapidly changing the landscape of minimally invasive surgery since the first robotic-assisted device gained FDA clearance in the year 2000. With this growth, surgical training programs face the challenge of expeditiously integrating robotic instruction, most of them only adopting robotic training within the past five years (Madion et al., 2022). As a result, many surgical trainees are trained by attendings who themselves are new to robotic surgery and are still in their robotic learning curve rather than by expert robotic surgeons (Zhao, Hollandworth, et al., 2020). Weis et al. (2023) found that the average number of robotic cases performed by surgical fellows in training per year increased from 3.6 cases in 2010 to 49.5 cases in 2019. While this is a significant increase, it is still less than one robotic case per week and remains within the initial robotic learning curve as most of these cases are performed under the guidance of a surgical attending.

The learning curve for robotic surgeons can vary significantly as several factors influence its length and slope, including case complexity and level of mentorship (Kassite et al., 2019; Wong & Crowe, 2022). Proven adjuncts to support surgeons during their robotic learning curve include surgical coaching (Esposito et al., 2022), simulator practice (Schmidt et al., 2021), and instructional videos (Reck-Burneo et al., 2018). Though effective, surgical coaching and simulator practice can be cost-prohibitive, are not widely available, and may not be convenient to use due to limited access and the time constraints of surgeons (Esposito et al., 2022; MacCraith et al., 2019). In addition, the current surgical culture can be a barrier to coaching as many surgeons perceive surgical coaching as a sign of incompetence, creating a juxtaposition with the image of the perfect, confident, and all-knowing surgeon (Mutabdzic et al., 2015). While instructional videos are convenient and accessible to watch via social media, they still rely on experienced surgeons taking the time to edit, provide commentary, and share their videos for educational purposes. In addition, there is no screening process before surgeons upload their videos to sites such as YouTube, resulting in many videos with inadequate and insufficient educational quality, leaving novice surgeons to distinguish between high-quality and low-quality videos on their own (Gorgy et al., 2022).

Video review is used across multiple fields, including teacher education (Baecher et al., 2018), sports (Walker et al., 2020), and throughout various healthcare fields (Zhang et al., 2019), and has been found to improve self-reflection and performance. In surgery, video review is the practice of recording and playing back surgical cases and comparing them to other surgeons' videos. Unlike surgical coaching and simulator practice, video review is accessible on personal computers and mobile devices, and therefore, it can be conducted independently anywhere and at any time.

Studies have found video review to be an effective method of improving self-assessment and, consequently, surgical skills, though most often, video review is conducted with a more experienced surgeon (Van Der Leun et al., 2022; Zhang et al., 2019). The results of *independent* video review studies for surgeons are more variable as several factors impact its effectiveness, including the availability of benchmark videos and video review guides (Scaffidi et al., 2019; Wang et al., 2020). Experience also plays a role in effective video review as expert robotic surgeons implicitly organize their reviews in a way that allows them to reflect on their surgical performance efficiently, a skill that novice robotic surgeons lack (Soliman & Soliman, 2023). Only one study to date has explored using a video review guide to improve surgical skills: Wang et al. (2020) found that independent video review with a video review guide was as effective as expert guidance in improving surgical knot tying. There has yet to be an established method of proper video review for novice surgeons, nor are there video review guides for robotic surgeons.

As with any new technology, there will be a limited number of expert robotic surgeons until robotic surgery becomes a ubiquitous modality and enough surgeons complete the robotic surgical learning curve and are readily available to support their peers and trainees. Due to the current limited available support from expert robotic surgeons (Zhao, Hollandworth, et al., 2020), the problem that this dissertation will address is the need for proper independent video review guidance for novice robotic surgeons to improve their surgical skills and accelerate their robotic learning curve.

Significance

The importance of surgical technical skill cannot be over-emphasized when it comes to patient safety, as recent literature reviews have found that surgeon technical skills can predict clinical outcomes, including 30-day complication and reoperation rates (Balvardi et al., 2022; Woods et al., 2023). Video review allows professionals to analyze and reflect on their practice to improve and refine their skills (Isreb et al., 2021; Schön, 1987; Tripp & Rich, 2012). Reflection through video review improves surgeons' self-assessment accuracy (Scaffidi et al., 2019), which can inform them of areas requiring performance improvement. Despite this, video review as a method of reflective practice is not yet widely used as, by some estimates, only five percent of residency programs regularly use video recording in their operating rooms (Esposito et al., 2022). The current lack of video review guidance in robotic surgery is a significant problem because a surgeon's self-reflection and self-assessment ability is essential for improving their operative performance and, ultimately, it is essential for the health and safety of surgical patients. Video review can be a powerful tool to improve surgical skills when utilized correctly; however, without guidance, novice robotic surgeons are left with no clear method for effectively reviewing their surgical performance. This deficit in reflective practice may result in a longer learning curve and, ultimately, a failure to adopt robotics into their surgical practice.

Purpose of the Study

This study aims to analyze and describe the impact of video review guide utilization on novice robotic surgeons. A video review guide with evidence-based strategies was created for this study with the aim of prompting critical self-reflection in surgeons. The use of an evidence-based surgical video review guide by surgeons aims to assist in improving robotic surgical technical skills, thereby accelerating the robotic learning curve of novices who lack expert robotic surgical support.

The findings of this study contribute to the field of surgical education by providing an independent, efficient, and cost-effective method of video review, which can accelerate the learning curve for robotic surgeons. The surgical video review guide is designed for reflection on robotic technical skills on a simulator. The guide provides a template for the creation of future video review guides to enhance both technical and non-technical surgical skills, including clinical judgment, communication, and leadership. This study highlights the value of video review and provides a structured method of independent video review that may also increase the currently underutilized practice of video review for reflective practice.

Research Questions

To evaluate the effectiveness of an intervention designed to improve robotic surgical technical skills, this study sought to answer the following central research question and sub-questions:

CRQ: What is the impact of utilizing a written video review guide during independent video review on the surgical skills of novice robotic surgeons?

- **SQ1:** Is there a statistically significant difference in the improvement of robotic surgical technical skills using a simulator between novice robotic surgeons who conduct an independent video review using a written surgical video review guide compared to those who do not use a guide?
- **SQ2:** To what extent do novice robotic surgeons perceive written surgical video review guides as useful?

Theoretical Framework

This study applied Kolb's (1984) Experiential Theory to examine the effect of video review on robotic surgical skills. Kolb's framework explains that learning results from a cycle of doing and thinking. The four-part experiential learning cycle posits that learning begins with a *concrete experience* (doing) followed by *reflective observation* (what happened?). Next is *abstract conceptualization*, where the learner applies theory to their experience (thinking), then finally, *active experimentation*, which is the learner planning how to proceed in future experiences (what now?). Figure 2 illustrates applying Kolb's model to surgical video review.

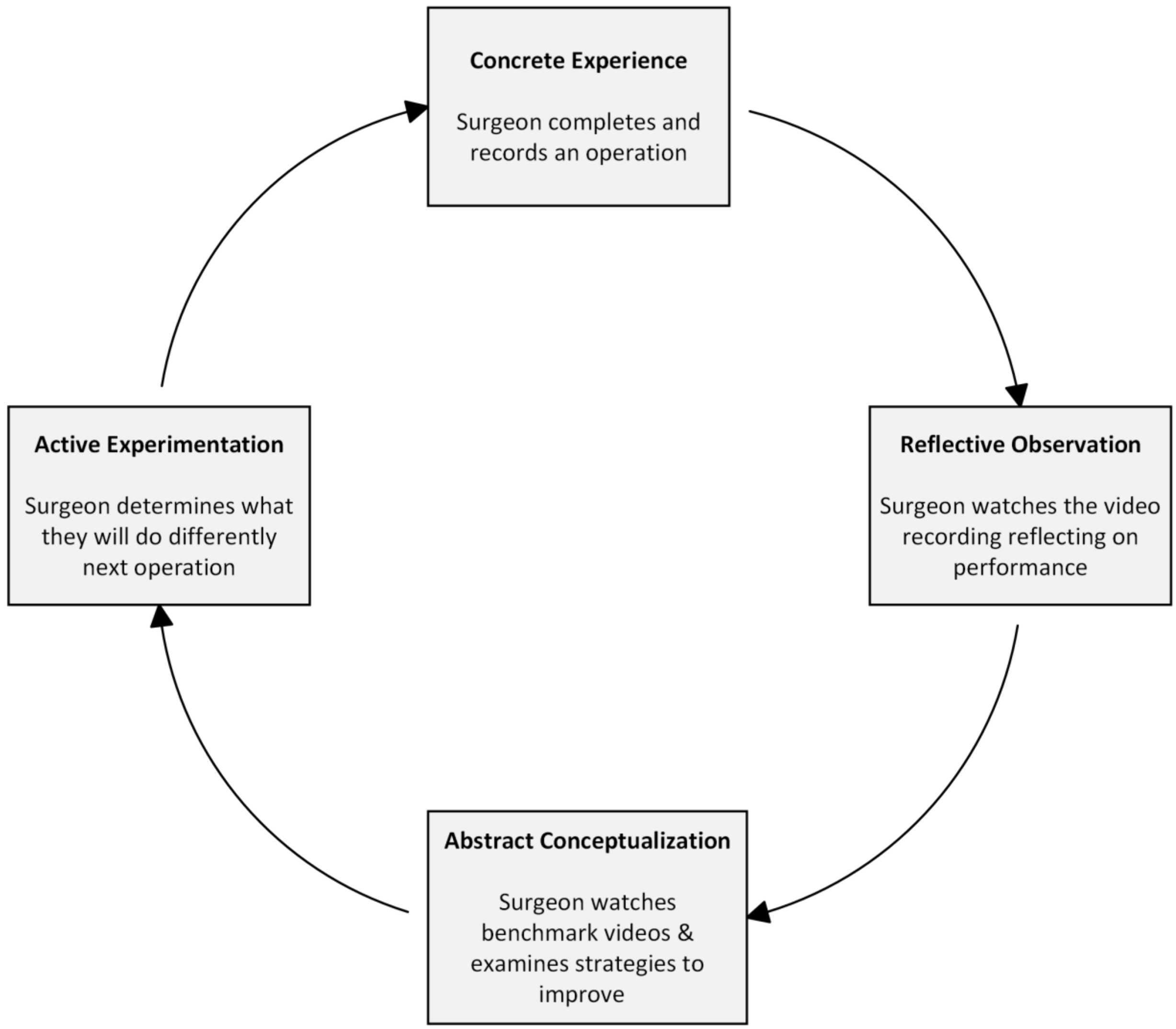

Figure 2

Example of a Surgeon's Progress Through Kolb's Experiential Learning Cycle

Kolb notes that while the stages are sequential, a learner may enter the experiential learning cycle during any stage. In this study, the experiment will begin with the participants watching a benchmark video of a surgeon completing the simulation (*abstract conceptualization stage)* so they may preview what is expected of them and mentally create an initial plan of how they will complete the exercise (*active experimentation stage*). Initiating the experiment with a benchmark video follows the findings that providing benchmark videos leads to more accurate self-assessment than video review alone (Hawkins et al., 2012; Scaffidi et al., 2019). The participants will then complete the simulation exercise (*concrete experience stage*) and then watch their recorded performance (*reflective observation stage*). The cycle will repeat once again, with a surgical video review guide to assist them in processing their learning (*abstract conceptualization stage*) and determining what they will do differently (*active experimentation stage*) during the subsequent simulation (*concrete experience stage*).

Gibbs (1988) expanded on Kolb's work by creating a Reflective Cycle that can be applied to the Experiential Learning Cycle and serves as a structured debriefing to reflect more critically on the experience, thus deepening learning. Gibbs cycle (1988) is as follows:

- Description of the experience
- Feelings and thoughts about the experience
- Evaluation of the experience, both good and bad
- Analysis to make sense of the situation
- Conclusion about what you learned and what you could have done differently
- Action plan for how you would deal with similar situations in the future or general changes you might find appropriate (Gibbs, 1988, pp. 49–50).

Figure 3 was created by the researcher to demonstrate how Gibb's Reflective Cycle fits within Kolb's Experiential Learning Cycle. Rather than reflection being isolated to a single step of the learning cycle, it is interwoven throughout the entire process. Numerous studies within healthcare have tested Gibb's Reflective Cycle as a method of facilitating reflection, and the National Health Services (NHS) in the United Kingdom has integrated it into the mandatory reflective portfolios for annual appraisals (Holder et al. 2019).

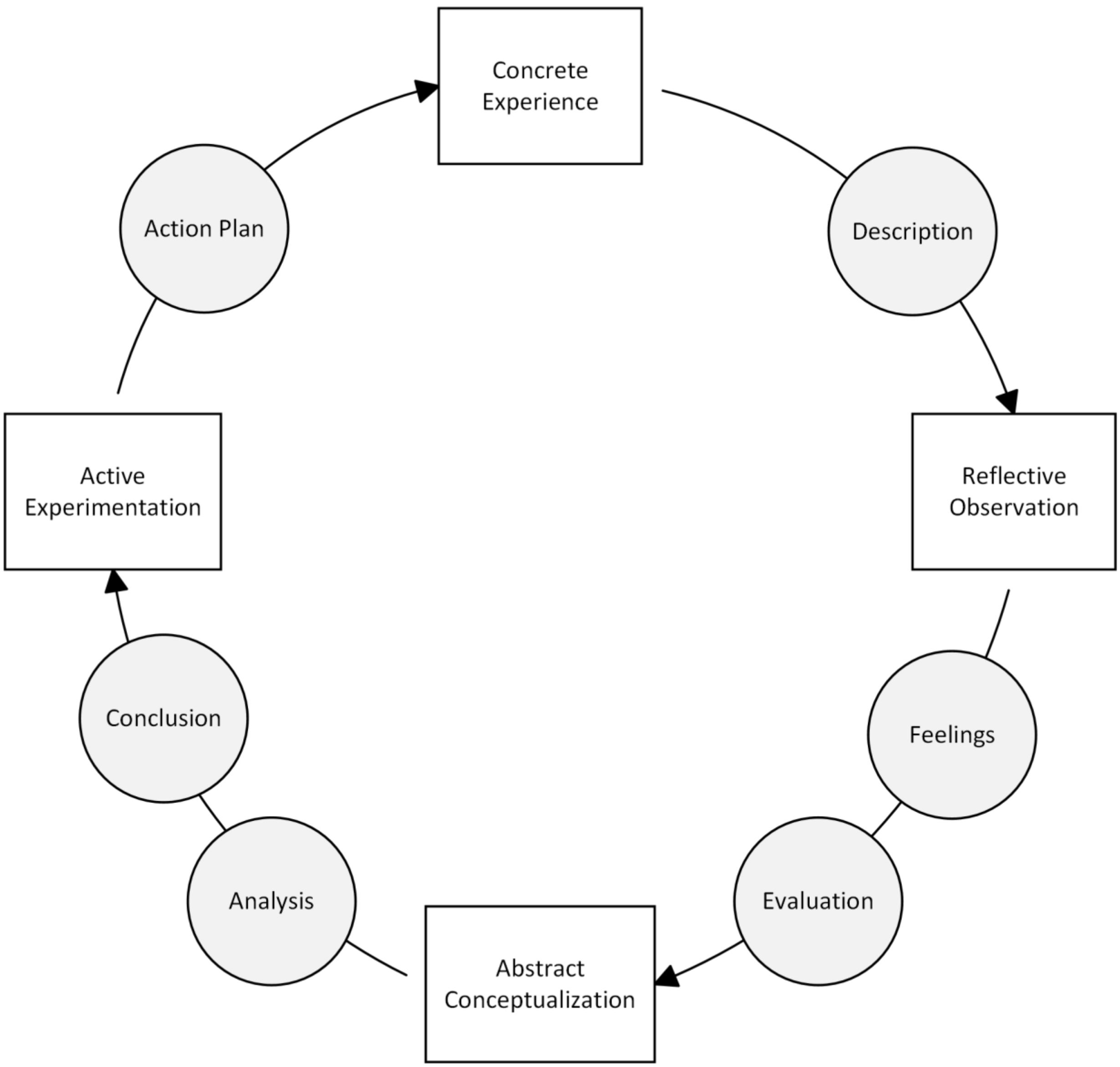

Figure 3

Gibb's Reflective Cycle Overlaid on Kolb's Experiential Learning Cycle

Experiential Learning Theory is an appropriate framework for this study because the literature review argues that surgical video review serves as a vehicle for critical self-reflection, producing more meaningful learning and ultimately improved surgical skills. The research design was structured to allow the participants to progress through all four stages of Kolb’s learning cycle while utilizing a video review guide developed according to Gibb’s Reflective Cycle.

Definitions of Key Terms

ABS: The American Board of Surgery is responsible for board-certifying surgical trainees who have successfully completed an ACGME-accredited residency or fellowship (www.absurgery.org).

ACGME: The Accreditation Council for Graduate Medical Education accredits all graduate medical training programs (www.acgme.org).

Instructional Surgical Videos: Surgical videos used to teach how to perform an operation. Videos may or may not include step-by-step instructions (audio).

FDA: "The Food and Drug Administration is responsible for protecting public health by ensuring the safety, efficacy, and security of human and veterinary drugs, biological products, and medical devices" (U.S. Food and Drug Administration, 2023).

Laparoscopic / Laparoscopy: A minimally invasive surgical modality involving a surgeon using laparoscopes (tubes) to perform surgery inside the human body to minimize the need for large incisions.

Robotic Surgery or Robotic Assisted Devices: A minimally invasive surgical modality involving the surgeon controlling multiple robotic arms bearing surgical instruments and a camera to minimize the need for large incisions.

Robotic Surgical Benchmark Videos: These may be the same as instructional videos but are used to compare one's surgical performance to exemplary performances. They are used to improve self-assessment and determine areas for improvement.

Robotic Surgical Learning Curve: In surgery, the learning curve is a correlation between the length of operative time and the number of operative cases

Robotic Surgical Simulator: A robotic console programmed with surgical exercises to allow surgeons to practice technical skills outside of the operating theater. Similar to video game consoles, simulators provide metrics to inform surgeons of their performance.

Surgeon Console: The control center of a robotic surgical system. The surgeon controls the robotic arms using hand controls, foot pedals, and a display screen attached to the robotic console.

Surgical Fellowship: A period of specialized surgical training following surgical residency to gain expertise in a specific surgical subspecialty. Fellowships are typically one to three years in length.

Surgical Residency: A period of general surgical training following medical school that typically lasts five to seven years.

Surgical Outcomes: The results of surgical procedures are typically measured in patient recovery, survival rates, postoperative complications, and the effectiveness of the intervention.

Surgical Video Review: Recording one's surgical performance and playing it back for analysis.

Surgical Video Review Guide (SVRG): The written video review guide designed specifically as the intervention for this study.

Video Review Guide: A written guide with prompts and questions to be used during video review to elicit reflection in a structured manner.

CHAPTER TWO: LITERATURE REVIEW

This literature review examines and critiques the research and scholarship on surgical video review. First, an overview of the current state of reflective practice in surgery is necessary to situate the importance of video review as a catalyst for reflection, learning, and skill improvement. Next, how videos are most frequently used in surgical education is outlined, highlighting the shortcomings of its current use. Although studies on the effectiveness of video review have been mixed, the researcher argues that this is due to a lack of consensus on effective video review design. As such, this literature review provides additional insight into how video review guides may deepen reflection and improve self-assessment, resulting in improved surgical skills without the need for expert surgeons as a means of support. The final section of this chapter briefly examines the research on perceived usefulness, which provides a framework for understanding if, when, and why surgeons may adopt a reflective tool. A comprehensive review of reflective practice and video review is necessary to establish the relevance of this study.

Reflective Practice

Background

Dewey (1933) introduced reflection as a crucial component of the cognitive thinking process and paramount for building knowledge. He argued that experience alone does not necessarily lead to learning; instead, it is critical reflection on the experience that fosters understanding. Therefore, reflection must be a deliberate act. Schön (1983) expanded on Dewey's work and defined reflective practice as the ability to reflect on one's actions to engage in *continuous* learning. He describes two types of reflection: *reflection-on-action* and *reflection-in-action*. Reflection-on-action involves comparing one's performance to existing knowledge and understanding to develop new schemas. Reflection-in-action is otherwise known as "thinking on your feet." Schön explains that expert professionals are able to make proper decisions quickly in the moment because they have built schemas through their ongoing reflection-on-action. Thompson and Pascal (2012) then added reflection-for-action, which involves planning for future action based on past performance and understanding new concepts. These three forms of reflection create the reflective practitioner and closely align with Gibb's Reflective Cycle overlaid on Kolb's Experiential Learning Cycle (as explained in the Theoretical Framework section in Chapter 1). Reflective practice combines theory, practice, active learning, questioning, analysis, and understanding with an open mind (Thompson & Pascal, 2012).

