Gaming Against Plagiarism (GAP)  
PROJECT DESCRIPTION

1.1 PROJECT VISION
The University of Florida (UF) and its partners propose to develop Gaming Against Plagiarism (GAP). This online, self-directed, interactive game will provide a role-adopting environment in which Science, Technology, Engineering, and Mathematics (STEM) graduate students will learn to recognize and avoid plagiarism. GAP will employ strategies intended to influence students' ethical behavior, and it will explore the impact of peer behavior, institutional norms, and differing cultural practices on plagiarism. It will be collaboratively designed, tested, and evaluated through a multi-disciplinary iterative development process by recognized experts in graduate science education, gaming, academic integrity, intellectual property rights, and educational digital media production. Six NSF Engineering Education awardees: Purdue University, Virginia Commonwealth University, University of Houston, Loyola Marymount, Oakland University, and Rowan University, have been recruited along with the College of Sciences, University of Central Florida to assist in the testing and final refinement of the GAP intervention. This project has the institutional support of UF’s: President; Dean of the College of Engineering; Dean of the College of Liberal Arts and Sciences; Assistant Dean of Students and Director of Student Conduct and Conflict; Associate Dean for Graduate Education, College of Medicine; and Dean of the Graduate School represented by the I3 Program partnership. The GAP project will be open source and freely available to these institutions and others to create the broadest possible national impact.

GAP’s intellectual merit lies in its goal of training STEM graduate students in U.S. institutions to function effectively and ethically as authors within multi-national research teams. Given the substantial documentation of significant differences in cultural attitudes towards plagiarism (Carroll, 2004; Handa and Power, 2005; Leask, 2001; Ramburuth and McCormick, 2001), cutting-edge 21st Century science will require a common ground for preparing and publishing results in the scientific literature. GAP will provide this common ground.

The broader impacts of GAP are its adaptability and scalability across a wide spectrum of American higher education settings. The game’s open source approach will allow each institution to integrate its own code of conduct, relevant policies, and branding while maintaining a common focus on what constitutes responsible conduct of research. Although the initial game will emphasize plagiarism, the gaming platform will accommodate additional game development on other ethical issues, e.g., fabrication of data. Because the project can be transmitted over the network, universities across the nation can request the GAP software and download an open source copy that can be updated to serve the needs of their particular institution.

1.2 BACKGROUND AND RATIONALE
Plagiarism is the most critical and widespread misconduct issue facing beginning researchers (McCabe, 2005). In a study of 1,946 students from 31 U.S. academic institutions, 75% of Engineering students and 64% of Natural Science students admitted to some form of written cheating: turning in copied material as their own work, fabricating or falsifying a bibliography or turning in work done by someone else (McCabe, 1997). A more recent and broader survey of 63,700 undergraduate students and 9,250 graduate students, revealed that cheating on written work occurs more frequently than cheating on examinations, and that 62% of undergraduates and 59% of graduate students had engaged in “cut and paste” plagiarism from either print or electronic sources at least once in the last three years (McCabe, 2005). Perhaps most disturbing, approximately half of the students surveyed in a 2003 study, who admitted to some form of plagiarism felt their actions were “trivial or not cheating at all” (Rimer, 2003, based on McCabe findings). Bringing about meaningful change will require much more than PowerPoints
and tutorials (see section 1.3) – to change student attitudes, we must engage students in a non-threatening, non-judgemental environment in which they can personally experience and grapple with the multiple dimensions of plagiarism (Carroll, 2007).

The shifting landscape of plagiarism is further confounded by the globalization of science and engineering. This international dimension of research is most obviously reflected in the steady increase of papers co-authored by multi-national collaborators (Leydesdorff and Wagner, 2008). Thus, U.S. academic institutions need to train STEM graduate students as global scientists, at ease working with colleagues from other countries and disparate cultures, and sensitive to culturally varying standards of plagiarism, codes of ethical conduct, copyright, etc. Thompson & Williams (1995) address these differences: “For many ESL (English as a Second Language) students, learning not to cheat is more than a difficult task, it is a cultural hurdle. In some Asian cultures, students are taught to memorize and copy well-respected authors and leaders in their societies to show intelligence and good judgment in writing.” In other words, what is defined as plagiarism by American standards is not defined as such by many Asian or European standards, in which “…taking ideas and words from different books and writers to build an answer seems to be an accepted academic practice” (Pennycook, 1996). Standards can differ not only between but also within cultures. In India, for example, undergraduates are not expected to cite sources and it is only at the graduate level where such activity is expected, but not necessary (Handa and Power, 2005). The GAP team embraces the notion that plagiarism should be introduced to students in “…the true spirit of internationalization by incorporating recognition of … cultural contexts … instead of assuming homogeneity” (Handa and Power, 2005). In fact, ethics training that fails to incorporate cultural differences may be worse than useless; by implying a single standard, it may foster a narrow attitude, which could threaten the success of international collaborations.

