

## **Concept Paper**

### **I. Proposal for a B.S. in Human-Centered Computing (HCC)**

Submitted by a cross-college team from the Golisano College of Computing and Information Sciences (GCCIS / IST), the College of Imaging Arts and Sciences (CIAS / Design) and the College of Liberal Arts (COLA / Psychology).

### **II. Abstract**

This document puts forward the goals of a proposed new B.S. program in Human-Centered Computing (HCC). With roots in multiple areas of computing, arts, and social sciences, HCC blends strength from these varied disciplines to understand the way in which people use technology. While the GCCIS Information Sciences and Technologies (IST) Department is taking the lead in the coordination of this new degree, the program presents a truly interdisciplinary degree, with the curriculum comprising offerings from GCCIS, CIAS, and COLA. The program fits within the strategic direction of RIT and addresses the market demand for trained HCC professionals.

### **III. Description of the New Program**

#### *a. Overview and Justification*

Fundamental to Human-Centered Computing (HCC) is a focus on humans, individually or in social contexts, and their interactions with technology. As emphasized in the NSF HCC Program<sup>1</sup>, this area blends computer advancements with understanding the ways in which people can interact with these advanced systems. Topics of consideration include the design, evaluation and implementation of interactive computing systems and the understanding of ways in which such systems transform our lives. With roots in Computer Science, Design, Cognitive Psychology, Engineering Sociology, Anthropology, Linguistics, and Human Factors, HCC blends core theoretical and applied human-technology concepts in a contemporary interdisciplinary curricular model.

This HCC B.S. degree will add to the RIT portfolio of professional degrees. It will be distinguished from existing degree programs at the colleges by providing students methods, computing, and / or psychology expertise that is not currently available, in combination. The HCC degree would supplement learning for students with those interests, allowing them to gain valuable skills in research methods, psychology, and to enter jobs that require this additional skill set. Given the growing reliance on computing in our daily lives, technology no longer is the exclusive realm of tech-savvy users, industry has recognized the need to make software and devices that are usable and desirable. This degree will prepare students for careers in industry or graduate study, offering options to specialize in different areas of HCC depending on individual student interests in computing, design, or psychology.

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<sup>1</sup> [http://www.nsf.gov/cise/iis/hcc\\_pgm12.jsp](http://www.nsf.gov/cise/iis/hcc_pgm12.jsp)

## *b. Summary of New Program Curriculum*

Our goal is to instill in undergraduates the ability to effectively respond to organizational and societal needs with respect to the changing values in technology design and development. Critical to career success in this area is the ability to communicate with technical and creative experts in multiple disciplines, and to be effective team members in multidisciplinary industry development efforts. To this end, skills in computing (development and/or ability to communicate effectively with developers), design (interactive design for new media media), and psychology (research methods, cognition, perception) will be important for all students. As the cornerstone of this HCC degree, students will develop core competencies in all three disciplines while choosing to personalize their experience through an emphasis in one. The program will not be a one-size-fits all model. Thus, it is not expected that all students taking this degree will be skilled programmers, designers, or social scientists. Rather, it is expected that they will have deep and broad skills in one of these areas, with sufficient knowledge of the others that they can effectively collaborate with other professionals in multidisciplinary teams.

At its heart, HCC is an evolving discipline, addressing the implementation, design, and user understanding of rapidly emerging technologies. A recent survey of HCC educators revealed that the greatest needs within the profession are for an understanding of methods, encompassing both design and empirical methods for product testing<sup>2</sup>. This emphasis underscores the need to develop critical analytical skills, the ability to frame problems, and knowledge of appropriate methodologies. Professionals must be able to critically analyze and evaluate a variety of user designs, requiring expertise in both methods that quantify effectiveness as well as methods that evaluate user abilities and experiences. The program, therefore, will promote the development of skills appropriate for evaluating the usability, effectiveness, and desirability of interaction experiences. To address these, course competencies can come, for example, from instruction in:

- Computing (GCCIS): Foundations of HCI, prototyping/rapid development, usability testing, user-centered design methods, web tools and development, interface programming, user interface design, accessibility, social and ethical dimensions of computing, information visualization, software design principles, social computing, immersion and the media interface and innovation.
- Design (CIAS): Digital media, design, layout, typography and web interactions, enabling students to apply design processes into simulations and prototypes for interactive projects.
- Psychology (COLA): Cognitive psychology (memory and attention; decision making and problem solving), research methods / statistics, social psychology, and perception (color, form and object perception).

