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# Using Mobile Apps to Entice General Education Students into Technology Fields

Michelle (Xiang) Liu
xliu@marymount.edu

Diane Murphy
dmurphy@marymount.edu

Information Technology and Management Science Department
Marymount University
Arlington, Virginia 22207, USA

## Abstract

It is of national importance to increase the number of college students pursuing degrees in information systems/information technology (IT/IS) subjects. The primary focus at many institutions is renovating or enhancing existing IT/IS programs and the target audience is the students who have selected to major in IT/IS subjects. This paper looks at general education students and how exposure to mobile app development may change their attitudes toward IT/IS and entice them into pursuing a technology major or minor. The research setting is a liberal arts university with a large female population and a diverse ethnic basis. The authors develop a new pedagogical strategy, teaching students to develop mobile apps using an easy-to-use tool, with the objective of transforming students from technology consumers to technology creators and increasing the number who choose technology as a career path. Techniques for the evaluation of the project outcomes are also discussed.

**Keywords:** mobile apps, general education, computational thinking, technology consumer, technology creator

## 1. INTRODUCTION

In a 2010 December report, IDC (one of the leading market research firms) predicted that app-capable, non-PC devices would out-ship PCs within 18 months (IDC, 2010). In essence, IDC concluded that this is the end of the personal computer era and the beginning of the mobile age. In September, 2011, Salesforce Chairman and CEO Marc Benioff asked Eric Schmidt, the Executive Chairman of Google, to discuss the industry's future. Schmidt commented that "…the next game changing shift will comprise mobile, local and social technologies and will create an environment that unfolds in true real-time…" As education professionals, this prompted us to reexamine and rethink whether understanding these technologies could help us attract more students into considering technology as a career or, at a minimum, to help them see the value of technology development in another field such as science or mathematics.

As technology becomes an essential part of everyone's lives in the global economy, it is critical for the U.S. to increase the number of STEM (Science, Technology, Engineering, and Mathematics) workers, male and female, who adopt technology as a career or who can apply technology effectively in another STEM field. In contrast, much evidence suggests that fewer students are leaving high-school with the intention of pursuing a STEM career (Carnevale, Smith, & Melton, 2011). Many of them are entering college as undeclared majors or lacking a strong conviction to the major they have

selected. Can they be influenced as they enter college or even in the latter stages of high school? If the answer is yes, how and what strategy and method do we use? One motivation of this study is to answer these questions and solve the puzzle.

MIT professor Seymour Papert's seminal book Mindstorms (Papert, 1993), took the education world by storm over thirty years ago. Surprisingly, most college students (especially incoming freshmen) still equate information technology (IT) to simply computers or computer programming. Subjects like IT or computer science (CS) has become the realm of "geeks" and one of the popular misconceptions is that all programming is difficult, tedious, and requires high levels of mathematics proficiency.

"We carry powerful computers in our pockets, our social networks and interactions are increasingly computer-mediated and online and offline lives are increasingly fused. That's the world that young people need to understand, and that's the technology with which they should be empowered" (Abelson, 2011). The ensuing question is how we, as educators, respond. As IT/IS faculty members, we believe it is our responsibility  to create an environment that encourages students to use computers or computing devices in the constructionist way that Papert envisioned – students creating computer applications and acquiring "a sense of mastery over a piece of the most modern and powerful technology" and through this endeavor establishing "intimate contact with some of the deepest ideas from science, from mathematics, and from the art of intellectual model building" (Grover, 2010; Papert, 1993).

In her widely-cited article Computational Thinking, Wing (2006) argued that "computational thinking is a fundamental skill for everyone, not just for computer scientists." Building on this theoretical pillar, we propose to teach mobile apps development courses to reach the general education audience, inspire their interests in technology, and change their image of the computing field. Furthermore, the project reflects the broader goals of computational thinking for delivery to general education students. It is believed that students today have embraced the use of technology (as consumers), particularly mobile technology, and that building mobile apps (as creators) could be the hook into a broader understanding of the contributions they can make in the technology field. Our ultimate goal is to let students recognize computational thinking as one of the fundamental skills in their daily lives and to motivate them to be active participants in creating the technology used in their world.

