

RADGRAD: IMPROVING ACADEMIC, PROFESSIONAL, AND SOCIAL
ENGAGEMENT DURING THE UNDERGRADUATE COMPUTER SCIENCE DEGREE
EXPERIENCE

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ABSTRACT

A casual analysis of the Hawaii technology community site, TechHui, suggests that over the past decade, recent alumni and current undergraduates have experienced several problems with various academic, professional, and social aspects of their ICS experience. A baseline student survey conducted in Spring 2017 reveals current and more detailed student perceptions on the ICS degree experience. Existing degree planning systems such as STAR, Starfish by Hobsons and Blackboard Planner fail to provide the specific support that an ICS student needs to create a complete and comprehensive degree plan. Existing academic social networks such as LinkedIn and TechHui fail to connect students closely with professors and alumni. Current popular video games suggest several gamification features that could encourage ICS students to achieve higher goals. A new system called RadGrad combines degree planning, social networking, and gamification in a way that aims to give ICS undergraduates the support they need to succeed and redefines what it means to have a successful degree experience.

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CHAPTER 1

INTRODUCTION

There are a lot of things that can make a department like no other—exceptional people, exceptional facilities, exceptional events, or exceptional work. I may be biased, but I believe the ICS department at UHM is a department like no other—and is exceptional in all these ways. The people are exceptional—I came into this major not knowing what to expect, but the people I have met along the way have exceeded all of my expectations. I have met some of the most brilliant, the most passionate, the most interesting and the most genuine people in this department. The facilities are exceptional—the computer labs are well maintained, and the new ICSpace is a great place for members of the department to socialize and create a sense of community. The events are exceptional—within this major, there are so many opportunities to participate in events. There are workshops, hackathons, competitions, and open source projects just waiting for participants. Finally, the work itself is exceptional—again, I may be biased, but I have grown to become very passionate about computer science, and I have met many others in the department who feel the same way. Computer science is constantly changing and it is a challenge to keep up with it, but it definitely keeps things interesting.

But nothing is perfect. Data gathered from 199 ICS students from 2008 to 2016 on the Hawaii technology community site, TechHui [19], suggests that the following ten categories have constantly displeased students over the past 8 years:

1. The ICS department needs to offer classes more frequently.
2. The ICS department needs to offer a wider variety of classes.
3. The ICS department needs a better sense of community.
4. Some of the professors in the ICS department need to improve their teaching.
5. The ICS department should offer more focused areas of study.
6. ICS classes are too time consuming and take up more time than anticipated.
7. The ICS department should offer more classes that meet focus requirements.
8. ICS books are too expensive.
9. ICS courses should involve more group work
10. ICS should encourage more interaction among students.

Categories 1, 2, 5, 6, 7, and 8 suggest problems with the coursework itself and categories 3, 4, 9, and 10 suggest social and communication related problems within the department. There were also some other complaints among students on TechHui that were not as common but stuck out to me nonetheless. There were at least eight students who mentioned that they felt intimidated when they started out in ICS, due to the impressions they got from their classmates and the major overall. This discouraged them in several ways and had an overall negative impact on their ICS experience. These sentiments further suggest social problems with the ICS community, as well as with how the department is perceived outside of the community. Additionally, apart from the sentiments expressed on TechHui, several ICS alumni that I remain in contact with are currently having problems finding ideal jobs after graduation. Feedback from employers suggest that this trend may be due in part to the small computer science market in Hawaii and in part to the lack of professional experience of many students straight out of college. Statistics like this suggest existing problems with professional development within the ICS department.

As ideal as it would be, it is hard to meet the needs of all current, past and present students in a department. However, after taking student and alumni feedback into consideration, several of these problems could potentially be alleviated by creating an online platform that provides students with the help they need–academically, professionally, and socially. By combining three aspects (degree planner, social network, and gamification), a new system called RadGrad could address many of the aforementioned student problems and needs.

CHAPTER 2

RELATED WORK

My vision of addressing ICS student problems through an online platform involves three major parts: degree planner, social network, and gamification. All three of these parts combine to create a robust, interactive, and effective system to enhance the academic journeys of current and future ICS students. In this section I discuss existing software in each of these categories, what they aim to accomplish, and why they do not fully satisfy the needs of ICS students.

2.1 Degree Planners



Figure 2.1: STAR homepage. *Source:* www.star.hawaii.edu

2.1.1 STAR

STAR is the degree planning system currently used by the University of Hawaii system [10]. As of June 2017, the student interface provides five main capabilities: Academic Essentials, Graduation Pathway, What If Journey, Transcripts, and Scholarships.

The screenshot shows the STAR Academic Essentials page. At the top, there are tabs for "ACADEMIC ESSENTIALS", "GRADUATION PATHWAY", "WHAT IF JOURNEY", "TRANSCRIPTS", and "SCHOLARSHIPS". The "ACADEMIC ESSENTIALS" tab is selected. The page displays a "Graduation Requirements Table" and a "System General Education Requirements" table. On the right side, there is a "Degree Net Yet Classified" section showing courses for Fall 2016 and Fall 2017, along with a "Degree" button. Below this is an "Advisor Notes" section with a list of items, some of which have "Read More" links. At the bottom, there is a "Events and Actions" section with a "View All" button.

Figure 2.2: STAR Academic Essentials page. *Source:* www.star.hawaii.edu

2.1.1.1 Academic Essentials

This interface provides information about the student's academic progress, and compares it to the student's academic requirements to show how close the student currently is to graduation. This information includes credit totals, grades, and required courses. This interface also includes a section for "Advisor Notes", which is filled out during advising sessions. There is another section for "Events and Actions" which lists important student academic events such as college applications, admittance, and graduation, and student academic actions such as Deans List award. A third section is called "Educational Goals", which provides the student's "immediate goals" and "highest ed goals" on a semester-by-semester basis. This information is provided by the student through occasional assessments upon log-in to STAR. The top of the page also has a section for students with financial aid.

The screenshot shows the STAR Academic Graduation Pathway page. At the top, there are tabs for 'ACADEMIC ESSENTIALS', 'GRADUATION PATHWAY', 'WHAT IF JOURNEY', 'TRANSSCRIPTS', and 'SCHOLARSHIPS'. The main content area displays two course schedules:

- Fall 2016:** Shows courses like MATH 101, MATH 102, and MATH 103 with grades A, A, and A respectively. It also lists 'CJS Long Term' and 'CJS Minor'.
- Spring 2017:** Shows courses like MATH 101, MATH 102, and MATH 103 with grades A, A, and A respectively. It also lists 'CJS Long Term' and 'CJS Minor'.

Below the schedules, there is a section for 'Academic Events' and 'What If Academic Events'. On the right side, there is a sidebar titled 'EDUCATIONAL GOALS' with a dropdown menu showing various goals like 'Arts, Humanities, or Social Sciences (3A, 3H, or 3L)'.

Figure 2.3: STAR Academic Graduation Pathway page. *Source: www.star.hawaii.edu*

2.1.1.2 Graduation Pathway

This interface is provided for certain programs or exploratory or pre-major students. It shows the course information for the courses that the student has taken previously and is currently enrolled in, and shows which requirements each course fulfills. It also shows future semesters and suggests future types of classes that the student should enroll in, in order to fulfill their major requirements. This interface does not suggest specific classes, but only lists the requirement that the class will need to fulfill.

2.1.1.3 What If Journey

This interface is provided for undergraduates at UH Manoa. It allows students to choose a different major than the one they are currently in. The page then reloads to show the STAR homepage, altered to show the requirements of the chosen major. This shows students where they would be in the program if they were to switch majors.

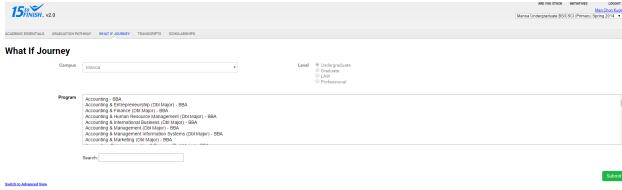


Figure 2.4: STAR What If page. *Source:* www.star.hawaii.edu

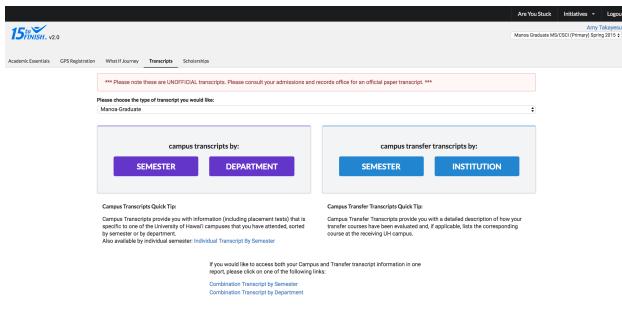


Figure 2.5: STAR Transcripts page. *Source:* www.star.hawaii.edu

2.1.1.4 Transcripts

This interface allows students to access their campus transcripts by semester and by department. It also allows transfer students to access their transfer transcripts by semester and by institution.

