Surgical Education Excerpts
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Best Practices in Surgical Education: The Training of Registrars and Residents

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Material in this document was taken from *Best Practices in Surgical Education: The Training of Registrars and Residents* and *Best Practices in Surgical Education: Innovations in Skills Training*.


Continua of Educational Concepts—Curriculum, Instruction, and Evaluation

When we think about surgical education, the questions that arise fall into the categories of curriculum, instruction, and evaluation, as well as administrative questions about budget, leadership and troubleshooting. This book is a compilation of expertise in all of these areas showing substantial differences across borders. Administration varies widely based on local circumstance and will not be discussed in this introduction.

To broaden our scope, we will consider curriculum the content that is taught, instruction as how it is taught, and evaluation as the means for measuring the effectiveness of the educational event. Often surgical educators speak of these three areas as if there were consensus on their definitions. Yet, we have found that there is no such consensus. One of the intents of this book is to further define and deepen the exact meaning of curriculum, instruction and evaluation, particularly in application to surgical education.

Each of these educational concepts—curriculum, instruction and evaluation—including a continuum of possibilities.

Curriculum

The Curriculum continuum ranges from surgical instructors who believe there is no need for formal content preparation—they walk in the room and teach—all the way to surgical instructors who work collaboratively with an on-site PhD educator to design the curriculum as a yearlong course that has conceptual integrity and consistency. In between, instructors use curriculum defined by a standard textbook, use off-the-shelf curricula that they purchase (e.g., Fundamentals of Laparoscopic Surgery www.flsprogram.org), base their curriculum on slides developed by other faculty, use a curriculum dictated by outside body (e.g., government or a professional society), use the Oxford “tutor” one-on-one model of curriculum, and/or use an apprentice model where the learners follow the instructor all day and observe whatever occurs.
On the most innovative end of the curriculum continuum, some institutions:

- Have teams of instructors who meet regularly to plan, develop, and change curriculum
- Run a case study based program
- Assign homework and expect learners to come to class with questions. (Face-to-face classroom lessons primarily offer the opportunity to get answers to their questions)
- Develop the plan for each semester and distribute it to learners at the beginning of the semester.
- Use an in-house designed electronic and interactive self-study curriculum

**Instruction**

Instruction means how the teaching is delivered. Generally, this varies depending on how the instructors were trained to teach. The Instructional Development continuum ranges from instructors who have only clinical training through surgical instructors who have advanced degrees in Education in addition to their medical degrees. In between, we see programs that have occasional department discussions about instructional improvements, programs that bring in an outside consultant to do a 1-2 day training for instructors on how to teach, and programs that run regular training (at least once a quarter) for instructors on how to teach. A relatively new phenomenon is the addition of a PhD Educator on staff for instructional development of faculty. Each of these options has benefits, and the old axiom “you get what you pay for” certainly applies in surgical instruction.

**Evaluation**

Evaluation is the methodology used to measure the success of the educational effort. In the field of Education, this often refers to student achievement. In surgical education, the continuum of evaluation ranges from no formal evaluation (based on the assumption that if they get into our program, we know they are good), to very elaborate and professionally designed evaluation systems. Evaluation often includes written or oral cognitive testing and skills testing. Sometimes, instructors are responsible for specified learners and must provide formal feedback individually. Other options include the use of an institution-designed checklist and use of an outside designed (e.g., government, society, certifying body, supplier) checklist. Relatively innovative evaluation methods include:

- Formalized peer:peer evaluation (other than chiefs)
- Electronic recordkeeping of learner progress
- Qualitative documentation methods used to record progress
- Formal written evaluation criteria distributed to learners in advance
- Regular required progress reviews with each learner
- PhD Educator on staff who evaluates learner progress along with the surgeon instructors
- Performance-based exams
- Additional personnel to serve as an administrator of evaluation
Opportunities for Improvement of Surgical Education

Observations of global programs suggest three major opportunities for improvement in surgical education:

- Instructional improvement
- Reconsideration of low-tech simulators for use in surgical practice before entering the operating room
- Development of a systematic curriculum based on competency acquisition

Each is briefly described here.