"The recent push for nurturing creativity and problem solving skills as essential 21st century skills provides weight to the rationale for exposing youth to the art – and joy – of programming. Youth as 'creators' not 'consumers' is the mantra of progressive pedagogues…" (Grover, 2010). "…logic and reasoning skills as well as the ability to leverage technology to get things done quickly, efficiently, and in a completely individualized way" are the important skills for today's students (Dawson, 2010). We will use the general education courses as a platform to teach students these skills.

We structure the rest of the article as follows: in the next section, we introduce the research context. Then, we elaborate the major objectives of the study and illustrate how we are going to implement the new courses. We will present the evaluation methodology and process. The paper concludes with a discussion of the major contributions of implementing the new courses and the broader impacts of this research.

## 2.  RESEARCH BACKGROUND

The authors work for a small liberal arts college with a diverse student population of approximately 3,500 undergraduate and graduate students (74% female, 15% African American, 13% Hispanic, and 8% Asian/Pacific Islander). Many students are working professionals, one-third of the students are first-generation college students, and transfer students from community colleges comprise almost one-half of the undergraduate population. The university is a student-centered learning community that has long placed a high priority on quality science, technology, and mathematics education, a commitment evidenced by the new state-of-the-art science building which substantially increases laboratory space and features state-of-the-art scientific and technology equipment.

In 2008, the integration of undergraduate research with education at the university was strengthened through the establishment of the DISCOVER Center for Undergraduate Research.

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The mission of the Center is to promote student engagement in the University learning community, as well as to develop a broader national and international community of learners, through research, creative work, and inquiry learning. Under this initiative, a part of the general education curriculum, freshmen students take a three-credit first year seminar, DSC 101, and entering transfer students take DSC 201, a one-credit course, in which they are exposed to inquiry learning and begin to develop or refine their research skills. This program forms the foundation for this study.

The purpose of this project is to use "mobile application (app) development" to increase the number of general education students who see technology as a career objective even though they may come to college with either an undeclared or in a non-IT/IS major, most often selected based on their success in a specific non-IS high school topic. Furthermore, the project reflects the broader goals of computational thinking for delivery to general education students. We hope the proposed program will prepare non-IT/IS students with substantial competencies and inspire them to participate in the computing field, in college and later as a career. The mobile apps courses will be essentially incorporated into the DISCOVER program and offered to any undergraduate students in their first semester at the university.

We design, develop, implement, and evaluate a series of new, inquiry-based mobile technology courses. Through the creation of mobile apps for an Android smartphone, the students will discover the direct application of technology to their lives as well as experience their role in creating it. By teaching the students how to use a simple and accessible development tool (i.e., App Inventor) in a creative and useful way, students will be encouraged to re-imagine the technology world and to explore it, not as consumers but as creators. Freshman, transfer students, and repeating students will all take these classes.

## 3. CREATING AND IMPLEMENTING THE MOBILE APPS COURSES

### Project Objectives

We will extend the creation of mobile apps in IT/IS-related subjects to a broader audience in general education and provide a formal assessment of the impact of the creation of meaningful technology courses on general education students. The program will provide an opportunity for students to use a required inquiry course (DISCOVER) in our university's general education program to explore the development of mobile apps (a common phenomenon in their young lives). A series of courses will be taught over a two-year period to a variety of students, followed by a formal assessment of learning outcomes and the impact of these courses on the students' confidence level in technology.

In developing the courses and assessing their impact on students, we make use of the theoretical framework from the CS Principles project funded by NSF and the College Board which focused on developing an AP (Advance Placement) course to "broaden participation in computing and computer science." (http://csprinciples.org). The six computational thinking practices established by the College Board: connecting computing, developing computational artifacts, abstracting, analyzing problems and artifacts, communicating, and working effectively in teams (The College Board, 2011) will be part of the course design and subsequent assessment.

