

Project Name

Development and Assessment of Mobile Device Instruction in STEM Education at K-21 Level

Principal Investigator Katharina Dittmar

Campus Buffalo, University at

Year of Project 2012

Tier Tier One

Project Team

- Bina Ramamurthy, University at Buffalo

Overview Summary

Leverages NSF Cyber-Infrastructure funds to develop a cloud-deployed, scalable, virtual tool for the instruction of theory and practice of population genetics in K-21 settings.

Outcomes Summary

Student data indicates broad adoption of the initial app release for use in learning. Additional data indicates that mobile device adoption does not necessarily translate into "mobile education".

Project Abstract

Introduction

This proposal builds on an ongoing NSF Cyber-Infrastructure project, which seeks to develop a cloud-deployed, scalable, virtual tool for the instruction of theory and practice of population genetics (NSF-OCICITEAM; Pop!World) in K-21 settings. This core goal has been achieved by successful launch of Pop!World on the Google App Engine ("the cloud") as an open education resource, and implementation into UB's BIO 200 introductory unit. The purpose of this application is to develop and deliver our already functional population genetics modules (Gateway, and Discovery) to mobile devices supported by Apple and Android

operating systems (under CC licensing). We pursue two aims by expanding Pop!World: Aim 1) Technology Development, and Aim 2) Strategic Assessment.

Specific Aims

Mobile devices are the Swiss Army knives of the 21st Century. They are owned and used by 53+% of American College students. Students use it while in transit, or in waiting, and 82% use it for school related tasks. While a distraction when used unsolicited in the classroom, one may be able to leverage this technological flexibility to enhance and personalize instruction outside the classroom. This integrates well with efforts by universities to expand their repertoire to sustainable online courses, which increases accessibility of college degrees to working professionals and other off-campus students. While developing an app for Pop!World is not a particular challenge (Aim 1), the risk of this technology comes with a dearth of data about the effectiveness and adaptability of such resource in STEM instruction. This knowledge however is important, particularly for STEM education, where some evidence suggests that the use of hybrid approaches combining traditional learning environments, online components and classroom mentoring may positively influence learning outcomes. With our project, we will explore the potential of mobile-device instruction in STEM education (Aim 2), and provide a proof of concept, whose outcomes will be informative to the educational community in general. Because a positive role of mobiledevice- instruction is unproven at this point, this falls under a Tier 1 classification (a.k.a "high risk").

Why are we testing this with population genetics?

Population genetics is central to evolutionary theory, and is an integral part of undergraduate through graduate level education in biology. Thus, we can assess student learning along a progressive educational trajectory. Because of its challenging content, combining theoretical concepts, mathematics, and biology, population genetics is an ideal test case for STEM education pursuits. Lastly, the ubiquitous nature of integration of population genetics (i.e. Hardy-Weinberg Equilibrium) into biology curricula at SUNY schools and at universities and colleges in the US makes the ultimate product widely applicable, and easy to adapt to varied learning environments (i.e. on-campus or off-campus) and disciplines (i.e. medicine, ecology, biomedical sciences, conservation biology and environmental sciences).

Tangible Outcomes

A) One immediate result of this project will be the availability of a stand-alone Pop!World app for our Gateway and Discovery modules. The Gateway module currently treats mono- and di-hybrid crosses, incomplete dominance versus co-dominance, and multiple alleles. The Discovery module deals exclusively with theory and practice of Hardy-Weinberg Equilibrium. The Gateway app will be particularly suitable for introductory biology courses (100 level), but can be used as early as the AP Biology level. The Discovery module can be seamlessly integrated from introductory to upper level undergraduate education (200 – 400 level). We will develop apps for the two popular platforms: Google's Android and Apple IOS. Android apps are written in a customized version of Java. Apple apps for iPad and iPhone will be written in Objective-C. Apps on both platforms will be developed using best practices in programming and will be provided with privacy and security features. Independent of the outcome of our assessment, the apps will further expand flexibility of course completion for undergraduate students at UB, SUNY, and other institutions across the country that choose to adopt this module in their instruction.

B) The other outcome will be the systematic assessment of the pedagogic/educational effectiveness of mobile device instruction in STEM education through controlled qualitative and quantitative research on a large scale (ca. 1500N). We will answer two questions: A) How effective is mobile device instruction within the paradigm of STEM education?, and B) What factors influence the acceptance and use of mobile instruction and learning? Results from this study will benefit learners and instructors in the public, as well as the private institutions (both traditional and online). Assessment results will also be interesting to the business sector, as it will inform about the potential profitability of mobile device instruction technology. To answer question A, we will measure student performance and student perception across delivery methods (i.e. lecture versus cloud-deployed module versus mobile-device-deployed-module, versus hybrid approach). Learning outcomes will be defined and assessed guided by the standards of the Middle States Student Learning Assessment Guidebook. To answer question B, we chose to follow a modified instrumentation of the Unified Theory of Acceptance and

Use of Technology Model (UTAUT), and will consider the following variables: Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions. A demographic questionnaire will be administered to capture participant responses about: Gender, Ethnicity, Field of Study, Prospective Employment/Further Educational goals.

Reports and Resources

- [Project website](#)

Instructional Design

- Gamification (Design)

Instructional Technologies

- Mobile Learning
- Open Source Programs and Apps