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Assisting student learning through professional development: The affect of website materials and real world science on teacher development

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To improve student learning and success in a science field while at university, it is important that students begin their studies with good basic science knowledge. Thus, it is important for high school science teachers to be teaching current scientific methods. To update their skills high school teachers need to participate in professional development programs to update their own knowledge of current science research and techniques used in labs. Towards this goal, the John A. Burns School of Medicine at the University of Hawaii developed a professional development program for high school science teachers. In 2012, eight high school science teachers attended the program for eight week days over a two week period. This study is a report of the teachers' experiences within the program. Specifically, this paper reports on the results of the teachers' evaluation of the online materials and their perspectives of real world application of the learned material are investigated. The data set in this study includes all eight teachers' pre-survey responses and final survey data.

Keywords: professional development, online learning, blended learning, educational technology.

Introduction

High school teachers are persistently looking for ways in which to inspire youths to commit to the science field. The competitive nature of the science field encourages a thorough understanding of current scientific techniques and knowledge to become successful in science. It is essential for teachers to be up to date with current skills and knowledge of science to effectively educate students. As The Committee on Science Engineering and Public Policy suggest (2007), professional teacher development is necessary to evolve and boost the current state of science education. Studies investigating the effects of professional development on science teachers have been positive. For example, Radford (1998) reports that teacher development training improved teachers' confidence to teach and content knowledge within science. Moreover, teachers who engage in hands-on science benefit in their teaching practices as there is a clear indication of improvement in creating a culture of science within their classrooms (Cuevas, Lee, Hart, & Deaktor, 2005).

Unfortunately, it is evident from previous research that it is scarce for high school science teachers' to attend professional development programs frequently and engage in hands-on lab work (Parisky & Boulay, 2010; Boulay, Parisky & Campbell, 2010). In efforts to help facilitate student learning and keeping teachers up to date with current research, online materials are fast becoming a popular method to augment offline learning (Parisky & Boulay, 2010). This type of learning is termed blended learning and is an important tool in the current professional development program. Past studies have found great success in implementing online learning materials. For example, one study found that introducing a simulation program prior to engagement in labs increased comprehension of techniques and concepts in comparison to those who did not have access to the simulations (Martinez-Jimenez, Pontes-Pedrajas, Polo, & Climent-Bellido, 2003). Utilizing a blended learning approach, The John A. Burns School of Medicine (JABSOM) developed a professional development program for high school science teachers with additional online materials to augment face-to-face learning.

To evaluate the usefulness of the program and the online materials, this study seeks to investigate how eight teachers' evaluated the online materials after engaging in a professional development program. Additionally, teachers' comments on how the learned material in the program relates to real world situations are examined.

Method

Program Development

Preparation for the professional development began in 2009 with the formation of the online materials (see Boulay, Anderson, Parisky, & Campbell, 2009). The first time the professional development program initiative was conducted occurred in 2010 at JABSOM (see Boulay, Parisky, & Fulford, 2010). The program was run three years in a row, each time taking place over the summer period. Each year, the program undergoes an evaluative procedure by which the head researchers and leaders consolidate the effectiveness of the program and make any changes necessary to update the program for the benefit of the participants. Additionally, online materials were developed to augment the learning of the high school science teacher's participation in the program (see Boulay, Anderson, & Parisky, 2009; Boulay, Parisky, & Campbell, 2010).

Data Sources

The data sources for this study include all of the teachers' pre-survey responses and all of the teachers' final survey responses. The pre-survey gathered additional information about the teachers' experience and background in education. The final survey included five major sections asking about the teachers' personal molecular biology definition, their experiences in the program itself, the molecular biology techniques they learned, their evaluations of the scientists' presentations, and their evaluation of the website. Teachers also completed final written reflective statements. The final written reflective statements included prompts on their experiences in five general areas. These areas asked teachers about their initial goals before entering the program, knowledge/skills acquired during the program, how participating in the program impacted their teaching, how participating in the program influenced their attitude towards teaching, and how the program impacted on their goals.

Participants

Eight high school science teachers were invited to participate in the 2012 professional development program. Teachers ranged in total teaching experience from 2-15 years (M = 8.5, SD = 4.14). Teachers taught at their current school for an average of 6.75years (SD = 2.49). The teachers' latest academic degrees varied. For example, the latest academic degrees awarded to the teachers were MEd in Secondary Education, M.S. in Biological Oceanography, B.S. in Biology, and Post-Bachelors in Science. The year the last degree awarded to the teachers ranged from 1994 to 2010. Teachers were selected for their multiple assumed roles in their high schools. For example, some of the extra roles teachers assumed were Assistant to the Director of Curriculum, Department Chair, Science Olympiad Coach, Advisor, Instructional Leadership Team Leader, and Science Fair Assistant Coordinator. Of the 16 techniques teachers reported to have used before, the most common techniques were pipetting, centrifugation, DNA electrophoresis, and microscopy. In the professional development program various techniques were practiced in the lab including multiple techniques new to teachers. Some of the main techniques practiced in the program were centrifugation, DNA electrophoresis, DNA plasmid purification, DNA ligation, restriction enzyme digestion, western blotting, polymerase chain reaction, use of a spectrometer, immunostaining, cell culture, tissue sectioning, microscopy, and pipetting.