Reflective practice has iterative and vertical dimensions. Iterative reflections are experiences that trigger deeper thinking, providing new understanding and changing future behavior (Boud et al., 1985). Vertical reflection refers to the level of depth of one's reflective thinking. Kim (1999) defined three levels of reflection in her Critical Reflection Inquiry Model: *descriptive* is the shallowest level, which is a thorough description of an event; *reflective* is the intermediate level and provides analysis of the situation, including feelings, attitudes, values, intentions, and practice standards. The deepest level of vertical reflection is *critical,* which involves critiquing, correcting, and changing ineffective practices. Effective reflective practice has been found to bridge the theory-practice gap, highlight poor practices resulting in improved patient care, enhance self-awareness, empower practitioners towards change, and stimulate critical thinking (Patel & Metersky, 2022).

Experience is critical for any form of medical education, whether during medical school rotations, residency, or continuing medical education for practicing physicians. In Kolb's Experiential Learning Theory, reflection plays a mediating role between experience and learning. Through reflection, the learner constructs knowledge and identifies missing knowledge, leading to deeper learning (Bui & Yarsi, 2023). Medical education is structured to provide countless experience opportunities; however, without reflection and abstract conceptualization, which day-to-day clinical practice often lacks, the experiential learning cycle is incomplete, resulting in limited learning (Sheng et al., 2018).

Reflection in Healthcare

Many surgeons unfortunately fail to take the time to reflect on their medical practice, thus restricting their ability to build knowledge and improve their surgical skills (Soleimani-Nouri et al., 2023). A literature review by Mann et al. (2009) found that healthcare professionals generally only reflect on challenging or novel situations. In addition, novices struggle to engage in critical reflection, limiting their reflection to descriptions of events rather than understanding processes, learning, and self-assessment (Kim, 2018). Davies (2012) found that physicians resist reflective practice because of a reluctance to challenge and evaluate their decision-making process. Additionally, she found that many doctors do not understand the reflective process, are unsure which experiences to reflect on, and believe that reflection is time-consuming. This is not to say that medical professionals do not believe reflection is important. An action research study by Naumeri (2023) found that pediatric surgery residents recognized the importance of reflective practice, acknowledging that it improves patient outcomes and helps with self-monitoring and critical appraisal. The participants believed that a lack of guided reflection, timely feedback, and time to reflect were the most significant barriers to reflective practice.

Struggles with reflective practice may stem from physicians' experiences with reflection during their post-graduate medical education. Gathu's (2022) narrative review of facilitators and barriers to reflective learning points out that there is evidence to support reflection as an essential aspect of graduate student learning; however, how it is conducted will influence whether students adopt it into their medical practice. Reflection is often part of summative assessments in which the students are externally motivated to earn a grade rather than intrinsically motivated to engage in reflective behavior genuinely, leading to students 'gaming the system' to meet assessment criteria (Truykov, 2023). The sheer number of reflective assignments in medical school, often filled with ambiguity and a lack of formative feedback, can lead to "reflection fatigue," resulting in students viewing reflection as merely checking a box or busy work (Trumbo, 2017). At worst, poorly taught reflective practice can lead students to hate reflection; as one nursing student said, “I am sure Gibbs was put on this earth to make student nurses a living hell!!!” (Timmins et al., 2013, p. 1373). While recognizing the value of reflection, medical students and residents across medical specialties strongly resisted written reflections (Shaughnessy & Duggan, 2013; Tonni et al., 2016; Tuykov, 2023). Furthermore, reflective practice is often not role-modeled outside the classroom, which leads students to believe it is a task to be performed in training but unnecessary once in medical practice. Additional challenges to developing reflective practice include a lack of guiding tools, the perception that it is time-consuming, and that it can lead to feelings of vulnerability (Holder et al., 2019). Reflection requires time, thus, if viewed as a low-value skill, it will likely be overlooked as an essential part of professional medical practice (Gathu, 2022).

Self-Assessment

While self-reflection involves asking what happened and what I would change, self-assessment asks how did I do, forming a dynamic relationship between self-reflection and self-assessment (Mann et al., 2009). Kruger and Dunning’s (1999) work on self-assessment found that the less knowledge or skill one has on a particular topic, the more confident they are in one's knowledge or ability and the less accurate they are in self-assessment. Nayar et al. (2020) validated this phenomenon in a literature review, finding that surgeons’ ability to accurately self-assess their surgical skills improved with age and experience. A study by Varban et al. (2022) comparing self-rated versus peer-rated surgical skills found that surgeons who over-rated their skills had higher leak rates for complex bariatric procedures.

Gordon et al. (1991) concluded that inaccuracies in self-assessment were often the result of inconsistencies between the criteria used by the self-assessor and the evaluator. If learners are not provided with explicit benchmarks, they will assess themselves based on subjective criteria that may not align with objective standards. Additional facilitators for accurate self-assessment include performance feedback and the review of the performance data by the learner, such as video reflection (Lu et al., 2021). These findings shed light on the risks associated with novice surgeons evaluating themselves in the absence of more experienced surgeons or standards. If novice surgeons do not know how to engage in deep reflection and cannot accurately assess their surgical performance, they may struggle to improve their surgical skills and adopt new surgical modalities. More importantly, they may put the health of their patients at risk.

Debriefing

Research reveals that reflective practice cannot be assumed, nor is it innate, but should be explicitly taught. Indeed, there is literature to suggest that effective reflective practices can be taught to novices across fields and result in positive outcomes, such as improved decision-making skills (Baecher et al., 2018; Gray & Coombs, 2018; Kim, 1999; Nagro et al., 2017; Tripp & Rich, 2012). Kirschner et al. (2006) expound that direct instruction, which entails fully explaining the concepts and procedures required to learn and providing strategy support, is an efficient way to alter long-term memory, which results in learning. In contrast, minimally guided instruction can overload a learner's working memory, resulting in little learning.

Graduating from an accredited medical training program is required to become a board-certified physician in the United States. The governing board responsible for accrediting all graduate medical training programs is the Accreditation Council for Graduate Medical Education (ACGME). The ACGME has outlined milestones specific to each specialty that residents and fellows must be evaluated on by their program each year (ACGME, 2019). Each of the 18 surgical milestones is divided into five levels, and tracking through the levels is synonymous with moving from novice to expert. One of these milestones is *Practice-Based Learning and Improvement 2: Reflective Practice and Commitment to Personal Growth.* The five levels for this milestone are as follows:

- Level 1: Establishes goals for personal and professional development

- Level 2: Identifies opportunities for performance improvement; designs a learning plan
- Level 3: Integrates performance feedback and practice data to develop and implement a learning plan
- Level 4: Revises learning plan based on performance data
- Level 5: Coaches others in the design and implementation of learning plans

This milestone is evidence that the ACGME acknowledges that reflective practice is a skill that takes years to develop and recognizes that it is an essential component of surgical proficiency.

One way surgical training programs help their residents meet this milestone is through morbidity and mortality (M&M) conferences. The ACGME mandates this weekly meeting for surgical training programs to maintain accreditation and Medicare funding for graduate medical education. The purpose of this weekly conference is to review patient deaths and complications and discuss whether they were preventable. This method of group debriefing often follows Kolb's Experiential Learning Cycle and Gibb's Reflective Cycle by providing an opportunity for reflection (*what happened?*), learning (*why did it happen?*), and planning (*what will we do differently next time?*) for future patient care. Naumeri (2023) interviewed pediatric surgery residents after a 12-month period of weekly M&M meetings that followed Gibb's Reflective Cycle and found that the participants actively engaged in reflective practice. A survey distributed to 129 surgery departments across the United States and Canada found that 98% of the departments require mandatory M&M conference attendance by residents; however, only 49% of faculty attended these conferences (Anderson et al., 2020). Furthermore, M&M conferences are typically only found in academic institutions, as hospitals without medical training programs are not required to hold them. This underscores the perceived value of group debriefing by physicians already in practice. While debriefing and reflection are emphasized in educational settings, they often do not continue in professional practice.

M&M conference is one formal method of debriefing specific for complications and death, but surgical debriefing can take several other forms as well. Debriefings can occur after simulations, clinics, and surgical operations and during didactic meetings. A meta-analysis by Keiser and Arthur (2021) found that debriefing leads to improved performance, especially when coupled with objective review media (e.g., videos). In addition, structured debriefing is more effective than unstructured debriefing. A literature search found 22 debriefing tools used in healthcare, though only one was designed specifically for surgery. The SHARP clinical debriefing tool for surgery (Figure 4), shown to improve the quality of debriefing objectively, is a five-step feedback tool for surgical attendings to use for structured debriefing with their trainees (Ahmed et al., 2013). This tool aligns closely with Gibb's reflective cycle except for its lack of reference to *description* and *feelings*. The written surgical video review guide designed for this study utilized aspects of the SHARP debriefing tool described in further detail in Chapter 3 of this dissertation. Despite the evidence supporting debriefing as an effective tool in surgical education, a literature review by McKendy et al. (2017) found that most surgical debriefings are unstructured and are performed inconsistently or inadequately. Therefore, novice robotic surgeons cannot always rely on their attendings, surgical partners, or peers for guided or collaborative reflection. Rather, they must be provided with the tools necessary to effectively self-reflect. Indeed, a study by Fatima et al. (2020) found that surgical residents who were asked to respond to a structured written self-reflection worksheet following a surgical skills lesson significantly improved their surgical skills on a post-test compared to peers who did not engage in structured self-reflection.

Figure 4

SHARP Debriefing Tool for Surgery (Ahmed et al., 2013)

Note. From "Operation Debrief: A SHARP Improvement in Performance Feedback in the Operating Room," by M. Ahmed, S. Arora, S. Russ, A. Darzi, C. Vincent, and N. Sevdalis, 2013, *Annals of Surgery*, *258*(6), 958–963 (https://doi.org/10.1097/SLA.0b013e31828c88fc). Copyright 2013 by Lippincott Williams & Wilkins. Reprinted with permission (Appendix A).

Self-Debriefing

While debriefing in a training setting is typically led by a facilitator to teach and guide novices, an integrative review by MacKenna et al. (2021) found that self-debriefing can be as effective as facilitator-led debriefing with additional resource-saving and psychological benefits (Keiser & Arthur, 2021). Self-debriefing reduces the demand for surgical trainers' time; Isaranuwatchai et al. (2016) found that guided self-debriefing was as effective as an instructor-led briefing with additional cost-savings when the willingness-to-pay for effect is less than ≤Can$200. Self-debriefing can also provide psychological safety for learners by reducing the pressure to respond correctly or promptly. Self-debriefing provides learners with privacy and the ability to think and reflect on their own schedules (Verkuyl et al., 2018). However, feedback, reflection, and user experience must be considered for self-debriefing to be as effective. Access to a video recording of one's performance in addition to benchmark data (video, checklist, scoresheet, etc.) can sufficiently replace live expert or peer feedback. Reflection can be elicited through a reflective guide, such as written prompts or questions. User experience involves providing clear instructions and suggestions for self-debriefing, including time, setting, and length. Reflection outside training programs is most frequently conducted alone; therefore, teaching novice surgeons how to self-debrief is critical in allowing for continuous reflective practice after formal surgical training is completed.

Video in Surgery

Video is an integral part of surgical education, and it is utilized in multiple ways and for various purposes in training and professional practice. The following section outlines the three primary forms of video in surgery: instructional videos, video-based assessment, and video review. It discusses the benefits and drawbacks of each method and how video review can be used as a catalyst for reflective practice.

Instructional Videos

The most frequent use of intraoperative video in surgical education is for the purpose of instruction before performing a procedure. Surgical training is based on an apprenticeship model with trainees supervised by faculty and given more responsibility over operative cases as they progress through the program. Instructional videos supplement this model by exposing surgeons to additional procedures, techniques, anatomical variations, and complications they may not otherwise encounter due to duty-hour restrictions or case types their attendings accept (Green et al., 2019). Video offers a visual guide for surgeons to observe intricate techniques and gain insight into the nuances of procedural steps. Furthermore, video enables surgeons to revisit specific segments of an operation as frequently as needed to reinforce their understanding. In addition, videos can be viewed in any place and at any time according to the surgeon's schedule. A systematic review by Youssef et al. (2023) found that video-based surgical education is effective for learning surgical skills, though the studies included in the review failed to indicate if they have a long-term impact on patient outcomes due to their limited durations.

Not all instructional videos are effective. A systematic review by Green et al. (2019) found that including schematics, diagrams/labels, and audio of procedure narration had >75% association with improved training. These findings are in line with Mayer's (2002) Cognitive Theory of Multimedia Learning and several of his 12 Principles of Multimedia Learning, including the *multimedia principle*: a combination of words and pictures, the *signaling principle*: highlighting key points with labels, and *temporal contiguity principle*: voiceovers. Surveys by Rapp et al. (2016) found that YouTube is the most frequently used source for surgical videos; however, a simple YouTube search reveals that not all surgical videos are made with multimedia principles in mind. Ninety-six percent of articles in a systematic review found that surgical videos on YouTube lacked educational quality (Gorgy et al., 2022). Furthermore, Halim et al. (2021) found no correlation between engagement metrics (views and likes) and content quality. These authors recommend directing learners to surgical journals and societies that offer peer-reviewed surgical videos; however, the barriers to publication, including time, cost, and loss of ownership, make it challenging to compete with social media.

Video-Based Assessment

Birkmeyer et al. (2013) published a landmark study using video assessment to establish a correlation between surgical technical skill and patient outcomes in bariatric surgery. Since then, there has been increasing interest in using video to evaluate surgeons' performance, and this study has been replicated numerous times across surgical specialties with similar findings (Brajcich et al., 2021; Fecso et al., 2019; Hogg et al., 2016; Jung et al., 2018; Stulberg et al., 2020).

In July 2023, the American Board of Surgery (ABS) moved from time-based to competency-based assessment for general surgery residents by introducing Entrustable Professional Activities (EPAs) (*Entrustable Professional Activities (Epas) for Surgeons*, n.d.). EPAs are observable units of work performed by residents and evaluated by faculty for feedback and assessment. In conjunction with this change, ABS introduced a pilot program exploring the use of video-based assessment as part of the board certification process (Pryor et al., 2023). Video-based assessment alleviates the time and resource limitations of requiring expert surgeons to directly observe trainees in the operating room (Mcqueen et al., 2019). Videos can be reviewed at increased playback speed, and assessors can focus on only pertinent parts of an operation to reduce assessment time by 50% to 80%. Videos can be submitted anonymously to prevent bias in the evaluation process and can be rated by multiple evaluators to increase reliability, which is impossible in a live operation. As video-recording capabilities in the operating room become more ubiquitous, more medical institutions are requiring surgeons to submit operative videos before approving hospital credentials or offering employment.

There are several different valid and reliable scales and metrics that can be used to evaluate surgical skills. The most commonly used scale is the Objective Structured Assessment of Technical Skill (OSATS) (Martin et al., 1997). Its seven domains, which include *respect for tissue, time and motion,* *instrument handling, knowledge of instruments, use of assistants, flow of operation and forward planning,* and *knowledge of specific* procedure, can be evaluated using a Likert scale. The advantage of this scale is that it can be used to assess any surgical modality (e.g., open, laparoscopic, robotic) and any surgical specialty (e.g., general, colorectal, urology, etc.). The Global Operative Assessment of Laparoscopic Skills (GOALS) is used to evaluate surgical skills in laparoscopic surgery. Its four domains include *depth perception*, which measures target accuracy; *bimanual dexterity,* which measures the utilization of both hands; *efficiency,* which measures speed and movement; and *tissue handling* (Vassiliou et al., 2005). Likewise, in robotic surgery, the Global Evaluative Assessment of Robotic Skills (GEARS) scale is used. This assessment tool measures the same four domains as GOALS and includes a fifth domain for *robotic control*, which measures camera and arm control (Goh et al., 2012). Like OSATS, the GOALS and GEARS scales can be applied to any surgical specialty using laparoscopic or robotic devices.

While these scales focus mainly on technical skills, other more detailed and encompassing scales have been developed for specific surgical specialties and procedures. For example, the valid and reliable Competency Assessment Tool (CAT) was designed to assess the laparoscopic skills of colorectal surgeons (Miskovic et al., 2013). Similar to OSATS, it assesses *instrument use, tissue handling, errors*, and *end-product*, but these four domains are evaluated for each of the four main tasks of a colorectal procedure: *exposure, pedicle control, mobilization,* and *resection/anastomosis.* The result is 16 competencies to be assessed rather than four, five, or seven as evaluated by the previously mentioned scales. The CAT offers a more comprehensive evaluation of a surgeon's performance. However, it also requires more time for assessment and an evaluator who is an expert in the specific procedure. The other, more commonly used scales have been found to be reliable even when utilized in crowdsourced assessment. Crowdsourced assessment relies on a large group of untrained individuals (crowd workers) to evaluate intraoperative videos, all using the same scale. A literature review by Olsen et al. (2022) found a strong correlation between crowd workers and expert surgeon evaluators, concluding that crowdsourced assessment can provide accurate, timely, and cost-effective feedback to surgeons.

Video-based assessment is not limited to formal settings for summative purposes. Using video for formative assessment is a learning tool that supports novice surgeons by providing constructive feedback to improve their surgical skills (Esposito et al., 2022). Crowd-Sourced Assessment of Technical Skills (C-SATS) is a subscription-based post-operative surgical insights platform that allows surgeons to anonymously upload their operative videos for formative assessment and maintain a personal video library (Ross et al., 2023). C-SATS uses crowd workers to objectively evaluate a surgeon's robotic video using GEARS or GOALS for robotic or laparoscopic cases. A surgical expert can also provide qualitative feedback, noting strengths and weaknesses, commenting on specific procedural steps, and recommending instructional videos for the surgeon to watch to improve particular skills. The advantage of a platform such as C-SATS is that it can efficiently offer formative feedback when mentorship and expert feedback are unavailable, as often is the case after the completion of surgical training (Tommaselli et al., 2022). Surgeons who choose to participate in a surgical coaching program find that they often begin with an expert first evaluating the mentee's video for formative assessment and then meeting with them for a guided video review and evaluation while providing strategies, recommendations, and video resources for surgical skill improvement (Fainberg et al., 2022). C-SATS and coaching programs offer feedback for a monetary fee, which is a barrier to access for many surgeons. Alternatively, surgeons can post their operative videos on social media, such as private surgical groups on Facebook (www.facebook.com) and specialty communities on the SurgeOn app (www.surgeonapp.com), to solicit formative feedback and operative advice free of charge.

Video-based assessment is not without its limitations. Though video recording technology is continually improving, recording open surgeries is not very common as it requires a room camera or GoPro headset, and it limits the privacy of the operating room team (Brennan & Kirby, 2023).

Standardizing video-based assessment for board certification or hiring practices would require a significant monetary investment by hospitals to purchase available technology (Ross et al., 2023). Several ethical and legal considerations surround video recording in the operating room (Quach et al., 2023). The question of intellectual property and data ownership arises, as does privacy and the risk of surgical videos being used as evidence in malpractice lawsuits. A survey on video recording in the operating room found that 63% of gynecologists, urologists, and residents surveyed preferred video recording only without audio (Van De Graaf et al., 2021). In the case of formative feedback, there is little quality control when seeking advice from online crowdsourced and social media platforms (Schlick et al., 2020). While video-based assessment can offer valuable feedback, it is not a reflective process. The use of scales and evaluators determines if specific criteria are being met (Cook & Hatala, 2016), whereas reflection is an introspective process that promotes a deeper understanding of performance and critical thinking (Kim, 1999). Despite these reservations, it is clear that the use of video-based assessment is increasing and will continue to grow and be implemented throughout the field of surgery, from training to certification, credentialing, and even employment (Prebay et al., 2016).

Video Review

Video review involves recording and playing back one's professional practice for analysis (Tripp & Rich, 2012). Video-based assessment differs from video review in that the former is intended to be viewed by evaluators, while the performer conducts the latter as a means of self-reflection and self-assessment. Unfortunately, video review appears to be an underutilized use of video in the field of surgery, as a literature search failed to retrieve any surveys or reviews examining how common video review practice is for surgeons. Additionally, only five percent of residency programs reported regularly using video recording in their operating rooms; it can be inferred from this statistic that video review is not commonly practiced in training (Esposito et al., 2022). A longitudinal study on the perceived usefulness of surgical residents recording their simulation performances for a video portfolio found that only 36% of the participants accessed their videos over the course of one academic year (McKinley et al., 2019). Though 95% of the residents expressed interest in access to a video library of their attendings' surgical procedures, only 59% were interested in recordings of their own performances, and 45% desired to review their videos with a senior resident or faculty member.