Instructional Improvement

Instructional improvement involves the teaching of teachers how to teach, as well as changing educational environments to promote learning. All over the world, fine surgeons who have no formal training in how adults learn are asked to act as instructors for the next generation of surgeons. Historically, this apprenticeship model has been used in every field because it was the best available method. Today, with the wealth of research in how to teach adults most effectively, new opportunities surface for surgical educators. Instructional improvement is already evident as a result of the decrease of the number of hours registrars and residents are expected to work, the increase of the use of simulation in preparation for entering the operating room, and an increase in the number of leaders in surgical education who have credentials in Education and/or who hire staff who have such credentials. All of these are promising. However, the potential for improvement is still apparent in the majority of programs that have not yet begun implementing instructional improvement practices.

As I taught experienced surgeons how to improve their instruction, four major themes have emerged. The first is that if instructors want learners to come prepared for class, then instructors must come similarly prepared. This means careful consideration of how the time will best be used to maximize the learning. The instructor should identify the learning objectives and methods to be used to achieve the objectives. It involves increasing the active involvement of the learner and decreasing the dependence of the learner on the instructor for content. In today’s world, with access to the Internet and a myriad of other easy-to-access sources of information, the teacher’s role must change.

Second, before going into the operating theatre with the learner, the instructor should pre-brief the team, and after the surgery, there should be time set aside for a team debrief. This ensures that “Lessons Learned” are clarified and implemented.

Third, instructors must acquire the principles and skills of education, just as one acquires the principles and skills of surgery. It takes intentional learning with feedback along the way to accomplish this. Becoming a fine instructor is a journey rather than a destination. For those with the natural gift of being a fine instructor, it involves making their unconscious teaching behaviors intentional so they are easily replicable. Raising to consciousness what one does when teaching is very powerful.
Finally, just as the fine surgeon uses the surgical method appropriate to the patient’s medical problem, the fine educator must use the educational method appropriate to the learning problem. This requires that surgical educators become collectors of educational “tools” and ideas. The best way to do this is to become a conscious observer of teaching and to practice what one learns before bringing it into the classroom. Tools include methods for showing the learner you are paying attention, methods for observing the learner, methods of questioning, and methods of presenting content. The bigger one’s “toolbox” of teaching ideas, the more facile one can become in an educational scenario.

All four of these themes are relevant when facilitating the instructional improvement of surgical educators.

**Reconsideration of low-tech simulators**

In addition to Instructional Improvement, reconsideration of low-tech simulators for use in surgical practice before entering the operating room is the second broad-based opportunity for improvement in surgical education. It is connected to instructional improvement: educational research shows that planned repetition increases student achievement. This repetition should be directly correlated with the skills, knowledge and attitudes demanded on the target behavior.

For example, if the target is the speed of suturing, in combination with strength of the knot, then practice will improve instruction. High-Tech Virtual Reality (VR) simulators are the ideal tools for practice since they provide immediate feedback and place the practice in the context of the surgical procedure. But the reality of surgical education today is that money is limited. Not every program can afford the best and most expensive VR simulators.

Thus, we must seriously consider low-tech and homemade simulators on which registrars/residents may gain sufficient practice in the basic skills before touching a human patient. The range of simulators goes from homemade (for example practicing on the buttonhole of a shirt), to harvested tissue models (e.g., turkey legs or porcine bowel), to low-tech boxes into which a camera may be inserted (such as “TASKit”), to inanimate plastic models that function like live tissue (see Limbs and Things), to high-end VR trainers (see Hapticarmor™, Simbionix™, Surgical Science™ and METI™). This continuum of simulation also includes live animal models and human cadavers. The surgical education community is very excited about VR simulation; yet, we need to remember the tremendous opportunity that exists in the low-tech simulators that are available to the majority of programs, and balance the use of high and low tech simulation.
Regardless of the simulation model, it is imperative that the model be a required part of a systematic curriculum. We have observed that otherwise, the simulators are not used and become “dust collectors.”

**Systematic curriculum based on competency acquisitions**

Reconsideration of low-tech simulators for use in surgical practice logically leads us to the need for development of a systematic curriculum based on competency acquisition. If it is true that many of today’s programs use the traditional apprentice model along with lectures, then this third broad-based opportunity becomes apparent. What is needed is:

- A thorough analysis of the needed competencies (as was done by the Association of Program Directors in Surgery in 2000 in the United States; http://www.apds.org/curricsurgical_resident1.htm)
- With an associated effort to simplify the competencies (as was done by the Royal Colleges of Surgeons of England and the USA ACGME in its RRC competency requirements; http://www.acgme.org/acWebsite/navPages/nav_440.asp)
- And then finally the creation of a systematic curriculum to achieve the stated targets (e.g., the work of the Royal College of Surgeons of England and SCORE, the Surgical Council on Resident Education, whose task is to examine the current state of surgical training and develop a new curriculum for use by all surgery residency programs in the United States).

