



The Science of Learning in Action

“Active learning fosters a sense of teamwork and shared responsibility, which reflects the movement of the medical field away from expert autonomy and towards holistic, cohesive care.” – OLIVIA HARRISON '21

THE KEY TO EDUCATING THE NEXT GENERATION OF PHYSICIANS IS INNOVATION: USING ACTIVE LEARNING TECHNIQUES THAT HELP STUDENTS BUILD SKILLS, AND BECOME SELF-DRIVEN, LIFELONG LEARNERS PREPARED FOR THE EVER-EVOLVING WORLD OF MEDICINE.

BY ERIN POST

PHOTOGRAPHY BY DAVID SEAVER

The University of Vermont Larner College of Medicine has a long history of leadership in medical education, from its 1967 curriculum redesign, which introduced earlier and more extensive clinical instruction and enhanced emphasis on lifelong learning, to the launch of the Vermont Integrated Curriculum (VIC) in 2003, which brought education in the basic sciences together with the health sciences and clinical skills in innovative ways.

Now, the College has once again taken the lead in developing a new paradigm for medical education, one that asks students to lean in—to engage with each other and with faculty members—and asks teachers to facilitate that discussion. Called active learning, this new approach evolves the role of teacher and student in important ways.

“The role of the faculty member is changing,” says UVM Assistant Dean for Medical Education Katie Huggett, Ph.D., director of the College’s Teaching Academy. “They’re still sharing their expertise, but in different ways. Faculty facilitate sessions, rather than lecture. They’re becoming content curators, rather than creators.”

This shift in how medical students are taught is driven in part by the rapid creation of new medical knowledge, which now outpaces any one person’s ability to absorb it. Students need to be able to retrieve information and apply it. In class, they engage higher order thinking skills and learn how to work in teams.

The College’s commitment to active learning is based on pedagogical evidence. Research shows that students internalize and retain problem solving skills better when they’re interacting with faculty and with peers—the seminal work being a 2014 study published in the *Proceedings of the National Academy of Sciences* that showed improved grades and exam scores in STEM fields when active learning was employed as compared to traditional lecture.

The Larner College of Medicine has turned the evidence into a launching pad for innovation. Five core active learning modalities with standard operating procedures have been identified as the foundation for all of the sessions used throughout the VIC. Faculty have a network of professionals on the active learning team—led by Director of Active Learning and Associate Professor of Surgery Jesse Moore, M.D.—and in the Teaching Academy ready to help them develop their teaching skills, design sessions, and assess outcomes. A working group is focused on identifying research opportunities—publications and presentations at national conferences are already in the works.

We invite you to dive into one moment in each level of the VIC that showcases how the Larner College of Medicine is re-imagining medical education. >

Preceding page: First-year students in the Nutrition, Metabolism and Gastrointestinal Systems course work in small groups in the Reardon Classroom.



Racquel DeCastro '21 delivers her first “baby” in the UVM Clinical Simulation Lab flanked by classmates, sim lab staff, and associate OB/GYN clerkship director Erin Morris, M.D., at left

CURRICULUM LEVEL 1: FOUNDATIONS

Rebecca Wilcox, M.D., begins a session during the first-year Nutrition, Metabolism and Gastrointestinal Systems course with a basic question: “Bile. What is it good for?”

Students sit in small groups at tables throughout the room—electronic tablets at the ready. Conversation picks up as the groups begin to confer and list all of the functions of bile. Along with Jill Sullivan, M.D.'04, associate professor of pediatrics and pediatric gastroenterologist, Wilcox stops to answer questions as she walks between tables.

“Dr. Lidofsky’s video is fantastic,” Wilcox says, referring to the work of a fellow faculty member who created pre-learning material for the session. She encourages students to think back to its main points. When students reconvene, and the conversation is again directed by Wilcox and Sullivan, there are moments when pop culture meets the finer points of liver function. Actress Kirsten Dunst makes an appearance in a GIF as a visual cue for one of bile’s key roles (Dunst waving good-bye=bile eliminating toxins and metabolic waste). Then, their final project for the day: With colored markers and large sheets of paper, students are drawing out the metabolism of bilirubin, a key process in a properly functioning liver.