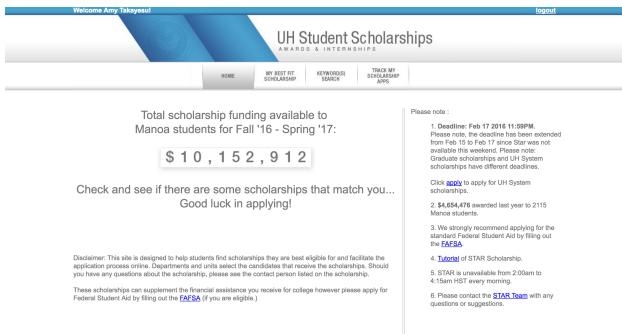


Figure 2.6: STAR Academic Scholarship Home page. *Source:* www.star.hawaii.edu

Welcome Amy Takeyusu

UH Student Scholarships
AWARDS & INTERNSHIPS

HOME MY BEST FIT SCHOLARSHIP KEYWORD SEARCH TRACK MY SCHOLARSHIP APP

W. Wesley and Hiromi Peterson Student Support Endowment*

Description: Professor W. Wesley Peterson was one of the founders of the Department of Computer and Information Sciences (CIS) at the University of Hawaii at Manoa. He was a member of the Association for Computing Machinery and a fellow of the Institute of Electrical and Electronics Engineers. Peterson was also a member of the IEEE Information Theory Group. Hiromi Peterson is a teacher of Japanese language at Punahoa School. She has written several Japanese language books and teaching textbooks "Adventures in Japanese" for teaching Japanese language at the secondary school level.

Purpose: The purpose of this fund is to provide an annual award or scholarship to be known as the "Peterson Award/Scholarship" to a student enrolled in a degree program in the Department of Computer and Information Sciences at the University of Hawaii at Manoa College of Natural Sciences for the purpose of encouraging and recognizing excellence in research and scholarship.

Basic Criteria

Campus: Main	Level: Undergraduate or Graduate	Need Based: any
College: Colleges of Arts & Sciences	Standing: any	Min GPA: 3.0
Major: Computer Science, Informatics, Computer Sciences	Residency: any	Gender: Any

Additional requirements: Application criteria for choosing a recipient (eg. excellence in research, excellence in teaching, etc.)

A scholar in both categories will be recommended by the CIS dept. awards committee & approved by the CIS Chair each year.

CAMPUS: Main
LEVEL: Undergraduate
COLLEGE: Colleges of Arts & Sciences
MAJOR: Computer Science
STANDING: any
RESIDENCY: HI Resident
GENDER: Female
NEED BASED: any

My Best Fit Auto-Search

Figure 2.7: STAR Academic Scholarship Best Fit page. Source: www.star.hawaii.edu

Welcome Amy Takeyusu

UH Student Scholarships
AWARDS & INTERNSHIPS

HOME MY BEST FIT SCHOLARSHIP KEYWORD SEARCH TRACK MY SCHOLARSHIP APP

Mr. & Mrs. Abraham M. S. Goo Scholarship Fund for the Sciences*

Description: Shin Quon and Abraham Goo both graduated from McKinley High School and went on to receive their undergraduate degrees in engineering from the University of Hawaii at Manoa. Abraham Goo served as a radio operator-pilot during World War II and later earned a degree in engineering. He took a position with Boeing and eventually became a supervisor of the aircraft maintenance department. He was involved in research and development unit in charge of the B-1 (staith) bomber. The Goo family has been giving back to the community through donations to the University of Hawaii at Manoa.

Purpose: The purpose of this fund is to provide scholarships to assist academically able and financially needy students who are pursuing a degree in a scientific field of study at the University of Hawaii at Manoa.

Basic Criteria

Campus: Main	Level: Undergraduate or Graduate	Need Based: Yes
College: any	Standing: any	Min GPA: 3.0
Major: Civil Engineering, Mechanical Engineering, Electrical Engineering, Computer Science, Physics, Mathematics	Residency: HI Resident only	Gender: Any

Additional requirements: Financial need, not necessarily as determined by federal guidelines. Pursuing a degree in a scientific field, such as engineering, computer science, physics, chemistry, mathematics, etc. Minimum cumulative grade point average of 3.0. Previous graduates of McKinley High School. If no qualifying graduates of McKinley High School can be found, then the scholarship may be awarded to a qualified graduate of a Hawaii public high school.

SEARCH TEXT: computer science
 Limit results to Manoa:

Search for Scholarships

Figure 2.8: STAR Academic Scholarship Keyword Search page. Source: www.star.hawaii.edu

2.1.1.5 Scholarships

This interface allows students to find scholarships by either using a keyword search or by selecting the “My Best Fit Scholarship” tab, which presumably gathers student academic data and compares it with scholarship data to find matches.

2.1.1.6 STAR and Academic/Professional/Social Engagement

STAR is the all-in-one place for UH students to check on their progress in general education and major courses, University status in terms of enrollment and tuition payment, and their official transcripts. Since STAR is designed to fit the general academic needs of all students at UH, it is unrealistic to expect STAR to provide specialized and detailed support for each department. Each department is different in terms of courses and requirements, and STAR does not offer any features that go into depth in each individual department’s idiosyncrasies. To get more detailed information about major requirements, students must access separate department websites or contact the department’s academic adviser. In features such as Academic Essentials, Graduation Pathway, and Scholarships, STAR only offers baseline information. For instance, in Academic Essentials, STAR focuses on the student’s broad academic goals (i.e. graduation date and highest degree goal) rather than their arguably more helpful and specific major-related goals. In Graduation Pathway,

STAR notifies students which course categories they are missing, but does not suggest the specific classes that they are missing. In Scholarships, STAR lists relevant scholarships but does not provide detailed information about how to apply or how to prepare for them. Although STAR succeeds at being a University-wide, cross-departmental degree planner system, it lacks the detailed department-specific support that is crucial for a student's success and growth within his/her major.

The screenshot shows the Starfish Connect dashboard for a user named Randy Albright. The interface is divided into several sections:

- Top Navigation:** Home, Services, Randy Albright (profile picture).
- Left Sidebar:**
 - My Success Network:** Includes links to Tutoring Center, Gold, Yasmin - 1st Year Advisor, Hand, Sara - Peer Mentor, and Jackson, Paul - Residence Hall Advisor, each with a "See available appointments" link.
 - My Messages:** Shows messages from Paul Jackson, Yasmin Gold, and Cindy Ayers, with timestamps like 7:14 pm 05-09-2014, 2:19 pm 05-07-2014, etc.
- Right Sidebar:**
 - My Success Path:** Shows an "Academic Recovery Plan (In Progress)" with a "View Details" button.
 - Appointments:** Lists "Yasmin Gold: Today at 5:30 pm General Concern" and "Sara Hand: 05-12-2014 at 1:00 pm Tutoring".
 - Courses I'm Taking:** Shows "College Composition II (246)" with details for Instructor (Gold, Yasmin), Ayers, Cindy, Advising Hours, Office Hours, and Group Session.

Figure 2.9: Example Starfish Connect page. *Source: Starfish CONNECT gallery*

2.1.2 Starfish by Hobsons

The slogan for Hobsons is “Education Advances: Imagine a world where all students find their best fit [11].” Hobsons offers a wide range of educational solutions, ranging from students K-12 to college students. Starfish by Hobsons is one of their platforms which focuses on success, support, and retention initiatives, and engaging students more effectively with the campus community. There are three main parts of the Starfish Enterprise Success System: Early Alert, Connect, and Degree Planner.

2.1.2.1 Early Alert

Early Alert is a early warning and student tracking model which mines student performance data from existing technologies at the particular institution to detect at-risk students. These students are detected early enough, such as at the first sign of a problem, so that there is enough time to make a difference. There is a type of reward system called Kudo (a positive feedback note), which is used to encourage students and reward them for improvement or good work.

2.1.2.2 Connect

Connect is an online appointment scheduling and case management system. This system promotes communication between students and their advisers, instructors, and tutors by means of in person meetings, phone calls, or virtual meetings. Connect includes a kiosk to allow easily scheduled walk-in meetings. These kiosks can help staff to manage a student queue and also allows students to

check wait times remotely, which can save a lot of time and frustration. Connect also includes a road map for each student, which documents the steps a student must take to achieve his or her goals. This map is created by an adviser and is visible to all members of the student's support network.

2.1.2.3 Degree Planner

Degree Planner provides academic templates which advisers can use to easily edit to adjust to a particular student's needs. It also focuses on students' constantly changing goals and ability to adjust the student's plan to accommodate these goals. When a student deviates from their given plan, the student's adviser is notified so that they can plan a meeting with the student to check on their status and re-identify their goals.

2.1.2.4 Starfish by Hobsons and Academic/Professional/Social Engagement

Starfish by Hobsons provides integrated systems that can keep track of students and keep students on track [11]. Its integration into different departments and customization of more specific goals fulfills the academic goals of RadGrad more than STAR. However, this system is concerned only with academics and does not take other factors into consideration such as internships, outside work and projects, and other extracurricular activities. While a student may seem to be on track based off their academic record, there are other factors that come into play when it comes to "staying on track." Traditionally, an "on track" student may have completed all of the coursework within 4 years with at least a 3.0 GPA. However, what if "on track" were redefined to be much more complex, and include other factors outside of coursework? Although these factors may not technically be requirements to graduate, they may be highly recommended, and a system that could help encourage students to pursue these other factors, without them being technically required, would create a different class of graduates entirely.

2.1.3 College Scheduler

The College Scheduler company has two products: Schedule Planner and Pathway Planner [2]. The Schedule Planner focuses on optimizing the way students can plan their schedules, and the Pathway Planner focuses on optimizing the way students progress towards graduation.

2.1.3.1 Schedule Planner

Schedule Planner allows students to easily schedule (or automatically generate) their classes around outside obligations. It also helps students to maximize their credit hours and graduate on time. Schedule Planner also analyzes student preference data to predict the optimal number of course sections to offer and helps to evenly distribute class fill rates. It enables advisers to create course



Figure 2.10: Example of Schedule Planner. *Source:* <http://www.collegescheduler.com/schedule-planner/>

schedules for groups of students at a time. One of their main goals is to allow students to focus on which courses to take rather than worrying about when they are being offered.



