Online College Laboratory Courses: Can They Be Done and Will They Affect Graduation and Retention Rates?

Eddy van Hunnik*
Carolina Biological Supply Company, North Carolina, United States

Submitted: November 10, 2015 | **Editor-reviewed**: December 19, 2015
Accepted: December 29, 2015 | **Published**: December 31, 2015

Abstract: Online education has been steadily growing during the last decade. This growth has mainly taken place in the non-laboratory science fields. This essay describes some of the best practices to increase and maintain student retention, increase student engagement and increase graduation rates for college running online laboratory science courses. This article further discusses how to run successful, hands-on laboratory courses for your online students. The most common issues are being discussed and what can be done to provide the students with the same hands-on experience online as what they would experience in a more traditional classroom setting.

Keywords: Remote laboratory, online laboratory, higher education, online education, digital education, retention, graduation, online faculty, online students

Traditionally, all college laboratory courses were done inside a building on a campus. Students had to travel to these sites at the time the laboratory classes were held. A college laboratory takes up a large amount of space, and enrollment is limited to the number of students who can safely work in the space available. This process has been followed for years and is understood by students, faculty, and administration to be a limiting factor in course enrollment. Students at times have to wait a term for an opening in a class that they want. This space limitation adversely affects completion rate. Another issue affecting completion is timing. When are the courses offered? The makeup of the student population has shifted over the last couple of decades (Stack, 2015). Instead of going directly to college after completing high school, some students delay this step until later in life, when they may have a family and/or a daytime job. Families and jobs limit the times during which a student can take courses. This shift in student population also adversely affects completion and graduation rates.

In response to the change in student population, colleges began offering hybrid classes. Most of these are designed in such a way that students take lecture parts online. Hybrid classes still require the student to come to the campus for some amount of “seat time.” Hybrid classes thus eliminate only part of the timing problem for the students. Students still need to travel to the campus. In many cases, the students have to spend almost as much time in transit as in class. To help meet these challenges, colleges began offering complete online degrees. Most of these degrees do not require the student even to set foot on campus. Most of the courses and degrees offered online do not have a laboratory component. They tend to be courses such as criminal justice, business, and history.

*Corresponding author (eddy.vanhunnik@carolina.com)

Suggested citation: van Hunnik, E. (2015). Online college laboratory courses: Can they be done and will they affect graduation and retention rates? *Higher Learning Research Communications, 5*(4). http://dx.doi.org/10.18870/hlrc.v5i4.289

A study done by the US Department of Education in the Fall of 2012 showed that 12% of students were enrolled in a strictly online degree in 2012 and that 25.8% of all post-secondary students took at least one course online (Radford, Cominole, & Skomsvold, 2015). Students who take just one or a few courses online generally do so either to complete a degree that was started sometime in the past or because they are interested in a course for their work (Adelman, 2006; Allen & Seaman, 2013; Ginder & Stearns, 2014; Johnson & Bell, 2014). The highest student enrollment in online classes occurs in states without many traditional educational institutions or states with large distances between populated areas (Ginder & Stearns, 2014; Radford, Cominole, & Skomsvold, 2015). Clearly, nontraditional online courses are filling a need. A study done by the US Department of Education showed that these online students in some cases performed better than those receiving traditional education (WestEd, 2008). The best student outcomes were obtained with blended courses. Blended courses mix an online component and a classroom component. All of these data suggest a need for distance education.

What are some of the factors pushing for distance education? In a recent publication, Bird (2014) from Rasmussen College summarized the advantages of online education. The student population has changed over the last couple of decades. More working people are taking classes in response to a demand from employers to have people with advanced degrees or specialized training. In a traditional setting, these students have to take night or weekend classes. Many of the students already have an established life with family and social responsibilities. Fitting traditional classes into their schedule would be hard. A major benefit of online education is flexible scheduling. Students can take classes when and where they want, balancing work and family obligations with getting an education. They can now take classes late in the evening, early in the morning, or during breaks at work. Time that would have been taken with travel to and from a campus can now be spent either on classes or on daily chores. Over the last couple of years there has been an increase in access to reliable high speed internet across the country (Executive Office of the President, 2015). This accessibility encourages students to choose online courses over traditional courses. In 2011, President Obama talked with leaders in higher education and pointed out that the country needs innovations in higher education, including increases in the use of technology in teaching and an increase in access to education through nontraditional means (Eaton, 2011).