Differences in occurrence and perception of plagiarism also occur within U.S. institutions and likely even within a given population of students. McCabe, Trevino, and Butterfield (2001) notes that “…women majoring in engineering, a major one might have considered male-dominated a few decades ago, talk about the need to compete by the ‘men’s rules’ to be successful in this major. Thus, generally higher levels of cheating were found among women in engineering compared to women in other majors, and women majoring in engineering reported cheating at rates comparable to men majoring in engineering.” (p.228) Such findings lend an urgent credibility to NSF’s implementation of Section 7009 of the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act. COMPETES requires that “…each institution that applies for financial assistance from the Foundation for science and engineering research or education describe in its grant proposal a plan to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduate students, graduate students, and postdoctoral researchers participating in the proposed research project.” This January 2010 directive is enormously challenging to implement.

McCabe et al. (2001) states that “…cheating can be most effectively addressed at the institutional level…However, at an even broader level, academic institutions are advised to consider ways of creating an "ethical community" on their campuses – one that includes clear communication of rules and standards.” (p. 228) Education as a method to reduce plagiarism is further supported by the work of Duff, Rogers, and Harris (2006) and Belter and du Pré (2009), who report significantly lower levels of plagiarism after students (both native and non-native) were given awareness training. McCuen (2008) argues that “education about plagiarism can not wait until the student is starting to write the thesis or dissertation. The education should begin when the student begins his or her graduate program, if not before…and mentors should
have high writing standards from the beginning, not waiting until the student is writing the final draft." (p.155)

At UF, there is an acute awareness of the need to address plagiarism issues (see Letters of Support). In 2000, a dissertation by UF student Kimberly Lanegran was plagiarized almost verbatim by Marks Chabedi, who had been awarded a PhD at The New School (New York, NY) and a professorship at the University of Witwatersrand (Johannesburg, South Africa). When the issue came to light, he was fired from his position, his PhD was revoked, and at least one publication from it was retracted (Langran, 2004; Zegeye, 2004). In 2006, UF science librarians taught an Honors course to freshmen who knew they wanted to pursue graduate degrees in science and engineering. Each student was mentored by a UF researcher and was required to write a research proposal. In spite of high motivation, intellectual aptitude, and personal mentoring, 25% of the students in the course engaged in plagiarism. This experience obviously raised awareness amongst science librarians, faculty, and administrators, and it played a decisive role in the science librarians’ initiation of the GAP project. An independent line of evidence of UF’s plagiarism problem comes from the Director of Student Conduct and Conflict Resolution, who reported a 55% increase in plagiarism cases between 2007 and 2009 (88 cases in 2007-08 vs. 163 in 2008-09). For the most current year (July 1, 2009 - February 15, 2010) there have been 125 reported cases of academic dishonesty, of which 64% (n=80) involve plagiarism. It’s especially noteworthy that these data document (1) the majority of academic dishonesty cases involve plagiarism, and (2) the frequency is increasing.

Currently UF has four discrete approaches to teaching ethical conduct of research:
1) Ethics is integrated into courses within various departments.
2) Workshops through the science library and the UF writing center teach how to avoid plagiarism. (These efforts include an online tutorial for e-learning STEM classes.)
3) UF’s Division of Sponsored Research offers a class and a self-instructional PowerPoint presentation on academic research integrity to satisfy the federal requirements of the COMPETES Act.
4) UF’s faculty senate formed a task force on academic integrity. Faculty and administrators recognize that none of these efforts is sufficient to provide a campus-wide, sustainable approach to dealing with the growing issue of plagiarism.

UF’s official documents define and outline procedures for breaches of responsible conduct in research (University of Florida 2007, 2008, and 2009). Academic dishonesty cases are officially reported to the Dean of Students Office and handled by the Director of Student Conduct and Conflict Resolution. When cases of plagiarism are found valid, students are often required to attend workshops on ethics and/or plagiarism. The UF Writing Center’s workshop on plagiarism includes an overview of the UF Honor Code and has 50 attendees each year. Students may now opt to attend the library’s workshop on plagiarism to satisfy requirements and regain good standing with the university.

Although UF faculty and administrators widely acknowledge the problem of plagiarism, it remains in the shadows – an awkward topic, easily ignored and unintentionally encouraged (assuming its practitioners generally receive credit for “their” work). The hard truth is that few faculty are trained to deal with it and corrective measures are largely reactive rather than proactive. Further, the vast number of graduate students in the STEM disciplines makes it daunting to implement an effective, comprehensive program targeted on an issue as nuanced as plagiarism.
Gaming Against Plagiarism offers a novel and sustainable approach towards raising awareness of plagiarism and lowering its incidence at UF and similar institutions. Because it will result in a certificate of completion, it will provide a level of institutional assurance that STEM students have had appropriate exposure to plagiarism and its potential impacts. GAP is designed to reach a multicultural audience through educational gaming.

1.2.1 EXISTING PLAGIARISM PREVENTION: ONLINE GAMES AND TUTORIALS
In February 2010, using the Center for Academic Integrity website (Center for Academic Integrity, 2007), open web searching, and ERIC database searches, five plagiarism games and 23 plagiarism tutorials were identified. Each was examined to determine relevance to graduate students and to STEM disciplines, including global research perspective, user engagement (i.e., how interactive), and availability of a certificate of completion.

Table 1 below is a comparison of the five games. All but one (U. Washington) are geared towards undergraduate students, none is specific to STEM disciplines, and none provides a multicultural (global) perspective. Although some are highly interactive, and most cover a relatively narrow range of topics.

