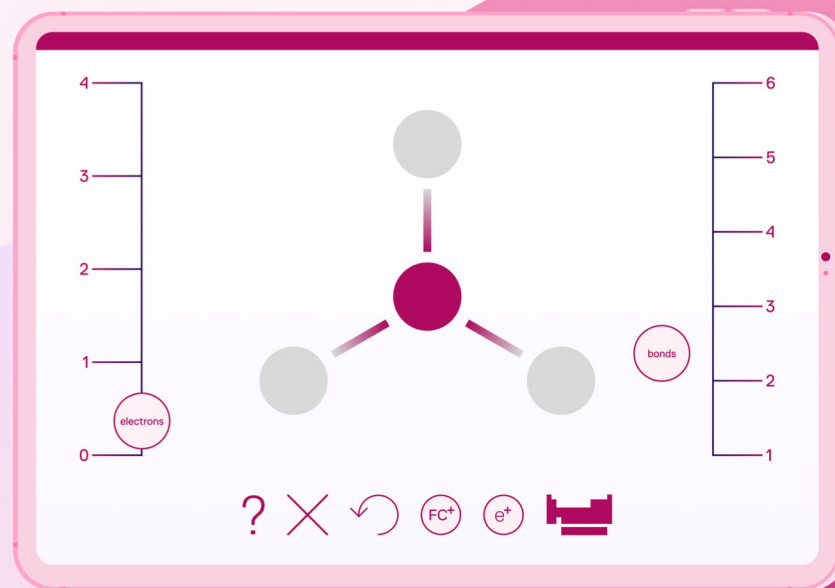
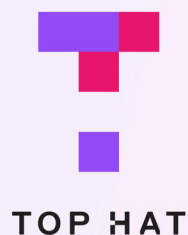


# Empowered to Learn: How Chemistry Professors Are Making a *Difference*

Real professors. Real challenges. Real transformations in student learning with the help of proven active learning strategies.



# The Case for Active Learning in Chemistry

Great chemistry teaching doesn't just happen—it requires creativity, engagement and a deep understanding of how students learn. Yet despite their best efforts, professors face steep challenges: research shows that **up to 60 percent of students in introductory STEM courses struggle to achieve a passing grade**<sup>1</sup> on the first attempt. Concepts can be abstract, content dense, and intimidating, leaving students unsure of where to focus or how to connect theory with practice. Even motivated students may feel lost, and instructors can struggle to translate their expertise into deep, lasting understanding for every learner.

Active learning offers a powerful solution. By creating opportunities for students to participate, practice, and apply concepts in real time, professors can transform classrooms from passive spaces into dynamic hubs of curiosity and discovery. Engagement, mastery, and confidence rise when students are encouraged to ask questions, explore ideas, and receive immediate feedback. This ebook highlights how three chemistry educators have embraced active learning—and how platforms like Aktiv Chemistry have helped them overcome challenges, inspire their students, and make the subject more accessible, engaging and rewarding.

<sup>1</sup>Castle, S.D., Byrd, W.C., Koester, B.P. *et al.* Systemic advantage has a meaningful relationship with grade outcomes in students' early STEM courses at six research universities. *IJ STEM Ed* 11, 14 (2024). <https://doi.org/10.1186/s40594-024-00474-7>

# *Building Confidence and Community in General Chemistry*

## Jill Ellenbarger

Associate Professor of Chemistry,  
John Brown University  
80 students taught per semester



## The Challenge: Making Chemistry Click for Every Student

For many students, general chemistry can feel like an uphill climb—filled with equations, math anxiety, and the belief that chemistry “just isn’t for them.” Dr. Jill Ellenbarger, Associate Professor of Chemistry at John Brown University, knows that her first-year students come from vastly different majors and levels of preparation. She teaches future engineers, chemists and medical professionals—all sitting in the same room, each with their own motivations and fears.

Balancing the need for both breadth and depth of content is a constant challenge. “We want them to understand the foundations, but also to know them deeply,” she explains. For many of her students, it’s not just about learning chemistry—it’s about learning how to learn at the college level. Helping them overcome intimidation, build effective study habits and see chemistry’s real-world relevance has become central to her teaching mission.

“

Start small, try one active learning strategy at a time, and give yourself grace to experiment. And don’t do it alone—build a community of fellow educators to learn with and from.”



## Active Learning Lessons: From Lecture to Collaborative Discovery

“

Active learning gives students space to identify what questions they have—and the confidence to ask them.



Ellenbarger's journey toward active learning began where many do—with traditional lectures. Over time, she saw that while she was covering all the material, students weren't necessarily connecting with it or each other. Simple changes like **small group problem-solving** quickly made a difference.