The first specific objective of the research project is to expose a wide variety of general education students to mobile app development in a variety of settings to raise the level of awareness and appreciation of technology as well as expose them to "what is behind the scenes of technology" (connecting computing). The techniques to reach these students include direct teaching in general education courses for initial freshman and transfer students; direct teaching for freshman who had some barriers to learning and who failed the initial Discover course with another topic; teaching by other faculty members where mobile app development is integrated as part of another science, applied science, mathematics, or applied mathematics course in the general education program; mobile apps taught as part of the topics in MIS/IT introduction level course for business students; and as taught as part of a summer school institute for high school students.

Second, we aim to convert the students from their traditional role as technology consumers to technology creators (developing computing artifacts) by:

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(i) Increasing the level of confidence in students to analyze problems and develop mobile apps to solve problems independently (analyzing problems and artifacts) and inspire students to participate in a technology field;

(ii) Improving personal problem solving ability (abstracting) and cultivate the students' ability to integrate knowledge and skills across different fields (connecting computing) particularly for students who may have not been previously academically successful; and

(iii) Improving students' communication skills in a team setting, particularly when talking about technology (communicating and working effectively in a team).

**How We Implement The Courses**

The mobile apps development courses will be offered to incoming freshmen and transfer students. These courses will expose general education students with different academic backgrounds and interests to some of the foundational elements of computing. The ultimate goal of the project is to research, develop, and recommend ways to improve the recruiting of students in the technology field, even if they did not see themselves as "technologists". Special attention will be paid to underrepresented groups in the technology field including women, minorities, Veterans, and students with barriers to learning.

The following student populations will be targeted over a two-year time frame:

* Incoming freshmen and transfer students who self-select their DISCOVER course based on a short description of the mobile apps focus;
* Freshmen and transfer students who must repeat the DISCOVER course because they failed in the first attempt;
* Freshmen students who self-select a course based on a topic other than mobile apps but where mobile app development topic is included in the courses  and whose faculty have been trained in mobile app development;
* Freshmen or sophomore students who have selected a "business major" and who have taken a DISCOVER course in their first semester without mobile app development

and take a required IT/IS course in their major; and
* High school students who might not be considering a IT/IS major in college, including rising juniors and seniors.

The timeline for the proposed program for the two-year period of performance is presented in Appendix: Figure 1.

*DISCOVER Course for Freshmen and Transfer Students*

The DISCOVER program has a required syllabus which allows for students to be exposed to the University expectations, events, and services, as well as for each faculty member to develop their own content in their designated subject area.
In the designated DISCOVER series of courses, students will learn how to create their own mobile apps using MIT App Inventor, a visual, web-based programming environment widely used at the college level. Previous programming experience is not a prerequisite. By teaching students how to design and implement mobile apps, the aim is to transform their role, or at least perspective, to one of technology creators rather than just technology consumers. The hands-on laboratory work and inquiry-based individual and group projects will improve students' problem-solving skills, impart up-to-date knowledge of technology, promote critical and creative thinking, information organization and management, and develop effective communication skills and teamwork. Early exposure to these fundamental elements of computational thinking will lead students to a better sense of their own interests in the technology field or beyond (Grover, 2009).

Working individually and in small teams, students will use an Android platform phone and App Inventor tool to build any app they want to imagine such as a game, a personal convenience app, an app to help people communicate, or an app that talks to web services like Twitter. For example, one English major student from the University of San Francisco created a mobile app called No Texting While Driving. The text "I'm driving right now. I'll contact you shortly" is sent in response to all texts while this app is running. Another example is the "Haiti Commodity Collector" mobile app created by a group of students from Trinity College and Wesleyan University. This app allows agronomists to track prices of commodities among various Haitian markets so they know where to buy food for

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humanitarian food assistance during crisis response. The unique feature of the program is that students can and will enthusiastically share their class work with friends and family, thus reinforcing their computational thinking skills. In addition to learning how to create an application and become better problem solvers, this course also allows students to explore the exciting world of information technology from the perspective of mobile computing and its increasingly important effect on society.