Figure 2.11: Example of Pathway Planner. *Source:* <http://www.collegescheduler.com/pathway-planner/>

2.1.3.2 Pathway Planner

The Pathway Planner allows students to plan their schedules in a multi-year format to encourage seeing the bigger picture and to plan ahead. It provides visuals to show students how their predicted course loads will affect their graduation date. Administrators can also see the courses that students plan on taking before registration. This allows for the addition and elimination of courses to best fit student needs.

2.1.3.3 College Scheduler and Academic/Professional/Social Engagement

College Scheduler focuses on the scheduling aspect of degree planning. However, it views scheduling as a long term event, and allows students and administrators to work together to offer courses in an optimal manner. While College Scheduler addresses the needs to students as a whole, it does not

offer individualized support based off individual needs. Every student has different goals, plans, and schedules, and there is no one master schedule that can accommodate them all. However, if it were to offer individual support on a case by case basis, it would be able to help a larger amount of students to reach their unique goals.



Figure 2.12: Example student view of the Blackboard Planner mobile application screens. *Source:* <http://www.blackboard.com/mobile-learning/planner.aspx>

2.1.4 Blackboard Planner

Blackboard recently bought out the college planning system MyEdu to create a new mobile student planning application called Blackboard Planner [1]. The main goals of Blackboard Planner are to improve student outcomes, simplify planning, and provide better support. Since the system was released in October 2016, at the time of writing, there currently is not much information regarding the system and its usage.

2.1.4.1 Improve Student Outcomes

Blackboard Planner aims to improve student outcomes by providing students with real labor demand information from Burning Glass and Roadtrip Nation, which can ideally allow students to make better academic and career decisions.

2.1.4.2 Simplify Planning

Blackboard Planner aims to simplify planning by offering customized scheduling, hassle-free registration, and an academic plan tracker. These features are aimed at helping students graduate on time.

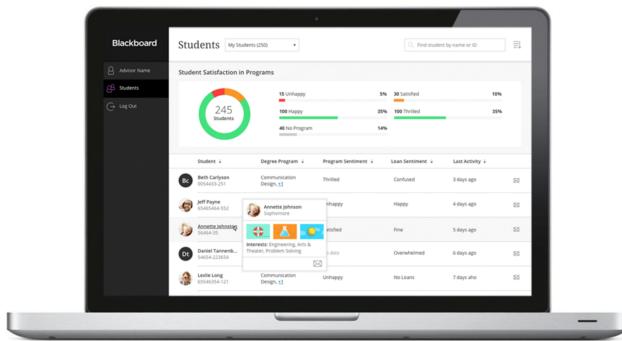


Figure 2.13: Example adviser view of Blackboard Planner.

Source:

<http://www.blackboard.com/mobile-learning/planner.aspx>

2.1.4.3 Provide Better Support

Blackboard Planner provides an adviser view which allows advisers to combine their insight into the student's academic plans, student sentiment, and predictive analysis together to offer well-informed support to students.

2.1.4.4 Blackboard Planner and Academic/Professional/Social Engagement

With the limited information available about Blackboard Planner, it seems to address many degree planning problems that older degree planners, such as STAR, Starfish by Hobsons, and College Scheduler do not. For instance, Blackboard Planner uses job market analytic services to provide students with the most relevant and up to date information regarding careers. However, while Blackboard Planner seems to excel at offering post-graduation advice, it seems to be lacking in pre-graduation advice. Blackboard Planner does not offer course advice to fit the student's current lifestyle, taking work and extracurricular activities into consideration. Planning for the future is important, but students must remember to plan for the present as well.

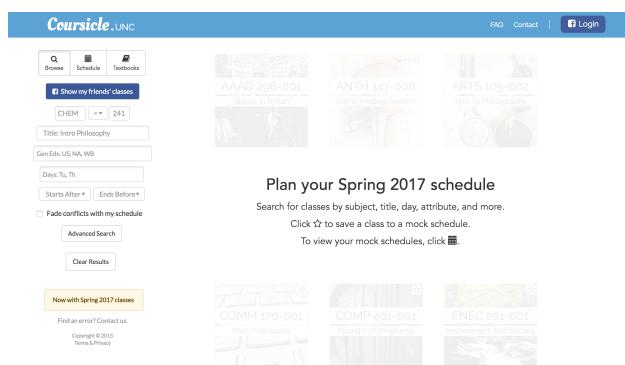


Figure 2.14: The Coursicle page for the University of North Carolina. *Source:*

<https://www.coursicle.com/unc/>

2.1.5 Coursicle

The slogan of Coursicle is “Course registration sucks but Coursicle makes it better [3].” The features of Coursicle are: students can receive text or email notifications when a seat opens up in class, students can schedule their courses using an attractive schedule planner, students can search through courses more easily with a variety of filters, students can create schedules with all prospective classes and then narrow them down to one workable schedule, students can easily compare textbook prices online through Coursicle, and students can view what classes their classmates are signed up for via Facebook.

2.1.5.1 Coursicle and Academic/Professional/Social Engagement

Coursicle is focused on making students happy by making registration easier and more enjoyable. However, although Coursicle makes it easier, it does not suggest classes to students based off their goals and previous coursework. Coursicle definitely helps alleviate the psychological pain of registration, but it does not alleviate the overall ongoing pain of degree planning.

2.1.6 Individual Student Software and Academic/Professional/Social Engagement

There are other types of download-able software currently available for students to use individually. These systems are for individual use, and are not tailored for institutional implementation. To use these systems, students input information about their education, such as classes, credits, and requirements. This data is then used to create organized visualizations to help students to better see their goals and pathway. A popular generic system is the Microsoft Office College Credit Planner Template. Many individual colleges and universities have their own custom download-able course planning spreadsheets as well. While these systems help students to organize the data they have, they do not offer any new ideas or suggestions for further improvement.

2.2 Social Network

2.2.1 LinkedIn

LinkedIn is widely known for being the world’s largest professional network [6]. It sets itself apart from other popular social media sites by being focused solely on building professional identities and forging professional relationships. There are six major components to LinkedIn: Home, Profile, My Network, Learning, Jobs, and Interests.

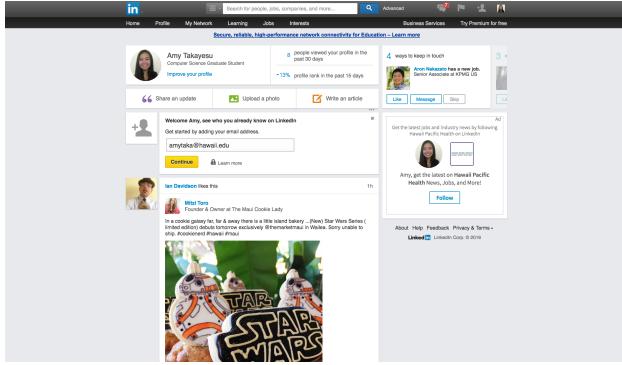


Figure 2.15: LinkedIn homepage. *Source:* <http://www.linkedin.com>

2.2.1.1 Home

A user's homepage is arranged in a feed type format, with quick information about your profile, profile views, and incoming messages. The feed section contains recent updates from connections and companies related to your interests. There are also sections that encourage engagement—for instance, quick ways to “share an update”, “upload a photo”, or “write an article” and suggestions to “reconnect with your colleagues” and to add someone you may know.

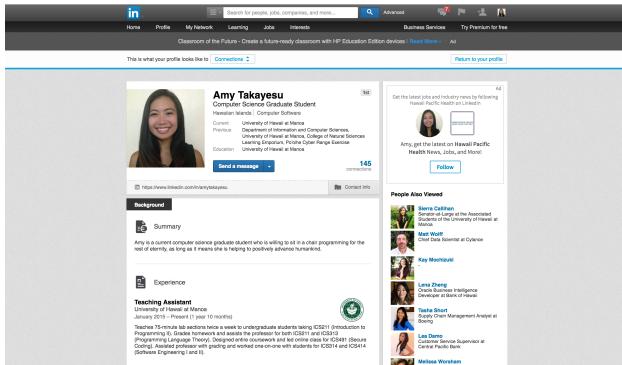


Figure 2.16: LinkedIn profile. *Source:* <http://www.linkedin.com>

2.2.1.2 Profile

A user's profile page is available for other LinkedIn users to see. Users can decide what information they would like to share about themselves, but it is all limited to professional related categories such as education, work experience, volunteer work, and skills and endorsements.

2.2.1.3 My Network

A user's network includes current connections, recommended connections, connections added through outside contact information, and contacts added through an alumni network.