The increase in availability of a reliable network coupled with advances in technology have led to a recent change in online classes. Online learning once involved simply publishing the chapters of a textbook online. This left to the students the burden of extracting crucial knowledge from each chapter. The addition of web-based video, instant messaging, and other tools allows students to interact with one another and with the instructor (Lohr, 2009). These advances provide students some aspects of a traditional college experience while allowing them to taking courses at home.

As we have seen, there is an increase in demand both from students and from industry leaders to veer away from traditional education and toward a more independent method of online learning. Educational institutions are measured by complex statistics that are considered for accreditation purposes and financial aid availability. Colleges pay close attention to the data gathered.

The first of these statistics is student enrollment. Courses are eliminated or added in direct response to enrollment. Education is a business, and courses with low enrollment will be cancelled as soon as they cost more money than they bring in. Data from the Department of Education clearly show an increase in enrollment in online education (Ginders & Stearns, 2014).

With this increase in demand, offering more online courses and degrees makes financial sense to an educational institution.

Another important statistic is retention. How many students drop out before completing the course or degree? Many accreditation agencies look at this statistic to gauge the quality of education offered at an institution. A comparison between online degree programs versus traditional degree programs has shown that the retention rate for online education was 10–20% lower than traditional education (Allen & Seaman, 2013; Angelino & Natvig, 2009; Carr, 2000). Other studies have shown that in many institutions the retention rate remains much lower in online education (Heyman, 2010; Wilson & Allen, 2011; see also The trouble with online college, 2013). However, other studies note that retention rates in online education have been climbing in the past couple of years, in some institutions even exceeding the traditional retention rates (Lynch-Newberg, 2010; Meyer, Bruwelheide, & Poulin, 2009).

What explains the discrepancy in retention between traditional and online approaches, and can the explanation point toward ways to increase the online retention rate? Studies have shown that there are several reasons for students to drop out of an online class (Bird, 2014; Hart, 2012; Lee & Choi, 2010; Lee, Choi, & Kim, 2012; Willging & Johnson, 2009). Traditional schools offer the students a feeling of belonging—being part of a college. This connection is often missing in online education (Erichsen & Bolliger, 2010). The student sitting at home may miss the feeling of shared accomplishment and collaboration. Students who are self-disciplined, motivated, and have a clear goal will do the work needed. Students who lack this vision often drop out of online classes since they have no peer pressure or direct pressure from the instructor to complete the work. In an online class the student does not have to face a professor and explain why they have not done the work. They are anonymous and can hide behind their screen names. This makes it harder for professors to motivate the students. Such students use obligations in their personal life as reasons for not completing a project. Furthermore, many students in a traditional school are part of a group. This peer group often helps a student keep motivated; they may sit together, take the same classes, and do homework together.

A major reason for students to drop out of an online class is frustration with technical difficulties (Regalado, 2009). We live in an online world. Platforms like Facebook and Twitter make it extremely easy to be connected and get feedback. Students often expect the same ease when taking an online class. Technical difficulties that occur frustrate and irritate the students. If too many problems arise, a student may think that taking an online class is a waste of time and money.

A close look at the issues affecting student retention reveals possibilities for improving the percentage of students staying in school. Of prime importance is to have a good network and network support. Ideally, prompt or immediate technical support should be available to handle any technical difficulties that occur. Having students go to computer orientation or training seems to reduce the occurrence of technical difficulties (Regalado, 2009).

Explaining to students what to expect and what is expected of them should help in the online classroom experience (Dennis, 2014; Garza-Mitchell, 2014). Just as traditional schools have counselors or advisors to assist students who are encountering difficulties, having a similar system in place for online students will reduce students' sense of being alone and increase their feeling of being part of a school. These counselors can advise the students and assist them with maintaining a life/study balance (Lee, Srinivasan, Trail, Lewis, & Lopez, 2011; Moore & Kearsley, 2005).

Making online students feel part of something bigger and part of a social group can be accomplished by having online classes include tools from the social networking world. Chat rooms and message boards where online students are free to share their opinions might make up for the peer interaction inherent in a traditional school. Having regular chat sessions where the instructor is available, or, if possible, video chat with the professor and fellow students dispels the anonymity of an online class. The student develops a relationship with the classmates and professor. This enhances the traditional college feeling and makes the student want to take more classes with the same group. All of these tools and techniques will increase student retention (Angelino, Williams, & Natvig, 2007; Bird, 2014; Joyner, Fuller, Holzweiss, Henderson, & Young, 2014).

