A CASE STUDY INVOLVING AN INTERNSHIP IN BIOMEDICAL SCIENCE

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Abstract

The purpose of this paper is to present a unique case study that combined online training with a biomedical laboratory internship for a secondary school student. This case study outlines the positive experience for one student in a unique research laboratory setting. The participant reported on the usefulness of the online materials, including video tutorials, to demonstrate basic techniques prior to their demonstration in the laboratory. The initial findings suggest that online training materials complemented with traditional science internships may increase the efficiency of training and reduce perceived burdens of allowing younger students into authentic laboratory settings.

Introduction

As the demand for scientists persists, it is important to increase the number of high school students matriculating into the sciences. Interest in science, technology, engineering, and mathematics (STEM) programs has been declining on American college campuses since 1967 (Astin, 2002). Because there is a growing disparity between the perceived usefulness of a science degree and the present day need for qualified scientists, this issue must be addressed and ways to increase interest in the sciences found. One of the problems that educators face is that students need to be exposed to science at a relatively early age, and their interest in science needs to be sustained throughout high school and into higher education. Although career development is a life-long process, the high school

years are a critical time in the career decision-making process (Ransom, 2000). Thus positive exposure to various sciences is important.

Literature Review

A way one can increase and protract interest in the sciences is through the use of laboratory internships. Internships are a form of authentic science practice which assist students in developing useable and transferable scientific skills and knowledge (Roth, 1995). Many science educators believe that as part of their science education, high school science students should be exposed to a learning environment where they could participate and experience science as everyday practice. Laboratory internships are one way to provide students with authentic science practices that will develop their core science skills and interpersonal skills, which will lead to an improvement in attitudes in science and subsequently increase the likelihood that they will enter scientific careers (Woolnough, 2000). Laboratory internships strongly resemble apprenticeship type learning experiences, which occur when a learner engages with an expert (mentor) in an authentic context such as a research laboratory. The process by which a research scientist learns about the lab they work is crucial as internships in science research settings have been found to be effective for helping students construct appropriate understandings, practices, tools and language used in the scientific studies they are involved in (Varelas, House, & Wenzel, 2005). One of the primary ways research universities have attempted to enhance critical thinking and practical skills of students is to expose them to the research process (Berkes, 2007). Providing all high school level students with individualized laboratory research internships, however, is a daunting challenge as it poses too large of a demand on scientists' time and laboratory resources. A new way of approaching laboratory internships is needed to minimize training time and make training more efficient.

Building upon the well-accepted practice of laboratory internships, a new blended learning approach is proposed, combining learning objects (digital and web-based), including virtual laboratories, to augment laboratory training. By adding in online training, the hope is that a young participant will be able to learn about techniques prior to being demonstrated these techniques in the laboratory. Using online digital learning objects will hopefully expedite the mastery of common research techniques and thereby allow a student more time in the laboratory participating in research rather than being shown and practicing techniques.

Research Questions

The research questions for this project are:

- Will a high school student using online materials along with their laboratory internship perceive the experience positively?

- Will a high school student value the online materials portion of their experience?

Method

A case study was conducted in the summer of 2010 with a female high school student, aged 16, who participated in a laboratory internship in a cardiovascular research laboratory at the University of Hawaii. A student who had never previously shown propensity towards science was selected, as the researchers were interested in capturing new interest in science. The particular student's favorite subject was French, and she had participated in a study abroad program. The student worked alongside and under the supervision of an American Heart Association national postdoctoral fellow for 6 weeks. In the first week, the student was asked to complete online training and was directed to ccrhawaii.org. The student was required to complete several topics to become familiar with the procedures she would be utilizing often. Those online topics included: Laboratory Safety, Molecular Biology Laboratory Equipment, Molecular Biology Laboratory Organisms, Nucleic Acid Amplification & Sequencing, DNA Restriction & Nucleic Acid Analysis, Molecular Cloning, Nucleic Acid Hybridization & Expression Analysis, and Preparation, Purification, & Quantization of DNA/RNA.

The initial data analysis reported in this paper will focus on identifying salient themes that emerged from a one-on-one, semi-structured interview with the participant at the end of her 6-week study. A doctoral student from another college, who is a National Board Certified middle school teacher, conducted the interview.

Online Training Materials

In order to accomplish these goals the researchers sought out an interdisciplinary collaborative partnership with the Distance Course Design and Consulting group that was responsible for implementing the College of Educations distance learning initiatives. A collaborative effort between the Center for Cardiovascular Research (CCR) and the Distance Course Design and Consulting group (DCDC) of the University of Hawaii at Manoa's College of Education was necessary for this project. The vast amount of content resources that were being placed online required that the CCR work with distance education experts that had substantial experience working with online/distance blended learning systems. The DCDC provided valuable guidance with respect to the online component of this molecular biology training.

The DCDC worked closely with Subject Matter Experts (SME), which included faculty and an instructional designer to adapt content materials for online delivery, to load content materials into the content management system, and to develop original content materials using multimedia technologies such as video, animations, tutorials, and PowerPoint, etc. Figure 1 has an example of this content and general layout. The DCDC was also responsible for reviewing the course in detail to edit for the proper use of English and to make sure that all the links within the modules are correct and pointing to the correct website. Open source content materials, from sources such as Howard Hughes and Cold Spring Harbor Laboratory, significantly reduced the development time that would be otherwise required to produce the content covered throughout the website. In total, there are 16 topics covered, each with learning objectives, content, video instructions and tutorials, student activities, etc.