Then came the pandemic, which prompted her to experiment with a **fully flipped classroom**. Students watched lecture videos outside of class and used class time for practice and discussion. While this boosted engagement for some, it also widened the performance gap. Today, she's found the sweet spot in a **partially flipped model**, where greater emphasis is placed on practicing problems and reinforcing concepts during class.

Ellenbarger has also noticed students now feel more empowered when problem-solving in small groups, and in turn, she and her Learning Assistants are able to respond to more questions live versus in a passive lecture.

Ellenbarger now helps lead an [Introductory Chemistry Learning Community](#), where educators collaborate to design and refine practical, active learning strategies for their classrooms. We've rounded up the most impactful ideas in the sidebar.

## Faculty-created active learning strategies

### ✓ Topic-specific learning tools

Faculty designed targeted strategies to help students grasp challenging chemistry topics, such as acid-base equilibria.

### ✓ 'When experiments fail' reflections

Instructors built lab-based activities that guide students through what to do when an experiment doesn't go as planned, emphasizing reflection, troubleshooting and resilience.

### ✓ Building class connections

Faculty curated a collection of class conversation starters, a chemistry-themed playlist and topic-related demos to use in class, which helped spark personal connection between students and instructors.

## How Aktiv Chemistry Enhances Learning

Ellenbarger first adopted Aktiv Chemistry to make her course less intimidating as well as more cost-effective for students, using it alongside an OpenStax textbook, *Chemistry: Atoms First 2e*. She quickly discovered it offered far more than affordability—it became a cornerstone of her teaching workflow, both in and out of class.

Students complete **daily quizzes, weekly homework and chapter-long practice sets** in Aktiv, all designed to promote steady, low-stakes learning. “It helps students think about chemistry more consistently—not just cram before an exam,” she says. For Ellenbarger, Aktiv doesn’t just deliver assignments—it reinforces the active learning environment she’s built. Students come to class ready to engage, ask better questions, and connect with peers because they’ve already practiced applying concepts on their own.



Aktiv's practice questions give students a longer timeline to reflect back—“Do I feel comfortable on all the content we’ve covered so far?” It really helps them build that knowledge at their own pace.”

### Ellenbarger uses Aktiv to:

- ✓ **Facilitate quizzes** to reinforce learning from the previous lecture as well as assigned chapters.
- ✓ **Provide instant, personalized feedback** that she wouldn’t have time to deliver manually.
- ✓ **Identify challenging** concepts by reviewing quiz results, then address them in class.
- ✓ **Support skill-building**, like math readiness, through targeted practice and reassessment opportunities.
- ✓ **Encourage flexible access**, letting students complete work seamlessly from any device.

### The Results

Ellenbarger’s innovative approach to teaching has transformed her classroom. By leveraging Aktiv to build a true sense of community and spark curiosity, she’s seen measurable improvements across every metric—higher engagement, stronger test scores (both in her own course and on the American Chemical Society national exam), and deeper student confidence. Her colleagues have also taken note, praising how her former students “really know their general chemistry” when they advance to upper-level courses—a testament to both her dedication and the lasting power of her teaching.

# Turning Fear Into Fluency: How One Organic Chemistry Professor Builds *Confidence* Through Active Learning

## Sharon Hamilton

Professor of Organic Chemistry,  
Ouachita Baptist University  
40 students taught per semester



## The Challenge: Making Chemistry Click for Every Student

For many students, organic chemistry has a reputation that precedes it—one of dread, difficulty and rote memorization. Dr. Sharon Hamilton, Associate Professor of Organic Chemistry at Ouachita Baptist University, knows that mindset all too well. Most of her students arrive with limited chemistry experience and a belief that success comes from memorizing formulas rather than understanding how concepts connect.

“I tell them organic chemistry is still math,” Hamilton explains. “It’s the logic side of math—about recognizing connections and patterns, not just memorizing reactions.”

The real challenge, she says, lies in helping students step outside their comfort zone and approach chemistry as a problem-solving discipline. Without that mindset shift, students quickly become overwhelmed—and disengaged.

“

Most students can memorize their way through a biology class, but that becomes very difficult in chemistry—especially organic. The big hurdle is getting them to learn in a different way than what they’re comfortable with.”



## Active Learning Lessons: Build Engagement, Confidence and Community

Hamilton's journey with active learning began more than a decade ago as part of her involvement in the New Faculty Scholars program during her first instructor position at Auburn University. Years later, she continues to lean on active learning methods as a way to connect with students on a personal level. Like so many educators, Hamilton knew that engagement involved more than disseminating information. It would require demonstrating care and concern for students' academic success on her part—and equally important, several opportunities for learners to apply their understanding in a low-stakes manner.