It is noted that students will enroll with varying degrees of expertise in and comfort with the use of technology.  Projects will need to be interesting and complex enough to challenge those who are proficient with technology while not leaving behind students who are less accomplished in its use.

*DISCOVER Courses for Students with Barriers to Learning*

Freshman who have failed the mandatory DISCOVER course in the fall semester are required to take the course again in the spring semester. As they will not need the level of "freshman orientation" that is built into the freshman course, there will be more time to address learning skills and to implement the active learning component of the course. Based on their knowledge of the barriers to learning with this population, the authors will modify the original course to reflect a different pace and additional support, whether it be in writing, in technology, or in learning skills. One of the authors will teach the course with a peer mentor from the university's Center for Teaching and Learning.

*Summer Institute for High School Students*

Our university offers a Summer Institute for local and international high school students and we will offer a mobile apps development session in subsequent years. The target audience is teenagers and young adults who have not been exposed to high-quality STEM programs in schools or are at a community college and want to explore technology applications further. The course will provide hands-on experience to show them that, unlike many existing stereotypes, "STEM subjects can be fun to study and can lead to career paths that are exciting and fulfilling, as well as practical" (Ferrante, 2011).

The experience with this population of future college students will also facilitate the refinement of the freshman and transfer student DISCOVER course for later semesters.

*Business IT/IS Course Changes*

The authors currently teach a service course for incoming undergraduate business students to cover the uses of technology in business and society. The broad purpose of the course is to explore the role of computers in this global age and understand how computers are used in business and in global society. For example, students should become more aware of the prominence of social media and the growing ethical implications of the use of technology, including the potential impact it can have on individual privacy. We have previously transformed the original curriculum to include social media and video technology topics. Following the same strategy, the mobile apps development component will be integrated into this service course with a primary focus on the development of "business" apps. The target audience will be the freshmen and sophomores from the business school who have taken a different DISCOVER course.

## 4. EVALUATION OF PROJECT

A variety of techniques will be used to assess the students. The logic model is shown as in Appendix: Figure 2.

The sample size is 450 students. The populations will be assessed throughout the project and a formal assessment will be made at the end of the period of performance,

Each course will be closely assessed including:

- A pre- and post-survey to ascertain students' attitudes and confidence levels with technology and mobile apps, in particular;
- A knowledge assessment based on one or more tests and projects to assess the students' knowledge learning gains;
- Participation in public display of the mobile apps (presentation of team projects in class, student research conference, mobile apps competition, etc.) to assess confidence levels, team work, and communication skills;
- A skills assessment based on a project which will determine whether the students have learned the appropriate computational skills, including the ability

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to analyze a problem, abstract the solution and create a mobile app artifact; and

- A student evaluation of the overall course.

In addition, the courses will be subject to the assessment process used for all DISCOVER courses. The pre- and post-survey instruments will be taken by all students enrolled in these courses. The impact design will be a randomized controlled trial where DISCOVER courses which do not involve any technology use, DISCOVER courses which incorporate some technology (e.g. video production), and the mobile app course outcomes will be compared. Of particular interest is the comparison of the courses taught by faculty members before their adoption of the mobile app model.

The results will be collected and analyzed by the university's Office of Institutional Effectiveness at the end of each semester. Feedback will be provided to the faculty on each course and the cumulative results of the assessments.

*Formative Evaluation*

On-going, periodic evaluation of project activities is critical to achieving program excellence. The formative evaluation will be used to:

- Actively engage all DISCOVER mobile apps course participants in a reflective process to generate feedback on their learning gains;
- Document key stages in the educational process; and
- Provide structured evidence for program planning and adjustments.