Table 1. Existing games designed to raise awareness of plagiarism

<table>
<thead>
<tr>
<th>Assessed Plagiarism Games</th>
<th>Audience</th>
<th>STEM</th>
<th>Certificate</th>
<th>Global View</th>
<th>User Engagement</th>
<th>Topics covered</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citation Game (University of Washington, no date)</td>
<td>Undergrad./Grad.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Low</td>
<td>Citation styles</td>
<td>15min</td>
</tr>
<tr>
<td>Goblin Threat (Lycoming College, no date)</td>
<td>Undergrad.</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>High</td>
<td>Plagiarism &amp; Citation styles</td>
<td>15min</td>
</tr>
<tr>
<td>Information Literacy Game (University of North Carolina Greensboro, 2009)</td>
<td>Undergrad.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>High</td>
<td>Plagiarism; Searching, Citation Styles, Privacy, Sources</td>
<td>10min</td>
</tr>
<tr>
<td>Library Squares (Sacramento City College, 2009)</td>
<td>Undergrad.</td>
<td>No</td>
<td>No (but one for related tutorial)</td>
<td>No</td>
<td>Medium</td>
<td>Plagiarism &amp; Copyright</td>
<td>3min</td>
</tr>
<tr>
<td>Secrets of Biblioland (London Metropolitan University, no date)</td>
<td>Undergrad.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Medium</td>
<td>Library history, Citation styles, Plagiarism</td>
<td>40min</td>
</tr>
</tbody>
</table>

The 23 plagiarims tutorials were evaluated on the same seven criteria, with the following results:

- **Audience**: Most tutorials focused on undergraduate students; only 22% included material for graduate students. Two tutorials targeted international students (English Club, 1997-2001; Gardner, 2006).
- **STEM-specific issues**: Most tutorials did not mention STEM disciplines or citation styles (87%). Two tutorials allowed students to select scientist characters, but did not alter content to show science-specific citation styles (Central Piedmont Community College, 2006; Vaughan Memorial Library, 2004-2008). Only one tutorial detailed STEM issues such as falsification of data (University of Maryland University College, 2003).
- **Certification**: Almost half of the tutorials offered a formal certificate of completion and three schools required undergraduate students to complete the plagiarism tutorial prior to
registration (Duke University, 2009; Georgetown University, 2009-2010; University of Baltimore, 2006).

- **Global view on plagiarism**: None of the tutorials presented cultural or global views; however, 26% showed representations of multicultural students or allowed the user to select a character to represent him- or herself.

- **User engagement**: Compared with the games, none of the tutorials had a high level of user engagement in terms of number of actions available. Most of the tutorials (65%) were judged to have a low level of engagement, such as clicking on a link for more information.

- **Time to complete**: Working through tutorials ranged from 3 minutes (Monash University Library, 2010) to 45 minutes (Georgetown University, 2009-2010). Most tutorials took between 5-10 minutes to complete.

- **Topics covered**: In addition to covering plagiarism, tutorials discussed citation styles, academic integrity, cheating, and library resources.

*These results highlight a national need for a more comprehensive, engaging, and multicultural approach of training students in the ethical conduct of research.*

### 1.2.2 GAP: Why a Gaming Solution for Plagiarism Training?

Gaming is universal among college-aged students. A 2003 study of gaming technology on college campuses showed that 100% of participants had played a video or computer game, 70% played digital games “at least once in a while,” and 65% were “regular or occasional game players.” Gaming has become a part of daily life on college campus, “students integrate gaming into their day, taking time between classes to play a game, play a game while visiting with friends or instant messaging, or play games as a brief distraction from writing papers or doing other work” (Jones, 2003). More recent research on teenagers (future college students) shows that not only is game playing universal, but that game playing facilitates social discussions and “can incorporate many aspects of civic and political life” (Lenhart et al., 2008).

According to the final report from the Summit on Educational Games (Federation of American Scientists [FAS], 2006): “Educational games and simulations may be especially effective in developing higher-order skills — such as strategic thinking, interpretative analysis, problem solving, and decision-making. For example, in games, players are making decisions continually, in contrast to low levels of decision-making in traditional learning. Educational games and simulations may also be effective in developing complex aspects of expertise, not simply short-term memory of facts.” (p.43)

The GAP team embraces the report’s findings on the value of educational games to foster experiential learning techniques. We believe an interactive game incorporating role playing in scenarios from real life will be effective in students’ learning how to best recognize and avoid plagiarism. Similar real life scenarios were used by Lloyd and van de Poel (2008) to create a collaborative design game with engineering students “to give students ‘practical’ experience of ethical decision-making in the process of design. (p. 446) …The role-play of the game shows another important aspect of ethical concepts in general and responsibility in particular. This is the idea that ethics must in some way be ‘felt’. Learning about the concept of responsibility in theory is a lot different from feeling responsible for something happening” (p.445). Although Lloyd and van de Poel’s Delta Design game is not online, the game scenario
of having multiple researchers collaborating on a research project provides an example of the type of complexity that will be incorporated in the GAP project.