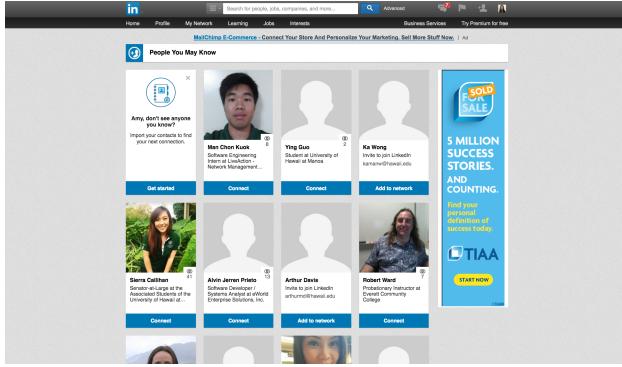


Figure 2.17: LinkedIn network page. *Source:* <http://www.linkedin.com>

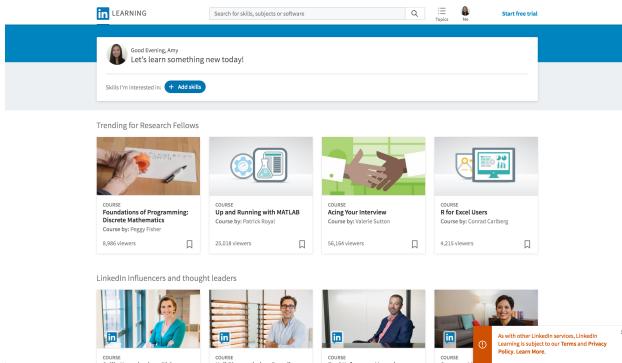


Figure 2.18: LinkedIn learning page. *Source:* <http://www.linkedin.com>

2.2.1.4 Learning

LinkedIn offers online courses on professional development topics such as leadership, storytelling, creating alliances with employees, and winning back a lost customer. There are also field-related courses, such as online code courses. These courses are often in the form of videos, and can be accessed by premium LinkedIn members.

2.2.1.5 Jobs

Jobs on LinkedIn automatically suggest jobs for users based off the information on their profile. Jobs can also be searched for using keywords such as job title, company, and location. Users can set preferences to refine their automatic suggestions.

2.2.1.6 Interests

In the Interests section, users can follow companies and groups based off their personal interests. There are also links to SlideShare and ProFinder, which offer services for creating professional presentations and hiring local freelancers, respectively.

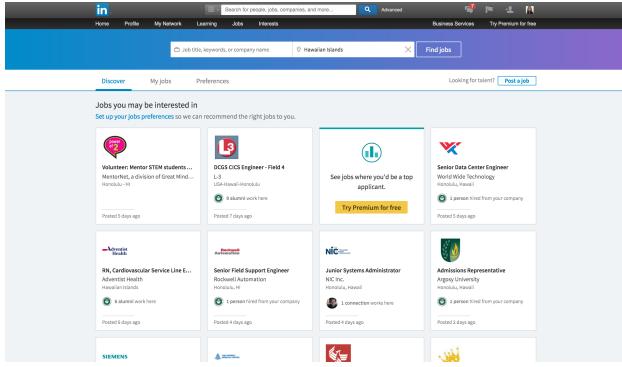


Figure 2.19: LinkedIn jobs page. *Source:* <http://www.linkedin.com>

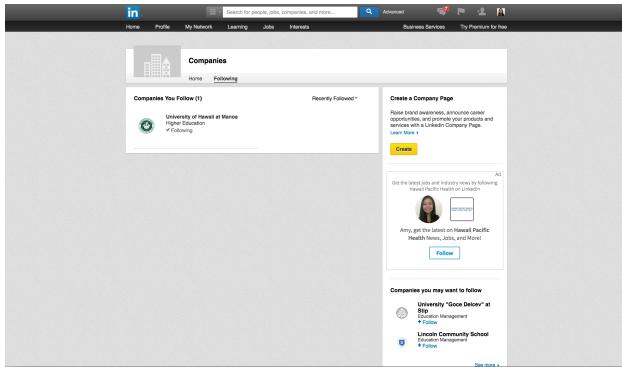


Figure 2.20: LinkedIn companies page in the Interests section. *Source:* <http://www.linkedin.com>

2.2.1.7 LinkedIn and Academic/Professional/Social Engagement

LinkedIn is a large global professional network. The more people it reaches, and the more diverse it becomes, the more successful it will be. This works on a large scale. Due to this, LinkedIn inherently fails to provide the intimate support of a smaller and more personal community. It is easy to become overwhelmed with the breadth of LinkedIn, but if there were a place that offered a smaller and more specific community with a lot more depth, people would be able to create stronger and deeper connections (with the trade-off being having less connections overall). For students who have not graduated college yet, having strong connections with the people they are surrounded by (colleagues, professors, alumni, etc.) is arguably more important than having many loose connections with a wider network. This is not to say one type of network is better than the other—but for students, the support they need will come from the smaller and stronger network.

2.2.2 TechHui

The TechHui page describes itself as being “Hawaii’s Technology Community [13].” The TechHui site has ten main sections: Profile, Members, Events, Forum, Groups, Photos, Videos, Blogs,

Directory, and Coders.

Figure 2.21: TechHui profile page. *Source:* <http://www.techhui.com>

2.2.2.1 Profile

Each user has a profile page which contains information such as a name, profile picture, occupation, areas of interest, software language proficiency and interests, and recent activity.

Figure 2.22: TechHui members page. *Source:* <http://www.techhui.com>

2.2.2.2 Members

The members page lists all members, including a section at the top for featured members. Each member is listed by their name, with their profile picture and location. Through this page, users can communicate with other users by commenting on other user's profile pages.

2.2.2.3 Events

The events page lists upcoming events and featured events. The event snippets include an imagine, a name, a time and date, a location, the name of the organizer, the type of event, and a brief

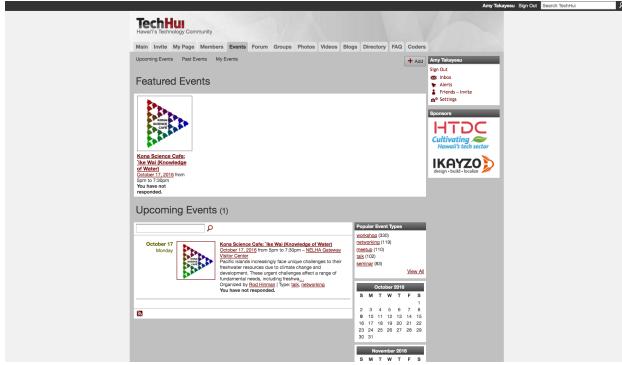


Figure 2.23: TechHui events page. *Source:* <http://www.techhui.com>

description of the event. Users can click on these snippets to go to an event page, which includes more detailed information and allows users to respond to events with “will attend”, “might attend” and “will not attend.”

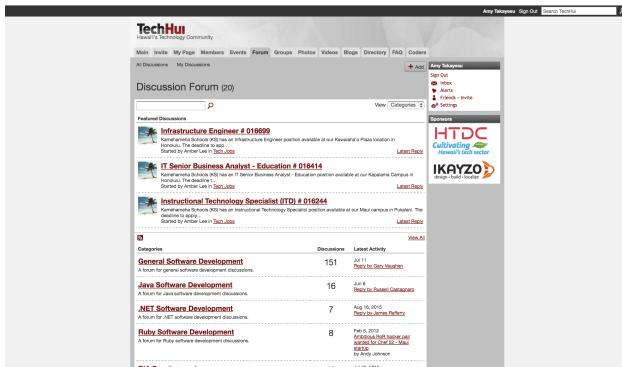


Figure 2.24: TechHui forum page. *Source:* <http://www.techhui.com>

2.2.2.4 Forum

The forum page includes a list of technology related categories, which can be clicked on to access a list of related forums. It also includes some featured forums at the top. Some of these categories include “General Software Development”, “Java Software Development”, “Funding Technology Startups”, “Software Design Patterns”, “Tech Jobs”, “Tech Resumes”, “Web Design”, “Tech Humor” and more. Users can both start discussion forums and respond to other users’ forums.

2.2.2.5 Groups

There are many different groups listed on this page, including some featured groups. Each group snippet has an image, a name, the amount of members in the group, the date of the group’s latest activity, and a brief description of the group. Users can click on these snippets to learn more about

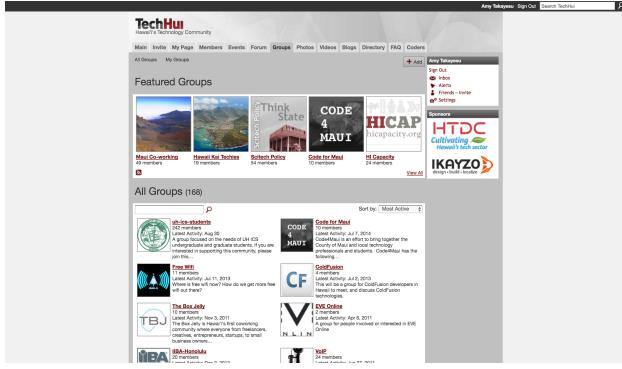


Figure 2.25: TechHui groups page. *Source:* <http://www.techhui.com>

the group and to join the group as well. Once in the group, users can participate in commenting on the group wall and creating and responding to group discussion forums.

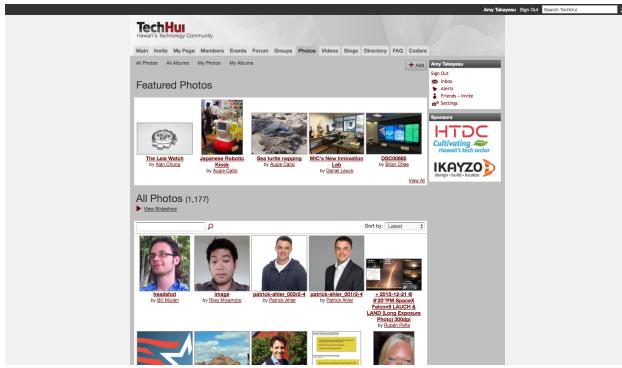


Figure 2.26: TechHui photos page. *Source:* <http://www.techhui.com>

2.2.2.6 Photos

On the Photos page, users can easily view all public photos uploaded by users (including profile pictures). Featured photos are included as well. Users can view these photos and comment on them as well.

2.2.2.7 Videos

On the Videos page, users can easily view all public videos uploaded by users. Featured videos are included as well. Users can view these videos and comment on them as well.