The final important statistic for colleges is completion rate. What percentage of the student population will actually manage to graduate? The trend in the last couple of years is for online education to have a lower completion rate than traditional colleges (Haynie, 2015; see also Comparing the graduation rates between online and traditional colleges, n. d.). Since completion rate is in part a direct result of retention rates, we expect the lower percentage for online students. However, there is more than simple retention involved in the completion rate. A great percentage of students taking online classes are not even pursuing a degree. Instead, they are taking courses to improve their chances for career advancement and promotion, assist them in a job search, make them more competitive in the job market, or to gain extra knowledge (Comparing the graduation rates between online and traditional colleges, n. d.).

Besides showing a lower completion rate, those online students who are in a degree program typically take a longer time between starting and completing a degree than is typical in traditional education (Haynie, 2015). A major contributor to this statistic is that online students tend to be part-time students, working people with a job and family responsibilities. In general, they have less time to dedicate to their studies than would a full-time student on a traditional campus.

Measures taken to increase retention will lead indirectly to an increase in graduation rate. However, it is important to note that the population of students taking online classes differs from the students taking traditional classes and will likely always have a lower graduation rate and longer graduation times. The goal is to minimize this gap. Giving the online student the “college experience” with the use of technology might assist in closing the gap while at the same time addressing the true needs of the student. If the student needs or wants only certain kinds of courses, the degree programs should be built around them. One option is to create a competencies-based testing program for the general education courses. Give the students an assignment with clear goals and a rubric to follow and see if they can complete it successfully. When they do, they can be given credit for the course without the need to take lectures and lessons on topics they have already mastered. This will lower the frustration of the student with the learning experience and lead to an increase in retention.

So far we have focused on classes that would traditionally be given in a lecture hall or classroom setting. In most colleges with online education, these are the sort of courses offered online. Any minor laboratory coursework required is mostly accomplished through simple simulations. This approach is not sufficient for students who are taking science as a major. Laboratory courses are the core of science programs. Doing simulations does not satisfy program criteria for accreditation boards. Focusing solely on simulation also prevent students from feeling that they are doing real experiments. It is essential that online students perform experiments identical to those in the traditional classroom.

Most of the issues discussed previously apply also to laboratory courses. For example, the students need to be engaged, and help needs to be available promptly when or if a student gets stuck. Some aspects are unique to an online laboratory course (McCalmont, 2013). Help is crucial for both student success and student safety. A message board where students can ask questions of the instructor and each other is extremely useful.

Students need concise instruction in order to do their work. This requires extra steps from the instructor running the course. In a traditional laboratory, the instructor is on site and can immediately clarify or adjust a step when students have problems with an experiment. A student at home lacks this resource. A clear timeframe for completion keeps the students on track. Some experiments are time sensitive, or the materials shipped to the students are perishable. A clear indication of when specific steps must be performed helps the online student get the most from the laboratory experience.

Another problem with online laboratories has been that online students miss the physical experience of being in a laboratory—the smell of the chemicals, the touch of the materials. This issue has been addressed by an increase in the quality of online lab materials. Newer laboratory kits include small quantities of the materials used in a traditional laboratory class. The laboratory equipment sent to the student is often a miniature or sometimes even a full-scale version of what a student would handle in an on-campus laboratory. Although the materials being sent to a student's place of residence have to be safe, many standard lab chemicals in limited quantities can be included.

There is a limitation for doing laboratory work at home. Most undergraduate coursework can be done with equipment suitable for sending to a home; however, higher-level courses often require the student to use equipment that is too expensive, sensitive, or large to send to a student's home. One option is for students to travel to a campus to take these courses, but alternative options are available. The first and less desirable is to train the students using virtual laboratory equipment. The students change parameters on a computer interface and observe the result. Students might view this type of laboratory simulation as a game. An argument for this type of class is that the same technique is becoming more widely used in industry. As an operator uses a terminal to make changes, the equipment, which might not even be in the same room, performs the tests. Still, the approach is viewed as a learning objective obstacle because the students do not interact directly with the equipment. As an alternative approach, some colleges have set up remote laboratories with real equipment such as microscopes and chromatography equipment. A student logs into the server and manipulates the equipment through his or her own computer interface. On screen, the student sees real-time images of the equipment performing the tasks. Typically, there are laboratory assistants present to perform maintenance duties and assist in troubleshooting. This approach does require the school to invest heavily into their IT system in order for the classes to run smoothly. Another issue that arises is the limited number of students who can run the equipment at the same time, requiring some students to perform the experiments at times that may be inconvenient for them.

