ABSTRACT
We describe three courses developed for information technology fluency at a new liberal arts college, Georgia Gwinnett College, emphasizing the development and assessment of the first fundamental course. The requirement for an IT course sequence is a direct outcome of our institutional mission and vision. We share our experiences as an example of re-engineering IT fluency across degree programs and contribute the lessons learned from our first year of design and assessment.

Categories and Subject Descriptors
K.3.2 [Computer and Information Science Education]: Computer science education, Information systems education

General Terms
Human Factors

Keywords
IT fluency, FITness, CS0, curriculum design, computer literacy, course assessment

1. INTRODUCTION
Undergraduate curriculum often includes at least one information technology (IT) course. Some are introductory courses for non-computing majors while others are developed to support specific degree programs (e.g., programming for engineers and productivity applications for business majors). At Georgia Gwinnett College (GGC), a new liberal arts institution, the importance of technology is explicitly included in our charter and mission statement. To ensure that students have a solid computing foundation, all degree programs require at least two IT courses. This expanded curriculum offers a unique opportunity to develop student capabilities in IT regardless of major.

In this paper, we first provide some IT fluency background and then the contextual application within the GGC community. We describe the three courses developed for IT fluency and how we have begun assessing their effects. We share our experiences as an example of re-engineering IT fluency across degree programs and contribute our lessons learned from our first year of development and assessment.

2. IT FLUENCY
Educators cannot assume that students will automatically arrive to college knowing how to use the computer to present and organize information effectively. Instead, incoming students may differ greatly with respect to access to personal computers, availability of high-speed Internet, and prior instruction with technology [2, 12]. To bridge this gap, computer literacy courses have traditionally addressed proficiency with specific skills such as word processing, spreadsheets, and presentation software. However, more recently, the focus has shifted from computer literacy to IT fluency [1, 11]. The term fluency emphasizes that students must have both current skills as well as the capacity to adapt as technology changes.

IT fluency requires a mixture of contemporary skills, foundational concepts, and intellectual capabilities [1, 8]. The contemporary skills component stresses competency with the prevailing hardware and software applications. For example, students should be familiar with personal computers, personal productivity software, and the Internet. The foundational concepts component covers central IT principles such as algorithmic thinking, computer networking, and societal impacts of information and computing. The intellectual capabilities component emphasizes using critical thinking skills to effectively interpret and present information and solve complex problems. One way of helping to build computational thinking and problem solving skills would be to teach non-IT students how to program [1, 7].

A key challenge in developing IT fluency across the curriculum involves delivering the instruction in a way that is meaningful for both non-IT and IT majors. Georgia Tech has been successful with a programming course that involves media computation [4, 6]. Washington and Lee University has embedded the teaching of several IT fluency concepts within a quantitative research methods course [9]. Other approaches to building IT fluency have been described; in reporting these approaches, Dougherty and colleagues have argued that the overall strategy for IT fluency will vary considerably based upon the context profile of the institution – its mission, goal, types of students, and resources [3].
3. IT FLUENCY AT GGC
Because of the importance of institutional context in developing a strategy for IT fluency, this section provides an overview of GGC

3.1 Institutional Overview
GGC was established in 2006 as a four-year public college in a suburb of Atlanta, Georgia. The institutional vision emphasizes educational innovation, student engagement, and administrative efficiency. The institutional mission emphasizes innovative use of educational technology within active learning environments. An open-access institution, GGC accepts students from varied educational backgrounds and provides remedial assistance as needed to facilitate student success. In Fall 2006, 17 full-time charter faculty taught transfer students working towards degrees in business, biology, and psychology. By Fall 2007, GGC had grown to 82 full-time faculty members and over 750 students. In addition, GGC began offering classes to support an undergraduate degree in IT. Because GGC has no dormitories, students must commute to campus. GGC students reflect the diversity of the metropolitan Atlanta area with 28 foreign countries represented. Although the majority of students are traditional freshmen, nontraditional students also matriculate, bringing the average student age to 23.9 years.