2.2.2.8 Blogs

This page displays a feed of all users' blog posts. Posts are also organized by featured posts, latest posts, most popular posts, and monthly archives. Users can click on these blog posts to read them

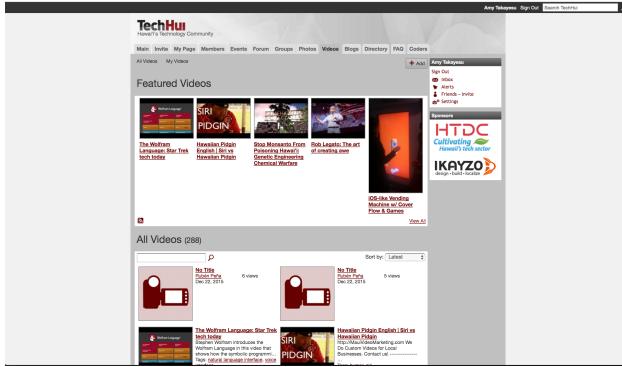


Figure 2.27: TechHui videos page. Source: <http://www.techhui.com>



Figure 2.28: TechHui blogs page. Source: <http://www.techhui.com>

in their entirety and can comment on them as well.

2.2.2.9 Directory

This page includes a listing of technology related jobs in Hawaii, organized into 21 subcategories. Users can click on these listings to view more details about the jobs, and also to access external websites.

2.2.2.10 Coders

This page lists web startups that are writing code in Hawaii. The list contains just the names of the startups, which can be clicked on to learn more at the startup website.

2.2.2.11 TechHui and Academic/Professional/Social Engagement

TechHui caters to a community much smaller than LinkedIn. However, it remains too broad to cater to the specific needs of undergraduate students. TechHui aims to satisfy the needs of a variety of people, with only a small portion of them being current undergraduate students. It is

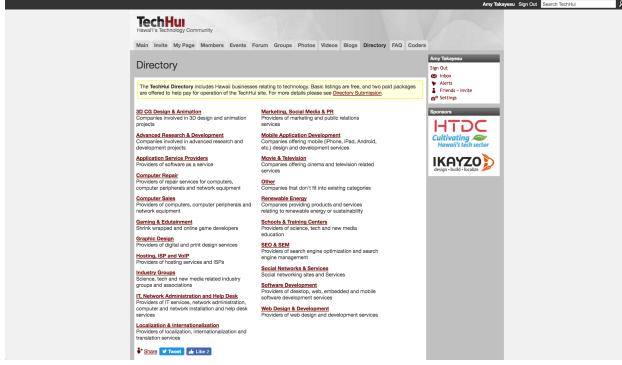


Figure 2.29: TechHui directory page. *Source:* <http://www.techhui.com>

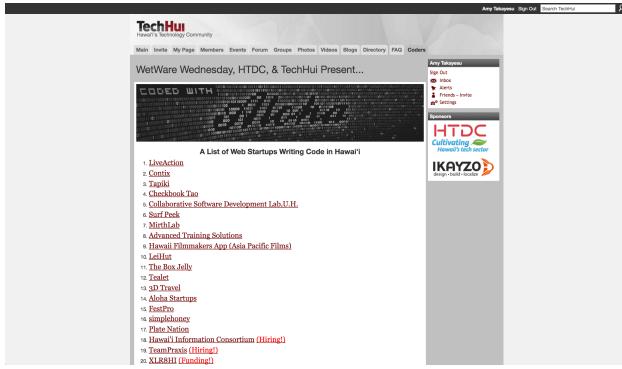


Figure 2.30: TechHui coders page. *Source:* <http://www.techhui.com>

unreasonable to expect TechHui to add features specifically for one group of members. However, if it were reasonable, TechHui ideally could suggest events and people to students based off their goals and interests. It could find ways to encourage students to engage with these events and people, and cultivate strong and healthy relationships between students and the rest of the community. It could provide ways for members to easily know what projects others are working on, and allow members to join projects that they are interested in. In this way, it would be more than just a discussion site, but a strong social network as well.

2.2.3 Rate My Professors

Rate My Professors allows users to communicate and share content with each other by posting reviews of colleges and professors [9]. Although users can create accounts, the reviews are listed as anonymous. Other users can provide feedback on reviews with either a thumbs up (user found this to be useful) or thumbs down (user did not find this to be useful). The site also contains site-generated blog posts and videos, but users cannot directly interact with these.

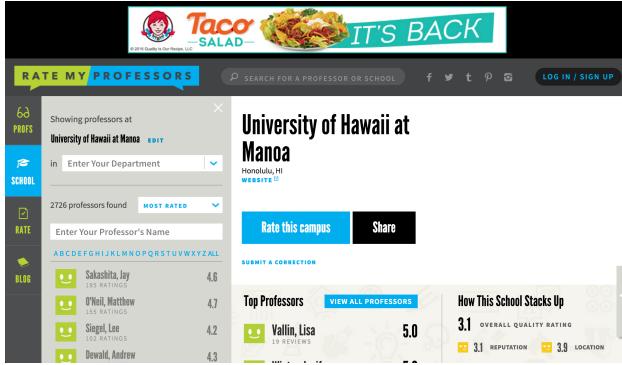


Figure 2.31: Example Rate My Professor page for UH Manoa. Source: <http://www.ratemyprofessor.com>

2.2.3.1 Rate My Professor and Academic/Professional/Social Engagement

Rate My Professor aims to be very disconnected from universities by allowing users to be anonymous and share openly without any direct association to the institution. While this allows users to post without fear of repercussions, it may encourage negative relationships between students and professors. It distances the two groups of people, and instead of providing constructive criticism to the professor, it simply encourages the perpetuation of the opinions of past students. In this way, it does not encourage forward movement. Rate My Professor could improve by becoming integrated with the university so that reviews are no longer anonymous, and students can take full responsibility of their opinions. Additionally, professors will be able to view informative data about their teaching effectiveness, which may allow them to improve over time. In this way, the goal will become to improve all members of the community, rather than to create more distance between them.

2.2.4 Other Popular Social Networks and Academic/Professional/Social Engagement

Social networks have become extremely popular and there are too many of them to describe in detail here. The top fifteen most popular social networks as of September 2016 [14] are Facebook, Instagram, YouTube, Twitter, LinkedIn, Pinterest, Google+, Tumblr, Reddit, VK, Flickr, Vine, Meetup, Ask.fm, and ClassMates. While most of these are not academically focused, they could potentially host an academic environment. Additionally, while RadGrad could be integrated directly into one of these existing social networks (i.e. become a Facebook application), creating a standalone application does not exclude members who do not have a Facebook or are not active on Facebook, it does not depend on the continuing popularity of Facebook, and I believe it may develop a stronger sense of brand.

2.3 Gamification

Since it would be ineffective and senseless to discuss every existing video game, I conducted a brief informal survey of some ICS students (both undergraduate and graduate students) regarding their current favorite video game. I was able to solicit sixteen responses shown in the table below. In the following section I will discuss four different video games, with each one from a different genre: Role Playing Game (RPG), Multiplayer Online Battle Arena (MOBA), collectible card, First Person Shooter (FPS), and augmented reality. One of the games is my current favorite video game and four of them are popular video games according to the surveyed ICS students.

ICS Students' Favorite Games			
Gender	Degree	Favorite Game	Game Genre
Male	Undergraduate	Seven Knights	RPG
Male	Undergraduate	Kerbal Space Program	Space Flight Simulation
Male	Undergraduate	League of Legends	MOBA
Female	Undergraduate	League of Legends	MOBA
Male	Undergraduate	Monster Hunter	RPG
Male	Undergraduate	NBA2k7	Sports
Male	Undergraduate	Hearthstone	Collectible Card
Male	Undergraduate	RimWorld	Construction Management
Male	Undergraduate	Geometry Dash	Arcade
Male	Undergraduate	Overwatch	FPS
Female	Undergraduate	Pokemon Go	Augmented Reality
Female	Graduate	Pokemon Go	Augmented Reality
Female	Undergraduate	Minecraft Sky Factory 2.5	Sandbox
Female	Graduate	Call of Duty	FPS
Female	Undergraduate	Assassin's Creed	Action/Adventure
Female	Graduate	Summoner's War	RPG



Figure 2.32: Summoners War gameplay

2.3.1 Summoners War

Summoners War is a mobile fantasy RPG with over 60 million players worldwide. It is based off a freemium model, with many players playing for free, and many other players playing with in-application purchases. Based off the iTunes Summoners War page, the basic premise of Summoners War is as follows: “Jump into the Sky Arena, a world under battle over the vital resource: Mana Crystals! Summon over 900 different types of monsters to compete for victory in the Sky Arena! Assemble the greatest team of monsters for strategic victories! [12]” As with many games, one of the interesting things about it is its ability to motivate users into completing several, often tedious and unenjoyable actions, in order to achieve a virtual reward. One of the examples of this is the weekly Arena Rank. The Arena is where players can battle against other players, in an attempt to reach as high a rank as possible. There are different ranks based off the amount of victories and defeats the player has had: Beginner, Challenger, Fighter, Conqueror, Guardian, and Legend. The Arena is often very difficult, and in order to achieve a certain standing, the player must constantly battle others, and set up a solid defense that cannot be defeated by other players. In order to improve one’s defense and offense team, a player must spend hours doing grueling tasks, such as gathering magical essences, gaining EXP points to level monsters, and collect “runes” which can be strategically placed on each monster to improve certain stats. Doing these tasks can take up a significant amount of time and energy. Each week, a player is awarded a certain rank based off their performance in the Arena that previous week. This rank is manifested in the form of a small icon next to the player’s name. When players see other players’ icons, they are immediately informed of that person’s standing in the game, and the player him/herself will be rewarded with feelings of pride and satisfaction.