Each of our contributing authors provides examples of his or her area’s efforts to develop systematic curricula.

What is missing is a method for communicating this thinking to the programs that are doing the teaching, globally—a routine, bilateral exchange of information. While it is obviously necessary to honor the differences that exist across countries and regions, there are curriculum elements that are transferable. This volume is aimed at promoting cross-cultural sharing of practical ideas that will eventuate in a systematic curriculum for registrar/resident education.

Development of a systematic curriculum based on competency acquisition presupposes an underlying set of curriculum development skills and principles. Curriculum development is an intentional pre-planning of the learning engagement. It starts with identifying the learning objective. For examples, perform a search (using Google.com or another search engine) of “verbs + writing instructional objectives.” The variables considered in curriculum development are learning objectives, learner needs, necessary teaching behaviors, the structure of the educational environment, and learning outcomes measurements. The preplanning session results in an effective step-by-step set of instructions for the educational event. Similar to the improved outcomes in surgery when one plans the surgery with the team before scrubbing, careful curriculum development results in improved educational outcomes.

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An Example: Applying Educational Concepts in Surgical Education

By way of illustration, the following is a brief example of how one might apply these educational concepts in surgical education. This example focuses on the teaching of surgical technique and skills, particularly hand/eye coordination in the context of colon surgery. At the Endo-Surgery Institute in Cincinnati, OH, USA, we have the opportunity to test new teaching methods and have done so in this example.

Our learning objective was to improve the technical skills of senior residents in their performance of colon surgery. The next few paragraphs describe the application of the concepts of instructional improvement, use of low-tech simulators for use in surgical practice before entering the operating room, and development of a systematic curriculum based on competency acquisition in a practical setting.

As we designed the curriculum for this resident course, we evaluated the necessity of using our limited face-to-face time between the learners and the instructors to present didactic material. Didactic and skill-building components have traditionally been considered together. Why? Surgery is by its nature a complex process including both cognitive and skill aspects. In our preplanning of this course, we concluded that these residents were sophisticated learners and could study the didactic material alone, reserving all of our face-to-face time for skill building. We designed two Pre-Course Study Material Packages and sent them to the residents. The first included generic anatomy lessons and surgical procedure videos. The second included presentations designed by selected faculty on the details of doing Hand-Assisted Laparoscopic Surgery (HALS), Procedure for Prolapse and Hemorrhoids (PPH), and Laparoscopic Colectomy. The intent was for the residents to complete these packages before arriving at our Institute.

After arrival at the course, all of the residents reported (anonymously in a written survey) that they had completed both of the Pre-Course Study Material Packages. The average total time they spent was 8.6 hours. When asked about having to study the materials before arriving at the face-to-face part of the course, they reported the following:

- I didn’t just study the material. I felt it synchronized me with the rest of the group. It focused my mind on this course.
- It is a new model of teaching and permitted me to spend more time in the lab.
- This information was exactly what was needed to get started.
- It is very important to have an idea of the activity we will be performing in the course. So, for me, it was great to have the didactic material regarding the topics we would be discussing.

The Pre-Course Study Materials improved instruction in the face-to-face element of the course. Too often, surgical educators use their time with residents lecturing. By providing the residents with the materials ahead of time, the residents were able to review the content at their own speed and repeat segments for clarity, if needed. In the classroom, this freed the instructors to facilitate learning. Facilitation of learning involves conscious consideration of both what is being “taught” and what is being “learned.”
The specific skills of facilitation of learning are analytically observing the learner, acute listening by the teacher, stimulating questioning, responsive answering of questions, intentionally designing the learning environment, and showing that you (as the teacher) are paying attention to the learner. Because the didactic content of our course had already been transferred to the learners, in the classroom our faculty was able to focus on engaging residents in active learning to solidify their mastery of the material.

During each face-to-face day of the course (in which the teachers and learners are in the same room), we started with a full hour of questions from the residents to the instructors regarding the Pre-Course Study Materials. The residents were told to bring their questions. This allowed the instructors to focus their limited face-to-face time with the residents on what the residents needed, rather than on generic content. In a sense, this changes the instructional paradigm from “teaching to the lowest common denominator” to teaching to the exact needs of the learner. The quality of the questions asked by the residents was remarkable. The faculty and all observers, each of whom had extensive experience in running Lap Colectomy courses in the past, were surprised at the apparent advantage this systematic curriculum model dividing didactic from skill acquisition gave to the learning of these residents. Note: the instructors were asked not use PowerPoint slides during the face-to-face course.

