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A Mastering Chemistry Story:

How to support student study habits and improve student engagement

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Key Findings

An instructor at a teaching university in Alberta, Canada believes implementing Mastering Chemistry and Learning Catalytics in their General Chemistry course is very beneficial in many ways including:

- **Supporting the modern study habits of students with access to eText on the phone and offline**
- **Encouraging student engagement, group work and cultivating discussion in class**
- **Reducing administrative burden through automatic marking**
- **Offering flexibility to cater to student needs and to support struggling students**

School: A 4-year university in Alberta, Canada
Course Name: General Chemistry
Course Materials: Customized edition with the bulk of the material from *Chemistry: A Molecular Approach*, 3rd Canadian Edition by Nivaldo J. Tro, Travis D. Fridgen and Lawton E. Shaw.
Time Frame: 2011-2020

About the Course

General Chemistry builds a solid foundation of chemistry based around topics such as chemical nomenclature, stoichiometry, classification of chemical reactivity, gases (both ideal and real) and thermochemistry.

Challenges and Goals

Because General Chemistry is a first-year course, with students coming directly from high school, the instructor's main goal is to help students build a solid foundation of chemistry knowledge to assist them towards achieving a bachelor's degree in science.

In 2011, after implementing several different interactive programs for the course and finding them all unsatisfactory, the instructor trialed Pearson's Mastering Chemistry. They found it to be *"the best choice on the market"* and have been utilizing it since.

Implementation

The instructor has been teaching General Chemistry since 2008, with experience teaching Physical Chemistry since 1993. They have been utilizing Mastering Chemistry for 9 of those years. They currently teach two sections with a total of approximately 160 students with a face to face implementation model, meeting for lectures 3 hours a week and labs, also for three hours a week.

Mastering Chemistry is used outside of class for assignments and practice. Assignments are open to students for a week after the lecture, they are able to utilize the hints feature and have 6 attempts to complete the question. Learning Catalytics is used during the lecture where it is used to work through problems and facilitate discussion between the instructor and students, as well as between the students themselves.

Assessments

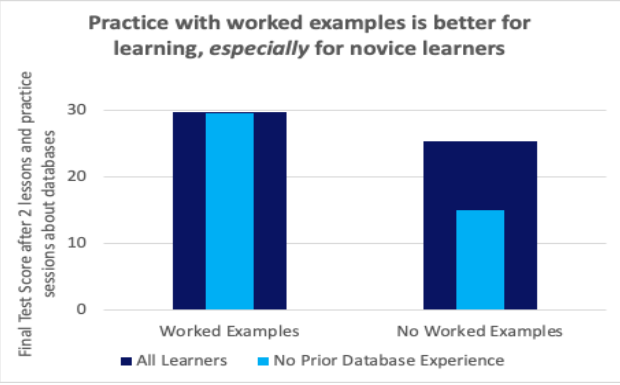
- Mastering Chemistry Assignments: 10%
- Two Mid-Term Tests: 15% (each)
- Final Exam: 30%
- Laboratory Component: 30%
- Learning Catalytics: up to 2% bonus marks

The Learning Science Behind MyLab

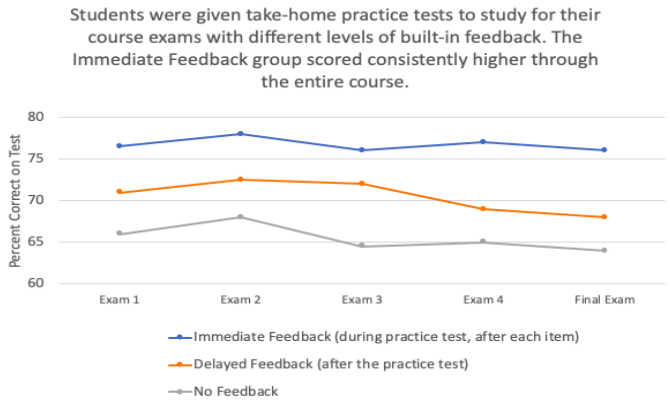
Many of the benefits the instructor and their students experience with the MyLab Math products are there by design, focusing on best practices around learning science. There are a lot of factors that influence whether a learning solution 'works'. Drawing upon guidelines based on evidence from the learning sciences, Pearson designs their products with the following instructional principles in mind, to help more learners learn more.

- MyLabs provide students opportunities to **practice** their skills and apply their knowledge, while receiving immediate **feedback** to **gauge their own understanding**.
- MyLabs provide ways of **authentically practicing** the target skills, so learners know what to do right away. This gets around "the inert knowledge problem" where learners cannot transfer their knowledge from the textbook/classroom to real-world application.
- Students have a variety of learning supports (or "**scaffolds**") available, such as links to relevant videos and appropriate sections in eText, as well as interactive worked examples in the "Help me Solve This" feature. This "just in time" support ensures the learners have a streamlined and effective learning experience.