“Having a strong handle on normal is the key to recognizing and understanding abnormal,” says Wilcox, noting that this work sets the stage for a later team-based session focused on clinical cases.

As students hash out bilirubin metabolism together and come up with creative ways to communicate it, they’re reinforcing what they

learned ahead of class and taking it one step further.

“We meet them exactly where they are,” says Sullivan. “We try to help them work through the entire metabolic process in preparation for clinical application.”

Students coming to the session having already completed some work on their own is important, says Wilcox, who is course director and an associate professor of pathology and laboratory medicine. Individual and Group Readiness Assurance Tests can be done prior to class or built into sessions.

“The pre-work is the foundational knowledge and the vocabulary,” she says. “Then when we apply that to a real case scenario, a real patient, we’re all speaking the same language.”

Once the pieces come together, student learning takes off.

“Their higher order thinking in the classroom sometimes just amazes me,” she says. “It’s almost like you release this potential in the room.”

The Takeaway

“Students are prepared when they come into class to integrate what they’ve learned. Instead of listening to a lecture and then studying, they learn the material first and then they apply it. It’s like the difference between reading about driving and driving a car. With active learning, you’re driving a car with the instructor in the seat next to you.” – Karen Lounsbury, Ph.D., *Foundations director and professor of pharmacology*

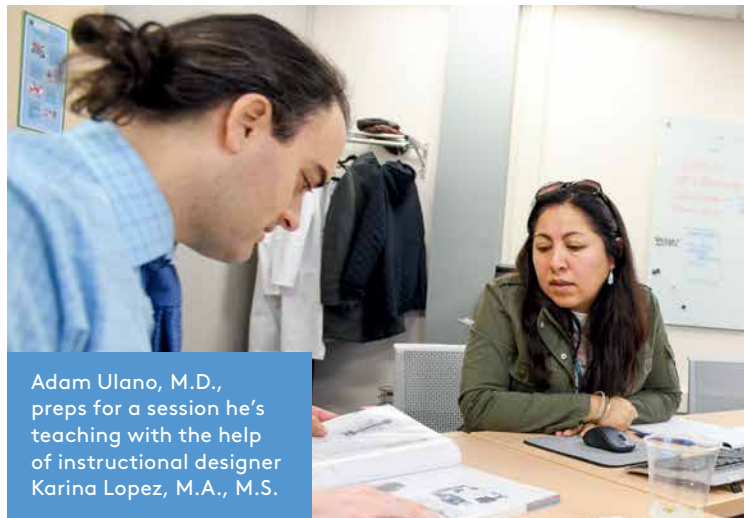
CURRICULUM LEVEL 2: CLERKSHIP

On the first day of the OB/GYN clerkship, students dive right into the practice of obstetrics: They deliver a baby in the safe confines of the UVM Clinical Simulation Laboratory. Flanked by a faculty member, a member of UVM’s simulation team, and a few classmates, they try out the basic maneuvers involved in a spontaneous vaginal delivery courtesy of a high-tech mannekin “mother” and “baby.” The five-hour clerkship orientation continues with other stations focused on pelvic and breast exams, knot-tying, suturing, and scrubbing into a sterile procedure.

That first day is a harbinger of what’s to come, as the six-week clerkship consistently asks students to access medical knowledge and apply it in real time, while working with a group to solve problems. Elise Everett, M.D., associate professor of obstetrics, gynecology and reproductive sciences and clerkship director, says the goal is to foster leadership skills along with an understanding of the benefits of a team.

“Knowing what you don’t know and being able to identify and fill those knowledge gaps is important,” she says. “And being reflective, self-aware and willing to ask for feedback and for help is key to taking care of patients safely.”

One innovation: Critical thinking cards that have helped shift the clerkship’s didactic content from about 15 lecture hours to zero. Students meet weekly in small groups with a faculty advisor to review patient cases that relate to what they recently experienced in the clinical environment. The critical thinking cards include a chief



Adam Ulano, M.D., preps for a session he's teaching with the help of instructional designer Karina Lopez, M.A., M.S.