3.2 IT Fluency Requirement
We define IT fluency as the ability to use IT effectively as a tool and the ability to adapt to changing technology. At the foundation of all degree programs is the outcomes-based Gen Ed curriculum which consists of 60 credit hours. In the context of IT fluency, four of these Gen Ed learning outcomes are especially relevant:

1. Clearly communicate ideas in written and oral form
2. Demonstrate critical and creative thinking
3. Demonstrate science literacy
4. Understand and effectively use IT

The curriculum was developed by a multidisciplinary committee lead by the Dean of the School of Science and Technology. The Gen Ed committee considered IT fluency to be a capability required of all GGC graduates. Focusing on more than a specific set of skills, the goal emphasizes being able to use IT as a tool for organization, communication, research, and problem solving. To ensure students achieve these IT-related learning outcomes, the Gen Ed program requires that all GGC graduates complete at least 8 credit hours of IT courses. Students may choose two of the following 4-credit hour courses to meet this requirement: ITEC 1001 Introduction to Computing, ITEC 2110 Digital Media, or ITEC 2120 Introduction to Programming. An overview of each of the courses in the IT sequence is provided next.

4. IT COURSE SEQUENCE
The requirement for an IT course sequence is a direct outcome of our institution mission and goals. The IT faculty developed the curriculum by mapping the college mission into specific course learning goals, and then designing the topics and learning activities.

4.1 ITEC 1001 - Introduction to Computing
ITEC 1001 Introduction to Computing is a prerequisite for all other IT courses. This course is designed for students with limited computing background and is designed to ensure that all GGC students attain a certain level of IT knowledge and skills. From the perspective of IT fluency, this course emphasizes contemporary skills as well as foundational concepts. The course was designed with the following IT fluency objectives in mind:

1. Students should understand the underlying technology of the machine that they use or will have to use on a daily basis.
2. Students should develop problem solving skills and gain proficiency in using personal productivity software (PPS) such as word processors, presentation software, spreadsheets, etc.
3. Students should see the relevance of topics covered to their daily lives and be able to learn new concepts.

The combination of these three goals and appropriate teaching methods ensure that students not only gain proficiency in using IT tools, but also develop an ability to learn new tools as technology changes. Based upon these high level objectives, more detailed course goals were designed. In general, these course goals require the students to understand the fundamentals of computers, apply knowledge to real life situations, and solve problems. Topics covered include evolution and ethical issues of IT, hardware components and applications, networking and security, and collaboration.

The delivery method of this course was an equally important part of designing the course. A variety of teaching methods were used during the first year of teaching this course including: hardware and software labs, software demonstrations, videos, web-based learning, traditional lectures, collaborative projects, in-class and online discussions. These teaching methods were selected to successfully achieve the course goals and were a direct outcome of the school’s vision to innovatively use educational technology within active learning environments.

4.2 ITEC 2110 - Digital Media
The Digital Media course enables students to better understand the broad forms of media they use daily by giving them a practical and theoretical introduction to producing and evaluating digital media. The course includes practical projects using free open source software products such as GIMP (http://www.gimp.org/), Inkscape (http://www.inkscape.org/), Blender (http://www.blender.org/), and Audacity (http://audacity.sourceforge.net/). The practical projects are supported by an accompanying theoretical introduction to the process of digitization and rendering for sound, images, print, video and web sites. A primary goal of this course is to make the students better able to design and deliver digital media. Topics include building digital media as a communication tool, publishing multimedia to the Internet, and understanding legal issues.

Through hands-on projects and discussion, the students gained experience in using multimedia, both in their liberal arts degree program and in their personal life. Discussions include: what is progressive download and why is it used to deliver video in an online environment? What is the tradeoff between compression ratio, video size and time to download? When editing videos, how is it possible to avoid loss of quality? How and why are there multiple formats for the same type of media? Through these discussions students gain a more thorough appreciation of the complexities involved in effectively producing, delivering, and ultimately communicating through various forms of digital media.
4.3 ITEC 2120 - Introduction to Programming

An introduction to programming course is commonly part of the curriculum for science and business majors, but all liberal arts majors can improve their understanding of the world around them by learning how computer programs are written [7]. The course assumes no prior programming experience and is tailored to student interest. Currently two versions are offered, one using Alice for animations and one using the FANG Engine for writing games in Java. In order to maintain efficiency in our curriculum and rigor in this course, the Introduction to Programming course is also one of the core courses in the IT major. Topics covered include analyzing real world problems using algorithmic and programming solutions; general ideas conditional expressions, functions, and control structures; and preparing, execute and debug program code.