Worked Examples: Learning from worked examples (a problem and an expert's step-by-step process for solving) have been found to be an effective and efficient instructional approach for helping novice students gain proficiency (see Renkl, 2014). For example, after two lessons and practice sessions on databases, undergraduates who practiced with worked examples did better on the unit test. In particular, the worked examples were especially helpful for the students with no prior database knowledge.

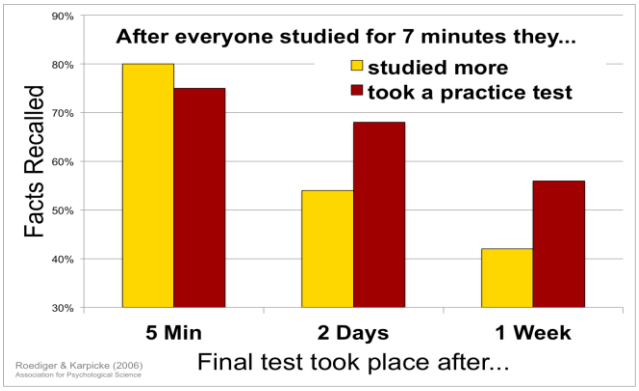


Immediate Feedback: Immediate feedback has been found to be beneficial for learning, whether in digital or analog environments (Azevedo & Bernard, 1995; Shute, 2008). In particular, when students are beginning to learn something new and potentially difficult for them, receiving immediate feedback (even just correct/incorrect) can keep them on track and help them achieve more.



Wrong-answer feedback: When students receive additional elaboration, beyond just whether a response is correct or incorrect, feedback is even more effective (see Shute, Hansen & Almond, 2007). In particular, feedback is most useful when it explains what is incorrect about the student response and provides guidance to help the student understand the correct response.

Retrieval Practice: Giving students opportunities to practice recalling and applying previously learned information is one of the most effective approaches for improving students' long-term memory for the content. In particular, compared to just re-studying, having opportunities to practice quizzing oneself leads to better retention after a delay.



The Educator Experience

The instructor believes Mastering Chemistry helps students achieve the course goal of developing a general understanding of chemistry, but they stress the importance of efficient implementation, saying *"It is a very good*

program. There is everything there, but one has to put it together in a way that is really effective. It's about learning how to take advantage of the product."

They believe Mastering Chemistry supports student learning in a variety of ways. First, the flexibility to edit or change questions allows the instructor to tailor pre-set questions to the needs of the students to better help develop concept understanding. Second, the ability to add comments in the main section to highlight theories students must master reinforces building that foundation of chemistry. Further, the instructor finds the instant feedback feature beneficial, especially struggling students *as "it works well because they have the immediate feedback it provides and Mastering Chemistry helps a lot."*

Another highlight of Mastering Chemistry is the reduction of administrative load. The instructor finds the gradebook especially helpful saying, *"another good thing about it is that once students complete the assignments, the gradebook calculates their scores for you and you are done."*

Because of what the instructor describes as the *"evolution of studies"*, the ability for their students, as well as themselves, to access Mastering Chemistry on their mobile device is extremely useful. They find students read their eText on the phone because it is easier for them and more accessible in the modern age where students are always on the go and always have their phone in hand.

Learning Catalytics is also used in the General Chemistry course. It is an interactive student response tool that encourages team-based learning by using students' smartphones, tablets, or laptops to engage them in interactive tasks and thinking. As an instructor, it allows you to pose a variety of open-ended questions that help your students develop critical thinking skills, while monitoring responses with real-time analytics to find out where they're struggling. With this information, you can adjust your instructional strategy in real time and try additional ways of engaging your students during class. According to the instructor, it has been an invaluable tool, as it supports student engagement, cultivates discussion and promotes group work in the classroom. *"When it comes to Learning Catalytics, it works perfectly for keeping their attention in class. It encourages them to speak to one another, so it is good for interaction."*

Compared to other products they have utilized, they have been exceptionally pleased with Mastering Chemistry, *"I trial them, check them out, and I think (Mastering Chemistry) is the best. I am not biased against any product. Compared to other products, this is the one that is working."*

Conclusion

Overall, the instructor has been very satisfied with their experience utilizing Mastering Chemistry and Learning Catalytics. They find Mastering Chemistry caters to current study habits of students, they appreciate the flexibility it offers and notes it offers *"a more interactive way of practicing the problems we do in class."* They believe the main benefit of Learning Catalytics is its ability to encourage student engagement. They continue to utilize Mastering Chemistry *"because of implementation, the way things are set up, the setting flexibility, and ability to edit questions. These are great things other products don't have. It is the product of choice."*