2. PROJECT PLAN

2.1 GAP EDUCATIONAL GOALS
The goal of this project is to train STEM graduate students to engage in responsible conduct of research as members of multi-national, multi-cultural global research teams. While the GAP project team recognizes the three infractions of responsible conduct in research as “Making up data or results (fabrication), changing or misreporting data or results (falsification), and using the ideas or words of another person without giving appropriate credit (plagiarism)…” (National Academy of Sciences, 1995, p.16), it has chosen to focus on plagiarism as being the most critical and widespread misconduct issue facing beginning researchers (McCabe, 1997, 2005).

GAP project objectives are:
1) Develop a culturally-sensitive tool reflective of the future ethical considerations faced by U.S. global researchers publishing in a multi-cultural research environment;
2) Incorporate game design strengths identified at the NSF co-sponsored National Summit on Educational Games: higher order skills, practical skills, practice for high performance situations, and developing expertise;
3) Create a transferable training environment that aids U.S. institutions in complying with Sec. 7009 of the America COMPETES Act;
4) Assure scalability and robustness of design to permit future content enhancements to cover additional aspects of responsible research conduct, such as the falsification and fabrication of data.

Specific Learning Objectives for GAP
STEM graduate students successfully completing the game will be able to:
1. Identify major types of contemporary plagiarism, including unique aspects of science/technology publishing (e.g., charts, tables, and diagrams).
2. List the basic rules to avoid plagiarism in research activities.
3. Demonstrate ability to apply the rules in increasingly complex scenarios.
4. Explain copyright, fair use and author’s rights (i.e., intellectual property rights).
5. Explain the potential consequences of plagiarism academically and professionally.
6. Recognize and acknowledge differences in cultural approaches to plagiarism.

2.2 GAMING PEDAGOGY METHODS
Teaching methods grounded in constructivist approaches to learning will be emphasized in the instructional design of the game. Gaming employs active learning on behalf of students. Players will have the flexibility to learn at their own pace and make decisions within the context of the virtual scenarios presented within the game.

The Federation of American Scientists ( "Why Games?" website 2007) indicates well designed games offer best practice pedagogical features. The features that will be incorporated in the GAP gameplay design include:
**Experiential Learning** – giving students real-world decision making practice;
**Problem-based learning** – skills sets are developed through hierarchical problem solving scenarios;
**Immediate feedback** – increases persistence in problem solving;
**Learner-centered learning** -- student is the focus of and controls the learning process;
Problem Solving in Complex Systems – successful problem solving is dependent on understanding core concepts of the system, e.g., in GAP, solving complex plagiarism scenarios will depend on understanding basic plagiarism issues; 
Social Relationships – social skills development is intrinsic to success, e.g., in GAP, understanding cultural perceptions of plagiarism will be integrated into the scenario; and, 
Prioritization among Competing Objectives – alternative choices lead to shifting game outcomes and game scenarios.

2.3 GAME DEVELOPMENT STRATEGIES
Gaming experts, pedagogical experts, science researchers, and librarians will collaborate to develop GAP using a rapid prototyping technique. This iterative approach consists of three stages:
1) Game Development Team develops a prototype informed by content/gaming pedagogy consultants.
2) Librarians conduct usability testing with student players.
3) Pedagogy consultants and librarians analyze feedback, which is used in future prototype design.

2.3.1 GAME PROTOTYPING
GAME CONTENT
Students' understanding of plagiarism will be built on progressively more complex levels of understanding and decision making. The first level will involve identification of and techniques to avoid the most common forms of plagiarism: intentional vs. unintentional plagiarism, patchwriting/stealing, misquoting or not quoting, insufficient paraphrasing/summarizing, and duplicating publications. Level two will address the various codes of conduct and consequences of plagiarism, and will incorporate cultural differences on plagiarism. These two levels will allow players to assimilate the basic issues. Level three will move beyond identification and understanding of consequences to focus on complex ethical situations such as discovering a published paper by the player's international research team contains plagiarized text. Successful completion of the game will result in a certification award. Students unable to master the material in the first attempt may continue through the game until they exhibit sufficient achievement in demonstrating their understanding of key plagiarism concepts. Dr. Donald McCabe from Rutgers Business School, an expert on college education, ethical development, and student cheating in college, will act as an outside source of reliability of initial game content, evaluating the game to ensure current standards and practices in the field are met.

GAMEPLAY
The GAP game will be built in the open source Java environment jMonkey (jME). The jMonkey Engine (jME) provides a 3D graphical environment that is both robust and evolving, and allows the game to be played on any contemporary computing platform (i.e. Windows, Mac, Linux, etc.). Computer and Networking Services of the UF Open Systems group supports all of the central University of Florida servers. The game will be developed and reside on these servers.

During the development phase, the GAP team will create scenarios based on at least some real-life plagiarism samples experienced by UF faculty and librarians. One base scenario
might be that the player is a scientist, working in ‘green technology.’ His/her goal is to work with other scientists to craft a proposal to the National Science Foundation. Along the way, the player must learn about plagiarism, collect sections of the proposal written by non-U.S. trained researchers, and then make important decisions about what can and can’t be included. Using a 3D environment; players will use arrow keys to navigate a university setting. They will use multiple choice inputs to answer questions.

The overarching “meta-game” will be a user’s success in submitting a plagiarism free proposal. “Mini-games” will be embedded in the play, allowing players to win badges for completing discrete challenges. For instance, in the 3D environment, there will be wall posters highlighting ethics, science, green technology information, etc. Students who read eight of 10 posters will be given a knowledge badge to add to their profile. Users who complete the game with the greatest number of badges, on top of their achievement certification score, will be the acknowledged leaders in the online GAP universe.