Only one article, written by the researcher, explored best practices and recommendations for video review; however, the study was limited to interviewing eight expert robotic colorectal surgeons (Soliman & Soliman, 2023). Despite this, there is evidence that video review is an effective way to improve professional skills across multiple fields, from teaching to sports, aviation, and surgery (Ali & Miller, 2018; Baecher et al., 2018; Walker et al., 2020; Zhang et al., 2019). In the surgical literature, video review for the purpose of *reflection* is not explicitly evident; instead, it is used as a means of self-debriefing with the goal of improving self-assessment and surgical skills (Nayar et al., 2020; Van der Leun et al., 2022), which is a direct consequence of reflective practice.

The first study to report the effective use of video review was by Goldman et al. (1970), who found that surgical trainees permitted to watch their recorded performance of an open inguinal hernia repair, either with expert guidance or independently, significantly decreased the number of inappropriate surgical movements in a subsequent operation compared to trainees who did not watch their recorded performance. Since this seminal work, numerous studies have replicated the positive effects of video review, including improved self-assessment, improved surgical skill quality and speed, and reduced skill degradation.

Jamshidi et al. (2009) found that residents who reviewed their videos twice on videoscopic suturing significantly improved in quality and time compared to the no-video control group. Likewise, Van der Leun et al. (2022) found significantly higher improved surgical simulation scores for medical students who were provided with their video performance and an expert benchmark video during practice sessions compared to medical students who were permitted to practice on a simulator without video. Vyasa et al. (2017) found that residents who watched their videos of a colonoscopy simulation improved their post-test performance over those who only practiced on a simulator. Kun et al. (2019) found that video review following a 72-hour delay from simulation performance reduced skill degradation compared to no video review. This is significant because it highlights the benefit of objectively watching one's performance and noticing aspects of the performance that may have been missed otherwise if relying on one's memory. Phillips et al. (2017) found that providing medical students with their video performance and an expert video is more effective than providing direct expert feedback without video. Independent video review has also improved the nontechnical skills of resident anesthesiologists to the same degree as residents who received expert debriefing without video assistance (Boet et al., 2011). A grounded theory study on how expert surgeons conduct robotic video reviews revealed several benefits of video review, including the ability to examine critical incidents objectively outside the pressure of the operating theater and the opportunity to track one's progress along the learning curve, resulting in perseverance and a growth mindset (Soliman & Soliman, 2023).

Not all studies support the conclusion that video review alone provides marked surgical improvement over other intervention methods. Halim et al. (2021) found no statistical difference between residents who self-assessed themselves performing laparoscopic intracorporeal suturing using video review and residents who received expert verbal feedback; however, they found that residents who received expert video feedback outperformed the other two groups. Likewise, both Hawkins et al. (2012) and Scaffidi et al. (2019) found that video review alone did not improve the self-assessment skills of surgeons. Aldinc et al. (2022) found significant improvement in the cricothyroidotomy performance of medical students who received expert video feedback compared to those who conducted video reviews alone.

These studies claim that independent video review is an ineffective technique for improving surgical skills; however, a more accurate statement is that *unguided* independent video review is inadequate. The participants in these studies were not explicitly taught how to conduct a video review; therefore, they failed to effectively reflect on their practice, resulting in limited learning or skill improvement. Asking novice surgeons to simply review their videos generates minimal learning because they are attempting to navigate a domain they have limited prior knowledge of; in other words, they do not know what they do not know (Kruger & Dunning, 1999). Ideally, all novice robotic surgeons should have access to guidance and support; however, providing experts to guide them through their video review is not a readily available solution. Fortunately, the literature points to alternative strategies novices can use in place of expert guidance.

Expert Video Review

Understanding expert surgeons' tacit knowledge and how they conduct video reviews can provide insight into what strategies novices can employ when instructors are not readily available to support them directly (Soliman & Soliman, 2023). The Implicit Theory of Intelligence is a motivational theory that posits that those with an entity (fixed) mindset believe that their ability and intelligence are static; thus, success is the result of talent. Conversely, those with an incremental (growth) mindset believe that ability and intelligence can be developed; thus, success is the result of effort (Dweck & Dweck, 2000). Mindset determines goal-orientation: those with a fixed mindset are performance-orientated, meaning they are concerned with performing better than others, whereas those with a growth mindset are learning-oriented, meaning they are concerned with developing new skills and value learning in and of itself (Wolcott et al., 2021). Many expert surgeons exhibit a growth mindset, which is precisely one of the attributes that, in turn, makes them experts. They continuously reflect on their surgical videos because they believe there is always room for improvement (Soliman & Soliman, 2023). Without a learning-oriented mindset, video review will produce little benefit.

There is a direct correlation between years of experience and noticing abilities; in reviewing videos, experts have developed the ability to notice relevant information that novices are still developing (Yang et al., 2021). The ability to improve noticing can be effectively taught through video-based learning (Qi et al., 2022). Asking surgeons what they pay attention to and what they notice while reviewing robotic videos provides a framework for what novices should be taught. Likewise, expert surgeons ask themselves numerous questions within several categories when reviewing videos, including safety concerns, efficiency, procedural steps, critical incidents, future planning, and general reflection (Soliman & Soliman, 2023). Many of these questions follow Gibb's Reflective Cycle described in chapter one, including *how do I feel, how did I do, what could have I done differently,* and *what is my goal for the next operation?* Providing novices with a list of questions they can ask themselves during video review can improve their noticing abilities and help develop a growth mindset, resulting in effective reflective practice.

Expert surgeons have greater situational awareness and can anticipate and avoid problems. Situational awareness is the ability to perceive the elements of an environment, comprehend what they mean, and anticipate future states of the environment (Endsley, 1988). When experts review videos of critical incidents, they not only examine what went wrong but also assess what circumstances, decisions, and techniques led to the incident to begin with, and they determine what they will do differently next time (Soliman & Soliman, 2023). They are reorganizing their mental schemas through reflective practice and abstract conceptualization, which in turn leads to improved surgical skills and better patient outcomes (Kolb, 1984; Schön, 1983). Situational awareness requires prior knowledge, which is cultivated through experience and expertise – qualities that novices inherently lack. The absence of experience can be supplemented with other methods, such as intraoperative videos, as a way for novices to build up their prior knowledge.

Benchmark Videos

Instructional surgical videos are increasing in numbers across social media platforms such as YouTube, Facebook, and SurgeOn, as well as in published journals and surgical society websites (Lima et al., 2022). Not only are surgeons using these instructional videos to learn or solidify their procedural knowledge preoperatively, but they are also using them as benchmark videos to compare their operative performance to exemplary videos postoperatively. While previously mentioned studies found that video review alone did not improve self-assessment, having surgeons conduct independent video review *with a benchmark video* improved their ability to self-assess (Hawkins et al., 2012; Scaffidi et al., 2019). In a qualitative study, expert robotic surgeons insisted that watching other surgeons' videos is equally essential as watching one's own videos because "novices don't know what good looks like" (Soliman & Soliman, 2023, p. 7). Providing explicit benchmarks can prevent learners from employing subjective criteria to assess themselves or comparing themselves to others instead of objective standards. Benchmark videos are effective because they allow one to compare and reflect on performance, resulting in more accurate self-assessment (Kruger & Dunning, 1999).

Video Review Guides

Video review can further be supported with the use of video review guides. Kirschner et al. (2006) acknowledged that an instructor is not always available to provide direct instruction and determined that process worksheets can be utilized as a form of direct instruction as effectively. A literature review by Tripp and Rich (2012) found that teachers prefer to analyze their videos using an observation guide. Kong et al. (2009) created a guiding framework for student-teachers to use during video review to scaffold their self-reflection because they are not yet discerning enough to identify pertinent aspects independently. Medical students who conducted structured self-assessment through the use of a checklist required fewer repetitions to master a mastoidectomy simulation compared to those who did not self-assess (Andersen et al., 2019). Finally, Wang et al. (2020) argued that guided video reflection is a novel tool that combines the concepts of video review with structured reflective practice, which may improve self-assessment accuracy and circumvent the need for an external expert or coach. Their study found that providing a group of medical students with a video of their knot-tying performance, a video review guide, and a benchmark video resulted in comparable performance to a group that was provided with expert feedback and one hour of expert guidance. The video review guide group achieved competency with fewer resources, saving time and money. Providing novice surgeons with a written video review guide encompassing expert techniques described in the previous section, such as reflective questions and prompts to guide what novices should pay attention to, may enhance their self-debriefing skills.

It is important to note that a video review guide is different from an assessment scale such as OSATS, GEARS, etc. Assessment scales serve as prescriptive checklists and outcome measures to ensure specific criteria are met, and tasks are completed consistently with minimal error (Martin et al., 1997). Reflective guides are more introspective and aim to facilitate critical thinking and thoughtful analysis of one's performance, what led to the quality of the performance, and changes that can be made to future performances (Nagro et al., 2017). While objective scales focus on performance and can improve self-assessment, they may not always promote a cycle of continuous learning and development in the same way a reflective guide can. Guides can help develop reflective skills in novices that experts exercise tacitly. They are a self-help tool that provides a methodology for a complex metacognitive process. Reflective guides offer flexibility in the amount of attention each step receives and serve as a bridge for novices to learn reliably until they can examine more subtle aspects independently (Leise & Beyerlein, 2007).

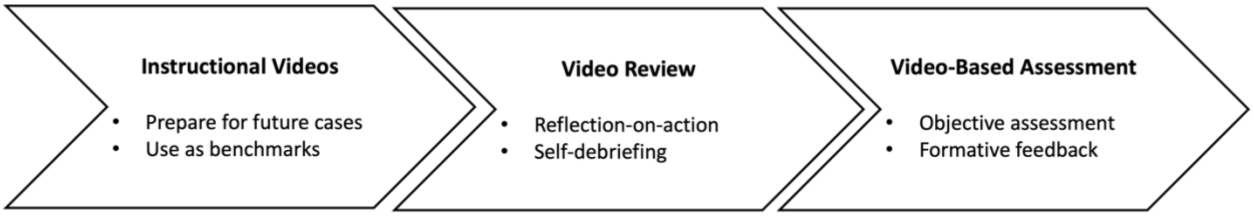

Figure 5

The Role of Intraoperative Videos in Surgical Education

Perceived Usefulness

The best tools have little worth if they are not utilized. The second sub-question of this study seeks to understand to what extent novice robotic surgeons find written surgical video review guides useful. Perceived usefulness is defined as the extent to which an individual believes utilizing an object or system will improve their job performance (Davies, 1989). This construct is most frequently used and measured as part of the Technology Acceptance Model (TAM), which is used to determine behavior intention and, ultimately, the likelihood of a product being adopted. The factors that influence perceived usefulness include ease of use, how compatible the tool is with the user's existing practices, beliefs, and values, the perceived benefits of the tool, and the opinions, recommendations, and experiences of others (Venkatesh & Davis, 2000). A systematic review of the adoption of mobile health applications validated the importance of perceived usefulness by healthcare professionals in choosing to utilize a new technology (Gagnon et al., 2016).

Summary

Reflective practice is not an innate skill but is most effective when explicitly taught (Gray & Coombs, 2018). A common form of reflective practice during surgical training is debriefing with a surgical attending post-operatively; however, this practice is not always completed effectively and often ceases once surgeons operate independently. The use of video in surgical education takes three forms: instructional videos, video-based assessment, and video review. All three forms are beneficial and should be utilized, but each serves a different purpose; thus, they are effective in various ways. While the literature on the first two forms is robust, video review is currently being utilized in a limited manner. Independent video review can serve as a catalyst for reflective practice when conducted properly. In place of conducting video reviews with expert surgeons, novices may be provided with benchmark videos and video review guides to achieve equivalent levels of accurate self-assessment and surgical skill improvement; however, to date, there are no video review guides for robotic surgeons. This dissertation contributes to the field of surgical education by testing the efficacy of a video review guide on robotic surgical skill improvement.

CHAPTER THREE: METHODOLOGY

This research study utilized the Experiential Learning Cycle (Kolb, 1984) as a framework to examine the effect of guided but independent video review on robotic surgical skill improvement. Constructs from Gibb's Reflective Cycle (1988) were woven through a written surgical video review guide and provided to novice robotic surgeons to explicitly teach them how to reflect on their surgical performance. This chapter explains the study design, participants, instrumentation, data collection, and analysis.

Research Questions

To evaluate the effectiveness of an intervention designed to improve robotic surgical technical skills, this study sought to answer the following central research question and sub-questions:

CRQ: What is the impact of utilizing a written video review guide during independent video review on the surgical skills of novice robotic surgeons?

- **SQ1:** Is there a statistically significant difference in the improvement of robotic surgical technical skills using a simulator between novice robotic surgeons who conduct an independent video review using a written surgical video review guide compared to those who do not use a guide?
- **SQ2:** To what extent do novice robotic surgeons perceive written surgical video review guides as useful?

Research Design

A quantitative study with a between-group quasi-random experimental design was conducted to determine how effective a surgical video review guide is in improving the surgical technical skills of novice robotic surgeons. An experiment is a suitable research design to determine whether an intervention influences an outcome (Creswell, 2019). This experiment sought to determine whether a surgical video review guide (independent variable) accelerates surgical technical skill improvement (dependent variable), thereby reducing the length of the learning curve. The acceleration of robotic technical skill improvement was determined by comparing the outcomes of two groups: a video review-only group (VRO) served as the control, and a surgical video review guide (SVRG) group served as the intervention. Improvement in technical skill from the first to the second simulation was expected across all participants due to repetition and purposeful practice – an intentional effort to improve performance (Ericsson & Pool, 2016). The robotic simulator provided immediate performance feedback in the form of an overall score. This feedback is a characteristic of purposeful practice and may have influenced their second simulation performance. Therefore, conducting the experiment with two groups was necessary to determine whether using a video review guide significantly improves robotic surgical skills while controlling for the confounding variable of purposeful simulator practice. To ensure that the effect of the SVRG was the only variable being measured, a comparison group was also necessary to control for the confounding effect of video review.

Sample and Recruitment

The study's target population was surgeons learning how to perform robotic abdominal surgery. The surgeons may be in training, such as a surgical residency or specialty fellowship, or in practice choosing to adopt robotics into their surgical career. Acquiring a new skill takes time and effort, and the relationship between time and skill improvement can be graphically represented as a learning curve (Yelle, 1979). Learning curve theory posits that the more a task is performed, the less time and resources will be required to complete the task. The learning curve length of individuals acquiring a specific skill can vary greatly based on how much expert support they receive (Rice et al., 2020). Providing sufficient support while a learner is acquiring a new skill is critical to prevent them from abandoning the task and to maximize skill transfer (Ritchie et al., 2021). Video review guides are meant to be scaffolding tools to assist learners in gaining and retaining a new skill (McVee, 2018). This study explores the impact of a video review guide as a means of support for novice surgeons in lieu of expert support. Pernar et al. (2017) found that overcoming the robotic learning curve ranges widely from 8 to 128 cases depending on surgical specialty and case complexity, with an average of 25–44 cases to overcome the initial learning curve for colorectal cases. Therefore, for this study, a novice robotic surgeon was defined as one who has completed less than 41 robotic cases independently.

The sample for this study was gathered from two different sites, as described below. The first site was a conference held in Orlando, Florida in November 2023. The second site was a robotics training course in Peachtree Corners, Georgia, in February 2024. The participants at both locations engaged in the study similarly, enabling the utilization of a single sample.

Site One

The first group of novice robotic abdominal surgeons was recruited during the Orlando Colorectal Congress (OCC) from November 15–17, 2023. The OCC is an annual meeting for colorectal and general surgeons, residents and fellows, gastroenterologists, advanced practice providers (e.g., physician assistants, nurse practitioners), and hospital administrators. The conference's objective is to teach new surgical techniques and procedures, discuss the surgical education of colorectal diseases, and review the management of clinical scenarios. This site was chosen due to the presence of a da Vinci Skills Simulator at the conference and the attendance of approximately 100 surgeons from across the United States, which allowed the sample to be more generalizable to the study population (Salkind, 2010).

A conference organizer announced the details of the study to the conference attendees at the start of each day, informing them of the study location and inclusion criteria. The study took place in the vendor exhibit hall where Intuitive Inc. displayed a da Vinci Xi robot, vision cart, and surgeon console. Though the study was available from 9:00 am to 4:00 pm each day, the participants were recruited during the conference breaks, which limited the number of attendees able to participate. In total, 15 participants were recruited from site one, with seven in the control group and eight in the intervention group.

Site Two

To increase the sample size, more participants were recruited during a Robotic Training Advanced Course hosted by the Association of Program Directors for Colon and Rectal Surgery (APDCRS) at Intuitive Surgical, Inc. in Peachtree Corners, Georgia, from February 28–March 1, 2024. This one-day course is for colorectal fellows in the United States who have completed basic robotic training and would like to learn more advanced techniques before they enter practice. The three co-instructors were expert colorectal surgeons from across the United States. The course was repeated for three days with different fellows daily to maximize the number of attendees. This site was chosen due to the availability of two da Vinci Skills Simulators and the attendance of 42 colorectal fellows. During surgical training, attendings guide fellows through the vast majority of the surgical procedures; therefore, none of the fellows had completed more than 40 robotic cases independently, allowing them to all qualify for this study.

The attendees received didactic instruction in a conference room each morning and hands-on robotic training in a lab. Didactics was delivered in a lecture format, introducing robotic principles and steps of the robotic operation the trainees would perform during the lab. The researcher introduced the study to each cohort in the conference room and then individually invited fellows to participate in the lab. During the lab portion of the course, every two fellows were assigned to one robotic station, and the fellows took turns operating on the surgeon console. The fellows who were not operating were invited to participate in the study. Once a fellow completed the study, they switched with their partners. In total, 28 participants were recruited from site two, with 14 in the control group and 14 in the intervention group.

A total of 43 participants were recruited across both sites – 22 in the intervention group and 21 in the control group. The participants were assigned to either the intervention or control groups using stratified quasi-random sampling. This method of assignment ensured that both groups were equal at baseline. Table 1 provides the distribution of the participants by robotic experience level and gender in each group.

Table 1

Stratified Random Sampling of Participants in Each Group

	Total Sample (n=43)	Control Group (n=21)	Intervention Group (n=22)
# Robotic Cases			
0–10	21	10	11
11–20	7	4	3
21–30	11	5	6
31–40	4	2	2
Gender			
Male	22	11	11
Female	21	10	11

Intervention

This study examined the efficacy of a written surgical video review guide in improving robotic technical skills. The participants in the study's intervention group received a physical copy of the Surgical Video Review Guide (SVRG) (Appendix B) to use during the video review portion of the study. The researcher created the guide to instruct novice robotic surgeons on effectively reviewing their robotic simulation video. The guide provides questions and prompts for novices as they watch their surgical videos to enable deeper self-reflection and accurate self-assessment. The intent was that by the end of the guided but independent video review, the participants would develop a clear, actionable plan to implement during the second simulation, resulting in improved simulator performance. The participants were given a pen and the option to take notes directly on the guide.

The researcher constructed the SVRG through a three-phase process. Phase one consisted of a literature search on video review guides, methods, strategies, and tools to prompt reflection on performance. Phase two involved consolidating, analyzing, and synthesizing these reflective resources, followed by an initial design of the SVRG. In phase three, the researcher consulted with a subject matter expert on robotic surgery and video review to revise and finalize the SVRG.

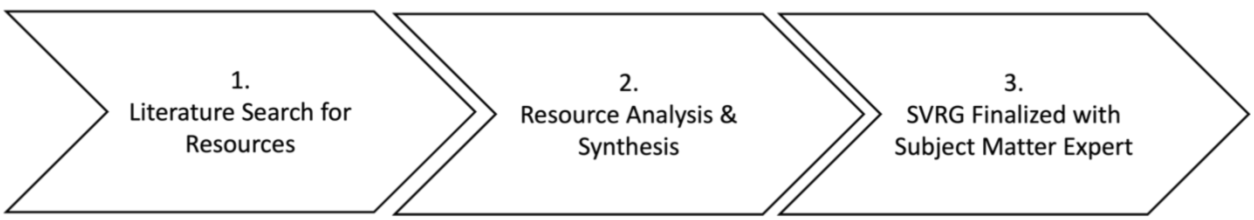

Figure 6

Three-Phase Development Process

The SVRG was constructed from a collection of evidence-based tools and strategies from previous research by Ahmed et al. (2013), Gibbs (1988), and Soliman and Soliman (2023). Following Gibb's Reflective Cycle (1988), the four main reflective questions prompt the participants to evaluate, analyze, and draw conclusions about their performance and then determine at least one change they will make during the next simulation. The SVRG follows a similar structure to the validated SHARP debriefing tool (Ahmed et al., 2013); however, it differs from SHARP in two ways. SHARP is designed to be used by attending surgeons when they debrief operative cases with their surgical trainees, and it begins with setting a goal with the trainee before the case begins. In contrast, the SVRG is designed to be used independently, and since it is constructed specifically for video review, it begins with determining the purpose of the review. The latter change was made because Soliman & Soliman (2023) found that expert surgeons first categorize their video review based on its purpose, which then determines what they pay attention to while they conduct their review. This structured approach allows surgeons to notice things they may have otherwise missed. Below each main reflective question are sub-questions to prompt further reflection, retrieved from the same study. Though expert surgeons collectively identified 65 questions they ask themselves during video review, only 10 were included, and the overall guide was limited to half a page to avoid cognitive overload (Sweller, 1988). Finally, the surgical video review guide was reviewed by a subject matter expert (a colorectal surgeon who has completed over 900 robotic cases and actively contributes to the field of surgical education) for content validation.

