

The Journey to Competency-Based Education

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Summary: In the middle of the 20th century, orthopaedic trauma patients were inadequately treated because of limited knowledge of bone-healing biology and fracture fixation procedures. The OTA/AO was established as an association in 1958 by a group of orthopaedic surgeons with the mission to improve patient outcomes through research, development, documentation, and education. Education has been recognized by the founders as a means to disseminate fracture fixation principles and techniques. Starting from just 69 learners at the first AO course in 1960, AO reached globally more than 50,000 learners in 2019. This achievement was possible because the AO improved its educational offerings and integrated evidence-based practices in medical education. Since its beginning, AO used simulations in combination with other educational methods, such as lectures and small group discussions. Around the year 2000, competency-based curriculum development was introduced and became a core tenet of AO education. AO's educational design today uses evidence-based concepts in needs analysis, planning and design of learning, faculty development, and assessment. In addition, the AO contributes to the medical education research with emphasis on measuring the impact of education, simulation, and development of performance assessment metrics.

Key Words: CPD, CME, evidence-based education, competency-based education

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During the past 30 years of the 20th century, the widespread adoption of the AO method of surgical management of acute orthopaedic trauma dramatically improved patient outcome with a huge economic impact.^{1,2}

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How did an academically unaffiliated group of 13 Swiss surgeons with interest in acute fracture surgical fixation in the late 1950s evolve into a global network that currently includes 14,000 faculty surgeons who provide direct education to more than 55,000 learners every year? Collaborating as a club-like organization, the Arbeitsgemeinschaft für Osteosynthesefragen (AO) was organized in 1958. Roughly translated as a “*Fellowship of purpose based on friendship*” this group sought to advance surgical care of fractures by building 4 critical workstreams as follows: developing a coordinated system of instruments and implants, researching the process of fracture healing, collecting and documenting clinical outcome data, and directly teaching the principles and techniques to surgeons wishing to use the method.³

EVOLUTION OF EDUCATION IN THE AO

The first face-to-face course occurred in 1960, and continued annually, in Davos, Switzerland. Lectures highlighting surgical principles combined with hands-on exercises on human specimens provided the new knowledge and technical skills for attendees to improve. Evening “fireside chats” with case presentations and analysis honed decision-making skills. This blend of educational formats was enthusiastically endorsed by an expanding group of surgeons, requiring courses to be offered elsewhere in Switzerland, then Germany, and across Europe by 1970.⁴

In 1972, AO International was formed to administer the expanding educational mission and creating a standardized AO Trauma “Basic Principles” and “Advances” course offering lectures, surgical simulation, and small group discussion. AO courses were delivered in the America and across Asia, with content and quality like the original Swiss programs. Forward thinking surgeons in other specialties appreciated that the techniques and instrumentation developed for use in human long-bone fractures could be of great value for them. Responding to this interest, between 1969 and 1981, AO sections in veterinary, craniomaxillofacial, and finally spine surgery formed to provide modified instrumentation and specialty-specific educational programs.⁵

Twenty-five years after its creation, the AO had grown exponentially in size and clinical scope, and its original administration was dissolved in 1984 to create the AO Foundation. Governance was by an executive committee that reported to a global elected board of trustees. Research along with clinical documentation and an education service unit provided support for their respective programs. Face-to-face teaching expanded to include a range of target audiences from operating room personnel and junior residents to established subspecialist experts. These programs triggered a continued need

for a library of linked enduring material (published monographs, guidelines and manuals, videos, journals, and web sites). In 1989, the AO Alumni Association (AOAA) was established to promote continued engagement of surgeons who had been AO fellows or served as faculty. With newsletters, social events at courses, and a triennial meeting, this represented the first efforts toward faculty professional development.

From CME to CPD—the Shift to Continuous Connected Learning Opportunities that Facilitate Behavior Change

The mindset of the medical education community changed during the years leading up to 2000. Driven largely by the American Medical Association (AMA), focus shifted to the needs and practice gaps of the physicians⁶ and awareness of the impact of external forces and the health systems linked to medical education.

The AO Education Commission, a governance body that advised AO International (the operating educational arm of AO) and oversaw the development in surgical education started consultations with and in the United States and United Kingdom academic experts in medical education. In the early 1990s, AO began to offer educational seminars for faculty who were especially interested in the principles and concepts of medical education and were motivated to strengthen their competencies as teachers.