Building “meta-games” with embedded “mini-games” is a proven technique used in successful commercial gaming properties. Adopting this technique into GAP will keep students engaged (returning to the game to boost their personal profile), as they increase their understanding of plagiarism. Students will encounter other important contemporary issues and learn research-associated skills as they play GAP: 1) diversity and cultural research differences – students will choose their own avatar (the representation of themselves in the game) by race and gender. The GAP-embedded characters they encounter will be of diverse race, gender, and career paths, and will have differing codes of ethics related to writing; 2) green technologies – increasingly of interest across STEM disciplines and to NSF – may serve as a content focus; and 3) proposal writing skills – while critical to research endeavors, many students don’t receive mentoring in proposal writing during their graduate study.

Dr. Richard Ferdig, RCET Research Professor and Professor of Instructional Technology at Kent State University, will act as an outside source of reliability and evaluation for initial game design, helping ensure that research-based methods and mechanics of game design are instilled in the design and the game builds.

2.3.2 Usability Testing
The purpose of conducting usability tests is to make the final game as intuitive as possible. We want to ensure that the human-computer interface does not create barriers to participation from a wide variety of users. As Rubin and Chisnell explain, “what makes something usable is the absence of frustration in using it…when a product or service is truly usable, the user can do what he or she wants to do the way he or she expects to be able to do it, without hindrance, hesitation, or questions” (Rubin & Chisnell, 2008). Because “usability testing is most powerful and most effective when implemented as part of an iterative product development process” (Rubin & Chisnell, 2008), we will employ an established rapid prototyping cycle: (1) design a gaming prototype, (2) test prototype with users, (3) redesign the game, based on user-feedback and interactions.

There will be three iterations of game design and development to allow developers to test the product with users and experts prior to beta implementation and testing. In addition, 5-10 students from the I³ project (see section 4.3 and Letters of Support) will be carefully monitored as they first encounter and play different versions of the game. This number is suggested by Rubin’s and Chisnell’s (2008) research which “indicates that testing four to five participants … will expose the vast majority of usability problems.” For instance, during the first iteration, students will be asked to log-in and play a prototype level. Data from the gameplay will be
recorded using Morae software and analyzed to examine difficulties. After the experience, students will be asked qualitative questions about their experience (designed in conjunction with both external consultants and the developers). This feedback will be given to the developers and experts Ferdig and McCabe to inform the next prototype.

2.3.3. FEEDBACK ANALYSIS
Margeaux Johnson will design the user testing protocols for the iterative game development and coordinate user testing of graduate students utilizing the Emerging Technologies User Experience Lab in the UF Libraries. After each iteration, McCabe and Ferdig will be given access to the testing results and to the gameplay data to provide feedback on playability and content validity.

2.4 RECRUITMENT
Because the GAP project is focused on development of software, our recruitment of graduate student participants serves a different purpose than in, for example, IGERT and GK-12 training grants. In particular, graduate students in GAP will be involved in testing the game. Three distinct groups of graduate students at UF will participate in beta testing: (1) members of the I³ Graduate Student Advisory Council (GSAC) will help during game development, (2) graduate students in an Engineering course and (3) NSF-funded graduate students.

(1) Innovative through Institutional Integration (I³) Program, Graduate Students Advisory Council (GSAC)
NSF recently funded an Innovative through Institutional Integration (I³) Program at UF. Its overall goal is to bring together and institutionalize all graduate training programs across campus. Ethics training is a particular focus of the I³ Program team. Unique among graduate training programs, I³ activities are generally conceived and implemented by graduate students, not faculty or administrators. Spearheading I³ activities is the Graduate Student Advisory Council (GSAC), a highly diverse group of students: approximately half (7 of 15) are Black, Hispanic, or have a disability; two are Black females; and two are females in a traditionally male-dominated discipline (engineering).

Key to this proposal, GSAC members are keenly interested in assisting with the development and usability testing of GAP and have agreed to work with librarians in testing and providing feedback on the iterative prototypes of the game (see Letter of Commitment). In light of the Council’s diversity and because it is housed in UF’s International Center, I³ can provide expertise in cultural differences associated with plagiarism and ensure broad validity and usability of GAP at its early stages of development.

A final and significant advantage of partnering with I³ is its institutional support -- both the President of UF (Bernie Machen) and the Dean of the Graduate School (Hank Frierson) are PIs on I³ and are deeply committed to improving graduate education on campus. With GSAC buy-in and strong university administrative support (see Supporting Letters), we are confident that GAP will become institutionalized, i.e., used as a component of required training in ethical conduct of research.

(2) UF College of Engineering graduate students
Engineering students at UF are especially diverse in terms of nationality. In 2009, over half of UF’s 2,728 graduate engineering students were non-US citizens, representing 69 countries. They, too, will be valuable for providing feedback on global research and cultural issues addressed in GAP. The beta version will be tested and critiqued by a group of graduate students selected by the College.
(3) NSF funded graduate students
Finally, we will use I3’s database of graduate students currently supported by NSF to recruit an additional 25-30 STEM students to take and provide comments on the beta version of GAP. Because these students are supported by NSF, we are confident they will be more diverse than the average population of STEM students at UF.