Overall, the HCC B.S. will emphasize hands-on experience. Projects will be required of all students seeking the HCC B.S. degree. These projects might take the form of design, development, or evaluation related to digital interactions depending upon a student's particular emphasis within the degree.

As a unique feature, the HCC B.S. program will take advantage of RIT's long-standing leadership in accessibility, providing students with unequalled expertise in this aspect of HCC. This expertise in accessibility will be designed to permeate design, development, and evaluation

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<sup>2</sup> ACM SIGCHI 2012 Report of Education Activities, <http://www.sigchi.org/resources/education/2011-education-project-1/report-of-2012-activities>

methods generally, such that students are trained in awareness of the needs of individuals with diverse abilities and backgrounds.

#### **IV. Fit with RIT Mission and Strategy**

The HCC B.S. addresses several of RIT's goals:

##### Student Success

Goal 1: Student retention. This degree will give students the opportunity to individualize their undergraduate experience based on their interests. While providing a core curriculum central to HCC, the program electives will allow students to focus on computing, design, or psychology.

Goal 2: Diversity. The HCC MS degree this year has shown the enrollment of 44% women. This number is far above the recruitment numbers of women in computing throughout GCCIS. The interdisciplinary foundation of this degree, drawing from Design and Psychology, both of which attract significant numbers of female undergraduates, will serve to ensure diversity of enrollment in terms of gender.

##### Opportunities for Innovation, Creativity, Research, Scholarship

Goal 5: Student participation in innovation, creativity, and research scholarship. A hallmark of this B.S. degree will be the participation of students in the development and evaluation of new interaction experiences through co-ops, student and /or faculty initiated research, and final year projects.

#### **V. Synergies with Other Programs**

In the past few years GCCIS has taken steps to increase RIT's visibility in the aligned area of Human-Computer Interaction (HCI). Within IST, a new M.S. degree in HCI has been created. The HCC B.S. program would expand on this effort, providing a strong background in the area for students who would seek a postgraduate degree in this field. Critically, the B.S. degree would provide an integrated curriculum across multiple disciplines.

Students who would like a greater knowledge within visual design would complete a custom 2-course design survey sequence offered by the New Media Design program within CIAS. These courses would establish a broad foundation in design principles. A deeper understanding would be available through a limited selection of New Media Design core sophomore and junior level courses that would be available to the HCC student.

Many students who minor in Psychology would like greater depth of knowledge than can be provided in 5 sophomore/junior level courses. The HCC B.S. degree would provide students with sufficient background in Psychology and other disciplines to take upper level track courses in Psychology. Their perspectives and training would complement those of students already taking these upper-level courses.

The hallmark of the program is that students will be able to get in-depth understand of computers as used by humans, with a breadth of knowledge about human abilities (Psychology) and what makes computing systems appealing (Design)

## **VI. Administrative Structure for the New Program**

Administratively, the program will be based in the GCCIS IST department. The program, however, will be structured such that there is a cross-college (GCCIS, CIAS, COLA) curricular group responsible for the curriculum design and delivery. The degree will require in-depth conversations among department leaders in the three colleges. Procedures for course identification, scheduling and advising will need to be considered in depth.

## **VII. Enrollment Management Expectations and Sustainment**

An undergraduate degree in HCC would be a unique offering among US universities<sup>3</sup>. HCC courses often are offered as a concentration within an undergraduate Computer Science degree, but are not complete degrees and typically lack the interdisciplinarity that the RIT degree would offer. Thus, this B. S. degree at RIT will serve to fill a void in undergraduate training of professionals with interdisciplinary HCC expertise.

From the RIT Enrollment Services<sup>4</sup>, the following projections were obtained:

1. Based on our initial discussion with Dr. Vicki Hanson and Dr. Andrew Sears, we encourage the program's developers to consider changing the title of the program to Human-centered Computing. Given the specific nature of the field, we believe that this title will be more understandable to a prospective student market, and will be more engaging to women, thereby supporting RIT's goal of enrolling more women, especially in STEM disciplines.
2. The program will attract new students from both freshman and transfer markets with the majority of new students entering in the fall. In addition, given RIT's recent conversion to a semester calendar, spring semester is an even more opportune time for new students to enroll, especially transfer students.
3. Most of the students will come from the Middle Atlantic States and New England. However, given the relatively small number of undergraduate degree programs in Human-Centered Computing, the program has the potential to draw students beyond those regions as well as internationally.
4. The Office of Undergraduate Admissions will work with the college to determine appropriate academic profile parameters for entering students with final authority for admission decisions resting in the Office of Undergraduate Admissions.
5. The Golisano College of Computing and Information Sciences will work with the Office of Undergraduate Admissions to maintain and enhance RIT's relationships with two-year schools to promote the new program and develop articulation agreements to facilitate the recruitment and enrollment of transfer students into the program. Flexibility in the application of transfer credits will be critical to enrolling those students.
6. The interdisciplinary nature of the program is a strength, however, it has the potential to draw some enrolling students away from some of the current programs in Golisano, Liberal Arts and CIAS. This should not be construed as a limitation of the proposal, but requires a conservative projection of the number of new enrolling students.
7. The program will attract internal transfers from other RIT colleges, the University Studies program, as well as other programs in the Golisano College. For purposes of these projections, however, only students who are new to RIT are included in the projections.

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<sup>3</sup> NJIT offers an undergraduate degree in HCI.

<sup>4</sup> Edward A. Lincoln, Assistant to the Senior Vice President, Enrollment Management & Career Services, in an email dated Feb 7, 2014.

8. The projections are based upon an assessment of the College Board's Student Search Service data using the following parameters to determine the level of interest in the student market: Combined PSAT scores at 110 or higher, high school grades of B+ or higher, and high school class rank in the top quartile of the graduating class. Entering transfer students would generally present a GPA of 3.0 or higher for admission.
9. As the program proposal is further developed, we recommend that there be close alignment between the first year of the program and the college's Computing Exploration program. Given the specific focus of the program, we believe that entering freshmen may need time to understand the nature and focus of the program and how it aligns with their strengths and interests.

### **VIII. Impact on Resources<sup>5</sup>**

Once the program has been approved and incorporated into a full marketing cycle, we project that 10 new freshmen and 8 new transfer students would enroll each September. Inputting those projection numbers along with the average (most recent four years) six-year graduation rate for Golisano College into the enrollment/cost model provided by Finance and Administration projects that accumulated headcount enrollment in the proposed program would be between 60 and 65 after four years. Please note, however, that the model, as it is currently configured, only provides input for freshmen and does not account for new external transfer students.

### **IX. Conclusion**

This proposed degree in Human-Centered Computing will provide students with a breadth of skills not currently available through a single discipline degree. The goal is to train students for careers in multidisciplinary teams for professionals that value computing, design, and psychology, all as critical components on interactive systems.

This degree will enhance RIT's strategic goals and provide a unique offering in undergraduate education.

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<sup>5</sup> From Edward A. Lincoln, Assistant to the Senior Vice President, Enrollment Management & Career Services, in an email dated Feb 7, 2014.

## Feedback Summary

We received two comments in response to the circulation of this Concept paper. One questioned whether the name of degree would be likely to attract women to the program, a key point in the development of the degree. The second raised the issue that there are potentially many different disciplines that could have a role in an HCC degree. The person who raised this comment suggested expanding the core degree to include Linguistics.

In terms of the program attracting women, the focus on “Human-Centered” is on people issues, which is known to be attractive to women. For example, computing at CMU enrolls more than 40% female students<sup>6</sup>. In large part, this is due to the emphasis on their HCI program, established after research showing differences in why men and women are attracted to computing<sup>7</sup>. The study found that women who are interested in computing are largely drawn to the discipline due to an interest in a larger social framework, being “concerned that their study of computer science not require a myopic focus on the machine, or detach them from people and other concerns” (page 13). If we look just at the *Women of HCI* page at CMU, there is a strong emphasis on doing work relevant to ‘people’ (see <http://www.women.cs.cmu.edu/WomenSCS/HCI/#> ).

We were unable to find statistics that break out the numbers of women in HCC. We, therefore, provide anecdotal evidence. As mentioned in the main Concept Paper, the GCCIS program in HCI has a much higher representation of women than do other programs within the college. In addition, Dean Sears reports that about 70% of the students that he has worked with in HCC over the years have been women or from underrepresented groups. At UMBC, their MS in HCC started graduating students in 2010. In the four years it has graduated students, 57% of the degrees have been awarded to women and 16% have been awarded to individuals from underrepresented groups. Although it is a graduate program, it is arguably one of the better predictors of enrollment in a BS degree at RIT.