Since then, she's experimented with everything from kinesthetic group exercises to collaborative 'think-pair-share' discussions. Today, her classroom thrives on conversation and constant interaction through annotating slides with reactions or equations in real time. Whether it's uncovering why her students were split 50-50 on a question or honing test-taking skills for future exams, Hamilton takes an empathetic approach to student success.

The goal isn't just to keep students active—it's to build their confidence. "Students often know more than they believe they do," she notes. "When they see they're part of the group that got the question right, that moment of success is powerful."

“

We always talk through problems and explain why answer 'A' or 'B' wasn't right. I really try to help them differentiate close answers and share tips to perform well on multiple choice tests in general.”

### Hamilton's advice on active learning

- ✓ **Start small**  
Incorporate low-stakes questions that promote discussion and real-time feedback.
- ✓ **Find a mentor**  
Learn from peers who have already implemented active learning techniques.
- ✓ **Don't overcomplicate it**  
“Active learning doesn't have to mean reworking your entire course,” Hamilton says. “Even clicker questions are a great place to start.”

## How Aktiv Chemistry Enhances Learning

“

Aktiv lets me meet students where they are. They are given two points per question—with one being participation focused—so even if they aren't fully understanding, my goal is for students to not feel penalized.”

Dr. Hamilton turned to Aktiv Chemistry after growing frustrated with traditional homework platforms that required her to rebuild her course with every new textbook edition. Today, she integrates Aktiv directly into her lectures, using interactive questions within her annotated slides to check comprehension in real time and revisit topics when needed. By leaving quizzes open that allow students to change answers as they learn throughout lectures, Hamilton shifts the focus from gaining points to gaining confidence.

Outside of class, Aktiv plays a central role in Hamilton's approach to reinforcement and mastery. Students begin with a core homework assignment, then move to a follow-up iteration that adapts to their weaker areas. With multiple attempts and a mastery threshold set at 80 percent, students know that if they put in the effort, they can succeed. Hamilton also converts completed homework into practice mode, giving students several opportunities for review. For her, Aktiv has become an essential tool for improving both mastery and confidence—reminding students that practice can, in fact, make perfect.





## Hamilton uses Aktiv to:

- ✓ **Run in-class polls** interspersed in annotated lecture slides, using Aktiv's targeted feedback to identify what topics students are struggling with.
- ✓ **Administer interactive homework assignments** with two attempts to reinforce understanding.
- ✓ **Target weak areas** with adaptive follow-up assignments—ensuring students get at least 80 percent of questions correct by using multiple attempts.
- ✓ **Create opportunities for retrieval practice** by assigning homework as 'practice,' offering students several opportunities to strengthen their comprehension.

## The Results

Students find it rewarding to get immediate feedback from their peers—and Aktiv—on areas of confusion. Hamilton often asks students to explain the solution they arrived at to a neighbor, which helps reveal misconceptions. Aktiv's targeted feedback and helpful hints also guide students in the right direction without giving away the answer.

“

I know that my students prefer Aktiv over other homework systems they've used. They appreciate how different it feels—and how it helps them actually learn, not just complete assignments.



# Closing the Preparedness Gap with *Low-Stakes* Assessment and POGIL

## Theodore Alivio

Associate Professor of Chemistry,  
Nicholls State University  
170 students taught per semester



## The Challenge: Bridging Gaps in Math, Motivation and Money

Teaching general chemistry at Nicholls State University presents a range of challenges that influence both student success and instructional strategies. Associate Professor Theodore Alivio has observed that many students, most of whom are first-generation students entering from public high schools in Louisiana, arrive with limited arithmetic literacy and college preparedness. He and research collaborators<sup>2</sup> found that students who lacked arithmetic automaticity—the ability to perform basic math quickly in their head, without a calculator—struggled in general chemistry. The rise of generative AI has accelerated this decline in ability as students prioritize quick solutions over the deeper learning process that chemistry demands.

In addition to the arithmetic automaticity gap, Alivio's students were confronted with affordability barriers. The digital homework platform that was previously in use required students to pay \$230, leaving many unable to access essential course materials and subsequently falling even further behind.

“

Students seem to be much more after instant gratification. They'll often say, 'hey, I need to know right away how to work out this problem. Show me the steps and I'll try to memorize it.'”

