

Online Chemistry in a Virtual School

Ms. Karen Tobias
Curriculum Specialist - Technology
Broward Virtual Education
6600 SW Nova Drive
Ft. Lauderdale, Florida 33317

Dr. David D. Kumar
Florida Atlantic University
College of Education
2912 College Avenue
Davie, Florida 33314

Abstract

This paper describes teaching online chemistry and discusses advantages and disadvantages in one of Florida Virtual Schools. A sample of activities that enhance the online chemistry learning experience is presented along with some observations about teaching chemistry in the online environment.

Introduction

Advancement in high-speed Internet has opened doors of opportunities for a wide range of online education. With the advent of the high-speed Internet, the ability to incorporate laboratory simulations, video clips, and soon to come video streaming all make curriculum possible to teach online. Online courses are on the rise both at secondary and post-secondary institutions. Chapp (2000) estimated 17,000 online courses in 2000, and this number continues to increase every year. In the State of Florida, the Florida Virtual High School officially came into existence in August 1997 as a project between the school boards of Orange and Alachua counties serving 1,758 (Office of Program Policy Analysis and Government Accountability, 2003). The current enrolment is over 40,000 students anywhere in the world. This paper deals with an online chemistry course offered by the Florida Virtual School through the Broward Virtual Education.

Adaptations

Teaching online requires the teacher to have a different mindset - your time is not spent creating and delivering lessons, your time is spent in guiding the students through the online curriculum. Email and telephone contacts with each student are imperative to replace the face-to-face time. Another adaptation is that the student is allowed to submit assignments at least twice for full credit. The student submits an assignment to the teacher and the teacher grades it giving detailed information about the sections of the assignment that is incorrect - this helps the student review the information they have not yet mastered. Then the student is allowed to redo the assignment and submit it for full credit. Each course has a pacing guide that dictates the minimum number of assignments that are to be submitted each week. An important part of the teacher's job is to track the student's pace and to contact the student if they fall behind. Many students comment that it is very easy to get sidetracked by other activities and fall behind in an online course.

Activities

The Online High School Chemistry course incorporates all possible learning styles and learning domains. For example,

activities such as students writing a poem about an element, composing a song about petroleum refining, and designing a bookmark extolling the virtues of antioxidants are part of the chemistry course. The assignments are designed to increase the student's computer skills in addition to the chemistry knowledge. The students must construct data tables, bring in graphics, design a concept map, convert document files to rich text files (.doc to .rtf) and use a discussion board along with being able to attach a file to turn in their assignments.

A review of math (conversions, graphing, data collection, exponent rules, etc.) and computer skills that a student needs to take an online chemistry course is provided at the beginning. The Internet offers online graphing programs and graphing calculators free for the students to use as needed in the course. Students have access to all needed information at their fingertips - one click away - it doesn't rely on the student to be organized and retain all of the class notes and work.

Online High School Chemistry is a laboratory-based course and one of the first questions asked by teachers, students and parents is how the students complete this component. Many chemistry labs can be adapted to be performed at home fairly easily - those that cannot be adapted can be found on the Internet in simulation form. Most classroom experiments can be performed at home with a thermometer and some measuring devices. The thermometer is provided to the students, but the measuring devices are not. If the student does not have measuring cups and spoons with metric measurements labeled, then the student must use conversions to see how many milliliters are in a tablespoon, teaspoon, or cup. Following are some brief examples of experiments contained in the Online High School Chemistry course.

1. Collecting data on phase changes can be completed by using a pan with water on the stove and a thermometer. Starting with ice, the temperature is taken every 15 seconds, while the pan is heated on the burner. At the end students complete a phase change graph.
2. Discovering the effect of size, temperature, and agitation on the rate of solution by using rock salt and table salt. This activity is also useful for introducing nanoscience.
3. When vinegar and baking soda are combined - a gas is given off and the students are asked to design an experiment to conserve the mass. They are asked to submit the numbered steps along with the balanced equation.
4. Creating Lewis dot models using gumdrops and toothpicks.
5. An adapted calorimeter experiment, using a burning peanut to warm water in a suspended soda can.
6. A quick lab that shows the effect of temperature on air (mixture of gases) and the effect of pressure where students heat a soda can in hot water, and then immerse it quickly (upside down) into cold water.
7. Students first learn about exothermic and endothermic reactions. Then they measure the temperature in an empty jar, while soaking a steel wool pad in vinegar. Remove the steel wool from the vinegar and wrap it around the tip of the thermometer and place it back into the jar. Record the temperature and determine whether the reaction is exothermic or endothermic and write the equation.
8. Using Alka-Seltzer and different temperatures of water, you can determine the effect of temperature on reaction rates. Also, by using whole, broken and crushed tablets, you can determine the effect of surface area on reaction rates.
9. By crushing red cabbage in hot water until the water turns purple results in a pH indicator that can be used to determine whether chemicals are basic, neutral, or acidic. If the solution turns red/pink it is an acid, if it stays purple it is a base, and if it turns green/blue the solution is basic.
10. By using the red cabbage indicator, vinegar and a variety of antacids, the student can compare the effectiveness of the antacids.