Both the Alice and Java course pay special attention to making the Introduction to Programming course accessible to students from all majors. Alice is designed to provide an easy to use programming IDE [10]. For the Java course, students used two tools designed with novices in mind. For the IDE, we use the Java Wiki Integrated Development Environment (JavaWIDE), a collaborative space where student programmers can write, develop, execute and share applets and applications using only a web-browser – no installations required (www.javawide.org). For the game engine, we use the Freely Available Networked Game Engine (FANG) (www.fangengine.org).

5. ITEC 1001 FIRST YEAR EXPERIENCE
ITEC1001 is a first and fundamental IT course that provides students with a window to the technical world; therefore, it is an important course. It was also the largest offering of the three IT courses in the Gen Ed program for our first year. In Fall 2007, 223 students took ITEC1001 and 7 instructors taught 13 sections. In Spring 2008, 183 students took the course and 7 instructors taught 14 sections. It is also an evolving course due to the involvement of many faculty members and the objectives of relevance and active learning. During our first year the IT faculty focused on the design and assessment of the ITEC 1001 Intro to Computing course. Hence, the rest of the paper is dedicated to the design and assessment of this course.

5.1 Course Description

The course goals determined the specific topics to include, the textbook, and the teaching methods. Appendix A discusses an example of goal mapping in detail. In addition to topics listed in Section 4, collaboration and active learning techniques were hallmarks of this course and are consistent with the GGC mission. The course goal related to collaboration was achieved completely by hands-on activities. A Wiki was used extensively, along with other applications like Google docs, MS Outlook, SharePoint, and WebCT. Our students are expected to use these tools for teamwork in other courses and in their club activities, as well. Some sections included “Build-A-Computer” lab, where student teams built a desktop computer and installed an open-source operating system, to understand the hardware and system components. The Mac lab provided more active learning opportunities in learning different types of application and system software. This was an important learning experience for students as less than 10% of our students use Mac or UNIX systems. Other topics like ethical issues were embedded throughout the semester and related to current topic: ethical issues related to green computing, ergonomics, social networking, piracy, computer security, and evaluation of websites. The content was also supported by discussions, projects, assignments and labs.

5.2 Assessment Approach

The assessment approach was complicated by the fact that there were many sections of the course taught by many faculty members. We wanted to balance flexibility for individual instructors with the desire to provide students with similar learning experiences. We also realized that there needed to be some common components across sections to allow for course-level assessment reporting. Considering all of these factors, the following decisions were made regarding an assessment approach:

1. Common lesson objectives that covered course goals would be developed.
2. Core questions that assessed all lesson objectives would be used by all sections.
3. For personal productivity software, lists of core skills would be developed and assessed, although the specifics of these labs and projects would be decided by individual instructors. This was later amended to include common assessments for PPS skills.
4. All sections would include a group project, the specifics of which would be decided by individual instructors.

Beyond these common practices, the instructors had freedom to develop the course in any way that they saw fit. The instructors met weekly to exchange ideas and experiences and to make decisions regarding these common components. Three instructors formed an assessment subcommittee to decide on a more detailed assessment plan.