This new approach of bringing educationalists from academia together with surgeon content experts involved in educational design intensified with the shift from Continuing Medical Education to Continuing Professional Development (CPD) as described in the 2003 AMA book publication “The Continuing Professional Development of Physicians.”⁷

In 2004, AO invited a group of the education consultants to partner with a group of AO surgeons involved and highly interested in education to write a dedicated textbook for the global AO faculty outlining the “AO Principles of Teaching and Learning.”⁸ The goal was to achieve a global quality standard in the delivery of education. The book, published in 2005, focusses on different competencies covering lecturing, small group discussion facilitation, guiding and managing simulations, and providing participant feedback. In parallel, AO established its first structured faculty educational program for teachers under the brand name “Tips for Trainers.” Over the ensuing decade, the AO Principles of Teaching and Learning book was given away to more than 3000 faculty globally as part of their development pathway as AO teachers.

The book represented a milestone for the shift to competency-based curricula development and the further design of the AO Faculty Development Program to support CPD. It also triggered the AO to actively engage in medical education research projects and to become active contributor to the leading associations and societies in CPD, surgical simulation, and faculty development.

Quality Medical Education

In the past decades, demands for high-quality education with measurable outcomes have increased because of rapid

scientific advancements in medicine and changing expectations from patients, health care providers, and societies alike. Since 2008, a collaborative effort by surgeon faculty together with professional educationalists has ensured that AO Foundation education remains relevant and effective; from 2010 onward, these efforts have been initiated and coordinated by the AO Education Institute replacing the former AO International activities as an organizational center of excellence.

For best-quality education a paradigm shift was introduced to the whole educational process from planning through execution to assessment and evaluation. Today, all AO Foundation educational events are built around 7 principles of adult education deemed important for continuous professional development of musculoskeletal surgeons (Table 1). Educational events are designed based on a standardized needs assessment protocol identifying gaps in the knowledge and/or performance of the participants.⁹ The backward planning process is then applied to the educational program development to address the practice and performance gaps of the learners to achieve the best possible outcome of patients.¹⁰ Performance gaps are analyzed and translated into the competencies needed by the potential learners. The competencies are deconstructed into knowledge, skills, and attitude components and trigger the development of learning objectives and the instructional design of activities. The execution of AO Foundation educational events has shifted from passive teacher-centered setups toward a learner-centered focus with more interactive formats ensuring ample possibilities for feedback and reflection. In this supplement, Wilber et al¹¹ provide a comprehensive description of the AO Trauma Competency-Based Training and Assessment Program as an example of the innovative educational activities within AO Foundation.

The AO Foundation conceptual framework for quality education consists of 4 overlapping areas around physician competencies: curriculum planning and design, faculty development, assessment and evaluation, and development of resources. AO Trauma launched the first global competency-based curricular events (Basic Principles and Advanced Principles Courses) using fixed core content allowing for adaptation to local needs. The first fully backward planned standardized curriculum in orthogeriatrics was introduced by AO Trauma in 2010¹² with a point-of-care learning app as additional resource.¹³ A long-term goal for AO Foundation has been the implementation of a standardized framework for evaluation and assessment of all educational activities. The relevance of our offerings as well as the faculty performance has been measured extensively.¹⁴ However, as medical education should lead to measurable changes in practice, mere evaluation of participation or participant satisfaction is not enough; education providers are expected to provide data on the value of their offerings on the participants’ practices and patient health outcomes. Measuring the effect of an individual educational event on patient or community health is demanding at best and would require the use of local, national, or international registry data. To gather information on the effect of our educational offerings on the participants’ practice the Commitment-to-Change

TABLE 1. Seven Principles of Quality Education—Planning, Execution, and Evaluation

1. Based on Needs
2. Motivates to learn
3. Relevant
4. Interactive
5. Provides feedback
6. Promotes reflection
7. Leads to verifiable outcomes

tool has been used.¹⁵ In this article, the participants are asked whether they intend to change anything in their practice as a result of the educational event; a 3-month follow-up assesses the status of the intended changes. Several barriers have been identified that prevent surgeons from implementing what they have learned, and the Commitment-to-Change has given us information on those barriers for further use when planning future education.¹⁶ A more complete illustration of the design and implementation of the AO Foundation evaluation and assessment framework will be provided by Ghidinelli et al in this supplement.

Faculty Development as Driver of Change

The AO faculty role has always been a volunteer position. Teaching is the major reason why surgeons engage in AO. In a recent worldwide AO faculty survey, 59% of the responders indicated interest in teaching was the most important reason they joined. Interest in faculty training to teach was important to 34% of the survey participants. The paradigm shift from being a teacher to learner centric organization meant that AO needed an evidenced-based program to train faculty in how to deliver content by a variety of educational methods with the goal of achieving measurable outcomes in surgical management of trauma and musculoskeletal disorders. The 3-tiered progression, faculty education program (FEP), chairperson education program (CEP), and leader education program (LEP) were developed to accomplish this mission.

