Findings from Spring 2022 Sabbatical

Enhancing General Chemistry Instruction Through the Use of Zero Cost Virtual Resources

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The COVID Pandemic starting March 2020 abruptly altered instruction as we moved our Chemistry courses at Moorpark College and across the nation from the classroom and laboratory to home computers. Students have developed new technological skills and independence during the pandemic. Chemistry instructors relied on virtual laboratory assignments, such as BeyondLabz and Labster paid for through Covid funding made available to schools, to replace hands-on chemistry labs. As a temporary measure this was the best choice in a bad situation. Virtual labs should not permanently replace hands-on, but the new technology may enhance instruction when used concurrently with hands-on chemistry labs. Students may learn theory and practice by following steps in a safe manner on a computer program, building confidence before they attempt hands-on chemistry labs. Many virtual lab resources are available for a variety of costs. During my Spring 2022 Sabbatical project, I have focused on tools/assignments/resources available at no cost and fairly easy for students to follow instructions independently. Additionally, I have compiled many sources for lecture content on free videos that may be made available for students to augment their preparation. This information has been organized on a Canvas Shell Platform. Modules include: original sabbatical letter proposal and findings, articles and papers of interest, interactive periodic tables, Chemistry teaching videos, Chemistry simulations, specific topics, Chemistry for younger students, lists of chemistry resources for simulations and virtual activities, more than chemistry... simulations, sources that need more information or downloads, sources that need registration, approval or purchase, and other interests.

This Canvas Shell Assignments provides some of the sources that I found most useful. In the Assignments several working simulations are available and linked for instructors to copy and then share for students to experience. My hope is that some of the links, readings, assignments, videos available in this Canvas Shell may be useful in meeting the **Moorpark College Chemistry Program Goal:** *Students participating in the Chemistry program will use the process of scientific inquiry to qualitatively and quantitatively solve chemistry problems by gathering evidential information, analyzing data, forming appropriate conclusions, and communicating these results through written and oral expressions.*

Major Findings

Best practices suggest hands-on chemistry lab is the preferred method of learning from both student's and teacher's perspectives. Virtual simulations may enhance chemical education, but should NOT replace hands-on lab work.

Students may prefer to register for a zoom lecture course asynchronous or synchronous, but it may not be the best practice for learning as their focus is often divided. The interaction in a classroom setting with other students and the instructor available to question, expand, re-state, practice etcetera allows for better focus.

The benefits of virtual labs and online feedback sources to enhance Chemistry Instruction include...

Simulations allow students to try out experiences in a safe manner

Students learn theory and skills that will establish confidence once they start hand-on lab activities

Replacement for a student who has a legitimate absence once or twice in a semester.

If lab hands-on difficulties make the data unusable, a virtual simulation may provide new data for analysis

The benefits of hands-on labs include...

Collecting real information and performing real experiments

Students must problem solve when the experiment has unexpected results

Students have access to peers and the instructor present in the laboratory to question, inquiry, engage, discuss.

According to the American Chemical Society...

Hands-on labs are critical to the learning process across all areas of study, beginning with kindergarten and continuing through post-secondary education. Research has shown that students who engage in well-designed laboratory experiences develop problem-solving and critical-thinking skills, as well as gain exposure to reactions, materials, and equipment in a lab setting.

Sustained investments in hands-on experiences help inspire students to further their education and prepare them for high-technology careers by fostering skills sought by potential employers.

Hands-on experiences significantly advance learning at all levels of science education when appropriately designed and guided by qualified educators. During hands-on chemistry activities, students directly and safely investigate chemical properties and reactions, utilizing laboratory apparatus and instruments. These activities are essential for learning chemistry and improving science literacy. Web-based and computer-simulated activities may help increase student exposure to chemistry, reduce costs, and eliminate hazardous waste and safety concerns; however, these tools cannot be considered as equivalent replacements for hands-on laboratory experiences.

The American Chemical Society believes that there is no equivalent substitute for hands-on activities where materials and equipment are used safely and student experiences are guided. The Society supports sustained investments to provide the facilities, equipment, curricula, and professional development needed for effective hands-on laboratory science experiences from kindergarten through post-secondary education

The five reasons below for hands-on labs come from www.universities-colleges-schools.com

1. MORE PROGRAM MATERIAL IS RETAINED

Student experience a huge increase in the amount of information that they retain when given the opportunity to practice what they are learning in the form of hands-on training. Studies have shown that when students sit and listen intently but passively in a lecture-style environment, they retain 20 percent of the presented information. When they are given the opportunity to practice what they have just learned, that percentage increases to 75 percent.

2. SIMULATED LEARNING IS AN ENGAGING ENVIRONMENT

When students are given the ability to learn in a practical hands-on environment, they are very often engaged, stimulated and want to learn as much as possible. The student's appetite for learning increases and they are more willing to listen and pay attention if they have a more practical or life like task to complete. Students also become more empowered in their own learning situation.

3. A HANDS-ON LEARNING ENVIRONMENT DEVELOPS CRITICAL THINKING SKILLS

A student's critical thinking skills increase in a hands-on learning environment. This occurs since students must make decisions on what to do next to receive the outcome they are striving to obtain. They no longer have to rely on memory and attention as they sit in a lecture environment. These critical thinking skills remain with a student as opposed to material that is simply memorized for a test and much of the material often forgotten after the exam. Critical thinking skills are very important to the workplace as every situation that an employee encounters cannot be learned from a book.

4. REAL-WORLD EXPERIENCE AND KNOWLEDGE FROM AN INSTRUCTOR CAN GO A LONG WAY

Students who learn in a hands-on environment have an instructor nearby who have real-world experience and knowledge and can help and give guidance to them if they have difficulty with a task that they are trying to complete. This expert advice can help them perform the task correctly and safely which is very critical in the workplace.

5. USE OF MATERIALS AND EQUIPMENT USED ON THE JOB

One of the benefits of a hands-on learning environment is that students will get a feel for materials and equipment that is commonly used in the workplace after the course. This is particularly good if the student is working with equipment and tools. One of the main reasons for accidents in the workplace comes from equipment and tools misuse; knowing how to properly handle equipment increases safety.

Thank you for this opportunity to research this project

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