2.5 MULTI-INSTITUTIONAL TESTING
Both UF’s I3 Program (see above) and the UF College of Engineering have diverse student populations that represent a variety of ethnicities, nationalities, and backgrounds. Testing with these diverse student populations will help ensure that the final GAP product will be accessible to a wide audience.

In month 16 of the project (Winter 2012), UF and GAP’s partnering institutions (see section 7. Partnering Organizations) will receive the beta version of the game for review by their STEM graduate students. Twenty-five to 30 graduate students at each institution external to UF will play the game and provide feedback using pre and post-tests (see section 3. Evaluation Plan). These institutions range greatly in size, geographic location, and type (private vs. public). Furthermore, our collaborators at the institutions vary greatly in their subdisciplines (see Section 7 and Letters of Commitment). Results of the online evaluation will be synthesized and will inform future revisions of the final product.

2.6 EVALUATION AND ASSESSMENT
Evaluation and assessment occur in the development of the game as described in 2.3 above. Evaluation of the game’s effectiveness in meeting its specific learning objectives is found in section 3. Evaluation Plan.

3. EVALUATION PLAN
There are two complementary phases required to assess and evaluate the production of the GAP game: (1) initial design, game testing and redesign (Section 2.3 above), and (2) completed game implementation and evaluation, which will be discussed here. These phases ensure participatory input into the design and implementation of the game from both experts in the field and future users of the game. Each evaluative process is discussed at the appropriate section within this document.

Once the beta version of the game is ready for effectiveness testing, 200 students will be recruited from UF and seven other institutions: Purdue University, Virginia Commonwealth University, University of Houston, Loyola Marymount (Los Angeles), Oakland University (Rochester, MI), Rowan University (Glasboro, NJ), and the University of Central Florida (see section 2.5 Recruitment and Supporting Letters). Students will be given access to the game and will sign an informed consent document prior to play. They will also be given a pretest. The pre-test will measure both their perceptions and knowledge of ethics in research. A similar post-test will be given at the conclusion of the game or when the course is over (whichever comes first).

In close collaboration with Dr. Ferdig, the GAP team will analyze pre- and post-test data, in combination with gameplay data (e.g., how long it took to complete the game, how many attempts it took) to determine effectiveness of the game in producing changes in knowledge and attitudes towards plagiarism.
4. LIST OF KEY PERSONNEL

4.1 UF SCIENCE & ENGINEERING LIBRARIANS
GAP team librarians will identify legal and ethical content for the game based on data derived from the literature review summarized above and in combination with data provided by faculty and administrators who have managed recent cases of plagiarism at UF. Librarians have expertise in usability testing and access to a lab that supports this activity. GAP will be tested with various groups of graduate students, representing a broad cross-section of STEM disciplines, genders, ages, and ethnicities. Making the tool useful for students with varying disabilities will be part of the project design and testing, as will sensitivity to cultural differences. The GAP librarian team members are:

Michelle Foss received her Master of Library Science (MLS) degree from Kent State University in 1995 and has worked in both corporate and academic environments. She joined the UF library faculty in 2004 and is currently responsible for copyright and intellectual property rights compliance. Foss is a recognized expert in intellectual property rights as they relate to academic library services and has spoken on these issues at international and national conferences. She regularly teaches workshops for science graduate students and faculty on authors’ rights, copyright, and right infringements including plagiarism. Her current research interests include the cultural bases of ethical decisions made by students and the broader issues of rights embodied in the Open Access movement. She will serve as GAP Project PI.

Amy Buhler received her MLS from the University of North Carolina at Chapel Hill. She was part of the original team that designed the Guide to Plagiarism tutorial for science and technology students, which has been adopted campus-wide by various programs and departments. Buhler has also been an instructor of the honors course Research for Science Students, which covers STEM research ethics in depth. Likewise, she brings extensive experience in teaching Writing for Engineers classes, which include units on plagiarism. She will serve as GAP Project Co-PI.

Margeaux Johnson is a recent MLS graduate from the University of Maryland, College Park, and is pursuing a second graduate degree in Educational Technology at UF. Currently, she coordinates instruction for science and engineering students at the Marston Science Library. She is a primary instructor of the for-credit honors course Research for Science Students which covers STEM research ethics in depth. Johnson also serves on the Libraries’ Emerging Technologies group where she is involved with user testing of digital collections, library websites, and library mobile apps. She will serve as GAP Project Co-PI.

4.2 UF DIGITAL WORLDS INSTITUTE (DWI)
DWI will provide an experienced team of programmers, artists, interface designers, interactive digital media producers, and graduate research assistants who will create the GAP software and graphics. By working collaboratively with the GAP development team, the DW team will translate the most relevant concepts and scenarios into a scalable interactive media environment.