The formative assessments with students will be distributed after the first month in the program and at the end of each month. We will use the responses to take necessary actions either to support the individual student or to strengthen the overall program.

*Summative Evaluation*

The summative evaluation will assess the overall effectiveness of the program in meeting the stated objectives as specified above. To that end, the following are proposed:

- The summative evaluation will be performed by University's Office of Institutional Effectiveness;

- The summative evaluation will examine the success of the program in meeting the program objectives; and
- A variety of techniques will be used to collect information, including direct and indirect measures.

At the end of the study additional data analysis will be performed to determine:

- Whether the course increased the entry into a technology track either in high school, as freshmen or as transfer students;
- Whether the course significantly affected the attitude of students towards technology and whether there were any factors in their background that correlated with their change in attitude or lack of attitude change, such as gender, high school GPA, high school course selection, technology availability and use, etc.;
- Whether the course made a difference in learning for struggling students;
- Whether the learning gains were greater in the mobile apps development courses as opposed to the other DISCOVER courses; and
- Whether a student with a specific major (such as business) is more likely to be influenced into a technology career than other students in the general student population.

## 5. CONCLUSIONS

The project has one main objective: to increase the number of students who consider a future career in technology. Our intention is to use the mobile app platform as a pathway to intrigue and inspire general education students to explore the exciting world of IT/IS. By teaching them how to create computer applications that meet various social needs and could be shared with friends and families, the project exposes the students to inquiry learning and computational thinking. To evaluate the impact of the program, student learning gains including computational thinking ability and their confidence level with technology will be formally assessed.

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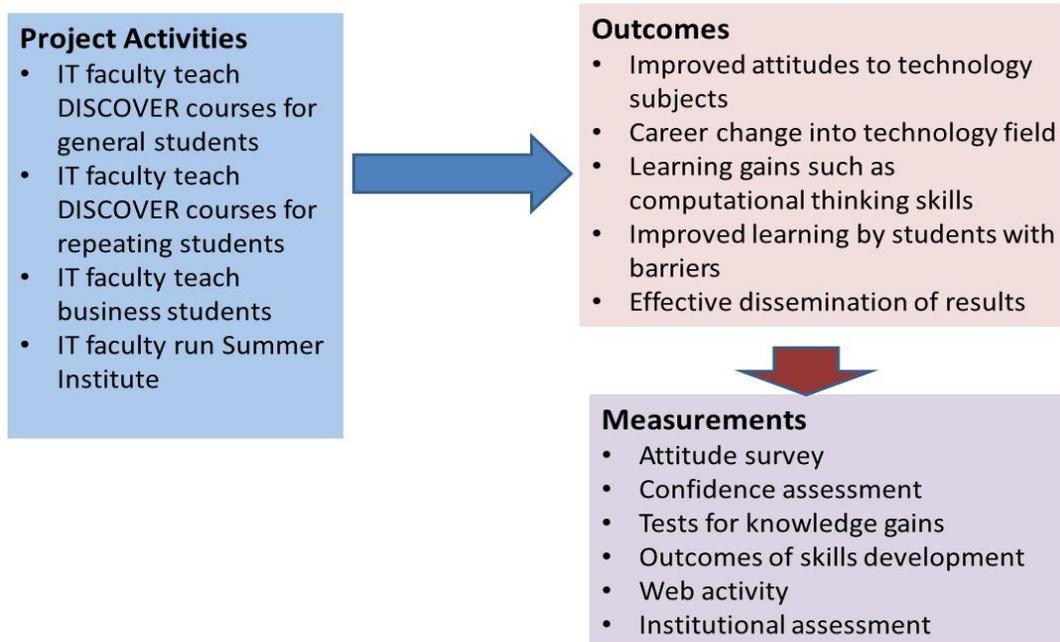
# Appendix



**Figure 1. The timeline for the program**

**Logic Model**



**Figure 2. The Logic Model for the Project Assessment**

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