The face-to-face part of the course was divided into two aspects of colon surgery. The first day focused on HALS and PPH. The second day focused on Lap Colectomy. During these two days, the instruction was significantly improved compared to the norm. When freed from their dependence on slides, our faculty excelled. They were able to interact with the residents in whole group, small group, and one-on-one settings. They were able to respond to resident questions, removing the barriers to the learners’ progress. One can identify excellent teaching because all of the learners are obviously engaged in the content, the instructors are fully engaged in the content, there is evidence that the learners are applying the concepts and integrating it into their own intellectual constructs, and there is a lively intensity and energy in the learning environment.

The face-to-face time was organized in what we called “Lab Sandwiches.” This theoretical construct honors the Adult Learning Principle of the three-step method of teaching:

1. Tell them what you are going to teach them (pre-brief)
2. Teach them
3. Tell them what you taught them (debrief)

In the course, to “tell them what you are going to teach them,” the faculty responded to resident questions regarding the Pre-Course Study Materials. This effectively oriented the group to what was going to happen in the lab. The labs themselves were the “teach them” step. To “tell them what you told them,” we held Lessons Learned sessions, where we asked each resident to state what their most important learning was. This is a bit more sophisticated than the standard method of having the instructor review “Key Learnings” at the end of a PowerPoint presentation because it requires the assimilation of the content by the resident. There is also a benefit of having residents...
hear what their peers have learned. Research in Adult Learning finds that adults learn best from their own experience and conclusions; thus the Lessons Learned method is very beneficial. Moreover, the Lessons Learned session provided the variation of stimulus that we know increases learning and increases resident involvement in the content. No lab was done outside of this three-step context; therefore, the impact of the labs was greater.

Over two days of the face-to-face part of the course, there were four labs, organized from simple to complex. Each was presented in the “Lab Sandwich” format. We leveraged the use of low-tech simulators before doing the procedure on virtual reality and animate models.

The intentional development of this systematic lab curriculum from simple skills to complex skills seemed to improve competency acquisition. Specifically, the learning objectives for the labs included the following:

- Practice proper insertion of the ENDOPATH DEXTRUS™ Minimally Invasive Access System
- Practice hand-eye coordination required in tying a knot in a laparoscopic venue
- Practice surgical procedure and instrument us
- Practice proper insertion of PPH medical device
- Practice use of circular staplers
- Practice procedures using Harmonic® energy technology to manage bleeding

Educational simulations and simulators were used to accomplish these learning objectives. Particular attention was made to replace, refine and reduce the number of animals used. Of the four labs, only one was an animate lab.

The Endo-Surgery Institute in Cincinnati, OH, USA has resources not typically found in registrar or resident programs. Thus, some aspects of this course would be difficult to duplicate widely.
What would be possible to duplicate include the following:

- **Instructional improvement.** Arrange for instructors to work as a teaching team, building upon each other’s comments and filling in gaps for the learners. It is always helpful for learners to learn more than one perspective about complex subjects such as surgical procedural methodology. We had two instructors in the classroom and lab at all times. The dialogue that occurs between the two faculty members on how to solve surgical problems provides an excellent model for the learners on how to consider surgical problems and their solutions.

- **Instructional improvement.** Actively engage the learner. When the registrar or resident is a passive recipient of knowledge, less knowledge is retained. Research on Adult Learning supports that the more active the learner is, the higher the potential for improved educational outcomes.

- **Instructional improvement.** Build in time for reflection and learner-to-learner dialogue. Neither of these adds out-of-pocket cost to the program, but they increase the learning potential in significant ways.

- **Reconsideration of low-tech simulators.** Described in detail earlier, this course built in the use of low-tech simulators as the primary element of the face-to-face component.

- **Systematic curriculum.** Permit learners to study content on their own time independently, thus reserving time with instructors for answering learner questions and fine-tuning learner skills. Considering the high cost and value of instructor time, over the long term, this could save considerable resources.

- **Systematic curriculum.** “Chunk” the learning into small, digestible bites. The adult learner has an attention span of 12-15 minutes. In addition, learners require frequent variation in stimulus to maintain alertness. Variations of stimulus might be transitioning from the use of slides to a video, from lecture to group case studies, from lecture to inanimate labs, and/or from completing a surgical procedure to asking participants to share the key lessons they learned from the session.

