Using Adaptive Learning Technology (ALT) to Improve Student Learning in STEM Courses

Dr. Laura Niesen de Abruna, Provost
Dr. Jessica Fautch, Professor, Physical Sciences
Ms. Cynthia Crimmins, Director of Academic Innovation
Agenda

1. Introductions
2. Why Adaptive Learning Technology?
3. Framework for Adopting ALT
4. Our Story
5. Best Practices & Resources
6. Questions?
What is the Public Value that Higher Education Should Address?

Higher education has both a social justice and a practical reason for focusing on having all students who graduate from high school not only access postsecondary education but also graduate with a credential. According to research conducted by the Bill & Melinda Gates Foundation, there will be over 11 million high school graduates between now and 2025 who will need postsecondary education to access a career with a living wage.

As former Gates Program Officer Jim Ptaszynski has pointed out, these students will need to succeed in:

1. Domain Knowledge
2. Critical Thinking
3. Written Communication
4. Oral Communication
What is the Public Value that Higher Education Should Address?

5. Quantitative Thinking
6. Qualitative Thinking
7. Social Skills

Many of these skills, especially in the community college sector, are offered in the first 60 hours of courses, sometimes known as “Gateway” courses, as they are the entryway to the higher level courses and graduation. They are the most likely places for students to falter and drop out or stop out.
How Does Digital Pedagogy Help?

Early experiments at selected, large public universities and community colleges working with the Foundation have shown promise for the role that digital learning can play, in addition to the other roles played by financial aid, advising, and cultural and social issues.

Blended and online learning, combined with high quality courseware, can improve progression through the first 60 hours of coursework by adapting to students’ needs.
How Does Digital Pedagogy Help?

High quality courseware can trigger a number of improvements to the learning experience, including:

- Improved feedback from the instructor
- Personalization of learning
- Incorporation of active learning strategies
- Improved instruction by providing real time access to analytics
- Creating capacity so that students have more options to take the courses needed for graduation
Digital Learning as Gateway for Improved Student Success

What is Adaptive Learning?

A more innovative use of digital learning is provided by digital courseware. This refers to instructional content that is designed and sequenced to offer an entire course packet in lieu of a physical textbook or sometimes in addition to a textbook. Students access this course software and receive personalized assessment and digital “coaching” as the program directs them to additional work that helps them understand content. They cannot proceed from one section to another without mastering content.

It is sometimes called “adaptive hinting.”
Advancing Digital Learning: Set the Stage

- Establish Rationale
  - “Change is accelerating across all of American higher education as the nation’s two- and four-year colleges and universities adapt to new student populations, new financial realities, and new digital pedagogical resources and strategies which can improve student learning and institutional outcomes.”
  - Dr. Laura Niesen de Abruna, Provost at York College of Pennsylvania

- Build Goals into Strategic Plan & Institutional Effectiveness Outcomes
  - At YCP: “Develop the most effective organizational model” and “Advance High Impact Educational Practices and Academic Innovation”
    - Moved Chief Information Officer and Library-Technology Services in Academic Affairs
    - Developed Center for Academic Innovation
    - Hired Instructional Designers

- Allocate Financial Resources
  - grants, stipends, faculty development resources, travel funds
Advancing Digital Learning: Get “Buy-in”

- Identify leaders, champions, and allies
- Share a consistent message
  - Describe the internal and external landscape
  - Approach from a position of inquiry, then advocacy
    - Work to understand needs, concerns, current practices, existing resources, initiatives
    - Use evidence-informed decision-making
    - Provide case studies as inspiration
- Develop comprehensive support structures (CTL, IT, ID)
- Identify target courses to pilot (e.g. high DFW in gateway courses)
- Invite participation and offer incentives
- Explore & select products together
- Provide comprehensive support throughout entire process
  (e.g. align faculty development programming w/ initiatives and build in IT support at events)
- Assess and showcase
ALT in General Chemistry: A pilot
Typically 9-10 lecture sections of ~30 students per semester
Taught by five or six faculty members
**Homework adjustment:**
**Personalized Digital Learning: ALEKS**

Assessment & Learning in Knowledge Spaces (ALEKS)
www.ALEKS.com

<table>
<thead>
<tr>
<th>Mastering Chemistry</th>
<th>ALEKS</th>
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<tbody>
<tr>
<td>• Standard “set” of questions</td>
<td>• Questions <strong>adapt</strong> to each student’s ability</td>
</tr>
<tr>
<td>• Wrong answers <strong>penalized</strong></td>
<td>• Wrong answers <strong>explained</strong></td>
</tr>
<tr>
<td>• Minimal feedback on wrong answers</td>
<td>• Full explanation and work shown for wrong answers</td>
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<tr>
<td>• <strong>No credit</strong> for the problem if explanation or answer is requested</td>
<td>• Explanation available <strong>without penalty</strong></td>
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<td>• Student can learn and <strong>forget</strong></td>
<td>• Knowledge checks <strong>hold students accountable</strong> for previous content</td>
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<tr>
<td>• Isolated</td>
<td>• <strong>Adaptive</strong></td>
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ALEKS: Adaptive Tool