5.3 Course Assessment Results

Assessment was considered throughout the design of this course. Every component introduced in the course was expected to have an assessment. The tests and exams were used to assess technical knowledge and problem solving skills; the PPS projects and in-class exams were used to assess proficiency in using application software; and the group projects were used to assess communication and creative thinking skills. At the end of each semester, instructors submitted assessment data to the assessment subcommittee. The assessment subcommittee then drafted a report answering the following two questions:

1. To what extent were the course goals achieved?
2. How successful were the various teaching methods?

The assessment report included three types of data. The first type of data related to performance on core questions in three tests and the final exam. This helped in identifying how successfully all the course goals were achieved and if the students’ performance improved from the tests to the final comprehensive exam. The second type of data related to students’ performance on PPS projects and group project. The third type of data related to effectiveness of teaching methods. A primary source of data here were instructors’ self-assessment of teaching methods used. In
addition, end of course evaluations completed by the students provided important insight on their attitudes towards the course.

A summary of student performance data on tests and PPS software is included below for Fall and Spring semesters:

**Table 1. Assessment data for Fall and Spring semesters pertaining to individual course goals**

<table>
<thead>
<tr>
<th>Course Goal</th>
<th>Fall 2007 (%)</th>
<th>Spring 2008 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NA</td>
<td>61.14</td>
</tr>
<tr>
<td>2</td>
<td>69.65</td>
<td>95.00</td>
</tr>
<tr>
<td>3</td>
<td>91.90</td>
<td>92.23</td>
</tr>
<tr>
<td>4</td>
<td>81.37</td>
<td>83.20</td>
</tr>
<tr>
<td>5</td>
<td>81.04</td>
<td>74.10</td>
</tr>
<tr>
<td>6</td>
<td>89.02</td>
<td>87.26</td>
</tr>
<tr>
<td>7</td>
<td>88.92</td>
<td>78.97</td>
</tr>
</tbody>
</table>

As Table 1 shows, this assessment uncovered some issues. Course goal 1 was not assessed in Fall 2007; accordingly, changes were made to include specific core questions related to this area. Students did not perform well on Course goal 2 during the Fall 2007 semester; therefore, additional emphasis was placed on the related areas during Spring 2008. Course goal 2 is related to ethical use of digital information. The delivery of this course goal was modified to include many class discussions and online discussions about ethical use of digital information throughout the course. Issues relevant to students were carefully selected to emphasize the importance of these issues. Course goal 5 related to security and privacy threats saw a drop in student assessment. Based on these assessment results an action item for a network lab was identified. In all other areas, student performance was satisfactory.

Selected questions from student end of course evaluation results are tabulated below:

**Table 2. End of course evaluation data for Fall and Spring semesters**

<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Fall 2008, Average Rank</th>
<th>Spring 2008, Average Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>This course has contributed to my personal educational objectives</td>
<td>3.9 (scale 1-5)</td>
<td>3.2 (scale 1-4)</td>
</tr>
<tr>
<td>I understand how this course contributes to my overall degree program</td>
<td>4 (scale 1-5)</td>
<td>3.2 (scale 1-4)</td>
</tr>
</tbody>
</table>

In Table 2, note the scale changed from a 5-point to a 4-point scale from Fall to Spring semester. In both cases, students report the course is relevant to them. In these end of course evaluations students also had an opportunity to write comments, some of which reflected the success of different teaching methods. Some examples of students’ comments are:

“The hardware lab that we did. It was something I had never done before. It was very hands on; also I enjoyed the crossword puzzles.”—Student 1

“It helped me to understand the basic components of a computer, how the Internet works, how to protect my computer at home from intruders and virus, how to network my home computers either with a cable or wireless and the ethics related to the use of computers and the Internet.”— Student 2

Finally, the course-level assessment reports helped identify not only course goals that needed more emphasis, but these reports along with the end of course evaluations are also helping the continuous improvement of this course.

Based on these and other similar results action items were identified. Some of these action items have been successfully implemented like Build-A-Computer hardware lab and common PPS assessments, while more are being identified and worked on like developing a network lab. Both the assessment results and student evaluations have shown that the use of educational technology within active learning environments plays an important role in successfully achieving the course outcomes.

**6. DISCUSSION**

The IT faculty members have taken the three IT fluency courses from catalog description to working courses which reflect the mission of the college. The first step was to clearly define the course specific goals for each of them and map these into the mission statement. For each course, assessment data was gathered. In the case of the foundational course, this included common assessment measures over common course components. For all three courses, faculty have developed active learning exercises and established a repository of laboratory materials and activities. Our first year assessment efforts have been focused on providing feedback on how well these courses cover their goals.

