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ABSTRACT

This paper describes the development of a mobile application (app) created as a learning tool to help organic chemistry students increase their conceptual understanding of a given topic. The learning needs of organic chemistry students studying the unit “functional groups” were first identified, appropriate learning theories were chosen, and then a working prototype of the mobile application “TsoiChem©” was designed and created using Apple’s iOS Software Development Kit. An iterative development process incorporated several learning theories along with the chemistry students’ feedback into the app’s design so as to best leverage the multi-touch feature of the device. This paper also discusses the preliminary data on the effectiveness of the design elements on student perceptions of the app and students’ conceptual understanding. Future directions for the app and this study are also presented.

Keywords: Conceptual Understanding, Learning Needs, Learning Theory, Mobile Application, Mobile Application Design, Mobile Learning, Organic Chemistry, Science Education

1. INTRODUCTION

Organic chemistry is known as a difficult course in post-secondary science courses of study. With its low passing rate, many researchers have proposed possible interventions to ameliorate this pervasive pattern. These approaches include active learning environments, Web-based pre-class student preparation activities, cooperative learning, poster sessions, and even changing the pacing and delivery of the curriculum (Bradley, Ulrich, Jones, & Jones, 2002; Collard, Girardot, & Deutsch, 2002; Hagen, 2000; Huddle, 2000; Paulson, 1999; Sartoris, 1992). Other researchers have attempted to look at the “root” of the problem and investigate the factors that may contribute to the high number of failures in chemistry (Angel & LaLonde, 1998; Bunce & Hutchinson, 1993; McFate & Olmstead, 1999). Conceptual understanding of core concepts presented in organic chemistry has been cited as perhaps one of the more influential factors contributing to the disparate patterns of student...
performance (Szu, Nandagopal, Shavelson, Lopez, Penn, Scharberg, & Hill, 2011).

Seemingly unrelated, the interest in mobile learning, or m-learning, has increased dramatically over the last few years. Leung and Chan (2003) note that there are over 1 billion mobile users worldwide and this number continues to grow every year. Technology and learning both have become more individualized and user-centered over the past 30 years (Sharples & Westmancott, 2002). Just as new technologies in the past have garnered excitement and buzz as the new “magic bullet” that will cure all our educational ills, the mobile device is gaining similar interest today. The difference with this new technology, however, is the fact that the mobile device is becoming a part of today’s students’ daily activities and lifestyle. Consumers’ expectations of their mobile devices are changing (Tucker & Winchester, 2009). Termed “cell phone culture” (Katz & Aakhus, 2002), today’s youth interact with the mobile device in more ways than just as a communication tool. Students use their cell phones for tasks such as viewing videos and pictures, accessing the Internet, scheduling, and reading e-mail. With a multimedia tool that is accessed several times a day, it follows that educators are considering the possibility of harnessing this avenue as a way to impact student learning inside and outside the classroom.

In this study, we attempted to merge these two ideas into a project to help students learning in three organic chemistry sections at a local 4-year college. We targeted, as the curricular topic of focus, the skill of identifying functional groups, a fundamental concept that is typically a challenge for organic chemistry students. A mobile application (app) called “TsoiChem©” was designed and developed to help students practice functional group identification and elucidate common misconceptions. Since conceptual understanding was indicated by research as one of the more influential factors of student performance, the design of the app focused on increasing students’ conceptual understanding of functional group identification. Therefore, we used educational learning theories to inform key decisions about the design and layout of TsoiChem© in order to maximize students’ conceptual understanding. The app was then provided to organic chemistry students through the Apple© iPod Touch device and data was gathered on student opinions and performance. This data was then used to inform revisions and changes to the TsoiChem© app. In summary, given the popularity of mobile devices among students today, we wanted to investigate how students would respond to an educational application when played on a touch-screen mobile device if the application was designed with their learning needs in mind and how it might affect their conceptual understanding.

In this paper, we describe the theoretical background behind the project (Section 2) and then detail the design of the mobile app (Section 3). We then provide student feedback on the TsoiChem© app as well as preliminary data on student performance in identifying functional groups before and after playing TsoiChem© (Section 3). Finally, we describe the future directions of this project (Section 4), which include long-term student use of TsoiChem© and porting this learning app to a tablet platform.

2. BACKGROUND

2.1. Mobile Learning

Mobile learning has become an important form of learning and has received a lot of attention in recent years. It has been described as any form of learning that is mediated through the use of a mobile device, with an emphasis on “mediated” (Winters, 2006). The fact that there is a 1:1 ratio of students to computers also allows for a more personalized learning experience (Chan, 2006). Another advantage of using mobile applications in learning is the ability to provide immediate feedback. It has been long accepted (Gilmer, 1979) that immediate feedback helps students self-correct and rectify prior misconceptions. All these advantages may have contributed to the recent increased use of mobile devices for learning.
The Significance of the Reflective Practitioner in Blended Learning
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