- **Systematic curriculum.** “Lab sandwiches” in which the learners can ask questions of the instructors before the lab, then do the lab, and finally end with a group discussion on “Lessons Learned.” This reinforces the three-step pattern for presentation of new knowledge—tell them what you are going to teach, teach it, and tell them what you taught them.

- **Systematic curriculum.** Within a learning unit, organize the lessons from simple to complex. This stair step approach ensures more effective learning because the learners build their competencies on a solid grounding.
Systematic curriculum. After new knowledge is delivered to the learners, give them the opportunity to apply the knowledge. This can be done in a lab, in discussion, in case study analysis, or in the operating theatre or operating room.

Systematic curriculum. Experienced Instructors can predict the content the residents will need. The traditional solution is that the instructors deliver a lecture on these topics. Another solution is to provide the learners with self-study packets and schedule face-to-face time to answer their questions. Metaphorically, this second solution creates “buckets” in the learners’ minds into which the content can be received. This increases their retention of learning and learner involvement in the learning session.

All of these educational tools can be applied in settings regardless of available budgets and/or other resources. They are dependent upon the curriculum designers’ and instructors’ commitment to educational quality.

Though social and economic conditions, culture, and traditions differ among countries, all educators share a commitment to improve their teaching. Too often we limit our pursuit of new ideas to those to which we have easy access. Extending our reach across borders provides us with a wealth of ideas and tested methods. All surgical educators need to deal with resource constraints, manage change, collaborate with educators abroad, and prepare registrars and residents to use newly developed instrumentation and techniques. Exemplary educational methods are transferable across international boundaries to a substantial extent because they are rooted in an understanding of how adults learn.

Together, the writing team presents a picture of registrar and resident education globally. We see this as an initial effort to stimulate the exchange of best practices across borders. Since all of us share the barriers of limited resources and time, there is no choice other than learning to work smarter and prioritizing that which will make a difference in educational outcomes and in the quality of patient care. We look forward to future efforts to continue our identification of best practices in order to improve patient care through educational innovation.
The Basics

The best surgical educators focus the training time in their programs, covering material quickly, but effectively. The need to do so arises from:

- Limits on weekly hours of residents
- The dramatic increase in information necessary to practice surgery
- Increased patient awareness and the resultant pressure on surgeons to be able to deliver a variety of surgical solutions
- Demands for assessment to demonstrate trainees have mastered core competencies, and
- Proliferation of new and more technically challenging surgical techniques.

In the United States, surgical residency programs must meet the requirements of the Accreditation Council for Graduate Medical Education (ACGME, http://www.acgme.org/outcome/comp/compMin.asp) and its surgical Residency Review Committees (RRCs). Programs must provide educational experiences that will allow residents to develop and demonstrate competency, which, by definition, include knowledge, skills, and attitudes. Of these three elements, attitude acts as a multiplier to achieve improved competency. When learners’ knowledge and skill are similar, their attitude is often the differentiator. Attitudes include enthusiasm, determination and commitment to excellence.

The U.S. Centers for Disease Control (CDC) defines knowledge as “an organized body of information usually of a factual or procedural nature which, if applied, makes adequate performance on the job possible.”¹ For example, surgeons need knowledge of anatomy and physiology.

In contrast to knowledge, CDC defines skills as: “the proficient manual, verbal or mental manipulation of data or things. Skills can be readily measured by a performance test where quantity and quality of performance are tested, usually within an established time limit.”²

Thus, a skill is “a learned psychomotor act” whose performance can be observed.³ Suturing is an example of a surgical skill.

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² Ibid.
There are two aspects of skills training:

1. Cognitive Orientation
2. Technical Action

Cognitive orientation includes organizing scientific information relevant to the skill and making a strategic plan about how one will accomplish the skill. Because of the complexity of surgery, cognitive orientation is needed for surgeons to make appropriate decisions. Cognitive orientation is particularly important for surgeons working at the frontiers of surgical practice, developing skills in minimally invasive surgical methods.

The technical aspect has traditionally included manual application, eye-hand coordination and dexterity needed to perform surgery. Because of recent ACGME requirements, the technical is now more broadly defined to include teamwork, leadership and patient interface. Repeated practice helps in attaining mastery of the technical aspects of surgery.
Because of the complexity of surgical competency, including knowledge, attitudes and both the cognitive and technical aspects of skills, educators are required to make prioritized decisions regarding how to use their training time. This book brings together thought leaders in the field and presents a variety of perspectives in the how to of skills training, showing how these educators make prioritized decisions resulting in focused training time.