A major hurdle still to be overcome is the reluctance of traditional professors to adopt online education. There remains a sense that online education lacks credibility. For lecture type online education, the data collected over the last decade clearly show that most online classes are as good as traditional ones. Over time, more data will be collected on the effectiveness of college laboratory courses taught online. Accreditation agencies are beginning to allow for laboratory courses taken from home. One way to encourage professors to accept online laboratory classes is to have them try out some of the newer lab kits. Their acceptance will go far in convincing traditionalists among the faculty to accept more online education.

For the students, the main problem encountered is the up-front cost for online laboratory classes. The student is responsible for buying a lab kit, which may be $200 or more per term. Although this is comparable to or even less expensive than traditional laboratory course fees, the students must pay the money up-front. Lower income students with families might find this difficult or impossible. Recently, students have become able to buy vouchers for their laboratory kits through campus bookstores; even when students are off campus they can order vouchers online. The use of vouchers allows students on financial aid to pay for their up-front laboratory costs. However, campus bookstores generally put a markup on the original price, which also needs to be taken into account.

In conclusion, online education is demonstrably effective, and performing real college laboratory science at home is feasible. Online science courses incorporating at-home laboratory activities will become even more effective as remaining challenges are addressed. The gap between online and traditional colleges in terms of retention and completion rates is decreasing, and the addition of online courses seems to boost student enrollment. Although brick-and-mortar colleges are still needed for the student population that benefits from the traditional college experience, online and distance learning education has already made its presence known and presents a good alternative or supplement to the traditional system. Growth in distance education will benefit even more students who, for a variety of reasons, cannot attend a traditional campus on a traditional schedule but can learn from home on their own schedule.

References

Adelman, C. (2006, February). *The toolbox revisited: Paths to degree completion from high school through college*. Washington, DC: US Dept. of Education. Retrieved from https://www.edpubs.gov/

Allen, I. E., & Seaman, J. (2013, January). *Changing course: Ten years of tracking online education in the United States*. Newburyport, MA: Sloan Consortium. (ERIC Document Reproduction Service No. ED541571)

Angelino, L. M., & Natvig, D. (2009). A conceptual model for engagement of the online learner. *The Journal of Educators Online, 6*(1), 10-19. (ERIC Document Reproduction Service No. EJ904059)

Angelino, L. M., Williams, F. K., & Natvig, D. (2007). Strategies to engage online students and reduce attrition rates. *The Journal of Educators Online, 4*(2), 1-14. (ERIC Document Reproduction Service No. EJ907749)

Bird, K. (2014, February 19). Online vs. traditional education: The answer you never expected [Blog post]. *College Life Blog*. Retrieved from http://www.rasmussen.edu/student-life/blogs/college-life/

Carr, S. (2000). As distance education comes of age, the challenge is keeping the students. *Chronicle of Higher Education, 46*(23), A39-A41. (ERIC Document Reproduction Service No. EJ601725)

Comparing the graduation rates between online and traditional colleges. (n. d.). College Classes. Retrieved from http://www.collegeclasses.com

Dennis, B. D. (2014). Examining and testing the use of an online orientation. *Assessment Fellows Grant* [Paper No. 30]. Retrieved from http://scholarworks.wmich.edu/

Eaton, C. (2011, December 5). At White House meeting on affordability, a call for urgency, innovation, and leadership. *The Chronicle of Higher Education*. Retrieved from http://chronicle.com

Executive Office of the President. (2015, January). *Community-based broadband solutions: The benefits of competition and choice for community development and highspeed internet access*. Washington, DC: The White House,

Erichsen, E. A., & Bolliger, D. U. (2010). Towards understanding international graduate student isolation in traditional and online environments. Educational Technology Research and Development, 59(3), 309-326. http://dx.doi.org/ 10.1007/s11423-010-9161-6

Garza-Mitchel, R. L. (2014). Case study: Texas State Technocal College Harlingen—Online orientation to improve student success. *The Community College Enterprise, 20*(2), 88-92.