- Instructor: assigns course learning objectives
  - Independent or tied to textbook
- Student: knowledge check
- Student experience:
  - Work to fill the “pie” of objectives (topics)
  - Individualized questions
  - Topics re-introduced when needed
  - Explanations without penalty
  - Three correct answers in a row → topic learned
  - Periodic knowledge checks
Does ALEKS impact learning?

- Pilot
  - ALEKS (n=28) vs. Mastering Chemistry (MC) (n=58)
  - MC: Different instructor; comparable teaching style and rigor

Assessments

- Common exam questions (multiple choice)
- Opinion survey
- Comparison: experiences with both MC and ALEKS
  Opinion survey
Common Exam Questions

<table>
<thead>
<tr>
<th>Concept</th>
<th>ALEKS</th>
<th>MC</th>
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<tbody>
<tr>
<td>moles</td>
<td>45%</td>
<td>28%</td>
</tr>
<tr>
<td>stoichiometry</td>
<td>80%</td>
<td>33%</td>
</tr>
<tr>
<td>ppt rxn</td>
<td>89%</td>
<td>73%</td>
</tr>
<tr>
<td>light and E</td>
<td>88%</td>
<td>90%</td>
</tr>
<tr>
<td>quantum numbers</td>
<td>92%</td>
<td>75%</td>
</tr>
<tr>
<td>VSEPR</td>
<td>78%</td>
<td>49%</td>
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ALEKS: n=28       MC: n=58
Student Perspectives

Cara:

“If you have trouble on a question the program will switch you to another, easier problem, forcing you to take a break from the frustration, rebuilding your confidence on another topic.”

Madison:

“While waiting for the tutor I noticed a kid from another class working on Mastering Chemistry and I told him I could help him...and I did!”
Student Response

- **I am comfortable explaining chem to others**
  - ALEKS pre: 4.60, ALEKS post: 6.00, MC PRE: 4.95, MC Post: 5.61

- **Homework helps my learning**

- **I feel autonomous in my learning**

- **I am confident in chemistry problem solving**
  - ALEKS pre: 4.90, ALEKS post: 5.80, MC PRE: 5.27, MC Post: 5.51

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ALEKS: n=10  
MC: n=41

Level of Agreement (Likert Scale 1-7)
Final Grade Distribution

<table>
<thead>
<tr>
<th></th>
<th>3.5-4 (A/B+)</th>
<th>2.5-3 (B/C+)</th>
<th>2 (C)</th>
<th>1/0 (D/F)</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALEKS (n=28)</td>
<td>14 (50%)</td>
<td>8 (29%)</td>
<td>2 (7%)</td>
<td>2 (7%)</td>
<td>2 (7%)</td>
</tr>
<tr>
<td>MC (n=58)</td>
<td>21 (36%)</td>
<td>18 (31%)</td>
<td>10 (17%)</td>
<td>9 (16%)</td>
<td>0</td>
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Both experiences: MC vs. ALEKS

Total respondents n=27

Dr. Bill Steel
Summary and Goals

• Adaptive Learning using ALEKS supported a positive learning experience for students in General Chemistry

• Pilot study → faculty buy-in
  • ALEKS currently used in all CHM 134 courses
    Fall 2018
  • ALEKS: summer prep course—work in progress

• Institutional perspective:
  • Success rate in CHM 134 → Retention in major → Retention at YCP → Graduation
Recommendations

- Engage faculty early and often to select new e-tools
- Provide data in accessible, relevant formats to help faculty make informed decisions
- Build-in support at every stage (technology, faculty development, instructional designers)
- Provide multiple opportunities for faculty to try new products
- Offer incentives, recognition, and rewards for faculty
- Pilot and assess with full implementation in mind
- Showcase early and often
Resources


Questions
Session Evaluations & Drawing

- Download and open OLC Conferences mobile app
- Navigate to specific session to evaluate
- Select “Evaluate Session” on session details screen (located under session type and track)
- Complete session evaluation*

*Each session evaluation completed (limited to one per session) = one contest entry

Five (5) $25 gift cards will be awarded to five (5) individuals
Must submit evals using the OLC Conferences mobile app or website