Surgical skills training is pragmatic and practical, and it addresses efficiencies and time savings in performing surgical operations. Training programs are giving increasing attention to quality assurance measures such as the following:

- Training programs need learning objectives that include measurable outcomes. These learning objectives are now developed at each training institution; objectives might eventually be standardized nationally. Effective skills training results in a specified behavioral change.
- Individual learners should be assessed prior to training to determine whether they must first be trained in prerequisite material before proceeding to advanced skills. Or, perhaps learners might be far ahead of their peers and would be appropriately mentored so as not to waste time on material already mastered.
- Formal assessment is needed to determine, in a consistent and replicable manner, whether the trainee has acquired the relevant skills.

When designing skills training, the educator considers many characteristics. These include:

- **Place.** Operating room (OR), lab, learner’s home, on the web.
- **Learner selection.** When does each learner learn each skill? Is there a pre-assessment? Can a learner test out of skills training?
- **Applied science** to provide a theoretical framework. Because of the complexity of surgery, learning skills often requires cognitive background.
- **Pre-test/post-test.** What are the learning objectives? How do we know the learner achieves them? How do learners receive feedback on learning success?
- **Instructions.** How to do the skill. This information might be supplied by the instructor, or it might be in a learning module or VR simulator.
- **Model.** Animate, inanimate, tissue, virtual reality, cadaver, role play.
- **Curriculum** in which training fits. Teaching skills will have no effect if done in isolation. Skills training must clearly fit into a comprehensive, systematic curriculum.
- **Protected time.** Residents and registrars have limited time-on-task. Every minute counts. Unless there is required and protected time for skills training, it won’t happen.
- **Learner motivation.** What is the end game from the point of view of the learner? What is in it for the learner?
- **Instructors.** How are faculty selected, developed and managed? How do we know if faculty are doing a good job? Can the faculty perform the skills they are teaching?
How to Maintain an Excellent Learning Environment for Skills Training

When discussing skills training, we often discuss the simulator and what to do with it. Sometimes, we forget to discuss the other elements that comprise an excellent learning environment for skills training.

Generally, a learning environment is a combination of all the elements that can positively or negatively affect learning – in this case, skills training. The learning environment is everything that enables the learner to progress through the content and task. Analyzing the learning environment in a formal manner can directly affect learning outcomes.

Examples of what can enhance skills training:

• An organized and orderly environment in which the training is to take place aids learning. For example, the simulators should be in working order and ready to go, and all necessary instrumentation and materials should be easily available. Skills training is all about preparation.
• Appropriate simulators or other models for the targeted skill.
• Instructors should be qualified in the material they are to teach and should be fully familiar with the teaching process (i.e., steps of this skills activity, how to use simulators, how to do the skills themselves, able to share tips and tricks, teaching methods).
• Instructors should be on time and on site. Availability of qualified instructors when the “teachable moment” happens is critical to learning.
• Protected time for learners to complete the entire lesson.
• Instructors and staff are enthusiastic and encouraging.
• Skills training resides within a well-thought-out curriculum, so learners can easily see the value of what they are doing.
• Institutional support for skills training.
• Clear objectives or measurements, so learners will know when they have accomplished the target.
In contrast, here are examples of what can undermine skills training:

- Simulators not in working order and no available staff to troubleshoot the equipment.
- Missing parts, materials (e.g., suture) or instruments
- Missing or inadequate instructions on how to do the skill or use the trainer
- Frequent distractions are particularly bad for the beginner. Note: Distractions can and should be introduced intentionally for the more proficient learner.
- Noise and music might be considered a distraction for the beginner. It is appropriate to discuss this with the learner.
- Instructors who are too busy to plan and pay attention to the details of their teaching, or who are not interested in teaching
- Instructors who are inexperienced with that particular skill, have no experience in the specified area or are not trained how to teach
- Lack of specified time for learners to practice skills. Resident life is characterized by too much to do in too little time. If skills training is not required, it won’t happen.
- Too many learners in the same environment at the same time introduces too many variables. For example, if learners in an OR include not only medical students and residents, but also the anesthesiologist and the nurses. With sufficient preparation, this situation could be managed. Without it, it is possible the learning environment could be compromised.