In terms of the second response we received about HCC potentially encompassing a number of disciplines, this is indeed the case. However, the core of the discipline is from Computing, Design, and Psychology. Across a number of related offerings at other universities (such as CMU, Georgia Tech, UMBC, University of Washington, and the University of Colorado), competencies in these three disciplines form the foundation for HCC. The *ACM SIGCHI 2012 Report of Education Activities* (referenced in the main Concept paper) mentions these three disciplines as key. Other areas, including Linguistics, certainly contribute to the broader field of HCC but they are not part of the core focus of such programs. Therefore, we propose that the degree move forward as proposed with the existing team while recognizing that additional disciplines and faculty will be invited to contribute to the program via electives.

The second comment also mentioned that there is an existing group of faculty at RIT that refer to themselves as the human-centered computing group. This is an ad hoc group of faculty that formed outside of the context of the proposed degree. The interests of this group appear to overlap with the proposed focus for the HCC degree, but they also go beyond what should be integrated into the core of the program. The proposed HCC degree follows in the tradition of similar, albeit graduate, programs offered elsewhere.

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<sup>6</sup> “Attracting Women to STEM” 2010. *Inside Higher Ed*, <http://www.insidehighered.com/news/2010/03/22/stem>

<sup>7</sup> Margolis, Fisher, and Miller, 1999. “Caring about connections: Gender and Computing” *IEEE Technology and Society*

The two responses to the Concept Paper are included here:

1. Name: Pat Scanlon  
Email: [pmsgsl@rit.edu](mailto:pmsgsl@rit.edu)

*Concerning the BS in Human-Center Computing, VII. 1.: "Based on our initial discussion with Dr. Vicki Hanson and Dr. Andrew Sears, we encourage the program's developers to consider changing the title of the program to Human-centered Computing. Given the specific nature of the field, we believe that this title will be more understandable to a prospective student market, and will be more engaging to women."*

*Is this a belief or a conclusion based on evidence? Specifically, how is the title engaging to women?*

*2. It was tremendously exciting to read the interdisciplinary proposal for a B.S. program in Human-Centered Computing (HCC). This is a well-envisioned and timely proposal that responds exceptionally well to trends in both industry and academia. I wish to express my strong enthusiasm and support for the proposed program. As the program's curriculum is further articulated, I hope it will take advantage of RIT expertise in related areas, and that the final program will integrate COLA faculty associates beyond Psychology, whose area of expertise clearly links to the program vision.*

*The concept paper recognizes "Linguistics" (p. 1, in "Overview and Justification") as one of the areas contributing to the emergence of HCC. I am a computational linguist in the College of Liberal Arts, also on the Extended Faculty of the GCCIS PhD Program, and a member of the Human-Centered Computing Group ([hccl.gccis.rit.edu](http://hccl.gccis.rit.edu)). In my department (English) we offer minor/immersion options in Language Science as well as an immersion in Human Language Technology & Computational Linguistics. With recent hires in our department and in IST for August 2014, RIT's expertise in computational linguistics is growing in incredibly exciting ways. This opens up new opportunities for further GCCIS-COLA collaboration, including potentially within the scope of the envisioned program.*

*In particular, there is great potential for integrating computational linguistics coursework into the program. My department offers a three-course sequence, already on the books, of which at least the last two seem especially relevant for the current proposal:*

*ENGL 351 Language Technology*

*ENGL 481 Introduction to Natural Language Processing*

*ENGL 582 Advanced Topics in Computations Linguistics [alternating themes]*

*I hope these offerings, which are also project-centered, can be considered for inclusion in the projected BS program (for instance as a "computational linguistics track" or within a "track" organized around computing and human sensors). Our course offerings in this area are likely to be expanded soon, as a tenure-track faculty member with strong expertise in areas such as speech technologies (speech recognition, etc.) and natural language processing applied to the health sciences is joining our department.*

*Finally, if there is an opportunity to serve on an interdisciplinary planning committee for this program, I would enjoy being part of the continued conversation. With my experience in collaborating with faculty in IST (and other GCCIS programs such as CS and the PhD unit) on research projects as well as based on my teaching and interdisciplinary mentoring experiences*

*with GCCIS and COLA students, I expect that I can make useful contributions.*

*Sincerely,  
Cecilia Ovesdotter Alm, Ph.D.*