Ginder, S., & Stearns, C. (2014, June). *Web tables: Enrollment in distance education courses, by state: Fall 2012*. [NCES Pub. No. 2014-023]. Washington, DC: National Center for Educational Statistics. Retrieved from https://nces.ed.gov/

Hart, C. (2012). Factors associated with student persistence in an online program of study: A review of the Literature. *Journal of Interactive Online Learning, 11*(1), 19-42.

Haynie, D. (2015, January 30). Experts debate graduation rates for online students. *US News*. Retrieved from http://www.usnews.com

Heyman, E. (2010). Overcoming student retention issues in higher education online programs. *Online Journal of Distance Learning Administration, 13*(4). Retrieved from https://www.westga.edu/~distance/ojdla/

Johnson, N., & Bell, A. (2014). *Scaling completion college services as a model for increasing adult degree completion*. Indianapolis, IN: Lumia Foundation. (ERIC Document Reproduction Service No. ED555863)

Joyner, S. A., Fuller, M. B., Holzweiss, P. C., Henderson, S., & Young, R. (2014). The importance of student-instructor connections in graduate level online courses. Journal of Online Learning and teaching, 10(3), 436-445. Retrieved from http://jolt.merlot.org/

Lee, Y., & Choi, J. (2010). A review of online course dropout research: Implications for practice and future research. *Educational Technology Research and Development, 59*(5), 593-618. http://dx.doi.org/10.1007/s11423-010-9177-y

Lee, Y., Choi, J., & Kim, T. (2012). *Discriminating factors between completers of and dropouts from online learning courses. British Journal of Educational Technology, 44*(2), 328-337. http://dx.doi.org/10.1111/j.1467-8535.2012.01306.x

Lee, S. J., Srinivasan, S., Trail, T, Lewis, D., & Lopez, S. (2011). Examining the relationship among student perception of support, course satisfaction, and learning outcomes in online learning. *The Internet and Higher Education, 14*(3), 158-163. http://dx.doi.org/10.1016/j.iheduc.2011.04.001

Lohr, S. (2009, August 19). Study shows online education is better than classroom education. *The New York Times*. Retrieved from http://www.nytimes.com

Lynch-Newberg, S. A. (2010). *The retention, success, and progress rates of rural females in traditional lecture and online developmental mathematics courses* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses. (UMI No. 3452860).

McCalmont, W. F. (2013). *The feasibility of distance learning with the traditional laboratory-based chemistry class*. Paper presented as partial fulfillment of the Master Teacher Program, Center for Teaching Excellence, United States Military Academy, West Point, NY. Retrieved from http://www.usma.edu

Meyer, K., Bruwelheide, J., & Poulin, R. (2009). Why they stayed: Near-perfect retention in an online certification program in library media. *Journal of Asynchronous Learning Networks, 13*(3), 129-145. (ERIC Document Reproduction Service No. EJ862361)

Moore, M. G., & Kearsley, G. (2005). *Distance education: A systems view* (2nd ed.). Belmont, CA: Thomson Wadsworth.

Radford, A. W., Cominole, M., & Skomsvold, P. (2015). *Demographic and enrollment characteristics of nontraditional undergraduates: 2011-12* [NCES Pub. No. 2015-025]. Washington, DC: National Center for Educational Statistics. Retrieved from https://nces.ed.gov/

Regalado, M. A. (2009, May 15). As more try online classes, tech issues arise. *ABC News*. Retrieved from http://abcnews.go.com

Stack, S. (2015). Learning outcomes in an online vs traditional course. *International Journal for the Scholarship of Teaching and Learning, 9*(1), Art. 5. Retrieved from http://digitalcommons.georgiasouthern.edu/ij-sotl/vol9/iss1/5

The trouble with online college [Editorial]. (2013, February 18). *The New York Times*. Retrieved from http://www.nytimes.com

WestEd. (2008). *Evaluating online learning: Challenges and strategies for success* [Report No. ED 004344P]. Washington, DC: US Dept. of Education. Retrieved from https://www.edpubs.gov/

Willging, P. A., & Johnson, S. D. (2009). Factors that influence students' decision to drop out of online courses. *Journal of Asynchronous Learning Networks, 13*(3), 115-127. (ERIC Document Reproduction Service No. EJ862360)

Wilson, D., & Allen, D. (2011). Success rates of online versus traditional college students. *Research in Higher Education Journal, 14*, 1-9.