When considering learning environments, the motivation of the learners to learn is important. Surgical education is a little different than most learning environments regarding motivation. If the environment is well maintained, the staff is well qualified, the learners have protected time and are required to participate, there should be no need to create motivation. Yet, if the surgical educator is having trouble motivating learners to engage in skills training, prizes or point systems for completion of a number of tasks, competitions (Butch Rosser’s “Top Gun” competition is the benchmark), or anything that will introduce fun into the environment can be effective motivators. Whether this is needed is a local decision.

Once the learning environment is established, considerable attention is required to maintain it. The obvious components of this are maintenance of the physical space and assuring the simulators are returned to “start” status after each learner leaves. Less obvious is the need for quality improvement processes built into every aspect of creating a learning environment. Those in charge must determine how to collect, analyze and apply learner and trainer feedback. The biggest challenge is not in gathering the feedback, but solidifying the process of what to do with feedback in order to ensure continuous improvement.
Surgical educators may be able to improve their training program by use of the following checklist.

**Is training the answer?**

The Naval Service Training Command often receives inquiries from others in the Navy who ask for training to be developed. The first question is always, “Is training the correct solution to this problem?” Sometimes people want to check a box to indicate they have done something about a problem versus solving the problem and measuring how effective the solution is. Chapman recommends we always start by asking if there is a better way to address the issue other than training.

**Do a proper analysis before designing training**

Sometimes people already have a solution in mind when they approach Chapman. This does not absolve the training officer of responsibility for doing a proper analysis of the problem and designing a training program that will have performance-based outcomes. In surgical education, we are beginning to do a better job in this category due to guidance of the ACGME, American Board of Surgery (ABS), American College of Surgery (ACS), Association of Program Directors in Surgery (APDS), and other organizations.

**Behavioral change is always the target**

Those who teach complex skills must focus on the end game. Behavioral change is always the target, as opposed to knowledge dissemination. Anyone can put a program in place, but being able to measure the results and show you hit the target differentiates good from great training. Similarly, surgical educators need a means to show the training is working.

**Pre-test learners**

Then, customize training for them. The Naval Service Training Command pre-tests all sailors using the Armed Services Vocational Aptitude Battery. This tool provides standardized base line information about each learner. Complementary to this information, a clear understanding of the new generation of learner is necessary. The “one size fits all” form of training no longer works. Training must be customized to the current culture of learning and individualized to each learner’s needs. While surgical residents are thoroughly tested before entering residency, the surgical pro-grams sometimes still use the “one size fits all” modus operandi: perhaps there is an opportunity for us to gain further insight from the Navy in this area.
The bar is higher

This generation of sailors requires more intensive training than previous generations. Today’s sailors must perform a wide array of tasks and use complicated equipment. Therefore, the Command’s training objective is that the sailors will learn more in a shorter time with a higher performance to meet the higher demand. Again, this is also true for today’s surgical resident.

With high turnover among trainers, how do you standardize the quality?

Chapman weaves discussions about instructor training into every topic. He says whatever we do for learners, we must do for the instructors. The Navy needs instructor buy-in to succeed in making changes to the way sailors are educated. Anytime a new educational product is introduced, the Navy ensures that the instructors experience it. If the trainers don’t understand the new educational methods or technologies, trainers won’t use them or take full advantage of them. In surgical education, once we agree on a standardized curriculum, it is recommended that trainers be fully trained in the instructional methods, curriculum, and evaluation methods, rather than assuming they will intuitively know what to do with a new set of teaching tools – and want to do so.
Use of Technology in Training Complex Skills

Based on an interview with Rodney A. Chapman, EdD, Lieutenant Commander (USNR, Retired), Chief Learning officer and Director of learning Strategies at the Naval Service Training Command. August 27, 2009

Chapman emphasizes gaming and simulation, both of which are often used in the basic training of sailors. Gaming is similar to any of the many popular video games; simulation is a physical environment in which one is immersed, such as being on an actual battleship rigged for training purposes.

When employing a technology for education, the Navy first tests the technology to validate that it achieves the desired behavioral change. Then, technology tools are used in a specified sequence and as part of a curriculum rather than in isolation. The sequence always begins with classroom instruction followed by practice. The sequence continues using educational games to reinforce knowledge and ends with immersion into a simulated environment.