James Oliverio is Professor of Digital Arts and Sciences and has served as the Director of the UF Digital Worlds Institute since 2001. His previous post included service as Georgia Tech’s Artist in Residence and Director of the Audio Lab in the College of Computing’s Graphics, Visualization and Usability (GVU) Center. In addition to numerous creative and research awards, he holds five Emmy Awards from the Atlanta Chapter of the National Academy of Television Arts and Sciences (NATAS) and twenty consecutive annual awards from the
American Society of Composers, Authors and Publishers (ASCAP). He has produced numerous arts and entertainment projects, ranging from work for Live from Lincoln Center to his digital media opera “StarChild”, produced from the Georgia Tech Olympic Village preceding the 1996 Olympic Games in Atlanta. His current research and development activities include the NSF-funded “Use of Haptics in a Virtual Reality Environment for Learning of Nanotechnology.” He is a vocal exponent of integrating the digital Arts into early and secondary learning in the STEM areas through the STEAM Learning Network. Oliverio will serve as GAP Project Co-PI.

4.3 INNOVATION THROUGH INSTITUTIONAL INTEGRATION (I^3) PROGRAM

As described above (Section 2.4) the goal of I^3 is to bring together and institutionalize all graduate training programs across campus. The graduate students who spearhead I^3 activities are especially eager to participate in GAP development – in 2009, an independently administered survey of NSF-supported graduate students at UF revealed that only 36% had ever received training in ethics and that 88% requested such training. Thus, the Graduate Student Advisory Council (GSAC) of I^3 embraces the GAP project (see Letter of Commitment).

Douglas Levey, Ph.D. is Professor of Biology at UF. He is a Co-PI of I^3 and PI of an ongoing NSF GK-12 Program (SPICE). In addition to being a liaison between GAP and I^3, he will bring to GAP the perspective of a seasoned educator, researcher and mentor of graduate students. His awards for teaching, mentoring, and research include UF’s highest faculty honor, Teacher-Scholar of the Year. Most of his research and students are based abroad, where they frequently encounter disparate cultural norms of ethical conduct of research. Levey has published on broader impacts in peer-reviewed journals and has been active in creating online media that describe recent scientific discoveries in easily accessible and understood formats (for an example, click here). He will serve as a GAP Co-PI.

4.4 EXTERNAL EVALUATION CONSULTANTS

Richard Ferdig, Ph.D. is a Professor of Instructional Technology at Kent State University’s Research Center for Educational Technology. He holds a Ph.D. in Educational Psychology from Michigan State University, with an emphasis on technology and cognition. Prior to joining the Kent State Faculty, he was on faculty at both Michigan State University and UF. Ferdig recently published a three volume Handbook of Research on Effective Electronic Gaming in Education. He currently serves as the Editor of the International Journal of Gaming and Computer-Mediated Simulations and the Associate Editor of Journal of Technology and Teacher Education. He brings expertise in the design, development, implementation and evaluation of games and simulations. His role on the project will be to support the design and development of the game, the iterative testing during game development, and the evaluation of the game in use.

Donald McCabe, Ph.D. received his undergraduate degree in Chemistry from Princeton and his Ph.D. in Management from New York University. A faculty member at Rutgers University, McCabe’s teaching specialties include Business Ethics & White Color Crime. He is an internationally recognized expert in the field of ethical decision making with an emphasis on the relationship between college education and ethical development and student cheating in college. He has published extensively in this area and has received best paper awards from The Canadian Journal of Higher Education for his September 2006 article “Academic Misconduct within Higher Education in Canada,” coauthored with Julia Christensen-Hughes, University of Guelph, Canada, and from The Academy of Management Learning and Education in 2007 for “Academic dishonesty in graduate business programs: Prevalence, causes and proposed action,” coauthored with Linda Trevino, Penn State and Kenneth Butterfield, Washington State.
He will review content as developed and assure that multicultural ethical differences are integrated into the game design.

5. PROJECT MANAGEMENT PLAN

The GAP project team’s planned phases and key sequenced activities are mapped out below, with accompanying descriptions of activities and responsible team members in each phase.

Chart 1. The overall project management plan

Table 2: Gap Project Plan by Month

| MONTH (starting September, 2010) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
|--------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Phase 1                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Phase 2                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Phase 3                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Phase 4                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Phase 5                       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Phase 1. Content Development (Pre-production visualization)
- **Time Frame**: 6 months (September 2010-February 2011)
- **Key personnel**: Team Leads = Amy Buhler & Michelle Foss; Partners = Rick Ferdig (pedagogy), Donald McCabe (academic integrity), Doug Levey (sample validation), James Oliverio (game pre-production), Librarians (game scenarios)
• **Key Activities:** Collect samples from STEM disciplines, Sample validation against NSF Codes of Conduct, Research global scientific ethics approaches and issues, Develop narratives appropriate for game play

**Phase 2. Game Development**

• **Time Frame:** 12 months, December 2010 - December 2011
• **Key personnel:** Team Lead = James Oliverio (Overall game interaction design and production); Partners = Rick Ferdig, graduate students in the Digital Worlds Institute
• **Key Activities:** Develop prototypes of animated and progressively more complex game modules, through iterative design processes; Include pedagogical aspects of the game design (Rick Ferdig)

**Phase 3. User Testing & feedback for development**

• **Time Frame:** 8 months, April 2011 - December 2011 (Summer & Fall 2011)
• **Key personnel:** Team Lead = Margeaux Johnson; Partners= Librarians, Rick Ferdig & James Oliverio, Doug Levey
• **Key Activities:** Develop testing protocols, Recruit STEM graduate students for tests, Analyze testing data, Use feedback to inform further prototypes for beta version