To implement the intervention, the participants' robotic simulation baseline performances were first video recorded. The participants in the intervention group were then provided with the SVRG and instructed to watch the recording of their baseline simulation independently while reflecting on their performance.

Instrumentation

In this study, instrumentation refers to the objective tools used to collect the participants' background characteristics, measure their technical skills, and measure their perceived usefulness of video review guides. Instrumentation consisted of a demographic survey, a robotic simulator, and two exit surveys—one for each group. To avoid collecting any identifying data, each participant was assigned a number, which they documented on both the demographic and exit surveys. The videos of their simulator performances were also saved with their assigned number, so all the participant data remained linked while maintaining anonymity. This section describes each of the instruments in detail.

Demographic Survey

Informed consent and demographics were collected through a single survey (Appendix C) hosted by Qualtrics (https://qualtrics.com). The first two questions following informed consent verified that the participants qualified for the study. *1. Have you been trained to use a da Vinci robot? (e.g. simulator exercises, basic robotic training, etc.) 2. Approximately how many robotic cases have you completed all or key portions of the operation independently?* If a participant answered *no* to question one or *41+* to question 2, the survey would have ended, and they would not be able to participate in the study. Demographic information included *gender, age, surgical position, surgical specialty, years of total surgical experience, where they live,* and *video review frequency.* Stratified quasi-random sampling based on the reported number of independent robotic cases completed determined whether each participant was in the intervention or control group. This form of sampling was chosen because the most significant indicator of surgical skill is experience (Azari et al., 2020; Ericsson, 2004). Ensuring that the participants' experience level was similar across groups increased the likelihood that the baseline simulator data would be similar, which was necessary to effectively compare surgical skill improvement between groups after the post-test.

Robotic Simulator

A da Vinci robotic simulator created by Intuitive Surgical Inc. was used to objectively measure the robotic technical skills of the participants at baseline and after video review. The participants completed the three-part *Combo Exercise* from the da Vinci SimNow Library, which is built-in software on the simulator (Figure 7). The exercise consists of a *three-arm relay*, which tests the surgeons' ability to use and control the robotic arms; *needle driving*, which simulates surgical suturing; and *energy usage*, which allows surgeons to practice cauterizing and coagulating tissue. This simulation was chosen because it highlights common technical skills required for abdominal surgery and takes less than 10 minutes to complete. In addition, it is considered a more advanced simulation, allowing for more room for improvement between pre and post-tests compared to a more basic simulation in which most participants would likely score high on their first try.

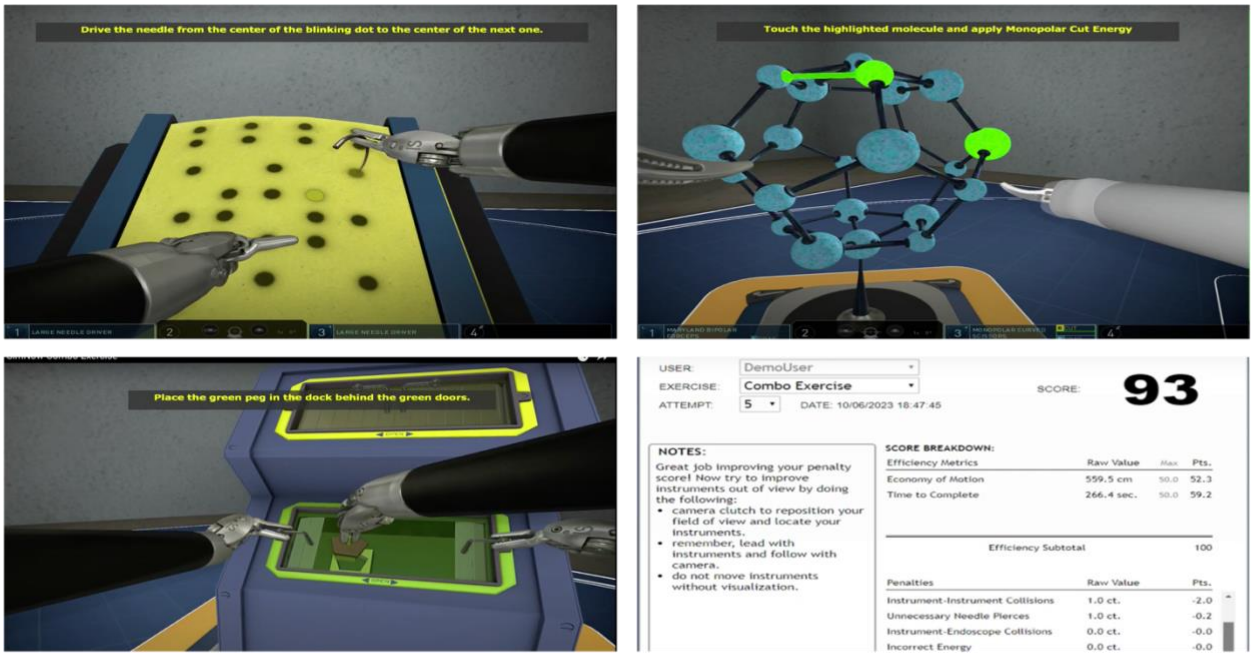

Figure 7

Images from the SimNow Combo Exercise

Note. From left to right: needle driving, energy usage, three-arm relay, score report. Images printed with permission (Appendix D).

The benefits of using a robotic simulator are that it ensures every participant receives identical tests and it can video record each participant's performance for subsequent review. The simulator collects validated objective data necessary for analysis, including time to completion – how long it takes the participant to complete the simulation exercise; economy of motion – the distance the robotic arms moved to complete the exercise; and penalties – how many errors such as robotic arm collisions, excessive force, etc. were committed. The simulator then provides a single overall score out of 100 based on these metrics (Tellez et al., 2024) (see Appendix E for a sample simulation report). The reports from the simulation exercise were used to determine the efficacy of the SVRG.

Exit Surveys

An exit survey was provided at the end of the study to gain insight into the participants' perceived usefulness of video review guides. Perceived usefulness is the extent to which a person believes a system or tool will improve their job performance (Davis, 1989). Understanding surgeons' perceived usefulness of video review guides is essential because it will determine the likelihood of them adopting the tool in their video review practice.

The participants completed one of two exit surveys depending on their group assignment (Appendix F). The exit survey for the intervention group included eight statements regarding their perception of the SVRG and six statements regarding their perception of video review guides in general. In addition, one qualitative question requests suggestions to improve the video review guide. The exit survey for the control group included the same six statements regarding their perception of video review guides in general, one statement on whether they think a video review guide would have helped them in this study, and two qualitative questions seeking to understand their video review process. The participants responded to the statements using a 7-point Likert scale, with one meaning *strongly disagree,* and seven meaning *strongly agree*.

A literature search located one existing exit survey on a video review guide designed to improve video comprehension for students learning Russian (Iskold, 2008). Three statements were adapted from Iskold's study with wording altered so that it was specific to the SVRG and video review guides in general, including, *the video review guide allowed me to notice things in my performance I may not have noticed otherwise; the video review guide was distracting,* and *I would use a surgical video review guide when reviewing my operative videos in the future.* The rest of the statements were created in collaboration with an expert robotic surgeon serving as a subject matter expert for this study, which were guided by the perceived usefulness scale and perceived ease of use scale from the Technology Acceptance Model questionnaire (Davis, 1989).

Data Collection Procedures

This research study received Institutional Review Board approval from the University of Central Florida in October 2023 (Appendix G). After data collection at Site One, a modification was submitted to IRB for approval of Site Two in an effort to increase the sample size (see Sample and Recruitment section). The modification was approved in January 2024. The following is the list of steps taken to collect data from the participants at both sites. The time it took the participants to complete the study ranged from 25 to 50 minutes.

1. The researcher approached each potential subject to participate in the study and presented them with an index card with a number written on it (the index cards were distributed in sequential order). They were asked to keep the index card for the duration of the study.
2. A sheet of paper with a Quick Response (QR) code was then presented to each participant for them to scan with their personal mobile device to access the Qualtrics survey, which contained the informed consent form and demographic questions. The participants entered their assigned number on the demographic survey and indicated how many robotic cases they had completed independently. This step was necessary to verify each participant's eligibility for the study and to stratify the participants so that the control and intervention groups had equal levels of robotic experience (see Sample and Recruitment above).
3. The participants were then presented with another QR code to access an exemplary video of the Combo Exercise simulation without audio on YouTube

(https://youtu.be/hQuDMT9wI8k). Allowing the participants to preview the simulation exercise before the pretest is consistent with findings that over 90–98% of surgeons watch surgical videos to prepare for surgery (Mota et al., 2018; Rapp et al., 2016). The participants were informed that they could increase the playback speed of the video and that they should not attempt to memorize or study the video but rather simply become familiar with what would be expected of them during the simulation.

4. While the participants reviewed the exemplary video, the researcher determined their group assignment using stratified quasi-random sampling to ensure that both groups were equal regarding robotic experience, as indicated on the demographic survey.
5. The participants then proceeded to the robotic simulator and performed the simulation Combo Exercise. At Site One, the da Vinci simulator was connected to a cloud-based system called Intuitive Hub, which allowed for direct video recording. This service was unavailable at Site Two, so the two simulators used were connected to personal laptops for video recording. The recordings were labeled with the participant number, group, and pre or post-test (e.g., 1CPre, 2IPost, etc.). The screens were turned off or turned around during the simulation to maintain the privacy of the participants during the study. The score sheet of the simulation performance automatically appears on the screen upon completion of the exercise and thus was included in each recording.
6. Upon completion of the pretest simulation, the video recording was stopped, and the participants were instructed to watch their recorded performance in its entirety. They were provided the option to pause, rewind, and adjust the playback speed as they deemed fit.
   - Participants in the control group were only instructed to review their video.

- Participants in the intervention group were given an SVRG and pen. They were told that the purpose of the guide was to help deepen their reflection, and they were instructed to refer to the SVRG while playing back the video recording of their performance. They were also given the option to write notes on the guide.

7. After completing their video review, the participants in both groups repeated the same simulation as a post-test. The second simulation performances were recorded to keep a backup copy of the results; however, the participants did not review the post-test videos. During the second simulation, the researcher recorded which group the participant was assigned to and how many robotic cases they reported performing on a spreadsheet to determine the placement of subsequent participants.
8. Finally, the participants scanned a third QR code using their personal mobile devices to access and complete the exit survey assigned to their group. The participants input their assigned number on the exit survey to link their exit survey data to the demographic survey and simulation scores.

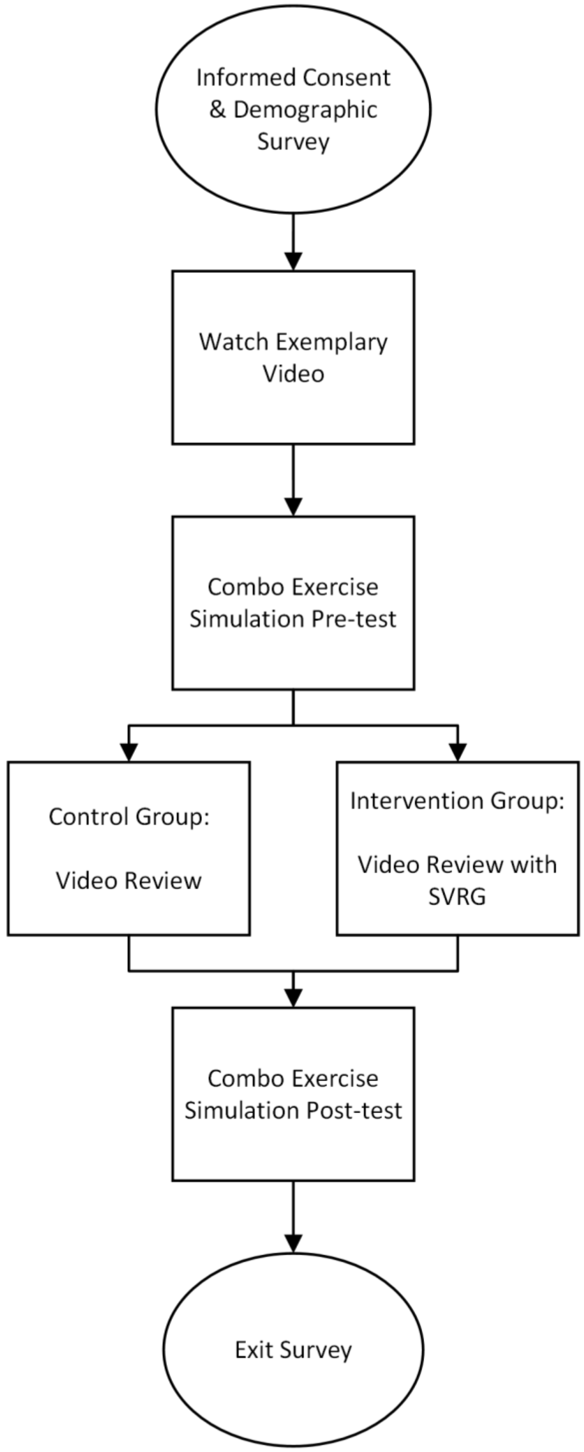

Figure 8

Flowchart of Study Procedures

Data Analysis

Data analysis for this research study consisted of quantitative analysis techniques performed using Jamovi Statistical Software. Descriptive statistics were calculated on both groups' pretest and post-test simulator data. A Shapiro-Wilk test determined if the two groups followed a normal distribution, and a Leven test was calculated to ensure the variance between groups was insignificant. Next, a Repeated Measures ANOVA between subjects and within subjects was calculated to determine what factors had an effect on the post-score. This test determines if the SVRG had a significant effect in improving the robotic technical skills of the participants. All tests were two-tailed with statistical significance set to *p*-values<0.05. Box and Whisker plots were generated to determine if there were outliers in the data and examine the variability within each group. Two scatterplots were generated: 1. To determine how well the prescore predicted the post scores of each group. 2. To determine how well the prescore predicted the difference between pre and post-scores. Finally, a correlation matrix examined if any demographic categories correlated with the pre or post scores of the participants.

Descriptive statistics were calculated on the exit survey data to determine whether novice robotic surgeons perceived video review guides as useful and if they believed the SVRG in this study helped improve their performance on the post-test. The reliability of each measure was calculated using Cronbach's Alpha. Only a few participants answered the qualitative questions at the end of the survey, so those questions were not analyzed due to insufficient data.

Threats to Validity

Table 2 lists the internal and external threats to validity and how they were addressed for this study.

Table 2

Threats to Validity

Threat	Status	Explanation
Internal		
Confounding variables	Mostly addressed	Participants in both groups were given the same procedures and amount of time.
		The baseline scores of both groups were the same.
		Having a comparison group and conducting pre/post-tests controlled for simulator practice and video review.
		Stratified quasi-random sampling controlled for prior robotic case experience.
		The study did not consider the amount of simulator experience each participant had prior to their participation. Some participants were familiar with the Combo Exercise, while others had never seen it before.
History	Mostly addressed	Most of the participants completed the study without interruption; however, because of the public locations of the robotic simulators, some of the participants were briefly distracted by people speaking to them or by their phones.
		The researcher conducted the study for all 43 participants therefore, there was no "instructor effect."
Maturation	Addressed	The participants completed the study in less than one hour.
Testing	Mostly addressed	Designing the study with two groups controls for the confounding variable of simulator practice.
		Performing the simulation twice within a short time span may contribute to fatigue; however, the average time to complete the pretest was eight minutes and seven minutes for the post-test.

Threat	Status	Explanation
		The total study duration of up to 50 minutes may have caused some participants to rush through the post-test resulting in a lower score than their pretest.
Instrumentation	Addressed	The simulator provides a validated, objective, and consistent measurement. The Combo Exercise glitched 6 times out of the 86 performances, requiring a participant to repeat the first portion of the simulation. Despite this, these participants' scores were within normal range of the group.
Statistical regression	Partially addressed	Data analysis found statistical regression towards the mean for outlier participants who scored extremely high on the pretest and worse on the post-test and for those who scored extremely low on the pretest and significantly higher on the post-test. However, there was no statistical difference between the two groups on the pretest therefore, any differences between the groups on the posttest cannot be attributed to statistical regression.
Selection	Addressed	The researcher did not personally know any of the participants and used stratified quasi-random sampling to assign the participants to the groups based on robotic experience.
Mortality	Addressed	All participants completed the study.
Placebo/nocebo effect	Mostly addressed	The participants were not explicitly informed of which group they were assigned to. Many believed video review alone was the intervention. The participants saw their pretest scores prior to the video review, and most were motivated to improve their post-test scores. Both groups perceived video review guides as useful.
Contamination effect	Addressed	The participants completed the study in less than one hour.

Threat	Status	Explanation
Hawthorne effect	Mostly addressed	There is no evidence that the researcher can influence simulator performance. The participants may have perceived video review guides as more useful because they knew this was the subject of the study.
Experimenter bias	Addressed	The simulator is an objective measure of robotic technical skill that the experimenter cannot impact.
Interaction effects	Addressed	Confounding variables such as simulator practice and video review were controlled by using a comparison group.
External		
Sample bias	Mostly addressed	The majority of the participants were colorectal fellows, who are included the target population. The study did not have many participants who were practicing surgeons in their robotic learning curve.
Reactive & interaction effects of testing	Not addressed	Surgeons would not perform an operation, review their video, and then repeat the operation in the span of one hour. Due to the limited time and access to participants, a longitudinal study was not possible, and the participants had to complete the study in one sitting.
Reactive effects of arrangements	Partially addressed	There is literature supporting the transfer of robotic technical skills from a simulator to the operating room (Schmidt et al., 2021). The ability to video record robotic operations is becoming more readily available and the SVRG is a simple intervention that can be accessed for free on any personal device. There are currently no high-quality surgical procedure simulations, so this study was limited to examining robotic technical skills using inanimate objects (e.g., pegs, doors). Surgeons review surgical videos to analyze safety, procedural steps, critical incidents, anatomy, and technical skills.

Threat	Status	Explanation
		The pre and post-test in this study were identical but no two surgical operations are identical in the same way.
Multiple treatment interference	Addressed	A single intervention was addressed in this study, the SVRG.

Summary

This study used a between-group quasi-random experimental design with a control and intervention group to determine the effect of a written video review guide on novice surgeons' robotic surgical skill improvement. A secondary research question sought to determine to what extent novice robotic surgeons find video review guides useful. The SVRG was constructed utilizing Gibb’s Reflective Cycle (1988) as a framework and evidence-based debriefing and reflective strategies for surgeons (Ahmed et al., 2013; Soliman & Soliman, 2023). Data analysis involved measuring the difference in robotic skill improvement on a da Vinci Skills Simulator between novice robotic surgeons (<41 robotic cases) who used the SVRG during the video review portion of the study and those who did not use the guide. Participants responded to Likert-scale statements on exit surveys to measure their perceived usefulness of video review guides. The following chapter will discuss the findings of this study.

CHAPTER FOUR: FINDINGS

Introduction

This study aimed to describe and analyze the effect of a video review guide on the robotic surgical technical skill improvement of novice robotic surgeons. Kolb's Experiential Learning Theory (1984) and Gibb's Reflective Cycle (1988) provided a framework for how reflection can lead to deeper learning. The use of an evidence-based surgical video review guide by surgeons aimed to enhance reflective practice. Reflective practice would result in improved robotic surgical technical skills, thereby accelerating the robotic learning curve of novices who lack expert robotic surgical support. To achieve this objective, a quantitative study with a between-group quasi-random experimental design was conducted. This chapter presents the data analysis and findings of the study.

Research Questions

The central research question and sub-questions that guided this study are listed below. The following sections present the demographic characteristics of the participants, followed by the statistical analyses and results for each sub-question. All data analyses were completed using Jamovi statistical software. A *p*-value <.05 was considered statistically significant. This chapter concludes with a summary of the results to answer the central research question.

CRQ: What is the impact of utilizing a written video review guide during independent video review on the surgical skills of novice robotic surgeons?

- **SQ1:** Is there a statistically significant difference in the improvement of robotic surgical technical skills using a simulator between novice robotic surgeons who conduct an independent video review using a written surgical video review guide compared to those who do not use a guide?

- **SQ2**: To what extent do novice robotic surgeons perceive written surgical video review guides as useful?