TEACHING THE TEACHERS

On April 25, 2019, UVM Assistant Professor of Radiology Adam Ulano, M.D., hosted his first-ever session teaching medical students. His charge: Introduce the first-year class to neural imaging techniques as part of the Neural Science course. Ulano already had an aptitude for teaching; he's the director of the UVM Medical Center Neuroradiology Fellowship Program. But many questions bubbled up as he considered the task at hand. How do you design an effective session? How should students prepare? How would he know his instruction was effective? Follow Dr. Ulano through some of the key moments as he prepares for his first session.

Read the story at VT Med Online med.uvm.edu/vtmedicine/web-extras

“At the Larner College of Medicine, we’ve been innovators of a medical education program that incorporates best learning practice and takes into account ever-evolving health care systems and educational environments. Physicians today need to be self-directed, lifelong learners; active learning develops the skills our students need to thrive.”

—CHRISTA ZEHLER, M.D.'99, INTERIM SENIOR ASSOCIATE DEAN FOR MEDICAL EDUCATION

complaint and questions to ask to begin to develop a differential diagnosis. Before the meetings, students review videos and book chapters to develop the knowledge base they need. In the small groups, they integrate what they've learned with what they've experienced in the clerkship and apply it to the cases they're reviewing.

“The most rewarding way to practice medicine is in an environment where we can all be teachers and learners and we can all learn together,” says Everett.

The Takeaway

“In the past, the doctor was expected to know everything and make decisions independently. Now, medicine is so complex and the amount of knowledge is so vast, this is no longer possible. I think the most valuable skills that we’re teaching with active learning is the ability to think critically, solve problems, and work as a team.”

—Elise Everett, M.D., associate professor of obstetrics, gynecology and reproductive sciences and OB/GYN clerkship director

CURRICULUM LEVEL 3: ADVANCED INTEGRATION

During the emergency medicine rotation, fourth-year students learn by doing: They spend two weeks in the emergency room at UVM Medical Center and another two weeks at either

Central Vermont Medical Center in Berlin or Champlain Valley Physicians Hospital in Plattsburgh, N.Y. Students triage patients, present a chief complaint and history to the attending physician, and work with them on diagnosis and next steps.

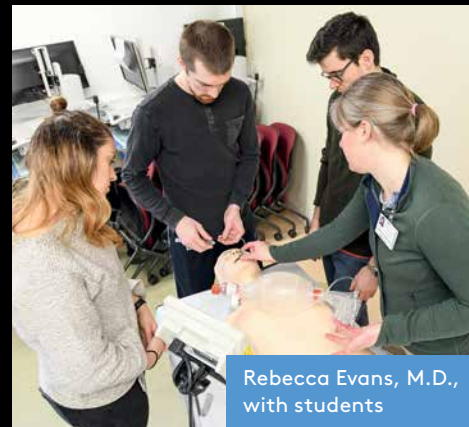
They also expand their skills and knowledge through a new case-based learning series, says Sarah Schlein, M.D.'10, assistant professor of surgery and emergency medicine clerkship director. Attending physicians use these cases as the foundation for sessions on a range of emergency medicine topics. Students have pre-learning material they work through and come to the sessions at UVM ready to discuss and diagnose.

“I’ve taken these cases that are real, as well as thought-provoking and interesting,” she says. “Students answer questions and generate what the next step would be. They are figuring out what the management approach is, and hopefully through that struggle they are learning and assimilating the information better.”

At the very beginning of the clerkship, students hone their point-of-care ultrasound skills through time in the UVM Clinical Simulation Laboratory. Keith Curtis, M.D., assistant professor of surgery and integrated ultrasound curriculum director, leads them through a series of stations where they try their hand at common emergency medicine procedures. It’s a continuation of work they’ve

BRIDGE: ANESTHESIOLOGY

In a high stress, high stakes environment like the operating room, teamwork and communication are critical. The anesthesiology bridge course—which runs during the one-week period when clerkship-level students are back on campus in between rotations—introduces students to the field and asks them to step into the shoes of an OR team. They learn procedures in the UVM Clinical Simulation Laboratory, work through cases in the Larner Classroom, and participate in a team-building workshop.