**Phase 4. Dissemination & Beta testing**

• **Time frame:** 5 months, December 2011 - April 2012 (Spring 2012)
• **Key personnel:** Team Lead = Doug Levey; Partner organizations; Library coordinator = Michelle Foss; Librarians
• **Key Activities:** Distribute beta version with pre- and post-tests to I^3 students, UF College of Engineering students, and other UF graduate programs; Distribute beta version with pre- and post-tests to partnering universities; Conduct beta test with 200 UF students and various partner organizations; Collect feedback from the pre- and post tests for evaluation

**Phase 5. Evaluation and final game**

• **Time frame:** 5 months, April 2012 - August 2010 (Summer 2012)
• **Key personnel:** Team Lead = Rick Ferdig; Partners = Donald McCabe, James Oliverio, Doug Levey, Amy Buhler, Michelle Foss, Margeaux Johnson
• **Goal:** Evaluate and develop final game
• **Key Activities:** Evaluate the game’s success as a learning tool, Evaluate overall project, Compile best practices to inform development of future modules, Develop final game

**6. DISSEMINATION PLAN**

GAP and its outcomes will be widely disseminated through conference presentations and publications. A national network of NSF-funded researchers, most of whom hold awards in Engineering Education (listed in section 7. Partnering Organizations) have been recruited to assist in the testing and iterative refinement of the GAP intervention. Many have indicated their interest in sharing GAP with other faculty on their campuses. Given the planned ease of adoptability and use of GAP, the team will also use several web resources to disseminate information about the game. Each of the team members will present this project at professional organizations relevant to their own expertise. Representative venues for distribution of information on the project include: 1) Conference presentations: American Society for Engineering education, American Libraries Association Conference (Science & Technology Section), Academic & College Research Libraries Conference, Computers in Libraries, Special Libraries Association; 2) Publications: Academic & College Research Libraries, Chronicle of Higher Education, Ethics and Behavior, International Journal of Gaming and Computer Mediated Simulations, Journal of Engineering Education; 3) Web resources: National Science Digital Library - [http://nsdl.org/](http://nsdl.org/), Engineering Pathway - [http://www.engineeringpathway.com/ep/](http://www.engineeringpathway.com/ep/).
Locally, the Libraries’ Public Information Officer will publicize GAP to the UF community, and disseminate information regarding its availability, using these strategies:

- Advertise on the libraries’ home page and training and instruction pages for faculty
- Send news release to media outlets: Gainesville Sun, The Independent Florida Alligator, WUFT-TV, WUFT-FM, Inside UF, Gator Times
- Write an article for the libraries’ newsletter distributed to UF faculty
- Send news release to the UF News Bureau for wider distribution and to publicize outside the UF community

### 7. PARTNERING ORGANIZATIONS

#### GAP Partners

<table>
<thead>
<tr>
<th>Lead Collaborator</th>
<th>Institution</th>
<th>Subject Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hong Z. Tan</td>
<td>Purdue University</td>
<td>Elect/Computing (ECE)</td>
</tr>
<tr>
<td>Dianne Pawluk</td>
<td>Virginia Commonwealth University</td>
<td>BioMedical (BME)</td>
</tr>
<tr>
<td>Xiaojing Yuan</td>
<td>University of Houston</td>
<td>Eng. Technology (ET)</td>
</tr>
<tr>
<td>Stephanie August</td>
<td>Loyola Marymount (Los Angeles)</td>
<td>Elect/Computing Sci (ECS)</td>
</tr>
<tr>
<td>Fatmi Mili</td>
<td>Oakland University (Rochester, MI)</td>
<td>CompSci&amp;Eng (CSE)</td>
</tr>
<tr>
<td>Ying Tang</td>
<td>Rowan University (Glasboro, NJ)</td>
<td>Elect/Computing (ECE)</td>
</tr>
<tr>
<td>Michael D. Johnson</td>
<td>University of Central Florida</td>
<td>College of Sciences</td>
</tr>
</tbody>
</table>

### 8. SUSTAINABILITY

Once GAP has been thoroughly tested, we anticipate its adoption into training programs in the responsible conduct of research that are already available at UF and required of NSF-supported students and postdoctoral researchers. The one most central to the university community is provided by the Division of Sponsored Research and consists of ten PowerPoint slides. We will work with the Division of Sponsored Research, the Dean of the Graduate School, the Provost, and the I3 Program to facilitate use of GAP as broadly as possible across campus (see Letters of Support). Chris Loschiavo, UF’s Assistant Dean of Students and Director of Student Conduct and Conflict Resolution, has indicated that a successful game will have multiple applications on the UF campus: "We will require most students found responsible of violating our plagiarism policy to complete the game unless there are mitigating circumstances. Additionally, we will use the game as a training tool for our student members that hear cases involving allegations of plagiarism. We may also make this game a requirement for all new students that will need to be completed before they are able to register for classes their second semester." (see Letters of Support)

Upon successful completion of the GAP intervention, funding will be pursued to create additional components for ethics modules on data fabrication and falsification. The GAP development team expects GAP’s effectiveness will lead to wide-spread adoption outside of UF and to suggestions for additional training modules, all driven by the common goal of training ethically responsible global researchers and engineers.