Participants

Data Cleaning

Data for this study was collected from two sites. To qualify for the study, the participants must be surgeons who have completed robotic training and have independently performed less than 41 robotic surgical operations. Fifteen participants were recruited from the Orlando Colorectal Congress in Orlando, Florida, and 28 from the APDCRS Robotic Course in Peachtree Corners, Georgia, for a total of 43 participants: 22 in the intervention group and 21 in the control group.

The data of two participants in the intervention group were entirely or partially removed prior to data analysis. One participant completed the Combo Exercise simulation pretest in 29.8 minutes and the post-test in 15.5 minutes, while the average time was 8.9 minutes and 7.1 minutes, respectively, resulting in a score of zero on both tests. Their data was entirely removed after concluding that they were not adequately robotically trained and, therefore, did not qualify for the study. The simulation data of a second participant was removed due to the simulator failing to provide a post-test score report upon completion. The exit survey data of this participant was included in the data analysis since they qualified and completed the entire study. One participant in the control group did not complete the exit survey; therefore, that person's simulator data was included in the data analysis of SQ1, but their exit survey data was not included in the analysis of SQ2.

Box-and-whisker plots revealed several outliers in the simulator portion of the data set; however, removing the outlier participants did not significantly affect the results. Therefore, their data remained in the final analysis to retain a larger sample size. The results of the boxplots will be discussed in further detail in a subsequent section of this chapter. Forty-two participants were included in the final data analysis, with 41 out of the 42 included in each sub-question.

Demographics

At the time of data collection, the 42 participants lived in 16 different states across the United States (see Figure 9). Table 3 outlines additional demographic information that was collected from the participants. The sample was made up of 50% males and 50% females. Since both data collection sites catered to colorectal surgeons, only two participants were general surgeons; no other surgical specialty was reported. Thirty-seven (86%) participants were in colorectal fellowship at the time of data collection and had similar years of surgical experience.

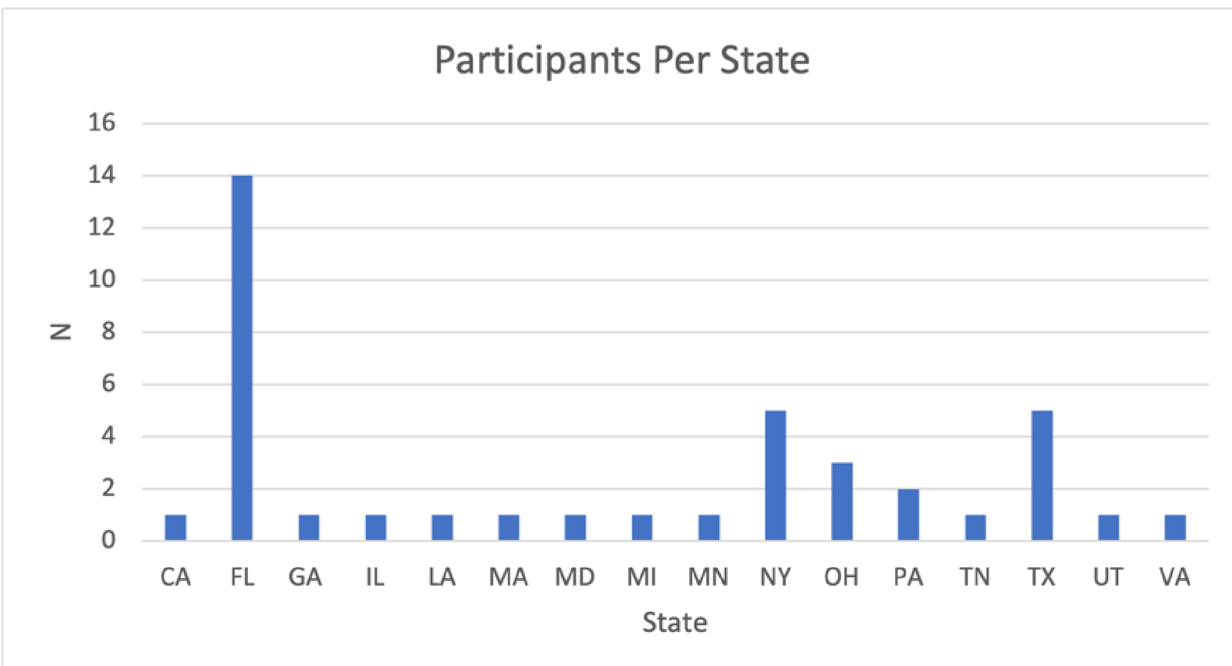

Figure 9

Count of Participants Operating in Each State

Table 3

Demographic Characteristics of Participants

Demographic Characteristics	Total Sample (n=42)		Intervention Group (n=21)		Control Group (n=21)	
	n	%	n	%	n	%
Gender						
Male	21	50	10	48	11	52
Female	21	50	11	52	10	48
Specialty						
Colorectal	40	77	20	95	20	95
General	2	5	1	5	1	5
Position						
Resident	2	5	1	5	1	5
Fellow	37	88	19	90	18	85
In Practice	3	7	1	5	2	10
Experience						
0-5 years	5	12	3	14	2	10
6-10 years	34	81	17	81	17	81
11-20 years	2	5	1	5	1	5
21+ years	1	2	0	0	1	5
Age						
25-34	23	55	12	57	11	52
35-44	18	43	9	43	9	43
45-54	1	2	0	0	1	5

Table 4 displays additional information collected from the participants at the beginning of the study. All of the participants at the APDCRS site were colorectal fellows. Several of these participants requested clarification when answering the question: *Approximately how many robotic cases have you completed independently?* The researcher instructed them to report how many robotic cases they have completed without any assistance from an attending, which may be less than the number of robotic operations they have participated in total. This question was included to ensure that both groups had equivalent levels of robotic experience at baseline. Eighty-six percent of the participants reported watching their own operative videos less than half of the time, with 41% stating they never watch their videos and 45% watching them sometimes.

Table 4

Robotic & Video Review Experience

Baseline Characteristics	Total Sample (n=42)		Intervention Group (n=21)		Control Group (n=21)	
	n	%	n	%	n	%
Robotic Cases						
0-10	20	48	10	47	10	47
11-20	7	16	3	14	4	19
21-30	11	26	6	29	5	24
31-40	4	10	2	10	2	10
Video Review Freq.						
Never	17	41	10	47	7	33
Sometimes	19	45	8	38	11	52
About half the time	3	7	2	10	1	5
Most of the time	3	7	1	5	2	10
Always	0	0	0	0	0	0
Site						
OCC	14	33	7	33	7	33
APDCRS	28	67	14	67	14	67

Sub-Question One

Is there a statistically significant difference in improvement of robotic surgical technical skill using a simulator between novice robotic surgeons who conduct independent video review using a written surgical video review guide compared to those who do not use a guide?

Da Vinci Xi robotic simulators were used to measure the robotic technical skills of the participants. The participants performed a three-part exercise from the SimNow Library named *Combo Exercise* for both the pretest and post-test. The simulator recorded the time measured in seconds and the economy of motion (path length) measured in centimeters required to complete the exercise. The simulator also counted penalties such as instrument collisions, excessive force, and improper energy use.

Based on these three metrics, the simulator provided a single overall score out of 100. The simulators were used as an objective measure of technical skill to determine the effectiveness of the surgical video review guide (SVRG) intervention.

Descriptive Statistics

Data analysis began with calculating the descriptive statistics for the intervention and control groups (see Table 5). Since time, the economy of motion, and penalties are composites of the overall simulator score, statistical analysis focused only on the pre- and post-scores of the intervention and control groups. The mean of the control group's baseline scores was slightly higher (*M* = 66.52, *SD* = 25.42) than the intervention group (*M* = 60.8, *SD* = 23.4). The post-test scores of the intervention group (*M* = 80.35, *SD* = 15.31) were nearly identical to the control group (*M* = 80.33, *SD* = 15.74).

Table 5

Descriptive Statistics for Intervention Group (n = 20) and Control Group (n = 21)

	Group	Pre Score	Post Score	Pre Time	Post Time	Pre EoM	Post EoM	Pre Pen.	Post Pen.
M	I	60.8	80.35	509.67	429.04	767.18	690.75	33.1	17.05
	C	66.52	80.33	495.56	429	754.51	691.07	26.71	16.86
SD	I	23.4	15.31	101.77	81.56	171.55	132.77	20.82	13.89
	C	25.42	15.74	150.74	81.85	185.42	137.51	18.53	13.58
Median	I	64	82.5	499.4	406.65	715.1	691.15	30	15.5
	C	74	88	472.5	418.8	717.8	633.3	23	12
Min	I	0	33	366.3	323.2	462.3	497.6	7	2
	C	6	35	290.4	281.8	537.6	524.4	2	5
Max	I	93	98	723.7	625.6	1082.3	974.2	100	65
	C	98	95	876.2	642	1252.2	961.3	77	62

Note. Score calculated out of 100. Time measured in sec. EoM = Economy of Motion measured in cm. Pen. = penalties measured as a count.

Tests of Assumptions

Tests of assumptions were conducted to ensure that the intervention and control groups were equal at baseline and that the data met specific assumptions required to conduct a repeated measures analysis of variance (RM-ANOVA). Table 6 presents Levene's homogeneity of variances test, which determined that both groups had equal levels of variance with a p-value > 0.05.

Table 6

Homogeneity of Variance Test

	Levene (F)	df1	df2	p
Pre Score	0.0604	1	39	0.807
Post Score	0.1518	1	39	0.698

Shapiro-Wilk test for normality was calculated for the pre-scores and post-scores of the intervention and control groups, and it was found that the data did not follow a normal distribution, with a p-value < 0.05 (see Table 7). However, since the sphericity assumption was met, an RM-ANOVA could still be calculated without risking a Type I error (Blanca et al., 2023).

Table 7

Shapiro-Wilk Test for Normality

Group	Variable	Shapiro-Wilk W	p
Intervention	Pre-Score	0.936	0.198
Control	Pre-Score	0.905	0.044
Intervention	Post-Score	0.821	0.002
Control	Post-Score	0.834	0.002

Inferential Statistics

An RM-ANOVA (Table 8) found a significant difference in the pre-and post-simulator scores of the participants within each group (p < 0.001), but there was no statistically significant difference in the scores between the intervention and control groups (p = 0.587). Therefore, the answer to SQ1 was there is no statistically significant difference in the improvement of robotic surgical technical skills using a simulator between novice robotic surgeons who conduct independent video review using a written surgical video review guide compared to those who do not use a guide.

Table 8

Repeated Measures ANOVA

Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p
Score	5700	1	5700	20.176	<0.001
Score * Group	169	1	169	0.597	0.444
Residual	11018	39	283		

Between Subjects Effects

	Sum of Squares	df	Mean Square	F	p
Group	167	1	167	0.300	0.587
Residual	21720	39	557		

The percentage change between the prescores and postscores of the participants was calculated, and this difference was compared to their prescores. Figure 10 demonstrates an inverse relationship between prescore and the percentage change from prescore to postscore. The lower the prescore, the greater the percentage change, suggesting this study had a ceiling effect, where there was less room for improvement for the participants who initially scored high on the pretest. In addition, there appears to be some regression towards the mean, where a few participants who scored high at baseline scored lower on the post-test.

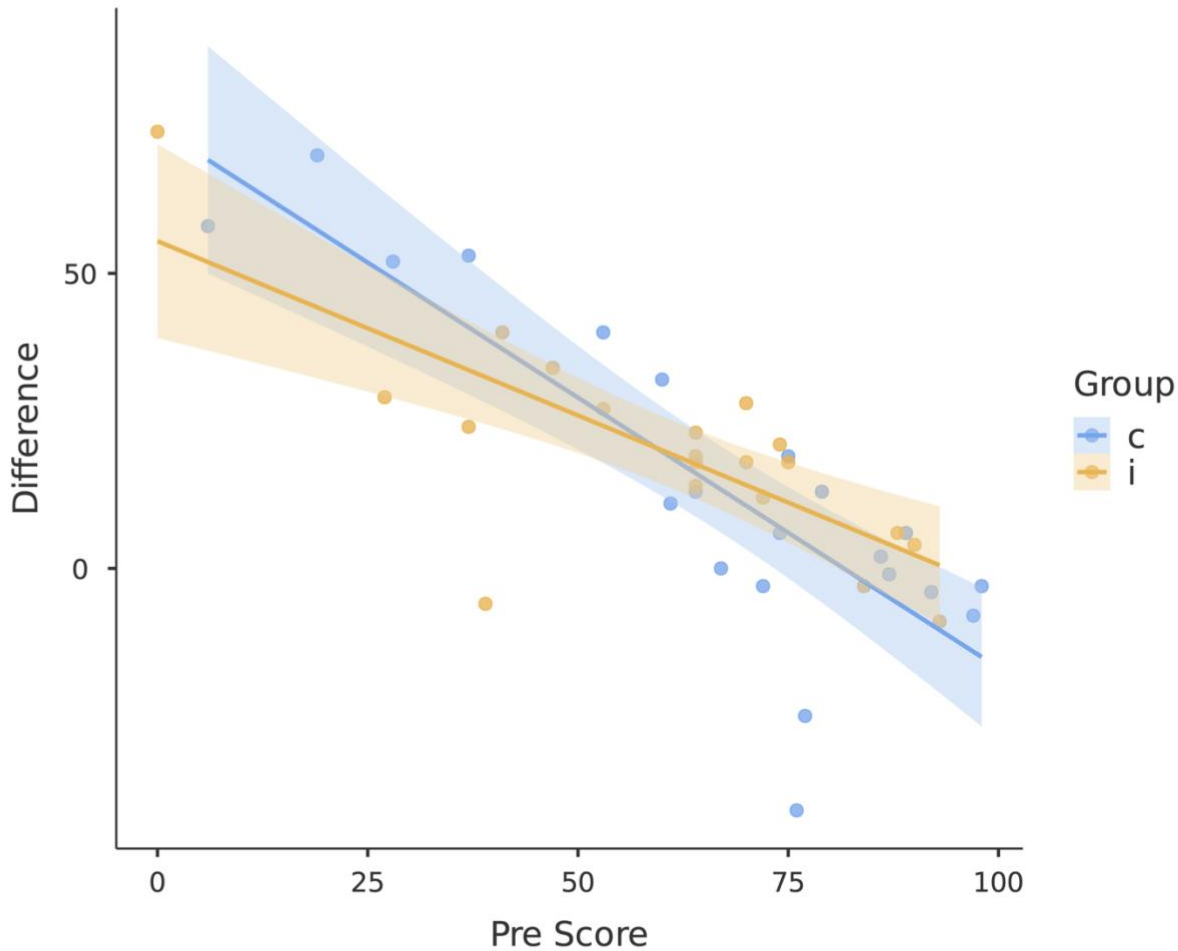

Figure 10

Scatterplot of the Score Difference Between the Baseline and Post Simulation Test

Finally, a correlation matrix was calculated to determine whether any demographic characteristics influenced the participants' robotic surgical skill improvement. Technical skill improvement was measured by the percentage difference between the participant's pre-scores and post-scores. This data was compared to each demographic category using Spearman's rho to determine if a correlation existed. No correlation was found between demographic characteristics and skill improvement, as shown in Table 9.

Table 9

Correlation Matrix of the Score Difference and Demographic Characteristics

		PrePostDiff	Pre Score	Post Score	Position	Yrs Experience	Age	VR Frequency
PrePostDiff	Spearman's rho	—						
	df	—						
	p-value	—						
Pre Score	Spearman's rho	-0.789 ***	—					
	df	39	—					
	p-value	<.001	—					
Post Score	Spearman's rho	0.104	0.458 **	—				
	df	39	39	—				
	p-value	0.518	0.003	—				
Position	Spearman's rho	0.058	-0.043	0.037	—			
	df	39	39	39	—			
	p-value	0.719	0.790	0.817	—			
Yrs Experience	Spearman's rho	0.045	-0.114	-0.178	0.637 ***	—		
	df	39	39	39	39	—		
	p-value	0.778	0.479	0.264	<.001	—		
Age	Spearman's rho	0.162	-0.252	-0.129	0.141	0.367 *	—	
	df	39	39	39	39	39	—	
	p-value	0.311	0.112	0.421	0.380	0.018	—	
VR Frequency	Spearman's rho	0.015	0.125	0.148	0.328 *	0.210	0.255	—
	df	39	39	39	39	39	39	—
	p-value	0.925	0.437	0.356	0.036	0.188	0.108	—

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Additional Insights

Though this study did not find a statistically significant difference in the technical surgical skills of novice robotic surgeons in the intervention group compared to the control group, some potential trends were revealed through additional data analysis. Figure 11 is a scatterplot of the relationship between the pre-scores and post-scores of the intervention and control groups. The steeper positive slope of the intervention group trendline indicates more consistent performance and pronounced improvement compared to the control group.

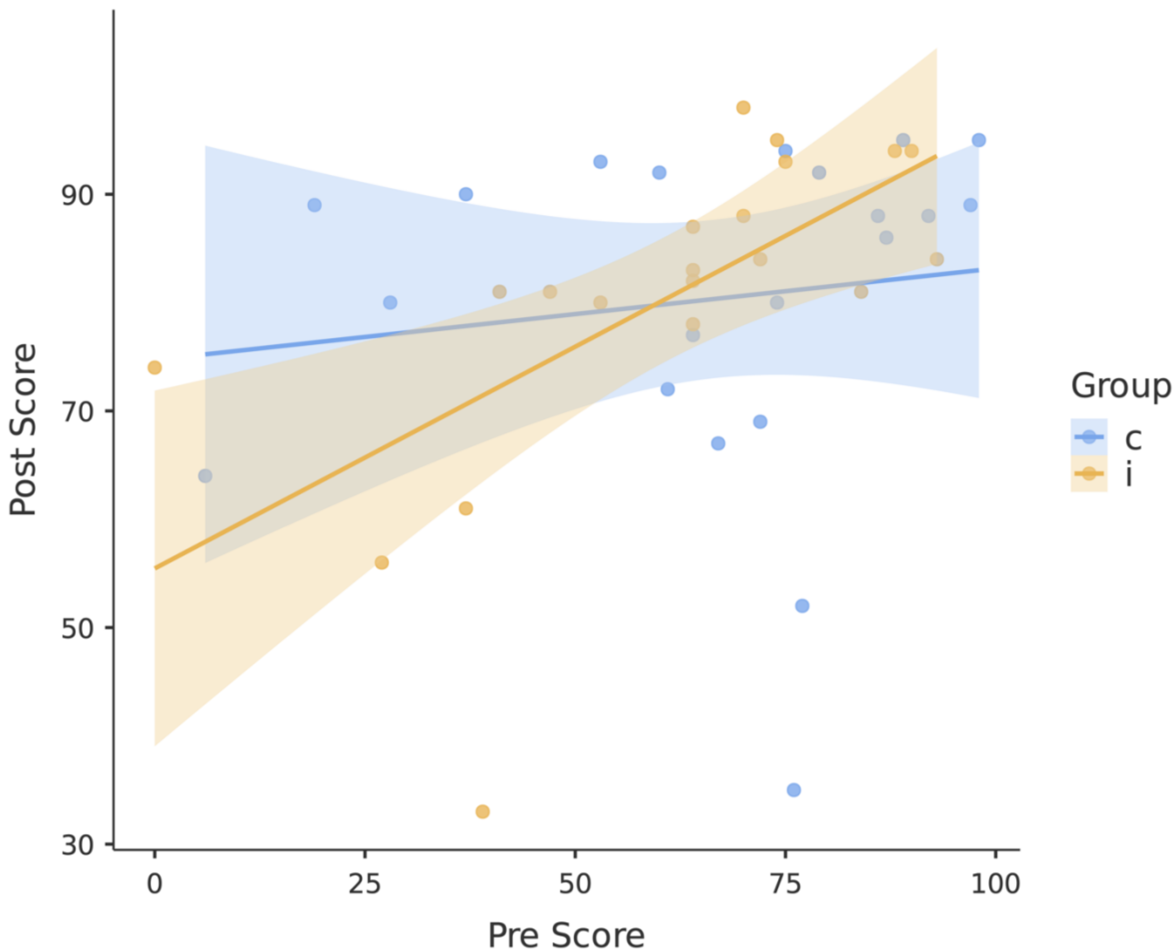

Figure 11

Scatterplot of the Relationship Between the Baseline and Post Simulation Scores

Simple linear regression analysis was conducted to evaluate the extent to which the pre-scores could predict the post-scores for each group (Tables 10 and 11). A significant regression was found (F(1, 18) = 11.58, $p = 0.003$) for the intervention group. The R^2 was 0.39, indicating that the pre-scores explained approximately 39% of the variance in post-scores. In contrast, a significant regression was not found (F(1, 19) = 0.36, $p = 0.56$) for the control group. The R^2 was 0.02, indicating that the pre-scores explained only 2% of the variance in post-scores. Therefore, the intervention had a significant impact on the relationship between the pre-scores and post-scores, whereas in the control group, the pre-scores did not significantly predict the post-scores.