<sup>2</sup>Alivio, T.E.G., Howard, E., Mamiya, B. et al. How Does a Math Review Impact a Student's Arithmetic Skills and Performance in First-Semester General Chemistry?. *J Sci Educ Technol* 29, 703–712 (2020). <https://doi.org/10.1007/s10956-020-09851-7>

## Active Learning Lessons: Embracing the Shift with Low-Stakes Engagement

Alivio recognizes that his students are from a different generation, where many are used to learning in a digital-first, bite-sized format. He's committed to helping every student find a deeper appreciation of chemistry by infusing lectures with active learning strategies.

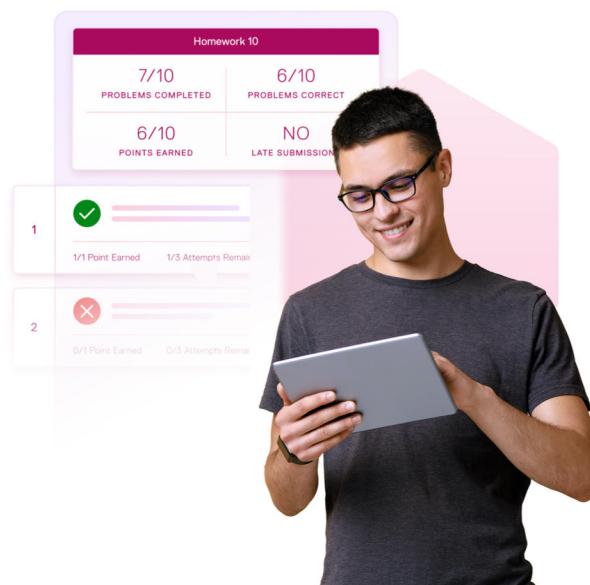
This year, Alivio has introduced Process-Oriented Guided Inquiry Learning (POGIL) in his classes to encourage students to chat more between themselves, compare notes and come up with explanations in their own words. Here's how it all comes together:

- **Kick off class with a lecture:**

Alivio begins each class with a 10-minute lecture to discuss the key topic(s) and skills students should hone by the end of that day's class.

- **Transition into a group activity:**

Next, Alivio splits students into small groups and asks them to take on four roles including manager, reflector, presenter and recorder. Groups then complete several activity sheets that gradually increase in difficulty.



### Alivio's advice on active learning:

- ✓ **Rethink traditional clickers**

Alivio moved from a traditional polling solution to Aktiv in order to provide instant feedback and test students on basic information in class. Questions are designed to cover foundational knowledge, such as drawing a molecule's structure.

- ✓ **Be prepared for pushback**

In Alivio's experience, students were hesitant to embrace new pedagogies such as the flipped classroom model or POGIL. Remind them why active learning is more effective and how it can deepen understanding.

- ✓ **Focus on low-stakes assessment**

Give students a chance to bounce back if they perform poorly. Alivio uses low-stakes exams to reduce added stress by shifting points to several smaller homework assignments throughout the term.



## How Aktiv Chemistry Enhances Learning

Professor Alivio chose Aktiv Chemistry to address key problems in his course, and it now plays a major role—contributing to 30 percent of each student's overall grade. Homework accounts for 20 percent where class participation in the form of polls makes up 10 percent. Attributing nearly one-third of the final grade to homework and participation combined greatly reduces student anxiety. Alivio lists the following benefits of using Aktiv in General Chemistry.



What I like most is Aktiv's dimensional analysis feature. Aktiv is the only homework platform that incorporates multiple conversion factors which students will use more in their daily lives."

- **Scaffold the dimensional analysis process:**  
The most valuable feature for Alivio is Aktiv's dimensional analysis tool. It uses drag and drop tiles to set up scaffolded conversions and allows for multiple conversion factors—a more realistic reflection of calculations encountered in chemistry.
- **Incentivize in-class participation:**  
Using Aktiv, Alivio has set up attendance and polls to only be accessible during the allotted class time. Doing so holds students accountable to attend and contribute during class.
- **Cut costs significantly:**  
With Aktiv, students pay \$75 for a two-semester subscription and get access to homework assignments and class polls from the same platform. Each student saves more than \$250 per term since Alivio has consolidated his classroom engagement tools.

## The Results



Alivio has transformed the traditional lecture into a dynamic, student-centered experience. He uses Aktiv during lectures and outside of class to complement POGIL sessions during which students collaborate, compare ideas, and explain chemical concepts in their own words—building a deeper understanding of the material. While some students were initially hesitant to move away from passive lectures, many have come to appreciate how 10-minute overview sessions followed by active learning strategies make chemistry more approachable.