United Streaming is a company that has over 5,000 video clips (5-25 minutes in length) that can be utilized in an

online course fairly inexpensively. A video clip gives the student a live or animated version of the curriculum content. Another popular way to deliver interactive experiences for the students is the search the internet for simulations. The following are examples from the chemistry course, with a brief description of their content:

1. <http://www.hazelwood.k12.mo.us/~grichert/explore/dswmedia/density.htm> This site allows the students to predict and find the densities of various objects.

2. gcscience.com is another site that students can use to see and play with the activity series.

Some sites require the students to join, while others are free.

Reflections and Discussion

One positive aspect of teaching chemistry online is selecting a suitable theme to deliver the content around. In the Chemistry course the themes are the hospital, nuclear power plant, water treatment plant, petroleum refinery, special effects studio, and a fertilizer manufacturing company. These themes are science, technology and society (STS) in nature and help students realize the importance of chemistry in everyday life.

Another positive aspect is the limitless opportunity for students to review the information in the lesson numerous times, until comprehension occurs. This helps students who have English as a second language. In the classroom the student will hear the information during the lecture and maybe again during a review, if the student's mastery of English is slightly below average, they can miss key points making comprehension of the material difficult.

According to the Office of Program Policy Analysis and Government Accountability (2003) the Florida Virtual School is "generally attaining its mission of reaching underserved students, including students in rural school districts and students in high minority schools" (p. 1). Access to the online teacher is another advantage because the teacher is much more available for help when the student needs it mostly around the clock.

Cheating is always an issue with online courses. Cheating can be reduced by using software products, like Turn-It-In-Dotcom. This software searches the web and any previous student work entered into the program to look for plagiarism. In math-based subjects the student are required to identify all variables, state the appropriate equation and then solve the problem to receive full credit. Cheating is prevalent in the brick and mortar schools and the teacher is the best line of defense against it.

Online courses are often portrayed as a panacea for improving education. One of the critical factors often overlooked in online education is the nature of the subject matter. Chemistry courses demand powerful personal computers for multimedia presentations, simulations, high-level critical interactive discourse, and adequate technical assistance for uninterrupted delivery through the Internet. Teaching chemistry online demands access to a variety of scientific information and the availability of quality chemical information on the Internet is paramount. Likewise, policies that favor adequate fiscal and instructional resources for implementing online chemistry are needed. As Stivers (1999) pointed out if not properly delivered online courses could lead to shallow learning experiences. There are both opportunities and challenges for teaching online chemistry. More research and development efforts are essential to shaping technology as an efficient tool for delivering chemistry instruction. How the Internet is molded to the advantage of chemistry teaching and learning will determine the success of online chemistry course. Meanwhile, the question "can the Internet and technology not only enhance, but also transcend established and effective teaching practices students currently enjoy" raised by Cannon (2002, p. 264) remains elusive and should serve as a beacon to guide efforts in online education in chemistry.

References

Cannon, J. R. (2002). Distance learning in science education. Practices and evaluation. In Altschuld, J. W., and Kumar, D. D. (Eds.), *Evaluation of science and technology education at the dawn of the new millennium*. NY: Kluwer Academic/Plenum Publishers.

One positive aspect of teaching chemistry online is picking a theme to deliver the content around

Charp, S. (2000). The role of the Internet. *T. H. E. Journal*, 27, 8-9.

Office of Program Policy Analysis and Government Accountability. (2003). *OPPAGA Progress Report*. No. 03-23.

Stivers, R. (1999). The computer and education: Choosing the least powerful means of instruction. *Bulletin of Science, Technology and Society*, 9, 99-104.