Table 10

Linear Regression for Intervention Group

Model Fit Measures

Model	R	R^2
1	0.63	0.39

Model Coefficients – Intervention Postscores

Predictor	Estimate	SE	t	p
Intercept	55.46	7.81	7.10	<.001
Prescore	0.41	0.12	3.40	0.003

Table 11

Linear Regression for Control Group

Model Fit Measures

Model	R	R^2
1	0.14	0.02

Model Coefficients – Control Postscores

Predictor	Estimate	SE	t	p
Intercept	74.72	9.99	7.48	<.001
Prescore	0.08	0.14	0.6	0.556

A graphic representation of the baseline scores and post-scores using boxplots provided additional insights relevant to the efficacy of the intervention. Figures 12 and 13 reveal that the intervention group performed slightly worse on the baseline simulation (though not statistically significant) while performing equal to the control group in the post-simulation. The boxplots of the post scores (Figure 13) indicate that the intervention group had less variability compared to the control group, suggesting more consistent performance among the participants after the intervention.

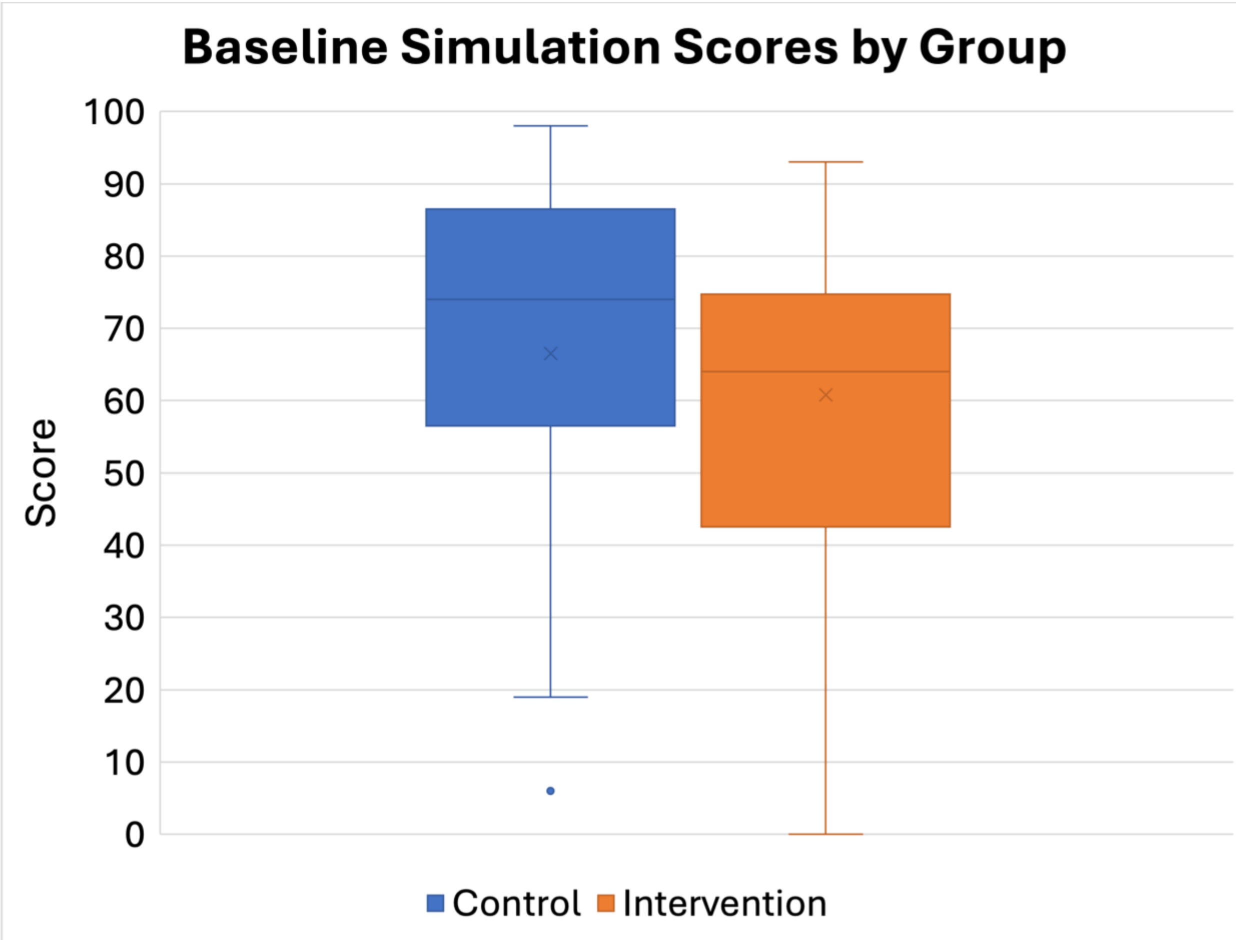

Figure 12

Box and Whisker Plot Comparison of Baseline Simulation Performance

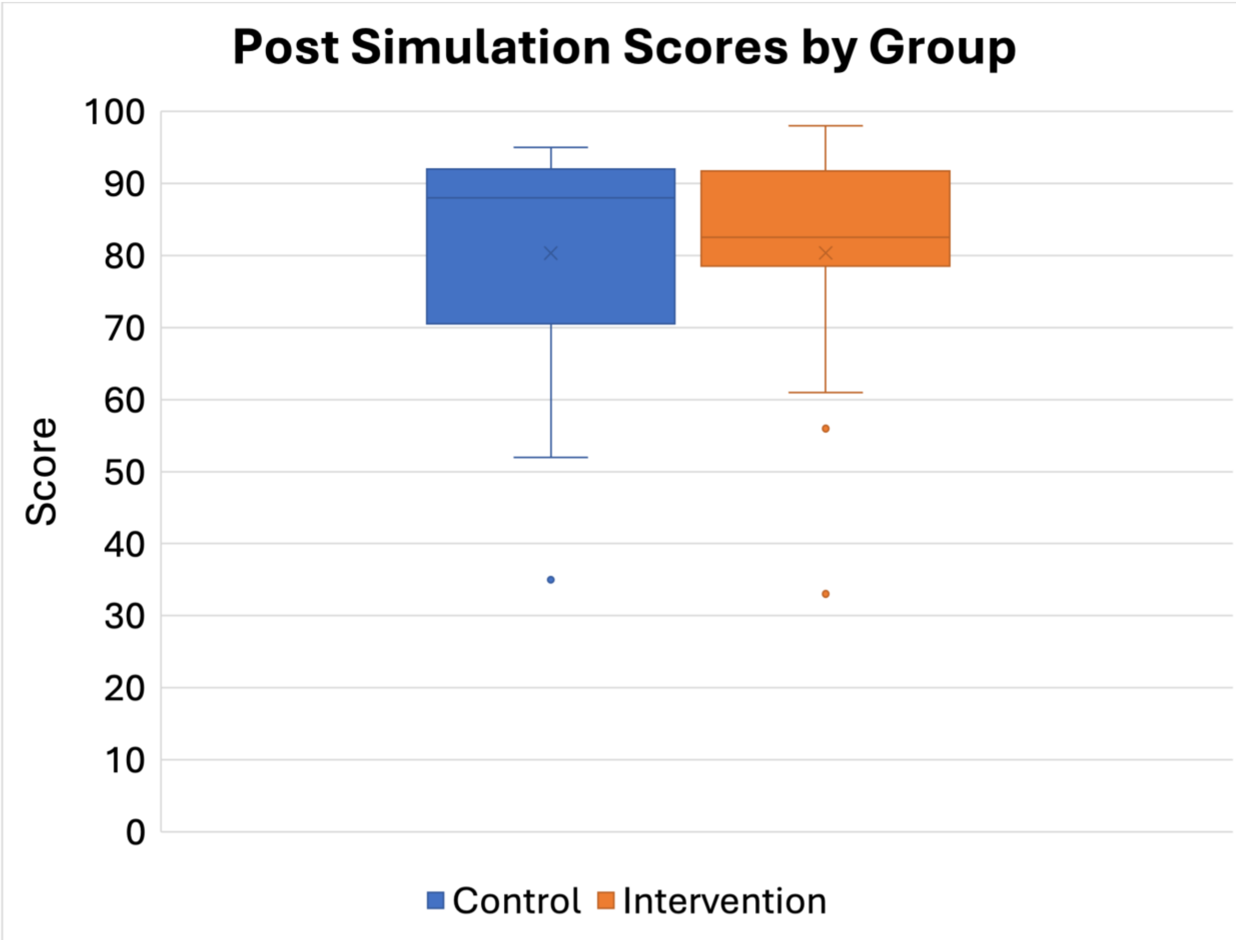

Figure 13

Box and Whisker Plot Comparison of Post-Simulation Performance

Power Analysis

With a total of 41 participants divided between two groups, a post-hoc power analysis was conducted to determine the statistical power of this study. The effect size, as measured by Cohen's d, was 0.001, and the power of the test was 0.05, meaning there was only a 5% chance of detecting a significant difference between the groups. To increase the power of this study to 80%, thus reducing a Type II error, the sample size must be increased to approximately 128 participants, with 64 participants in each group for a medium effect size ($d = 0.5$) with a significance level of $p < 0.05$.

Sub-Question Two

To what extent do novice robotic surgeons perceive written surgical video review guides as useful?

To answer the second sub-question, the participants completed one of two exit surveys at the end of the study, depending on their group assignment. Both exit surveys included six statements regarding their perception of video review guides in general (VRG statements). The exit survey for the intervention group included an additional eight statements regarding their perception of the Surgical Video Review Guide (SVRG statements). The exit survey for the control group included one statement on whether the participants believed a video review guide would have helped them on their second simulation performance. The participants responded to all of the statements using a 7-point Likert scale, with one meaning *strongly disagre*e and seven meaning *strongly agree.*

Data Analysis

Descriptive statistics were calculated to determine the extent to which the participants perceived video review guides as useful (Table 12). First, the scores from statements four from the VRG statements and 5-8 from the SVRG statements were reversed to obtain accurate means. The overall mean for the perceived usefulness of VRG was $M = 5.70$, $SD = 0.92$. Therefore, all the participants perceived video review guides in general as "somewhat useful" to "useful." The mean response for the intervention group ($M = 5.74$, $SD = 0.91$) regarding VRGs in general was slightly higher than the control group's mean (M = 5.65, SD = 1.52); however, an independent samples t-test indicated that the difference was not significant ($t(39) = 0.54$, $p = 0.59$). Likewise, there was no significant difference in the perceived usefulness of VRGs for any other covariates.

Table 12

Descriptive Statistics of Perceived Usefulness of VRGs

Statements	Total Sample (n=41)		Intervention (n=21)		Control (n=20)	
	M	SD	M	SD	M	SD
Item 1	6.00	1.05	6	0.63	6	1.38
Item 2	6.02	1.06	6.01	0.70	5.95	1.37
Item 3	5.71	1.29	5.57	1.08	5.85	1.50
Item 4	5.12	1.45	5.19	1.25	5.05	1.67
Item 5	5.61	1.43	5.81	0.98	5.4	1.79
Item 6	5.71	1.17	5.76	0.83	5.65	1.46
Total	5.70	0.92	5.74	0.91	5.65	1.52

Only the intervention group responded to statements regarding the SVRG (Table 13). The overall mean for the perceived usefulness of the SVRG was M = 5.43, SD = 1.05. Therefore, the participants in the intervention group perceived the surgical video review guide used in this study as "somewhat useful" to "useful." The participants in the control group agreed that they would have performed better on the second simulation if they had a surgical video review guide (M = 5.25, SD = 1.55).

Table 13

Descriptive Statistics of Perceived Usefulness of the SVRG (n=21)

Statements	M	SD
Item 1	5.29	1.59
Item 2	5.71	1.31
Item 3	5.29	1.38
Item 4	5.29	1.62
Item 5	4.48	1.69
Item 6	6.00	1.10
Item 7	5.95	1.02
Item 8	5.43	1.25
Total	5.43	1.05

Instrument Reliability

Cronbach's alpha was used to determine the reliability of the VRG and SVRG statements (See Table 14). The VRG statements had a Cronbach's α of 0.83. Removing statement four, *video review guides are more time-consuming than helpful*, which was the only reversed scored statement among the VRG statements, increased Cronbach's α to 0.92. The SVRG statements had a Cronbach's α of 0.89. Removing statement eight, *the video review guide was time-consuming,* only slightly increased Cronbach's α to 0.9, though it is of note that both statements inquired about the guide's usefulness compared to time consumption.

Table 14

Internal Reliability of Perceived Usefulness Scales

Scale	N of Items	Cronbach's α	If One Item Dropped
VRG	6	0.83	0.92
SVRG	8	0.89	0.9

Central Research Question

What is the impact of utilizing a written video review guide during independent video review on the surgical skills of novice robotic surgeons?

To answer the central research question, this study sought to explore both the efficacy of a surgical video review guide and the perceived usefulness of video review guides by novice robotic surgeons. The results of the first sub-question found that the SVRG was not a quantifiably effective method of improving surgical technical skills. The results of the second sub-question found that surgeons perceive video review guides as useful in that they believe that guides can help surgeons improve their surgical skills. Therefore, the answer to the central research question, that is, determining the impact of a written video review guide on novice robotic surgeons, remains inconclusive.

Summary

This chapter presented the results of the statistical analyses calculated to answer the study's two sub-questions. The answer to the first sub-question is that no statistically significant difference was found between surgeons who used the SVRG during video review and surgeons who did not use the guide. The intervention group had less post-score variability and a stronger trendline between their baseline and post-simulation scores. In response to the second sub-question, this study found that surgeons perceived both the SVRG and video review guides in general as useful. Both statistical significance and surgeon perception should be considered when determining the overall impact of utilizing written video review guides. Therefore, due to the weak power of this study, the findings remain inconclusive.

CHAPTER FIVE: DISCUSSION

Introduction

This study sought to address the problem of limited expert support and guided video review for novice robotic surgeons. The value of reflective practice and the use of video to guide reflection is well documented in the literature; however, novice surgeons struggle with these skills when tasked to conduct video review independently. The inability to properly reflect on their performance may result in a longer learning curve, poorer patient outcomes, and failure to adopt robotics into surgical practice. The present study investigated the impact of a surgical video review guide on the technical skills of novice robotic surgeons. The final chapter of this dissertation discusses the study's results in comparison to existing research. It examines the limitations of the study design and offers recommendations for future research. The chapter concludes with the study's overall significance and its implications for robotic surgical training.

Summary of the Study

This quantitative study with a between-group quasi-random experimental design examined the effect of a written surgical video review guide on novices' robotic technical skills. The purpose of the guide was to explicitly teach novice surgeons how to reflect on their technical surgical simulation performance. The Surgical Video Review Guide (SVRG) was created using Kolb's Experiential Learning Cycle (Kolb, 1984) as a framework and questions from Gibb's Reflective Cycle (Gibbs, 1988) integrated throughout the guide. Few studies have been conducted on the use of guided but independent video reviews to improve robotic surgical skills. This dissertation study was guided by the following central research question:

CRQ: What is the impact of utilizing a written video review guide during independent video review on the surgical skills of novice robotic surgeons?

To answer this central question, the study was designed around the following two sub-questions.

- **SQ1:** Is there a statistically significant difference in the improvement of robotic surgical technical skills using a simulator between novice robotic surgeons who conduct an independent video review using a written surgical video review guide compared to those who do not use a guide?
- **SQ2:** To what extent do novice robotic surgeons perceive written surgical video review guides as useful?

Forty-two participants were individually recruited from two different sites in November 2023 and February 2024. The participants were divided into two groups using stratification based on robotic case experience to ensure that both groups were homogenous. All of the participants watched a benchmark video of the simulation, performed the same baseline exercise on the simulator, and watched their performance. The intervention group was provided with the SVRG to guide their reflective process, while the control group was only asked to review their video independently. Both groups then repeated the simulation exercise and completed an exit survey based on which group they were assigned.

Discussion of Sub-Question One

Is there a statistically significant difference in improvement of robotic surgical technical skill using a simulator between novice robotic surgeons who conduct independent video review using a written surgical video review guide compared to those who do not use a guide?

Data analysis found that, on average, both the intervention and control groups significantly improved their robotic technical skills scores from the pretest to the post-test. However, no statistically significant difference was found between the two groups. The findings of this study are similar to those of another study that explored the use of a written video review guide to improve surgical skills. Wang et al. (2020) conducted a two-group experimental study with 31 participants measuring the knot-tying skills of a video guide reflection group compared to a self-regulated learning group. The self-regulated learning group received one hour of supervised practice with expert feedback, an OSATS evaluation tool, and an instructional video. The video reflection group was provided with a reflective guide, an instructional video, and their video performance. Both groups significantly improved their knot-tying abilities, but no difference was found between the groups. The authors concluded that a written video review guide was as effective in improving knot-tying skills as expert support with the added benefit of cost-savings. The present study sought to extend Wang et al.'s research by determining whether there is a difference between independent video review with a written guide and unguided video review.

The study presented in this dissertation differs from Wang et al. (2020) in several respects. The study design by Wang et al. introduced several variables between the two groups, and the data analysis failed to control for the covariates. Both groups received a knot-tying board and an instructional video, but the video reflection group was provided with two additional variables (reflective guide and video performance) that the self-regulated group did not receive. Likewise, the self-regulated group received three additional variables (supervised practice, expert feedback, and an OSAT evaluation tool) that the video reflection group did not receive. Without controlling for these five additional variables, it is difficult to determine which variable (or combination of variables) led to the improved knot-tying performance for each group. This study addressed these issues by ensuring that both the control and intervention groups received the same treatment apart from one independent variable: the SVRG. Examining the results of both the present study and Wang et al.'s together, it is evident that all the participants improved technical surgical skills irrespective of the utilization of a written video review guide or expert feedback. Skill improvement in these studies may have been the result of another variable or combination of variables, including repeated testing and the presence of a benchmark video.

This dissertation's theoretical underpinnings were Kolb’s Experiential Learning Theory (1984) and Gibb’s Reflective Cycle (1988). Continuous learning and growth within one’s surgical practice requires a cycle of planning for and performing surgery, followed by reflecting on and learning from the experience. Reflection and self-assessment are often used interchangeably in the literature, and while they are inextricably linked, they are also two distinct concepts. The purpose of reflection is to learn from experiences by deriving meaning from them and gaining deeper insights (Desjarlais & Smith, 2011). Self-assessment is a product of self-reflection but focuses more on improving one’s future efforts and skills. Video review in this study may have lacked deep self-reflection because the simulation did not offer a meaningful experience for the participants. In contrast to performing a high-risk surgical procedure on a human being, the robotic simulation required the participants to move pegs, open doors, and suture a sponge in a low-risk environment. Despite the low-risk environment, self-assessment may still have taken place since the simulation focuses on improving one’s technical skills.

Certain aspects of this dissertation’s study design were deliberately chosen based on prior research findings that examined video's influence on self-assessment and skill improvement without expert support. Specifically, the designs of four similar studies were examined: The study previously mentioned by Wang et al. (2020) had the participants self-assess themselves, and their scores were compared to the scores of external evaluators. The study found that though both groups improved their knot-tying skills equally, the self-assessment scores of the video reflection group demonstrated higher post-test reliability (0.69) with the expert evaluators compared to the self-regulated learning group (0.36). Hawkins et al. (2012) found that video review with a benchmark video improved the self-assessment scores of medical students performing a suturing task compared to video review alone.

Scaffidi et al. (2019) found that a benchmark video alone improved the self-assessment scores of novice endoscopists in the short term, while a benchmark video coupled with a video review improved self-assessment scores in the long term. Finally, Vyasa et al. (2017) found that video review and benchmark videos separately improved surgical skills, but only benchmark videos improved the self-assessment scores of novice endoscopists. These four studies highlight the importance of providing benchmark videos to novices to support their self-reflection. These studies concluded that video review alone may not be sufficient for improving the self-assessment of novice surgeons. Expert surgeons have a wealth of prior experience they can compare their performances to, whereas novices have limited prior knowledge of what to expect from a high-quality performance. When video review is coupled with a benchmark video, novices' ability to accurately judge their performance improves because they have a standard to compare themselves to (Hawkins et al., 2012).

Accurate self-assessment was a necessary skill for the participants in this study to possess to improve their technical skills. Since all of the participants were novice robotic surgeons, it was deemed necessary to provide a benchmark video based on the findings of the studies mentioned above. The present study built upon previous findings by determining what type of effect video review with a written video reflection guide would have on surgical technical skills rather than the effect on self-assessment skills. Though the effect of an SVRG is not statistically evident in this study, the improvement of surgical skills across both groups supports the positive effect of video review coupled with a benchmark video on novice surgeons.