The Navy uses educational games to achieve behavioral change in individuals and teams. When creating games for learning, they balance the advantage of games with the educational objectives. Educational games are much slower than entertainment games. Educational games should be fun so sailors can learn without being conscious of being in a learning environment. This includes tough consequences such as sinking a ship: consequences are built into the game. The game permits the learner to overcome, if challenged. Games include excitement and capitalize on the informal learning environment.
But, can the learner transfer the critical skills from the games to the real world? If we decide to use games as a means to teach, we must be able to define the performance outcomes and weave them into the game. There doesn’t have to be constant action/motion/challenge. One needs to balance the benefits of games with the benefits of education: too much gaming cancels out the educational benefit, and too much education causes a decrease in motivation to repeat the game. We want the learner to have the desire to play the game again and again. With games, we must clearly focus on the expected outcomes, the objectives and the performance measures.

It is easier to change the game-based environment (since it is entirely computer-based) than the simulated environment since there are physical attributes (such as an actual battleship) to a simulation. Thus, the Navy uses games earlier in the curriculum than simulation. This permits the Navy to change the rules and make adjustments, as needed, at a lower cost.

The Navy’s start simulator is a half battleship that has been rigged to have fires, water leaks and other situations requiring target sailor behaviors. It is called Battle Stations 21. This is not their first simulated environment for training, and the current model is now realistic enough. In Battle Stations 21, sailors are tested; not everyone passes the test. In the simulation, both the individual and the team are tested. The trainers use handheld devices to reset the training scenarios and record testing data. All devices are connected to a database where the data are stored and analyzed. Those who fail receive remedial training.

In addition to Battle Stations 21, the Navy uses Flat World, a space filled with large plywood boards, mirrors and multi-media projectors. This is a relatively low-cost method of simulation and provides the look, feel and smell of real life. Some of these Flat World simulators use avatars.

The bottom line in simulation is that the learner has the sense of having been in the situation before going into the real situation. Do we want to give residents experience with patients, nurses and techs, attendings and technologies before entering the operating room? Are we doing enough to make this happen?

The Navy also makes use of avatars in standard known-algorithm teaching. The avatars play different roles, freeing live instructors for higher order teaching and coaching. In other words, avatars can be programmed to handle the routine, expected, planned teaching tasks, and people are freed to do the individualized and personalized aspects of teaching.
The Navy uses many lower cost technologies in addition to games and simulated environments. To provide sailors with the opportunity to face real officers, the Navy uses long-distance video conferencing and avatars to provide practice to the sailors in taking commands, as well as practice for the officers-in-training in giving commands. How could surgical educators use such methods, perhaps using live feeds from the operating rooms in many different resident programs, permitting the teachers to decrease duplication? Could we use this method to simulate interactions with patients, decreasing the cost to each program using patient actors, by doing part of this activity with avatars and/or video conferencing? Where could we find efficiencies when linking resources from many surgical programs? What performance-based exercises could we do in surgical education using these methods?

Another low cost educational technology is the use of the classroom performance systems, e.g., OptionFinder. These systems provide each learner in a classroom with a handheld input device, and the system collects and analyzes the responses, real time. Response systems increase motivation, increase competition in a positive way, provide the learners with immediate feedback and increase learner engagement. The instructors can use these systems to take attendance and test learners. Instructors can create questions on the fly in real time. The systems can be used to revitalize the classroom experience, but the instructors must select appropriate content and alter that content to make it more interactive. If a learner isn't answering, the screen in front of the room protects their anonymity, yet the system knows who is not answering and will alert the instructor. Data can be collected and stored on both individual and team results.

When the Navy adds a new educational technology to its toolbox, it markets this advantage to the stakeholders. It produces videos in which leaders discuss the new educational strategy and talk about training successes. The Navy collects data on the new technologies and shares the data in its marketing efforts. They make videos of learners, teachers and classroom observations when the technology is in use. Then, the Navy shares this information to ensure it realizes quick adoption of the new technologies in the many settings in which it teaches.

In the future, the Naval Service Training Command intends to leverage mobile training capability, perhaps using the iPod touch® to collect learner feedback. In this system, the Navy will recapitalize existing training material. They can reintroduce learners to concepts they have already learned, including taped discussions by motivational speakers. To evaluate the effect of this mobile training capability, the Navy will do a comparative analysis of learners who are given access to it versus learners who are brought back into the classroom for retraining.

What is noteworthy for surgical educators about the way the Navy uses technology to train is its strategic consideration of what, where, when and how the use of technology fits together. In surgery, we are making progress in the development of a variety of technologies for teaching. Our opportunity is to put it all together in a curriculum, deciding which technology comes when and what is the target metric. This will certainly be part of the standardized curriculum currently under consideration by national surgical education leadership.