The AO FEP concentrates on competencies that enable faculty to deliver high impact lectures, lead interactive small group discussions, and to effectively teach surgical skills in simulations. The AO CEP teaches curriculum design and management. The program reinforces using best practices in education to select content, choose learning methods, manage faculty conduct evaluation, and provide feedback. The AO LEP teaches relevant leadership skills to faculty who are likely to be elected to important governance positions in the organization. Participants in this program learn about self-assessment of their leadership behavior, they apply models of behavior to build and lead teams, facilitate change, and to be an advocate for continued improvement in education and leadership. All the faculty development courses are delivered by 5 weeks of online self-directed learning with a 1.5 to 2-day face-to-face interactive program. The program is taught by educational specialists and AO faculty surgeons trained in the regional education team training (RETT) program.

The coaching training program was started by AO Trauma in 2012. The goal was to train regional and experienced faculty to assume a dual role of being a teaching faculty and a faculty coach in real time. The program includes a precourse online self-assessment, readings, and discussions. The structural training sessions occur before an AO teaching event, and the coaching skills are practiced on site during the course. Coaching is different than teaching or mentoring; peer coaching at AO courses helps each faculty get immediate feedback on what they did well and what they may choose to do differently in their next teaching assignment. Peer coaching is effective in improving teaching skills, strategies, and improves teacher satisfaction.¹⁷

By the end of 2019, AO has trained 3675 individuals in the FEP, 1350 in the CEP, and 270 in LEP worldwide. The program is required for any faculty member seeking a successful career path at AO. It ensures delivery of consistent quality educational events. Besides a continual need to train new faculty, additional training will be required to develop synchronous and asynchronous online teaching competencies as well as those needed to educate in virtual environments and to guide learners through simulations remotely. Online learning requires similar education approaches but different methods of communication and platforms.¹⁸ Technologies are expanding and changing rapidly. Interactive webinars are already part of clinical divisions teaching portfolio. Blended formats of education became a necessity due to COVID-19 travel and social restrictions and have been implemented successfully.

Surgical Simulation—AO's Approach

AO pioneered a blend of surgical simulation, lectures, and case discussions for the first time in 1960. At that time, AO used human bones to simulate fracture fixation with screws, plates, and nails.⁴ Over time, the use of real bones became problematic and “low fidelity” plastic bones were produced and used to simulate fracture fixation. This allowed for full global scaling of courses.¹⁹

Currently, the highest fidelity simulation available are human anatomical specimens or living animal models. AO uses anatomical (sometimes prefractured) specimens for the education of experienced surgeons, where soft-tissue awareness and handling drives a clinical outcome, and it is educationally worthwhile to use these complex and expensive simulation methods.²⁰

AO uses simulations also to teach biomechanical and surgical concepts normally difficult to explain through conventional lectures. Examples include how much torque the surgeon can tighten a screw before it fails, inadvertent soft-tissue penetration differences when using sharp and blunt drills, reduction techniques, and biomechanical variations of plate and nail fixation. To better teach these concepts, AO developed the “Skills Lab” that consists of 10 unique interactive stations to simulate different surgical scenarios. These stations allow handling of instruments and implants to provide surgeons feedback to improve their knowledge and skill. The “Skills Lab” strives for surgical competence, a higher level of educational outcome than typically can be achieved with didactics alone.²¹

The goal of AO is to provide evidence-based education and simulation environments that lead to measurable improved surgeon performance, demonstrated by better outcomes for their patients. This requires not just surgical competence but proficiency in their practices. Therefore, the AO and its education institute embraced the concept of proficiency-based progression.^{19,22} To demonstrate that proficiency-based progression will be effective, AO is doing its own series of studies to characterize surgical procedures and define observable metrics. Currently, procedural simulations are available on the app-based platform “Touch Surgery.”²³ Full virtual reality simulations with limited haptic feedback and hybrid augmented/virtual reality simulations are being developed to teach procedures to the surgeons, allow for deliberate practice, and measure proficiency. These exciting new technologies, when guided by proven educational principles and evidence-based methodologies, may well transform the surgical education initiated by AO 60 years ago.

After 60 successful years, AO’s education journey continues. As learners needs evolve, learning technologies get smarter, and the environments require us to think of how to teach health care providers to learn faster and better. AO will continue to evaluate its educational approaches to provide the most effective opportunities for its learners.

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