Ali and Miller (2018) reviewed video-assisted debriefing (VAD) in healthcare and found the literature inconclusive on its effectiveness. One of the challenges the literature review faced was the lack of description of how the VAD was performed – specifically, whether it was led by a facilitator or self-led. Several studies support the use of expert-led VAD compared to self-led VAD: A study by Aldnic et al. (2022) found that medical students who received expert video feedback outperformed those who conducted video review alone in cricothyroidotomies. Likewise, Halim et al. (2021) found that surgical residents who received expert video feedback improved their laparoscopic intracorporeal suturing skills compared to those who conducted video review alone or received expert verbal feedback with no video. It is possible that the mixed findings of Ali and Miller's (2018) literature review resulted from ineffective or less effective self-led VAD. This dissertation sought to determine whether participants who conducted video review with an SVRG would outperform those who conducted video review alone, thus providing an explanation for Ali and Miller's findings. While this study did not compare expert support to independent video review, it does provide evidence that surgical skills can be significantly improved without expert support.

The findings reported in Chapter Four revealed two potential trends when comparing the intervention group to the control group. The pre-scores of the intervention group more accurately predicted the participants' post-scores compared to the control group, as indicated by the steeper trendline and linear regression. In addition, there was less variability between the post-scores of the intervention group compared to the control group, suggesting that the participants in the intervention group had a more consistent performance. While statistical significance is crucial for assessing intervention effectiveness, consistency of improvement offers valuable insights into the reliability and predictability of the intervention on the participants. The only difference between the two groups was using the SVRG since all other variables, including demographics, were controlled in this study. Wang et al.'s (2020) study found no significant difference in skill improvement between the video review guide group and self-regulated learning group; but did find a significant difference in their ability to self-assess. Likewise, it is possible that underlying learning or improvement of an unmeasured skill, such as self-assessment, occurred in the present study, accounting for the variability and predictability difference. Examining the difference in variability between groups can determine whether a larger-scale study is warranted, particularly when considering internal and external validity issues with this study (discussed in the limitations section of this chapter) (Beets et al., 2020). A statistically significant difference may not have been detected in this study due to the sample size, but it is also possible that the reduced variability was caused by chance. A larger study is required to determine if this difference is replicable.

Discussion of Sub-Question Two

To what extent do novice robotic surgeons perceive written surgical video review guides as useful?

Perceived usefulness is defined as the extent to which an individual believes utilizing an object or system will improve their job performance (Davies, 1989). The participants in this study found both the SVRG and VRGs in general to be 'somewhat useful' to 'useful.' These findings are supported by previous research that found that trainees prefer to analyze their videos using an observation guide (Kong et al., 2009; Tripp & Rich, 2012). The factors that influence perceived usefulness include ease of use, how compatible the tool is with the user's existing practices, beliefs, and values, the perceived benefits of the tool, and the opinions, recommendations, and experiences of others (Venkatesh et al., 2003). The following is a breakdown of each of these factors as they relate to the perceived usefulness of video review guides.

Effective reflective practice can enhance self-awareness and stimulate critical thinking (Patel & Metersky, 2022). As a result, reflective practice improves patient care by highlighting poor practices and empowering practitioners towards change. Despite the importance of reflective practice, many healthcare workers fail to engage in reflection and attribute this failure to the amount of time required for reflection (Davies, 2012). Ease of use refers to the extent to which one believes a tool will be free of effort (Venkatesh & Davis, 2000). Therefore, statements regarding how time-consuming video review guides are and whether they found them distracting were included in the survey to determine the participants' beliefs on the tool's ease of use. Many studies have found that learners are interested in reflection but strongly resist written reflections. Providing the participants with the option of taking notes on the SVRG without making writing a requirement allowed them to be more receptive to reflection and offered psychological safety (Holmes et al., 2018; Shaughnessy & Duggan, 2013; Tonni et al., 2016; Tuykov, 2023). Only two of the 22 participants in the intervention group chose to write on their copy of the SVRG. While a video review guide does not decrease the amount of time reflective practice requires, the participants did not believe that it would increase the required time or felt it to be an additional barrier, thus concluding that the tool is easy to use. The benefit of independent video review is that it can be performed at any time and in any place, as videos and a reflection guide can be accessible on a personal phone, which may ease the time barrier.

The perceived compatibility of a video review guide with novice surgeons' existing practices, beliefs, and values was measured by inquiring about their existing video review practices and whether they believed a video review guide would be helpful. Eighty-six percent of the participants reported engaging in video review less than half the time, with 41% stating they never watch their videos. This is consistent with reports that only five percent of residency programs regularly video-record surgical operations (Esposito et al., 2022). Video review is not the only vehicle for reflective practice; debriefing can occur post-operatively with an attending and weekly at Morbidity and Mortality conferences (Anderson et al., 2020; Keiser & Arthur, 2021). However, the lack of video review practice among surgical fellows raises the question of how common any form of self-reflection is in training and whether this skill is being transferred to surgical practice after training. The participants in this study may have perceived a guide as useful because, like the pediatric surgery residents in a study by Naumeri (2023), they recognize the value of reflective practice but do not engage in it because of a lack of guidance.

The present study did not explore the social influences on the participants' considerations of utilizing a surgical video review guide, that is, what their peers may think of video review guides. However, the participants responded positively to statements regarding whether they would recommend a video review guide to other surgeons and whether they themselves would use a guide if provided one in the future. An advantage of a video review guide is that it can be utilized independently and afford privacy to the user. There is no requirement to submit a written reflection for assessment, nor is there pressure to offer a correct and timely answer, as can be the case during a group debriefing (Verkuyl et al., 2018). When implementing video review, it is essential that it is viewed as a way to build intrinsic motivation rather than an exercise to fulfill a mandatory requirement (Truykov, 2023).

Determining the perceived usefulness of a tool is as important as measuring the efficacy of the tool. If surgeons have no interest in a product or do not perceive it as valuable, then it will not help them, even if it is effective. A systematic review of the adoption of mobile health applications validated the importance of perceived usefulness by healthcare professionals in choosing to utilize new technology (Gagnon et al., 2016). The participants in this study likewise recognized the value of video review guides for developing reflective skills and shortening the robotic learning curve.

The participants' perceived usefulness of video guides also sheds light on trainees' desire for additional support during video review. A systematic review by Lim et al. (2022) reported that one of the most common barriers to deep reflection is the lack of guidance on the know-how for learners to carry out effective reflection. The present study’s findings support the conclusions of an action research project that states that a reflection guiding tool helps learners think about aspects of their performance they would not have otherwise considered (Holder et al., 2019).

Discussion of Central Research Question

What is the impact of utilizing a written video review guide during independent video review on the surgical skills of novice robotic surgeons?

The impact of video review guides on novice robotic surgeons was explored by seeking to understand two underlying processes: the efficacy of a surgical video review guide on robotic technical skills and the perceived usefulness of video review guides by novice robotic surgeons. The results of the first sub-question found that the SVRG did not make a quantifiable difference in improving surgical technical skills over video review alone. The results of the second sub-question found that surgeons perceive video review guides as useful and as a way to help surgeons improve their surgical skills. Together, the findings of the two sub-questions provide a more well-rounded understanding of the impact of a written video review guide on surgeons. Based on the mixed results of the two sub-questions, the answer to the central research question remains inconclusive.

The findings suggest a nuanced understanding of the role of independent but guided video review in surgical training. Though the immediate impact of a guide on technical skill improvement may not be statistically evident in this study, the positive perception of video review guides among novice robotic surgeons suggests potential value and practical relevance in supporting the learning process of novice robotic surgeons. Even if video review guides do not provide immediate significant improvement in surgical skill over the use of video in general, guides can assist in building greater mental schemas by having the learner explore multiple aspects of their performance, more so than they may have examined when conducting video review without any support. Larger mental schemas will expand and solidify their prior knowledge and build their expertise (North et al., 2011). This, in turn, will improve their ability to reflect-in-action during future surgical cases and improve their surgical skills long term (Schön, 1983). Video review guides are a scaffold, a temporary tool to develop reflective skills until they become second nature (Kong et al., 2009). Guides tailored for specific procedures help novices by pointing out crucial areas they might overlook due to their limited prior knowledge and lack of situational awareness (Endsley, 1988; Yang et al., 2021). As these markers of expertise increase, the need for a video guide decreases. The participants may have been more inclined to perceive video guides as useful because they understood that they are temporary tools that do not require additional time or effort.

Furthermore, interactions between interventions need to be considered as well. A meta-analysis by Keiser and Arthur (2021) found that various combinations of different factors, including objective media, facilitation type, goal type, and duration, influence the degree of statistical significance. We know that benchmark videos coupled with video review have a positive effect on surgical skills (Vyasa et al., 2017; Wang et al., 2020), but it remains unclear whether combining these two tools with a video review guide can have an additional positive effect on surgical skills. Regardless, this study found that surgeons perceive guides as useful and validated findings that surgical skills can be improved without expert support. No negative impact was detected from the use of an SVRG, and it is possible that the intervention group experienced decreased variability in their post-scores and a stronger pre-score to post-score trendline due to the surgical video review guide.

Limitations

Considering the limitations of any study is imperative when reporting and discussing the findings. This study's limitations include sample size, simulator experience as a confounding variable, and generalizability. Prior to data collection, it was determined that a minimum sample size of 30, with 15 participants in each group, would be sufficient based on prior studies examining the effects of video on surgical skills and self-assessment (Halim et al., 2021; Scaffidi et al., 2019; Takagi et al., 2023; Vyasa et al., 2017; Wang et al., 2020). In total, the data of 41 participants was analyzed for sub-question one; however, a post hoc power analysis determined that a minimum of 128 participants would be required to detect a medium effect size.

The survey the participants took at the beginning of the study recorded the amount of robotic experience they each had. Robotic experience was essential to collect to conduct stratified quasi-random sampling and ensure that both the control and intervention groups were similar at baseline. The focus on robotic experience was due to previous research that found that surgical experience has one of the greatest impacts on surgical skills (Azari et al., 2020; Ericsson, 2004). Data analysis, however, did not find a significant difference in either simulator performance or skill improvement between the four levels of robotic experience (0-10, 11-20, 21-30, 31-40 cases) measured in this study. Unfortunately, the present study did not consider prior simulator experience. It became evident throughout the course of data collection that some participants were quite familiar with the SimNow Combo Exercise used in the study while others were not, though they had similar levels of robotic case experience. Although prior simulator experience was not measured, it did not create a significant difference between the two groups. Conversely, high levels of prior simulator experience may have created a ceiling effect for some participants and may have shortened their robotic learning curve. Currently, novice robotic surgeons are defined by the number of actual robotic cases they have performed. The variable of simulator practice is currently not being considered, though research supports the use of simulators as an effective method of improving surgical skills (Yang et al., 2017). This raises the question of if and how simulator experience can be accounted for when determining the learning curve for novice robotic surgeons.

Likewise, the survey the participants took at the beginning of the study inquired about their video review frequency but did not explicitly investigate their current reflective practice. Though the majority of the participants reported rarely reviewing their surgical videos, it is possible that they regularly engaged in other means of reflective practice and did not need a guide to explicitly teach them effective reflective strategies. Furthermore, the simulator automatically and immediately provided an objective score report to the participants upon task completion. This information may have supplemented the video review by assisting them in determining what areas they needed to focus on during the subsequent simulation. After actual operations, no such scoring system is provided to surgeons. They must determine for themselves how well they did and what areas need improvement; guided video review can support them during this self-assessment.

The current study design offered some challenges to the external validity of the results. A typical surgeon would not watch an operation, perform the operation, immediately watch the recording of their performance, and then repeat the identical operation in the span of less than one hour, as was required of the participants in this study. The quick succession of the pretest followed by the post-test may have caused a reactive effect of testing in which performing a pretest greatly influenced the results of the post-test (Willson & Putnam, 1982). Evidence from previous research shows that a video review performed 72 hours after a simulation can reduce surgical skill decay (Kun et al., 2019). Due to the lack of follow-up opportunity, the participants in this dissertation had to complete the study in a single setting; therefore, there was no time for potential skill decay or for a video review to improve their memory after a prolonged period of time.

The reactive effect of the experimental arrangement refers to participants behaving differently during a study compared to how they would behave in the real world. While there is evidence that surgical skills on a simulator transfer to the operating room (Schmidt et al., 2021), reflective practice more often occurs on complex experiences (Mann et al., 2009), which the Combo Exercise simulation lacked. Examples of complex experiences would be an operation where a complication occurred, imperative decisions had to be made, patient safety was in jeopardy, and/or multiple personnel had to be managed. Surgical skill is a combination of technical expertise, cognitive abilities, clinical and procedural knowledge, decision-making skills, situational awareness, and interpersonal skills (Azari et al., 2019). Due to the current lack of high-fidelity complex surgical procedure simulations, a technical skills maintenance exercise was chosen for this study. While the selected simulation offered a well-rounded exercise of multiple technical surgical skills, it offered very little in the way of surgical decision-making as it was a guided exercise. It provided a low-risk environment, which is atypical in the operating theater, and the exercise involved doors, pegs, and sponges rather than human tissue, nerves, and vessels, which reduced the concern of harming a patient. These simulator limitations may have resulted in reduced opportunity for reflection, which in turn limited the amount of skill improvement.

Implications for Practice

Reducing the learning curve for robotic surgeons entails implementing multiple strategies, each with its own benefit. Instructional videos can provide procedural knowledge, and simulations offer opportunities for deliberate practice. Expert support through surgical coaching and video-based assessment are ideal standards in surgical education, but unfortunately, they are not always available to novices. The findings of this study add to the existing literature by offering an additional alternative method of improving the surgical skills of novice robotic surgeons in lieu of expert support. Providing surgeons with benchmark videos and their own recorded performance can significantly improve surgical robotic technical skills. A video review guide is an additional tool that can help surgeons develop reflective skills and assist them in noticing areas in need of improvement that may otherwise be overlooked.

This study further adds to the existing literature by providing evidence that novice surgeons need to be supported during video review and that there is an interest among novice surgeons in video review guides. Reflective practice is crucial for continuous learning and professional development, but it is often overlooked by surgeons who believe they lack the skills and/or time for reflection (Davies, 2012; Naumeri, 2023). Designing video review guides for surgery would not be limited to technical skills but would encompass all surgical skills, including procedural and clinical knowledge, technical skills, safety, and interpersonal skills when interacting with the operating room staff, which can provide surgeons with an opportunity for well-rounded reflection. Assuming that surgeons already have access to video recordings of their operations, video review guides are a low-cost solution that can be utilized in any location at any time, does not require additional equipment, and can be conducted independently.

Recommendations for Future Research

Based on the results of this dissertation study and the review of current literature, the following is a list of recommendations for future research.

1. The majority of the participants in this study reported rarely reviewing their surgical videos—these findings support previous studies that recording one's operations for video review is currently not a common practice. Future research should further survey and explore the current context and frequency of surgical video utilization as well as surgeons' perceptions of video review. Educators and practitioners can develop clearer pathways to integrating video review into surgical training and continuous medical education by understanding the barriers and facilitators to video review.
2. Future research should analyze and compare the differences between expert and novice surgeons in how they review videos. Understanding the gaps between these two groups can help surgical educators develop effective interventions for novices to develop reflective practice skills more efficiently.
3. The surgical video review guide utilized by the participants was designed specifically for the robotic simulation exercise used in this study. As previously discussed, it was limited to robotic technical skills; therefore, future research should focus on measuring the efficacy of video review guides designed for actual surgical procedures that encompass multiple surgical skills, including procedural and clinical knowledge, interpersonal skills, safety, and technical skills. High-fidelity exercises simulating human tissue and surgical steps should be further developed and used to measure and test surgical skills in a more realistic environment.
4. This study utilized a quantitative exit survey to determine that the participants perceived video review guides as useful. Qualitative research exploring surgeons' needs and desires while

learning a new modality, technique, or procedure can offer meaningful insights and practical implications to help design and refine interventions.

5. A longitudinal study should be conducted to examine the effects of video review on surgical skills after six months and one year compared to surgeons who do not conduct video reviews. This research may provide a better understanding on the long-term effects of video review and how it contributes to reflective practice.
6. Wang et al. (2020) found that those in the reflection group significantly improved their self-assessment scores compared to those in the self-regulated group, even though their knot-tying skills improved to the same degree. Future studies may explore the role of reflection in improving the self-assessment skills of robotic surgeons, as there may be variation between self-assessment ability and skill improvement.
7. There has been increasing discussion regarding artificial intelligences' (AI) role in surgical education. AI can now analyze videos and offer feedback in multiple fields. While AI does not replace human reflective practice, it may be able to enhance and guide it (Abdel-Karim et al., 2023). Future research should explore training AI programs on evidence-based reflective techniques, which novices can use as a tool to guide their video review instead of expert surgeons.
8. This study failed to take into account the participants' simulator experience when determining their robotic surgery experience. Future studies should measure correlations between simulator experience and the learning curve for robotic surgeons.

Conclusion

Surgical education faces the challenge of adequately training surgeons in the face of ever-changing technology. This dissertation addressed the lack of expert support for novice robotic surgeons. Video review allows professionals to analyze and reflect on their practice to improve and refine their skills. However, reflection is not an innate skill; it should be explicitly taught. Using Kolb's Experiential Learning Theory as a conceptual theory and Gibb's Reflective Cycle as a framework, a surgical video review guide was created to guide novice robotic surgeons through the video review process. The study aimed to analyze and describe the impact of video review guide utilization on novice robotic surgeons.

The participants who utilized the guide were compared to a control group to determine what effect the guide had on their robotic skills. In addition, the study measured the participants' perceived usefulness of video review guides to determine the likelihood of novice surgeons adopting them during video reviews. Overall, the robotic technical skills of both groups significantly improved, and video review guides were found to be useful. Though there was no significant difference in skill improvement between the two groups, the intervention group exhibited less variability in their post-scores, with a stronger linear regression between their pre-test and post-test scores.

Though the study has a few limitations, the findings are relevant to the field of surgical education in several ways. The improvement across all participants validates previous findings that combining video review with a benchmark video can improve surgical skills. The perceived usefulness of video review guides provides a more nuanced understanding of the role of guidance during reflection. The desire for guidance by novice surgeons indicates that alternative, independent methods need to be considered, especially when expert guidance is not available. The guide designed for this study focused only on surgical technical skills; however, video review guides can be adjusted to fit the needs of various procedures and focus on a wide range of surgical skills, including clinical knowledge and interpersonal skills. Video review guides are a low-cost and accessible tool that surgeons can use anywhere on their own time. It is a simple solution that may assist in creating life-long reflective practitioners.

APPENDIX A: PERMISSION TO REPRINT SHARP DEBRIEFING TOOL

Sunday, September 24, 2023 at 04:56:25 Mountain Standard Time

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Subject: Re: SHARP Debriefing Tool
Date: From: To:
Thursday, September 21, 2023 at 11:15:55 AM Mountain Standard Time Mary Soliman
Arora, Sonal

Dr. Arora,

Thank you! Much appreciated!

Mary

From: Arora, Sonal <sonal.arora06@imperial.ac.uk> **Date:** Thursday, September 21, 2023 at 2:14 PM
To: Mary Soliman <ma210027@ucf.edu>
Subject: Re: SHARP Debriefing Tool

Hi Mary
Yes please do go ahead.

Many thanks Sonal

Sent from my iPhone

This email from ma210027@ucf.edu originates from outside Imperial. Do not click on links and attachments unless you recognise the sender. If you trust the sender, add them to your safe senders list to disable email stamping for this address.

On 21 Sep 2023, at 19:06, Mary Soliman <ma210027@ucf.edu> wrote:

Hello Dr. Arora,

I am a doctoral candidate at the University of Central Florida, USA, and I am conductng my research on the use of video review to improve robotic surgical skill.

I have read your work on surgical debriefing, which you wrote with Dr. Ahmed in 2013, and I think it is fantastic! My dissertation is testng whether a surgical video review guide (inspired by your SHARP Debriefing Tool) can help facilitate effective independent video review and ultimately improve robotic surgical skill.

I emailed Dr. Ahmed as she was the corresponding author, however I have not heard back from her. I realize some time has passed since its publication and she may no longer have an active email address at Imperial College.
I am writing to ask your permission to reprint the SHARP Debriefing Tool image you created in my dissertation. I believe this image will greatly benefit the reader in understanding what elements of your research were used to help create the surgical video review guide as well as offer insight into what previous research has been conducted on reflective practice for surgeons.