Summoners War also allows players to join guilds in order to receive guild points, which can be used to purchase additional helpful items. Guilds are composed of at most 30 players, and they must strategize and work together in order to move up in rank and gain more points.



Figure 2.33: League of Legends gameplay.

2.3.2 League Of Legends

League of Legends is a multiplayer online battle arena (MOBA) type of video game and also follows a freemium business model [5]. In this game, the player assumes the character of a summoner who controls a champion with unique abilities, and they battle with a team of other champions against another team of champions (either other live players or computer controlled). The main goal of the game is to destroy the opposing team's nexus, which is a structure at the middle of the team's base and is protected by defensive structures. At the start of each match, all champions start off weak, but they can increase in strength throughout the game by accumulating items and experience. Each match typically lasts from 20-60 minutes. There are three different game modes: Summoner's Rift, Twisted Treeline, and Howling Abyss. Each game mode is similar in that a team of players must work together to accomplish a terminal objective and a victory condition. Each mode also includes smaller intermediate objectives that can help teams to get closer to victory. Opposed to Summoner's War, gold gathered during the match and items purchased with that gold only last for that match, and do not carry over to future matches. Each match begins with each player being more or less equal in terms of advantage, regardless of how much time or effort the player has put in beforehand. However, the game does include other incentives to continue to win games and see personal development. Players get player experiences from playing matches on a single account. As their experience increases, they can ascend from level 1 to 30. Higher level players are given access to different maps, game modes, and additional abilities and features which give players a small boost in battle.



Figure 2.34: Hearthstone gameplay.

2.3.3 Hearthstone

Hearthstone is a free to play online collectible card video game. It is turn based between two opponents, who use constructed decks of thirty cards, and a selected hero with a unique power [4]. Players can attack the opponent using mana points. The main goal is to reduce the opponent's health to zero. If the player wins, they can earn in-game gold, new cards, or other in-game prizes.

Players can use the gold or microtransactions to purchase new cards to improve their decks. There are several different game modes: casual and ranked matches, daily quests, and weekly challenges. Unlike many other popular collectible card games, Hearthstone does not allow players to trade cards. Instead, players can disenchant their unwanted cards into arcane dust, which can then be used to craft new cards of the player's choice.



Figure 2.35: Overwatch gameplay.

2.3.4 Overwatch

Overwatch is a team based multiplayer first person shooter (FPS). Each team has six players, and each player may select one predefined hero character [7]. There are four classes of heroes: Offense, Defense, Tank, and Support. Each hero character has unique movements, attributes, and skills. As the team is being set up, the game will provide advice if the team is unbalanced. However, once the game starts, players can still switch characters after a death or after returning to their home base. The team of heroes work together to secure and defend certain control points and/or escort a payload across the map in a certain amount of point. As players continue to play matches, they can gain rewards that do not affect gameplay, such as character skins and poses. At the end of each match, a server-determined Play of the Game (PotG) is replayed for all players. This play is based off certain factors such as a high scoring moves or effective use of a skill. Up to four individual achievements per team are highlighted, and afterwards players can vote for one to promote. The player who wins the most votes get a reward of experience points. As players gain experience points, they can earn a loot box, which provides certain in-game prizes and in-game currency. If players do not have enough experience points for a loot box, they also have the option to obtain one through a microtransaction. The game supports several different gameplays such as tutorial and practice modes, casual matchmaking, weekly brawls, custom games, and competitive play. Casual matchmaking allows players to play alone or with friends, and are randomly matched against others with similar skill levels. The weekly brawl gameplay was inspired by Hearthstone, and features matches with unique rules, which change weekly. Custom games allow users to have

private or public games and can edit different options for that specific match. Competitive mode allows players within a certain region and on a certain platform, to become ranked. This mode is run in 2.5 month seasons. Only players at level 25 or above can participate. Participants also much first play ten preliminary matches which will assign the player a skill rating from 1 to 5000, which is used to create ideal matches. Similarly to the arena battles in Summoners War, there are seven skill ranking tiers: Bronze, Silver, Gold, Platinum, Diamond, Master, and Grandmaster. Players can be demoted to a lower tier or promoted to a higher tier based on their performance. Each competitive win awards a player with in-game currency. Players will also get an additional award based on their final ranking at the end of the season.

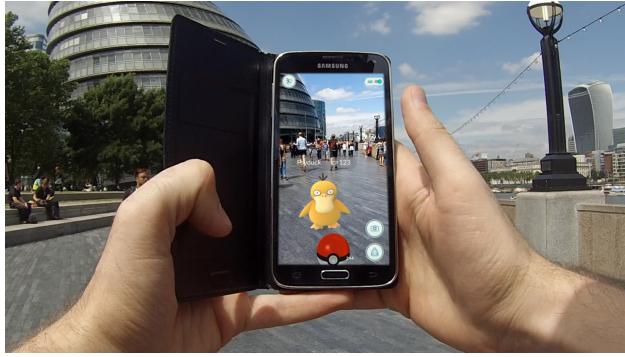


Figure 2.36: Pokemon Go gameplay.

2.3.5 Pokemon Go

Pokemon Go is a free-to-play, location-based augmented reality game for mobile devices [8]. Players use their device's GPS to locate, capture, battle, and train virtual monsters known as Pokemon. The Pokemon appear through the device's camera as though they were in the same real-world location as the player.

Players can customize an avatar, which is displayed throughout the game on a map using the player's current geographical position. The map will show game related locations such as PokeStops and Pokemon gyms. Players can get items from PokeStops such as eggs, Poke Balls, berries, and potions. Users can also equip PokeStops with lures, which can attract wild Pokemon. Pokemon gyms are where players can battle and take over the gym in a “king of the hill” style. These PokeStops and Pokemon gyms are usually located at real-world places of interest.

Different types of Pokemon are located in different areas of the world. For example, water-type Pokemon are typically found near bodies of water. Players can capture wild Pokemon by “throwing a Poke Ball” (making a swiping motion on the device) at the Pokemon. When the Pokemon is caught, the player additionally receives stardust and/or candies, depending on the type of Pokemon. These items can be used to raise the Pokemon's combat power (CP).

The ultimate goal of the game is to capture and evolve all 151 Pokemon. However, throughout the game, there are also many other ways for players to gain experience points. Players can increase in level, and at level 5, they can join one of three teams: Team Valor, Team Mystic, or Team Instinct. These teams play a role when battling at the Pokemon gyms.

2.3.6 Gamification and Academic/Professional/Social

Clearly there are certain aspects about popular video games that make them so enjoyable, addictive, and satisfying to so many people. Even the two students who initially declared that they “don’t have time for games” or simply just don’t play games eventually admitted that they did play Pokemon Go at one point. All four games discussed above have a few things in common: multiplayer, small and large rewards throughout the game, additional rewards given simply for putting in time, and the persistence of the player. Four of the five games also include a team aspect which encourages players to work together to advance individually.

The multiplayer aspect of the games allows players to interact with and become competitive with other players. Rather than beating one’s own score, these games allow players to compare themselves with others and advance relative to other players, rather than simply advancing relative to their past selves. Multiplayer games encourage healthy competition, which can cause players to become more motivated.

The format of the rewards in these games suggest that small rewards as well as large rewards throughout the game, given for a diverse amount of tasks, continues to motivate players and make sure that they do not get discouraged. These awards are often just ranks or an in-game item that can help the player to improve.

Another similarity in the four games discussed above is the rewards given to players simply for putting in time to play (i.e. EXP points). While players who constantly lose may feel unmotivated and lose interest, if they are given some kind of point just for trying, it makes their attempts seem less fruitless. Players should be encouraged to play, and even more so if they encounter problems.

The persistence of the player in these video games allows players to continuously improve over time, rather than starting anew with each game. When players can see their improvements, they can be reminded of their past progress, and be encouraged to continue the progress, regardless of how grueling it may be. Once users see that they have done it before, they will know that they can do it again.

Finally, the team aspect of many of these games suggest that many players enjoy working together with other players to achieve both team and individual goals. This shows that when people work together, they can become stronger both as a team and individually.

CHAPTER 3

SURVEY DESIGN

The first part of the experimental design of this research project involves a baseline survey. The main goal of this survey is to gain better and more specific insight into the current undergraduate experience. This survey was given to current undergraduate ICS students and prospective ICS students. It was deployed electronically via Google Forms and students completed the survey on an iPad either before or after an advising session with an ICS advisor. The original goal was to gather at least 50 responses. Ultimately, the results of this survey may be useful in a future study that compares the ICS student experience before and after integrating RadGrad.

3.1 Baseline Survey

The baseline survey contains the following questions. The full assessment can be found in Appendix A.

3.1.1 Basic Information

1. *What is your gender?* Goal: Since the ICS program currently has significantly more male students than female students, what are the differences between the experiences of the two genders? Could this give any insight into why there are so little female students? Is this something RadGrad could address? After implementing RadGrad, have there been any differences in the gender ratio or the disparity between the experiences of the two genders? Ideally, both genders should have equally positive experiences in the ICS program.
2. *What is your current status in the ICS degree program?* Goals: How do student experiences evolve as they progress through the ICS degree program? Are there any patterns? Future goals: Does RadGrad have any effect on this? Ideally, students from all levels should have equally positive experiences in the ICS program.