This IT fluency requirement has opened the door to many other curriculum innovations. Students are now expected to create multiple media forms and to use the collaboration tools for group projects. For example, GGC biology students prepare videos portraying the interaction between living organisms and the environment. GGC English students write essays using a digital photo storyboard.

Despite these early successes, the IT faculty members realize several key challenges remain. These include the need to design an introductory course that can deal effectively with students from very different starting backgrounds in IT and keep up with frequently changing technology (e.g. switch from Microsoft Office 2003 to Office 2007). For the intermediate course (i.e. Digital Media and Programming), a key challenge is to teach these courses in such a way as to appeal to both IT and non-IT majors. Finally, as the college grows, the courses will need to be redesigned to scale in terms of efficiency cost effectiveness.

One initiative designed to address some of these challenges involves the introduction of hybrid courses. Hybrid courses (also known as blended learning) significantly reduce face-to-face instructional time by incorporating alternative learning experiences such as online instruction, student research, and practical exercises [5]. For example, a class scheduled to meet on Monday, Wednesday and Friday could hold two face-to-face meetings and reserve one day for experiences outside of class. A
pilot project for running hybrid versions of both the Introduction to Computing and Introduction to Programming courses will be undertaken within the next year. Anticipated benefits include accommodating students that want more flexible scheduling due to family or work obligations, developing students that are more self-directed learners, and increasing efficient use of resources.

Another initiative involves expanding the assessment plan to look at IT fluency across the curriculum. After the Gen Ed sequence has been completed, are students able to retain and transfer the IT skills they learned? Currently, student learning is assessed immediately after each course. However, in the upcoming year, we plan to gather more long-term assessment data. This will be done by conducting focus groups with prior students that have gone through the course and by communicating more with non-IT faculty about any difficulties students seem to have in their courses using IT. In addition to longitudinal assessment, there is also the need to do breadth assessment:

- Do the courses cover the goals for each degree program?
- Are the course goals covering all the Gen Ed goals?

We currently have a team of faculty from various disciplines defining the computer literacy and IT fluency expectations for our students, as well as ways to assess these.

7. CONCLUSION

Much progress was made during this first year teaching IT fluency courses at GGC: the course goals for all three courses were defined, course-level assessment data to measure student learning outcomes was collected, and a repository of laboratory and active learning exercises was established. We have a unique opportunity to assess the effects of a multi-course computing requirement across degree programs, from its inception. When our first freshmen graduate in four years, what will we be able to say about the effects of the IT course sequence? We plan to develop institution-wide assessment of key components of IT fluency so that we will be able to answer this question.

8. REFERENCES


9. Appendix A

Gen Ed Goal 4: Understand the role of IT tools in supporting collaborative projects

Major topics: Collaboration using MediaWiki, Outlook web calendar, email features such as folder, filtering, tasks, appointments, WebCT, Google Docs, SharePoint, etc.

GGC’s vision: Innovative use of educational technology within active learning environments

Description: This course goal covers the fundamentals of collaboration and the software products that help individuals to collaborate. Hands-on activities using wiki, google docs, email, calendar and other advanced features, etc. are used to demonstrate the application of theoretical knowledge to real-world situations. This knowledge is then later used in the remainder of the semester to complete other projects, discussions, etc. and eventually in other classes as discussed in Section 6. Although the data from SharePoint, WebCT and Google Docs cannot be shared, the following links to wiki pages demonstrate the students’ proficiency and application of this knowledge to achieving other course goals:

2. [http://wiki.ggc.usg.edu/mediawiki/index.php/Main_Pag e#Courses](http://wiki.ggc.usg.edu/mediawiki/index.php/Main_Page#Courses) (Main courses page with links to all courses requiring students to contribute to wiki)

This also satisfies all three of our high-level IT fluency goals. The students learn the fundamentals, learn to use the software, apply their knowledge and learn new concepts.