Thank you in advance for your consideration,

Mary Soliman

Mary M. Soliman, M.Ed.
Doctoral Candidate
Curriculum & Instruction Ed.D.
Department of Learning Science and Educational Research College of Community Innovation and Education
University of Central Florida
ma210027@ucf.edu

APPENDIX B: SURGICAL VIDEO REVIEW GUIDE

Surgical Video Review Guide

Directions: *Please watch your video in its entirety. Reflect on the following questions and prompts below as you review your simulation performance. You may pause, rewind, and adjust the playback speed as desired. Feel free to write any notes on this sheet.*

What is the purpose of this review?

- E.g., review an error, improve technique, monitor progress, share with others, etc.

How did I do?

- What went well? Where can I improve?

What did I learn?

- How was my performance different from the exemplary video, and why?

What will I do differently next time?

- Choose one area of focus to improve your robotic skill

Additional questions to think about…

Did I articulate my wrists? | Did I have wasted movements? | Did I have good visualization? | How was my bimanual dexterity? | Did I optimally position/reposition? (needle, camera, arms)

APPENDIX C: INFORMED CONSENT & DEMOGRAPHIC SURVEY

Video Review Study Demographic Survey

Start of Block: Default Question Block

Title of Study: Examining the Efficacy of a Video Review Guide to Facilitate Robotic Surgical Skill Improvement
Principal Investigator: Mary M. Soliman, Doctoral Candidate

Key Information: The following is a short summary of this study to help you decide whether or not to be a part of this study. More detailed information is listed later on in this form.

Why am I being invited to take part in a research study?
We invite you to take part in a research study because you are a surgeon with prior experience using a daVinci robotic simulator and have completed fewer than 41 robotic operations.

Why is this research being done?
The purpose of this study is to investigate the effectiveness of a video review guide in enhancing the improvement of robotic surgical skills. A potential benefit of this study is reducing the learning curve for novice robotic surgeons.

How long will the research last and what will I need to do?
We expect that you will be in this research study for 35-45 minutes.
You will be asked to:
1. Watch a video of a robotic surgical exercise
2. Perform the same robotic surgical exercise on a simulator
3. Watch your recorded performance with or without a surgical video review guide
4. Repeat the same robotic surgical exercise
5. Complete an exit survey.

More detailed information about the study procedures can be found under *"What happens if I say yes, I want to be in this research?"*

Is there any way being in this study could be bad for me?
Participating in this study involves minimal risks. Though rare, viewing 3D images on a monitor may cause temporary motion sickness, perceptual after-effects, or eye strain. The simulation exercises are designed to mimic robotic surgical tasks and might induce mild frustration or fatigue.

Will being in this study help me in any way?
We cannot promise any benefits to you or others from your taking part in this research. However, possible benefits include gaining insights into your robotic surgical skills, improved reflective and analytic abilities, and contributing to the advancement of surgical education and training methods.

What happens if I do not want to be in this research?

Participation in research is completely voluntary. You can decide to participate or not to participate.

<u>Detailed Information:</u>
The following is more detailed information about this study in addition to the information listed above.

What should I know about a research study?

- Someone will explain this research study to you.
- Whether or not you take part is up to you.
- You can choose not to take part.
- You can agree to take part and later change your mind.
- Your decision will not be held against you.
- You can ask all the questions you want before you decide.

Who can I talk to?
If you have questions, concerns, or complaints, or think the research has hurt you, talk to the research team: Mary M. Soliman, Doctoral Candidate, EdD in Curriculum & Instruction Program, College of Community Innovation and Education, UCF, at (480)206-4563 or by email at ma210027@ucf.edu. Dr. Glenda Gunter, Faculty Supervisor, Department of Learning Sciences & Educational Research at (407)823-2428 or by email at glenda.gunter@ucf.edu

This research has been reviewed and approved by an Institutional Review Board ("IRB"). You may talk to them at 407-823-2901or irb@ucf.edu if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research subject.
- You want to get information or provide input about this research.

How many people will be studied?
We expect 60 people will be in this research study.

What happens if I say yes, I want to be in this research?
You will be randomly assigned to either the intervention or control group. Both groups will watch an exemplary video of a simulation exercise and then engage in the same simulation exercise using a da Vinci robotic simulator. Subsequently, you will watch a video recording of your group's performance. The key difference between the two groups lies in the video review process.

Intervention Group: If assigned to the intervention group, you will receive a written video review guide. This guide is designed to help you independently reflect on your simulation performance and effectively analyze the video recording for areas of surgical skill improvement.

Control Group: If assigned to the control group, you will review the video recording of your simulation performance without any additional guidance.

Following the video review, you will repeat the simulation exercise to assess any potential skill improvement. You will then complete an exit survey on your perceptions of surgical video review guides.

The estimated time it will take for you to complete the study is 35-45 minutes. It will take place in the exhibit hall of a surgical conference.

Your simulation performance will be video recorded. No sound, personal images, or other identifying information will be recorded; therefore, the recording will remain anonymous. If you do not want to be recorded, you will not be able to be in the study. Discuss this with the researcher or a research team member. If you are recorded as part of this study, the recording will be kept in a locked, secure place. The recording will be erased or destroyed after five years following study closure.

The group you get will be chosen randomly; you will not choose which group will be assigned to. You will have a 50% chance of being placed in the intervention group.

What happens if I say yes, but I change my mind later?
You can leave the research at any time it will not be held against you.

What happens to the information collected for the research?
No personal or identifiable information will be collected during this study. You will be assigned a random number at the beginning of the study to track your simulation videos, performance reports, and surveys in order to compare and report performance differences within and between groups. Organizations that may inspect and copy your anonymous information include the IRB and other representatives of this organization.

Do you provide your consent to participate in this research study?

○ Yes (1)

○ No (2)

Q2 Have you been trained to use a da Vinci robot? (e.g. simulator exercises, basic robotic training, etc.)

○ Yes (1)

○ No (2)

Skip To: End of Survey If Have you been trained to use a da Vinci robot? (e.g. simulator exercises, basic robotic training,... = No

Q12 What type of robotic training have you received? Check all that apply

☐ Online training modules (1)

☐ Simulator training (2)

☐ Hands on training (3)

☐ Case experience (4)

☐ Video review (5)

Q3 Approximately how many robotic cases have you completed independently?

○ 0-10 (1)

○ 11-20 (2)

○ 21-30 (3)

○ 31-40 (4)

○ 41+ (5)

Skip To: End of Survey If Approximately how many robotic cases have you completed independently? = 41+

Q4 Please enter the number assigned to you for this study.

____

Q5 What is your current surgical position?

- ○ Resident (1)
- ○ Fellow (2)
- ○ In surgical practice (3)

Q6 Years of surgical experience (including training).

- ○ 0-5 (1)
- ○ 6-10 (2)
- ○ 11-15 (3)
- ○ 16-20 (4)
- ○ 21+ (5)

Q7 Surgical specialty

- ○ Acute care/Trauma (1)
- ○ Cardiothoracic (2)
- ○ Colon & Rectal (3)
- ○ General (4)
- ○ Gynecology/Obstetrics (5)
- ○ Otorhinolaryngology (6)
- ○ Pediatric (7)
- ○ Urology (8)
- ○ Other (9) ____

Q13 What state do you currently live in? (Please list country if you live outside the US)

____

Q8 Age

- ◯ 24 or under (1)
- ◯ 25-34 (2)
- ◯ 35-44 (3)
- ◯ 45-54 (4)
- ◯ 55-64 (5)
- ◯ 65-74 (6)
- ◯ 75 or above (7)

Q9 Gender

- ◯ Male (1)
- ◯ Female (2)
- ◯ Non-binary / Third gender (3)
- ◯ Prefer not to say (4)

Q10 How often do you review your own operative videos?

- Never (1)
- Sometimes (2)
- About half the time (3)
- Most of the time (4)
- Always (5)

End of Block: Default Question Block

APPENDIX D: PERMISSION TO PRINT SIMULATOR IMAGES

From: Gillian Duncan <Gillian.Duncan@intusurg.com>
Sent: Tuesday, May 14, 2024 5:54:28 PM
To: Mary Soliman <marymsoliman@ucf.edu>
Subject: RE: [EXTERNAL] Simulator Images

Hi Mary. You have my approval to use these images in your dissertation. I look forward to reading it!

Best Wishes,

Gillian

Dr. Gillian S Duncan
Senior Vice President
Professional Education & Program Services – Worldwide
Mobile: 1 408 373 7492
Direct: 1 408 523 2356
gillian.duncan@intusurg.com

INTUITIVE

1020 Kifer Rd
Sunnyvale, CA 94086 USA
intuitive.com

From: Mary Soliman <marymsoliman@ucf.edu>
Sent: Tuesday, May 14, 2024 12:15 PM
To: Gillian Duncan <Gillian.Duncan@intusurg.com>
Subject: [EXTERNAL] Simulator Images

Hi Gillian,

Thank you for meeting with me today!

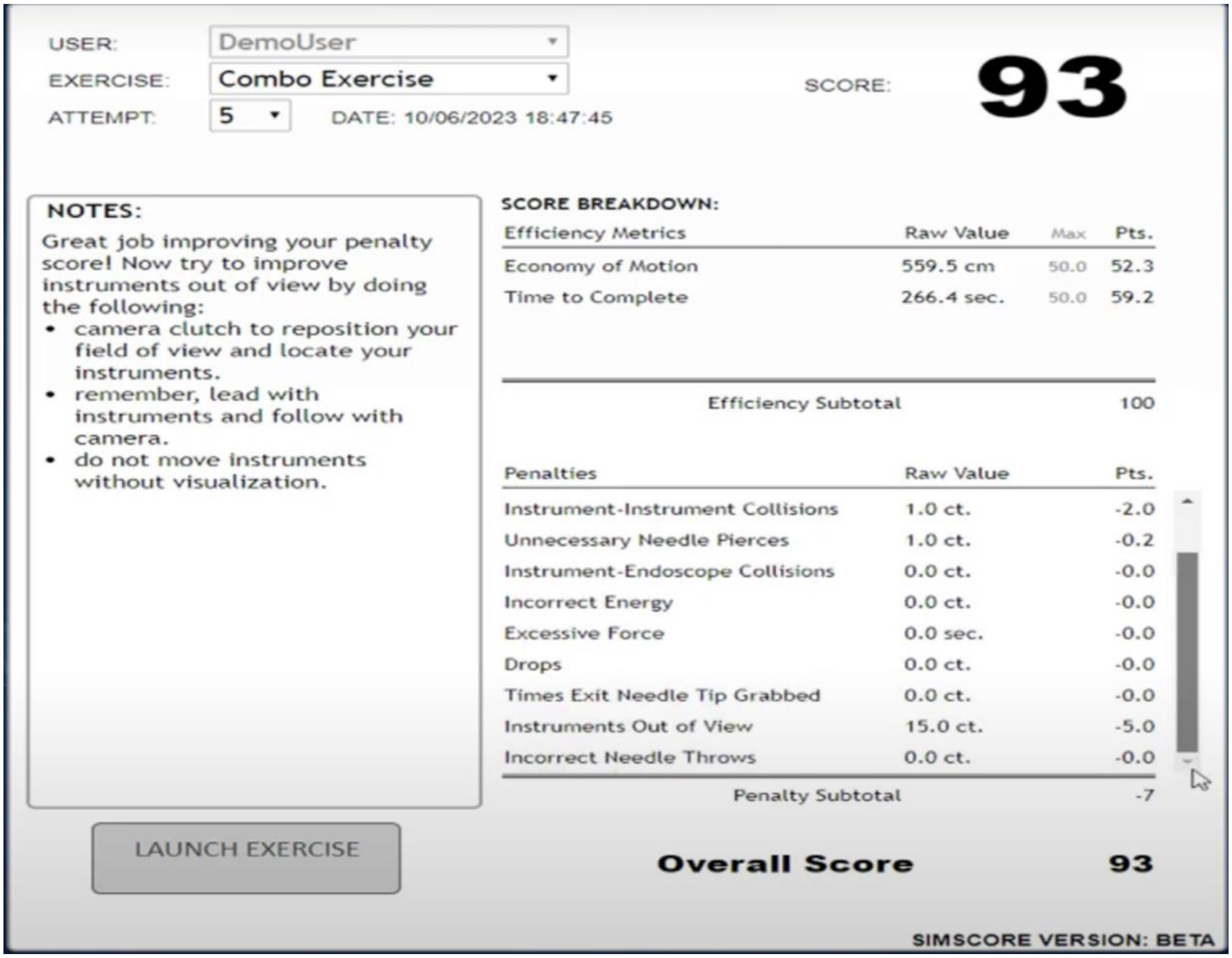
Attached are the images I would like to include in my dissertation with Intuitive's permission.

Regards,

Mary

NOTE THAT THIS EMAIL ORIGINATED FROM OUTSIDE OF INTUITIVE SURGICAL.
Be alert for fraudulent emails that spoof internal "@intusurg.com" email addresses. Report any suspicious emails using the "**Report Phish**" button. Click KB0014776 for more information on the "Report Phish" button and to learn more about differentiating phishing from spam and bulk email, please review KB0014940.

APPENDIX E: SAMPLE SIMULATION REPORT



USER: DemoUser

EXERCISE: Combo Exercise

ATTEMPT: 5

DATE: 10/06/2023 18:47:45

SCORE: 93

NOTES:

Great job improving your penalty score! Now try to improve instruments out of view by doing the following:

- camera clutch to reposition your field of view and locate your instruments.
- remember, lead with instruments and follow with camera.
- do not move instruments without visualization.

LAUNCH EXERCISE

SCORE BREAKDOWN:

Efficiency Metrics	Raw Value	Max	Pts.
Economy of Motion	559.5 cm	50.0	52.3
Time to Complete	266.4 sec.	50.0	59.2
Efficiency Subtotal			100

Penalties	Raw Value	Pts.
Instrument-Instrument Collisions	1.0 ct.	-2.0
Unnecessary Needle Pierces	1.0 ct.	-0.2
Instrument-Endoscope Collisions	0.0 ct.	-0.0
Incorrect Energy	0.0 ct.	-0.0
Excessive Force	0.0 sec.	-0.0
Drops	0.0 ct.	-0.0
Times Exit Needle Tip Grabbed	0.0 ct.	-0.0
Instruments Out of View	15.0 ct.	-5.0
Incorrect Needle Throws	0.0 ct.	-0.0
Penalty Subtotal		-7

Overall Score 93

SIMSCORE VERSION: BETA

APPENDIX F: EXIT SURVEYS

Video Review Guide Exit Survey - INTERVENTION

Start of Block: Default Question Block

Q1 Please enter the number assigned to you for this study.

____

Q2 Did you use the video review guide provided to you during this study?

○ Yes (1)

○ No (2)

Q3 Thinking about the video review guide provided during this study, please rate the following statements.

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
The video review guide was helpful. (1)	○	○	○	○	○	○	○
The video review guide improved my reflection. (2)	○	○	○	○	○	○	○
The video review guide allowed me to notice things in my performance I may not have noticed otherwise. (3)	○	○	○	○	○	○	○
The video review guide helped improve my simulation performance. (4)	○	○	○	○	○	○	○
I would have performed the same on my second attempt with or without the video review guide. (5)	○	○	○	○	○	○	○
I would have performed better WITHOUT the video review guide. (6)	○	○	○	○	○	○	○

The video review guide was distracting. (7)	○	○	○	○	○	○	○
The video review guide was time-consuming. (8)	○	○	○	○	○	○	○

Q4 Thinking about the concept of video review guides in general, please rate the following statements.

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
Video review guides would help surgeons reflect on their practice. (1)	○	○	○	○	○	○	○
Video review guides would help surgeons improve their robotic surgical skills. (2)	○	○	○	○	○	○	○
Video review guides would help shorten the robotic learning curve for surgeons. (3)	○	○	○	○	○	○	○
Video review guides are more time-consuming than helpful. (4)	○	○	○	○	○	○	○

If provided, I would use a surgical video review guide when reviewing my operative videos in the future. (5)	○	○	○	○	○	○	○
I would recommend the use of a surgical video review guide to other surgeons. (6)	○	○	○	○	○	○	○

Q5 Please provide any comments or suggestions to improve the video review guide.

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End of Block: Default Question Block

Video Review Guide Exit Survey - CONTROL

Start of Block: Default Question Block

Q1 Please enter the number assigned to you for this study.

____

Q2 A video review guide is a written guide with prompts and questions to help guide your reflection while you review your surgical video.

Thinking about the concept of video review guides, please rate the following statement.

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
A video review guide would have helped me on my second simulation performance in this study. (1)	o	o	o	o	o	o	o

Q3 Thinking about the concept of video review guides in general, please rate the following statements.

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somewhat agree (5)	Agree (6)	Strongly agree (7)
Video review guides would help surgeons reflect on their practice. (1)	○	○	○	○	○	○	○
Video review guides would help surgeons improve their robotic surgical skills. (2)	○	○	○	○	○	○	○
Video review guides would help shorten the robotic learning curve for surgeons. (3)	○	○	○	○	○	○	○
Video review guides are more time-consuming than helpful. (4)	○	○	○	○	○	○	○

If provided, I would use a surgical video review guide when reviewing my operative videos in the future. (5)	○	○	○	○	○	○	○
I would recommend the use of a surgical video review guide to other surgeons. (6)	○	○	○	○	○	○	○

Q4 How did watching your video change the way you approached the second simulation, if at all?

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Q5 Reflect on what you paid attention to while watching the video of your simulation performance.

____

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End of Block: Default Question Block

APPENDIX G: IRB APPROVAL

UNIVERSITY OF CENTRAL FLORIDA

Institutional Review Board
FWA00000351
IRB00001138, IRB00012110
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

APPROVAL

October 23, 2023

Dear Mary Soliman:

On 10/23/2023, the IRB reviewed the following submission:

Type of Review:	Initial Study, Categories 6, 7a, 7b
Title:	Examining the Efficacy of a Video Review Guide to Facilitate Robotic Surgical Skill Improvement
Investigator:	Mary Soliman
IRB ID:	STUDY00006024
Funding:	None, None
IND, IDE, or HDE:	None
Documents Reviewed:	• Demographic Survey.pdf, Category: Survey / Questionnaire; • Exit Survey Control.pdf, Category: Survey / Questionnaire; • Exit Survey Intervention.pdf, Category: Survey / Questionnaire; • HRP 502 Consent VR-UPDATED.pdf, Category: Consent Form; • HRP 503 VR-UPDATED.docx, Category: IRB Protocol; • Simulation Video Low.mp4, Category: Test Instruments; • Simulator-Brochure.pdf, Category: Other; • Study Announcement.docx, Category: Recruitment Materials; • Surgical Video Review Guide.pdf, Category: Debriefing Form; • VR Demographic Survey UPDATE.pdf, Category: Survey / Questionnaire; • VR Screening Survey.pdf, Category: Survey / Questionnaire;

The IRB approved the protocol on 10/23/2023. Continuing review is not required. This approval includes approval of the request for waiver of documentation of consent.

In conducting this protocol, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB

Library within the IRB system. Guidance on submitting Modifications and a Continuing Review or Administrative Check-in is detailed in the manual. If continuing review is required and approval is not granted before the expiration date, approval of this protocol expires on that date.

If this protocol includes a consent process, use of the time-stamped version of the consent form is required. You can find the time-stamped version of the consent form in the "**Documents**" tab under the "**Final**" column.

To document consent, use the consent documents that were approved and stamped by the IRB. Go to the Documents tab to download them.

When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Harry Wingfield
Designated Reviewer

Institutional Review Board
FWA00000351
IRB00001138, IRB00012110
Office of Research
12201 Research Parkway
Orlando, FL 32826-3246

UNIVERSITY OF CENTRAL FLORIDA

APPROVAL

January 11, 2024

Dear Mary Soliman:

On 1/11/2024, the IRB reviewed the following submission:

Type of Review:	Modification / Update, Categories 6, 7a, 7b
Title:	Examining the Efficacy of a Video Review Guide to Facilitate Robotic Surgical Skill Improvement
Investigator:	Mary Soliman
IRB ID:	MOD00004968
Funding:	None, None
IND, IDE, or HDE:	None
Documents Reviewed:	• HRP 503 VR-Modication.docx, Category: IRB Protocol; • QR Codes.pdf, Category: Survey / Questionnaire; • Study Announcement Modification.docx, Category: Recruitment Materials;

The IRB approved this modification on 1/11/2024.

In conducting this protocol, you are required to follow the requirements listed in the Investigator Manual (HRP-103), which can be found by navigating to the IRB Library within the IRB system. Guidance on submitting Modifications and a Continuing Review or Administrative Check-in is detailed in the manual. If continuing review is required and approval is not granted before the expiration date, approval of this protocol expires on that date.

If this protocol includes a consent process, use of the time-stamped version of the consent form is required. You can find the time-stamped version of the consent form in the "**Documents**" tab under the "**Final**" column.

When you have completed your research, please submit a Study Closure request so that IRB records will be accurate.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Harry Wingfield
Designated Reviewer

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