3.1.2 Prospective ICS Students

1. *How EXCITED are you about entering the ICS program? Rank from 1-5.* Goals: This will provide information regarding how students view the ICS department, based solely on outside information and before their own experiences. Future goals: Compare this answer to the same question on the post-deployment assessment. Ideally, RadGrad will create more excitement among prospective students due to better presentation and the appearance of a strong, supportive community and satisfied alumni.

2. *How INTIMIDATED do you feel about entering the ICS program? Rank from 1-5.* Goals: This will provide information regarding how students view the ICS department, based solely on outside information and before their own experiences. Future goals: Compare this answer to the same question on the post-deployment assessment. Ideally, RadGrad will create less intimidation among prospective students due to the appearance of a strong, supportive, and diverse community and satisfied alumni.

3.1.3 Current ICS Students

1. *Which of the following extracurricular activities, if any, pertain to you?* Goals: This will provide information about how much initiative students are currently taking to get additional ICS education and experience outside of the classroom. Future goals: Compare this answer to the same question on the post-deployment assessment. Ideally, RadGrad will increase the amount of student involvement in outside ICS-related activities due to providing students with stronger connections to the ICS community.
2. *Do you feel that you get enough support from others in the ICS department?* Goals: Are students lacking support in certain areas? If so, how can RadGrad help to address this? Future goals: Compare this answer to the same question on the post-deployment assessment. Ideally, RadGrad will provide a way to give more students the support they desire from others in the department.
3. *As a student, do you feel like you have a voice to make changes within the department?* Goals: If most students indicate that they do not feel like they have a voice within the department, what can RadGrad do to address this problem? Future goals: Compare this answer to the same question on the post-deployment assessment. Ideally, RadGrad will cause more students to feel like they do have a voice to make changes in the department.
4. *What makes you proud to be a part of the ICS department?* Goals: This provides information about how current students view the department. A successful department should have a positive reputation among students, which can be manifested with a sense of pride. Future goals: Compare this answer to the same question on the post-deployment assessment. Ideally, RadGrad will cause positive changes in the ICS department's reputation, leading to a greater sense of pride among students, which may play a role in students' success

3.1.4 Current ICS Students: Influences

1. *To what extent have ICS alumni influenced your development in the ICS program?* Goals: This provides information about the extent of academic and professional interaction between ICS students and alumni. Future goals: Compare this answer to the same question on the

post-deployment assessment. Ideally, RadGrad will facilitate more student-alumni interaction, and cause more students to be influenced in some way by an alumn in an ICS-related way.

2. *To what extent have ICS peers influenced your development in the ICS program?* Goals: This provides information about the extent of academic and professional interaction between ICS students and their peers. Future goals: Compare this answer to the same question on the post-deployment assessment. Ideally, RadGrad will facilitate more peer interaction, and cause more students to be influenced in some way by a peer in an ICS-related way.
3. *To what extent have you influenced your ICS peers development in the ICS program?* Goals: This provides information about how students perceive their academic and professional interactions with their peers. Future goals: Compare this answer to the same question on the post-deployment assessment. Ideally, RadGrad will facilitate more peer interaction, and cause more students play a role in influencing their peers in an ICS-related way.

3.1.5 Graduating ICS Students

1. *Now that you are nearing the end of your ICS degree program experience, how well prepared do you feel to find a job after graduation?* Goal: If the ICS department is fulfilling its duty, most graduating students should feel at least adequately prepared (ideally well prepared) for the future. If most students indicate that they do not feel prepared, what can RadGrad do to address this problem? Future goals: Ideally, after deploying RadGrad, a higher percentage of students will feel either adequately prepared or well prepared for the future.
2. *If you answered above that you feel unprepared to find a job after graduation, please explain why.* Goal: Are there any common reasons for students not feeling prepared? If so, is there anything RadGrad can do to address this problem? Future goals: Ideally, after deploying RadGrad, there will be a lower percentage of students who indicate the same problems as the preliminary questionnaire.

3.2 Analysis

After collecting 100 survey results, I analyzed the data to see if there are any notable patterns, or any indications of common problems that could be addressed by RadGrad. Ideally, after RadGrad, future studies will show that there is less disparity between student expectations and reality, greater student satisfaction with the department, more student engagement, and more positive student feelings overall.

CHAPTER 4

SYSTEM DESIGN

I believe that the best way to address current ICS student issues is through an online system that combines degree planning, social networking, and gamification. The specific features of the system evolved over time through a process conducted in Fall 2015-Spring 2016 by Philip Johnson. This process incorporated feedback from the four major RadGrad user groups: students, faculty, academic program advisers, and alumni/local high tech community members. Spring 2015 students in Software Engineering II became directly involved in the design process by creating their own paper and HTML mockups and by doing user tests and analyses on their suggested systems. Faculty members and academic program advisers provided feedback through a RadGrad advisory board and through advising sessions. Alumni and local high tech community members became involved through RadGrad talks at local tech meetups. In this chapter, I present the design of the RadGrad system resulting from these activities.

4.1 Degree Planner

4.1.1 Degree Plan

Each student in RadGrad will have a degree plan, which displays the student's courses, extracurricular activities, and outside work on a semester-by-semester basis. This plan contains future data as well as historical data. This allows students to easily view their progress and prepare for the future.

4.1.2 Degree Goal

Although each student is aiming for a bachelor's degree in ICS, a more specific goal is beneficial in helping the student find a focus for their education and career goals. Some of these specific goals include B.S./B.A/B.S Computer Engineering and Security/Ph.D. Prep/Silicon Valley Tech. By specifying these specific goals in a concrete way, students can feel less overwhelmed by the large expanse of ICS classes, more prepared for the future, and more easily form communities of interest with other like-minded students.

4.1.3 Dashboard

Each user has access to a personal dashboard, available upon login. This dashboard provides a quick look at some of the user's stats, such as current ICS GPA, current ICS credits awarded, summary of schedule, current degree goals, interest tags, user picture, suggested vignettes, stoplight,

recommendations, currently active petitions, and predictions. This is a quick and easy way to provide students with a variety of information on their overall progress in their major.

4.1.4 Recommendations

Recommendations aim to help students understand how to change their current behavior to improve their ICS experience. Unlike Starfish by Hobsons, RadGrad will base recommendations on factors beyond academics, such as the student’s current degree plan, degree goals, and professional interests. Some examples of possible recommendations are: relevant courses or extracurricular activities not already present in their degree plan, an estimate of ideal maximum work hours, predicted impact of their GPA, and relevant mentorship opportunities that are not being taken advantage of.

4.1.5 STAR Interface

RadGrad will request a relationship with the UHM STAR website, which will provide students with their current and past courses and their resulting grades. This will allow students to see all of their relevant course information in the same place that they get all their other ICS information. RadGrad could also integrate with the STAR scholarship database to find ICS-related scholarships and encourage students to apply for them, based off their information and goals. For instance, if one of the student’s main goals is to graduate debt-free, they should be informed of applicable scholarships. In addition to the information provided by STAR, since the database will be much smaller, RadGrad could provide more specific details about each scholarship, how to become eligible, and how to apply.

4.1.6 Workload Adviser

RadGrad will implement a virtual workload adviser, which will combine the student’s course load, outside work hours, ICS grade data, and employer expectations to give the student advice on how much work they should be taking on at one time. It will offer suggestions, such as “If you drop 1 ICS course and reduce your work hours to 10 per week, the average ICS GPA is 3.4.” Unlike Blackboard Planner, RadGrad offers suggestions for students in the present time, rather than just for the future. This can help students to have a more realistic view of their goals, prevent students from getting burnt out, reduce stress levels, and encourage a healthier school-work balance.

4.2 Degree Planner: Possible Further Implementations

4.2.1 Predictions

Each student will have a prediction model, which predicts post-graduation aspects based upon recent graduates, data from local tech organizations, recruiters, headhunters, etc., and data from

the ICS faculty. This data is then combined with the student's individual degree plan and degree goals to produce a customized prediction. This feature will hopefully help students feel better prepared for their future after graduation.

4.3 Social Network

4.3.1 Profile

Students, faculty, graduates, and administrators will each have their own respective profiles. Student profiles will contain personal information including name, email, details about their degree, images, interests, projected graduation date, and professional recommendations based off their inputted information. Faculty profiles include name, email, image, professional interests, and descriptions of current projects they are working on. Graduate profiles will include details about their life after graduation such as place of employment and position description. All profiles will be publicly available so that the ICS community can view each others' profiles and find connections.

On a gamification level, profiles also allow users to be persistent and easily view their progress. Since each user has a username and profile, they will be persistent on RadGrad, and all of their achievements will build up on their profile as they progress through college and beyond.

4.3.2 Course Feedback

As a supplement to the UH system's end-of-semester course feedback system, RadGrad offers a mid-semester public course evaluation system. This allows students to reach out and communicate with each other and professors to make the learning experience as ideal as possible for all parties, while there is still time left in the semester. Ideally this will improve the quality of courses, the satisfaction of the students, and the teaching abilities of the professors. Unlike Rate My Professor, this process is not anonymous, and encourages professors to improve, rather than encouraging other students to avoid a certain course.

4.3.3 Degree Feedback

RadGrad will reach out to ICS alumni approximately six months after graduation. At this time, these ICS graduates will answer a number of questions regarding their life after graduation (i.e. graduate education, career prospects, retrospective thoughts about the ICS department, etc.). This feature will provide data that will help the ICS department improve their degree program, and also provide clear and convenient lines of communication between alumni and the ICS department.

4.3.4 Feedback and User Evaluation

RadGrad will provide a easy and convenient way for users to provide RadGrad feedback about the system. There will be links for immediate feedback, and there will also be yearly surveys to measure user satisfaction over time. By providing an easy stream of communication between users and RadGrad developers, RadGrad can be constantly growing along with the department in order to serve their evolving needs as best as possible.