Rebecca Evans, M.D., with students

This is the second year the bridge course has used 100 percent active learning modalities.

Rebecca Evans, M.D.'10, assistant professor of anesthesiology and anesthesiology bridge course director, says one goal is to reinforce the importance of collaborating to solve problems.

“It’s hard to do your own thing in the OR,” she says. “And medicine as a whole has become much broader—you’re working with pharmacists, dietitians, nurses. We want students to work on communication skills.”



Jennifer Boccia '20 (left), and preceptor Jennifer Jachowski, D.O., in the emergency room at Central Vermont Medical Center.

done since the first year, when point-of-care ultrasound instruction begins and continues throughout the curriculum.

The goal for the clerkship, says Schlein, is to give students a solid foundation in emergency medicine as well as prepare them for the demands of residency.

“The communication and leadership skills they develop are so profound,” she says. “This creates the scaffold for them to tie in the medical knowledge and the patient care that they need to learn in the clerkship setting.”

The Takeaway

“This is true across the field of medicine: It’s not what you know; it’s how you think. We’re helping students work through a challenging problem while asking them to think outside the box. We want them to draw connections, practice retrieving little bits of medical knowledge and apply it.” —Sarah Schlein, M.D.'10, assistant professor of surgery and emergency medicine clerkship director

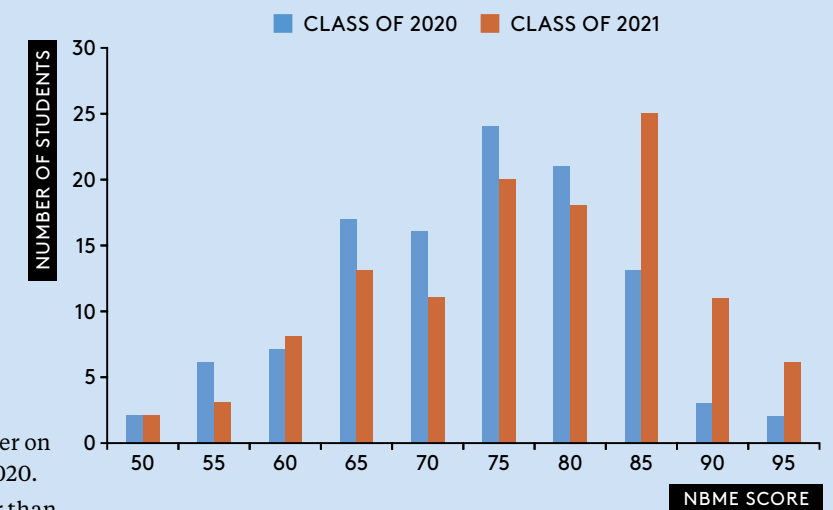
DOES IT WORK? ASSESSING STUDENT OUTCOMES

The College is actively monitoring academic outcomes of active learning. Students in the Cardiovascular, Renal and Respiratory Systems (CRR) course take a customized National Board of Medical Examiners (NBME) shelf exam to measure what students learned in the course. The classes of 2020 and 2021 received the same NBME exam, which means their scores are an excellent measure for assessing changes in the curriculum. **VM**

Key Points

- CRR was the first Foundations course to convert to 100 percent active learning.
- The Class of 2021 scored four percentage points higher on average on the NBME shelf exam than the Class of 2020.
- Forty-two students in the Class of 2021 scored higher than 85 on the NBME shelf exam compared to 12 students in the Class of 2020.
- Analyses show that:
 - On average, students in the Class of 2021 entered Larner College of Medicine with slightly lower MCAT scores than students in the Class of 2020.
 - Learning course content with 100 percent active learning modalities was associated with higher NBME scores at all levels of academic ability upon entering medical school.

National Board of Medical Examiners Shelf Exam Scores



- Research has shown that active learning is particularly beneficial for women and underrepresented minorities. While there is not yet an adequate sample size to detect meaningful differences, the same trends are seen for these groups of students. Data will continue to be monitored.