Analysis

Investigator triangulation (Keyton, 2006) was used in thematic analysis of the current data (Braun & Clarke, 2006; Glaser & Strauss, 1967). In the original data from 2010, multiple researchers agreed upon a set of 24 codes without any *a priori* hypotheses or themes. In 2011, researchers coded with the original set of codes in mind but several extra codes arose. In the 2012 dataset, 27 agreed upon codes were used to manually code post-surveys and final written reflective statements. In this study, only the codes labeled *website* (W) and *real world application* (RW) are investigated. In the thematic analysis nature, codes were designated as important if they were recurring (same thread of meaning), repeated (repetition of key words or phrases), and forceful (stressed phrases or words) (Owen, 1984).

Results

The results are separated into three sections. Firstly, teacher's responses to one core question in the pre-survey are reviewed. Secondly, teachers' website experiences and evaluations are reviewed. Thirdly, teachers' perspective of real world application of the content learned in the program is reviewed.

Pre-survey

Program expectations
The last question in the pre-survey asked teachers what their expectations were for the professional development program prior to participating. The most frequent theme in this question was teachers' goal of improving their abilities to help educate their students. For example, some of the teacher responses to the question were:

> To gain knowledge and experience to take back into the classroom. Also, to stir up more of an excitement first within myself, then transfer it unto the students.
>
> Learn, Learn, Learn... Advance my lab skills to be able to teach my students.
>
> Learn real-world applications of biological science principles to share with my students and to promote some career choices.
>
> I would expect to have a much deeper understanding of molecular biology concepts, learn new techniques and increase my skill level to make me a more effective instructor for students and teachers.

Undoubtedly, teachers show a concern for the welfare and future of their students. As noted above, teachers aim to inspire students into the science field, once they complete high school, and to help them succeed in their future. The following excerpts from teachers after participating in the program shows that their expectations for the program succeeded.

Website

Any reference made to the online materials was coded as *website* (W). The online materials received very positive reviews from the teachers. A theme within the W code is the teachers' perspective of using the website in their own classrooms. For example:

Classroom application using online materials

> … I will use it more as I improve my current curriculum of my molecular biology course at my school.
>
> The content on tissue culture (the video) was useful and I will use this in my class with plant tissue culture.
>
> This is a great resource for teachers to use in the classroom.
>
> I plan on using it (the website) more in the future as I expand the curriculum in my courses.
>
> I will definitely be sharing this (Information of Safety and Laboratory Equipment and Protocols) with my students.
>
> I plan to use the website materials (particularly Module 1) to help my students learn more about the laboratory procedures and techniques that I hope to cover in class.
>
> I will use the website material for before I start the lab activity with my students. I will use it as homework for them.

Real-world application

Any reference made to the application of current research was coded as *real-world application* (RW). Especially from the evaluations of watching professional scientist presentations, teachers' commented on the importance of real-world examples to take back to their students. For example:

Classroom application of real world research

> I loved learning about what the researchers are currently doing. I will be using examples from their lectures in my classes. I now have many more answers to the dreaded question "why do we need to know/learn this?" Just being able to give specific examples of how the lab techniques are used today to find new breakthroughs will be extremely valuable to me and my students.
>
> I would also love to have any of the scientists come to my class to present what they do to my students. Nothing beats real-life experience and they can provide more for my students when it comes to true application in research.
>
> Just learning about what is going on right here in Hawaii. I would never have known about the great things happening right now if I did not get to hear their presentations. I would love to have them speak to my students and get the younger generations excited about science and research that they can do here at home.
>
> By looking at the facility and learning from the people who actually works in it, I could definitely give "real-life" example of why we're learning molecular biology, as it is often the questions of students.

Conclusion

In conclusion, the results of the present study describe the usefulness of the professional development program and the online materials. The eight high school science teachers reported positive experiences after participating in the program. Before participating in the program, it was clear that teachers wanted to learn new material or update their skills to help their teaching abilities. After participating in the program, teachers found the online materials to be very helpful to them but also to their students and future curriculums. Incorporating online materials into an educational setting is also being introduced and tested at the tertiary level. For example, Andrewartha and Wilmot (2001) describe how students learning style is altered when utilizing computer based program to replace existing face-to-face teaching. By integrating virtual learning during high school, students transitioning college may benefit immensely. The evaluation of the online materials in this program clearly indicates the usefulness and attainable application of extending online learning into college curricula.

Meeting the scientists in particular gave teachers some real world examples to bring back into their classrooms to help show students why a career in science is important. Making clear the usefulness of scientific research to high school students, it is more likely their dedication to the field will extend into college. Keeping this in mind, future professional development programs should seek to update both teachers' knowledge and abilities in a scientific lab and teaching skills to bring back into their classrooms to benefit students success at the tertiary level.

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