Figure 1: An Example of the Website the Student Completed

For more details on the development process of the online materials refer to Boulay, Parisky, and Campbell (2010); Boulay, Parisky, and Fulford (2010); Parisky, Boulay, and Anderson (2010); or Boulay, Anderson, Parisky, and Campbell (2009).

Results

While participating in a medical laboratory during a short period of time could potentially be quite difficult for young students. The online introductory website may have particularly eased this student's transition into the laboratory and effective learning of techniques.

The student was able to review the materials at her own pace and thus allowing her to revisit content areas until she was comfortable to move into the hands-on learning in the lab:

> . . . it [The website] helps you get familiar with the material so that when you're going in, you might not know exactly what to do, but you have an idea of how to do it

The online materials demonstrated the skills that the student would need to be familiar with when they performed various molecular biology techniques in the laboratory. The student was able to develop a basic understanding of the materials, which brought about a certain confidence about the content prior to moving into the actual laboratory:

> but you might not know exactly where stuff is but once you get it you can say, "Oh ok I know how to insert this and how to carefully do this" and, you know, very cleanly so nothing happens, you know, there's no accidents.

The opportunity for the student to view and review the techniques on the website brought about a basic understanding of the techniques that the student would be performing in the laboratory. The website provided the student with the basic skills and the confidence to continue learn about the techniques:

> It was really helpful for me. The website really made a difference.

Overall, the internship for this participant was positive:

> I think it was good to see a more in-depth, um, science because normally I'm at school I have science for four hours in a week and so, here it was 7 hours per day and it was really good to be able to see the intensity and the dedication with which everyone's working and I think it definitely helped me. I'll probably want to minor in something, or um, look at it for the future, in my future.

The participant thought that internships in a biomedical laboratory would benefit students her age in general:

> I think this would benefit all of the students at my school because it really gives you, I mean if they were interested in science because it really lets you explore the field and it shows you all about the different ways to look at certain problems because there's always more than one solution with science, so . . .

While the participant was overall positive about her experience, *participating in science discovery* emerged as exciting for this participant. What the participant noted repeatedly was the value she placed on participating:

> I thought everything was really interesting and um, the — it was mostly, not so much seeing something that was really cool, but being able to participate in it. So everything was really interesting even if I was running a gel for the 70th time, it was still really cool to know that I was able to do it by myself.

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> they're making discoveries and they're working on a project all the time, so it was. . .it was different from just, you know, being in a cubicle, typing in information, you could see the work they were doing and that they were, um, you could see the products. Not right away, but you could see, you know, you run a gel and you could see all the little lines on the screen and you know what they mean.

Limitations

A major limitation of this study is its exclusive reliance on only one case and the opinions from that one participant. While case studies are very valuable, the ability to generalize the findings from one or two cases is a concern. However, in this particular project, using online training materials was an experiment to regular practice of training individuals in laboratory settings without the aid of the online training materials. Pursuing the general reactions, interest, feasibility, and usefulness of this approach was practically very useful in this case. As a result, this approach for training younger students will be adopted more broadly and future research could more robustly report on the widespread patterns. The usefulness of a singular case was beneficial in providing institutional buy-in to the utility and feasibility of combining online materials and regular laboratory internships. The approach of digital resources complemented with hands-on inquiry in the laboratory may be particularly instrumental at including younger students in research endeavors.

Conclusion

This paper reports on a new approach to try to introduce and interest students in science in unique ways. Such innovative approaches are needed to meet projected workforce demands. This particular case study focused on a high school student participating in a summer internship in a medical laboratory, which she found to be a positive and rewarding experience. Specifically, the student seemed to be most excited by being able to participate in the discovery process and be a part of the laboratory. This finding supports previous research that identifies the benefits of hands-on participatory activities linking to higher student interest in science (e.g., Woolnough, 2000).

It is particularly encouraging to note that this participant was not a student already interested in science. Instead, this student had a propensity towards languages and participated in a study abroad and French club at her local school. Given that the participant was as positive about her science laboratory internship experience demonstrates the value of youth participating in science in authentic settings. Finding the mechanisms that make it manageable and reasonable to include more students at younger ages into settings such as medical research laboratories is needed. Using online training materials may provide one such mechanism.

The unique aspect to this case study was the online introductory website used simultaneously with the in-the-lab training. The website played an important element in facilitating the student's introduction and expedited her learning process to maximize the potential gains achieved during a short-term experience. While laboratory internships have been purported as useful in encouraging students' interest in science, this case study had a unique contribution in combining online training materials with a summer laboratory experience. The combination also minimizes the burdens of training by experts by allowing online materials to cover the basics. This in turn essentially increases the efficiency of the training while providing users the option of learning at their own pace. As the student familiarizes themselves with the materials using the online resources, they are effectively learning the basics of molecular biology prior to receiving any formal laboratory training. Future research on the effectiveness of training interns using web-based training and how it improves the learning experience of interns should be considered as the value of using online resources increases.

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