4.4 Social Network: Possible Further Implementations

4.4.1 Department Feedback

Any type of user can initiate department feedback by starting a petition. The petition will be public, and any other user can edit it as well. Once the editors of the petition reach a consensus and get at least 20 votes of confidence from other users, the user will become finalized and other users may sign the petition over a course of two weeks. The petition will then be discussed at a faculty meeting, eventually leading to the petition being implemented, not implemented, or deferred. By giving users a platform to easily collaborate with each other over a common cause, members of the ICS department will feel more empowered, more involved, and ideally more satisfied.

4.4.2 Mentorship

RadGrad users can be certified mentors if they are in ICS 390 or a TA. A student is working under a mentor if they are a ICS 499 student working under a professor or participating in a research group opportunity under a faculty sponsor. There can be other possible instances of mentorship, and over time, a network of mentorships will form, which could possibly help foster more and better mentorships with future students.

4.4.3 Billboard

RadGrad can also provide some physical hardware (i.e. a large monitor) to be displayed in the ICS department. This display will show aspects of RadGrad (i.e. statistics gathered from RadGrad, upcoming events, current petitions, etc.). This will further encourage engagement throughout the department, as it will be a constant reminder of the current status of the community, and will perhaps contribute to promoting an overall closer “community” feel.

4.5 Gamification

4.5.1 Stoplight

The stoplight is a UI widget embedded in the dashboard, which takes on the appearance of a traffic stoplight, and uses the red/yellow/green colors to indicate the extent of that student's ICS activity. The light is green if the student is taking excellent advantage of what the department has to offer. The light is yellow if the student is taking sufficient advantage of what the department has to offer, and the light is red if the student is not taking enough advantage of what the department has to offer. To determine this, the stoplight takes into account the student's professional interests and goals, their GPA, available opportunities, the opportunities they have taken advantage of, the available courses, and the courses that the student has taken. By being encouraged by the changing colors of this stoplight, fueled solely by the student's actions, students may take this as a personal challenge, or game, to keep the stoplight at a certain color as much as possible. This is a simple way for students to track their progress throughout their ICS journey. This is an example of small rewards that are given throughout the "game" of ICS—students can visually see improvement, as though they are achieving a new rank. Similarly to EXP points in games, students can get these achievements simply by putting in more time and effort. They don't necessarily have to win a Hackathon or get straight A's, but as long as they are participating and putting in the effort, it will show on their Stoplight.

4.5.2 Leaderboard

A public leaderboard will be available for students to actively compare themselves against others in the department in terms of ICS GPA, velocity (a calculated value indicating a student's progress through the program), and professional preparation (a calculated value combining coursework and extracurricular activities). An award ceremony type of tradition could be started out of this, which awards high ranking students. This type of active and constant comparison could help foster healthy competition and higher engagement among students. This is an example of the multiplayer aspect of the aforementioned games that foster healthy competition and drive within players. Without the RadGrad network, students are left mostly oblivious to the progression of others and only have themselves to relate their progress to. If a student has always progressed slowly, that student may believe that he/she is continuing to do well, as long as they do not begin to progress even slower. With RadGrad, this student would be able to see the quicker progression of other students, and suddenly create a different goal in his/her mind.

4.5.3 Gamification: Possible Further Implementations

4.5.4 ICE

ICE is an acronym for Innovation (i.e. a student's involvement in research or other innovative activity), Competency (i.e. a student's grades in ICS courses), and Experience (i.e. a student's involvement in high tech environments through internships or other professional activities). ICE is a measurement of these aspects, calculated using the information provided on the student's profile. This balances the three aspects to emphasize the importance of all three in an ideal ICS experience. Details on how these aspects are measured can be found at www.radgrad.org. These clear measurements of "success" can be eye opening for students. It can be easy to get caught up in the minor details of a major and lose track of the bigger picture. ICE helps students to remind themselves to balance their ICS experiences out, in order to become as attractive as possible for future employers. This feature can also be physically manifested in terms of badges or stickers, as a symbol of rank. This can encourage students to become more competitive and therefore less lazy and more productive. (It helps that a lot of ICS students enjoy the incentives provided by video games.) This is also an example of the rewards and competitive multiplayer aspect of many popular video games.

CHAPTER 5

SURVEY RESULTS

The survey was conducted with 100 ICS students between January and April 2017. This represents roughly 22% of the current ICS student population. All participants were given the survey using Google Forms on an iPad, either immediately before or immediately after an ICS advising session.

5.1 Basic Information

What is your gender? (100 responses)

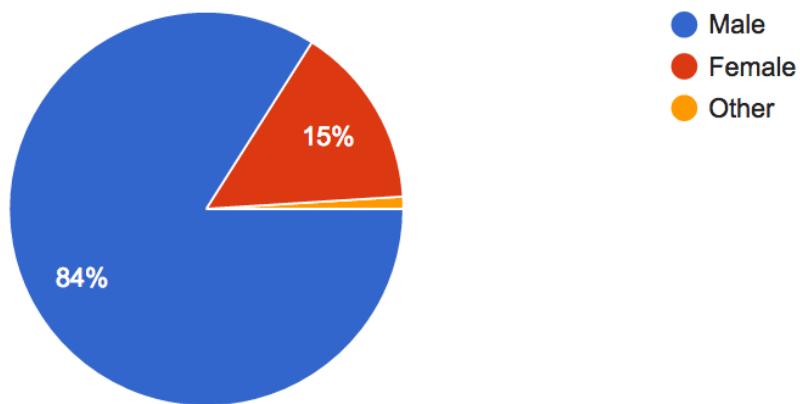


Figure 5.1: Gender distribution.

1. *What is your gender?* In Fall 2016, there was a total of 445 ICS students. Of the 445, 366 identified as male and 79 identified as female (Figure 5.1). This means that there was roughly 18% females and 82% males. The distribution of my survey has close proportions: 15% female, 84% male, and 1% other.
2. *What is your current status in the ICS degree program?* The two most represented groups in the survey are those that had completed 1-2 ICS courses (35%) and those that had completed 5 or more courses and expected to graduate within 3 or more semesters (29%) (Figure 5.2). 15% of students surveyed were either in or about to start their first semester of ICS. Together, students who were in the middle of the program (completed 3-4 courses or 5 or more courses

What is your current status in the ICS degree program? (100 responses)

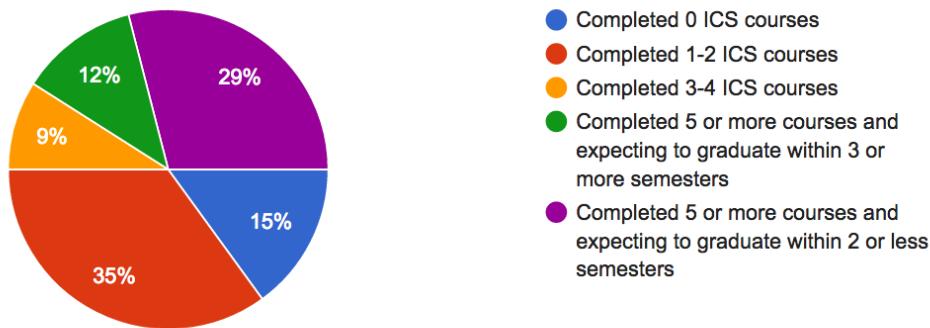


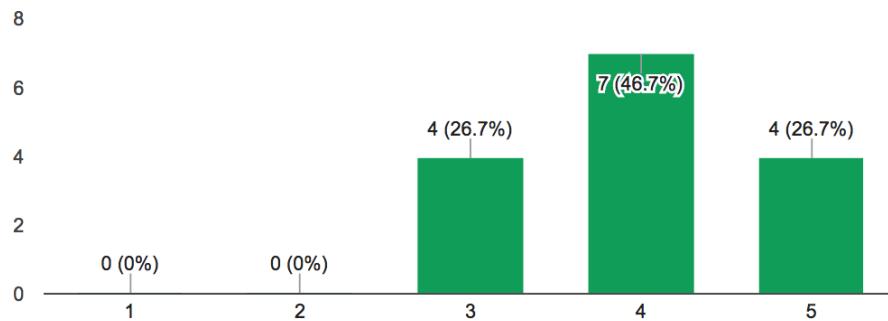
Figure 5.2: ICS program status distribution.

and expected to graduate within 3 or more semesters) comprised of 21% of the total population surveyed. The fact that most of the students surveyed were either in the beginning of the program or about to graduate can be attributed to the fact that these are the students that physically go in for advising the most.

5.2 Prospective ICS Students

1. *How EXCITED are you about entering the ICS program? Rank from 1-5.* The results of the survey show that all of the students surveyed felt either neutral or excited about entering the ICS program (Figure 5.3). No students stated that they were not excited. Further studies would be required to understand more behind the outside factors that affect incoming students' perceptions of the department.
2. *How INTIMIDATED do you feel about entering the ICS program? Rank from 1-5.* The results of the survey show that a majority of the students surveyed (12 out of 15) felt either neutral or intimidated about entering the ICS program (Figure 5.3). None of the females surveyed felt less than neutral in regards to intimidation, while three males did feel less than neutral. Further studies would be required to understand more behind the outside factors that affect incoming students' feelings towards the department, and to understand if there are any differences in feelings between genders.

How EXCITED are you about entering the ICS program? Rank from 1-5.
(15 responses)



How INTIMIDATED do you feel about entering the ICS program? Rank from 1-5.
(15 responses)

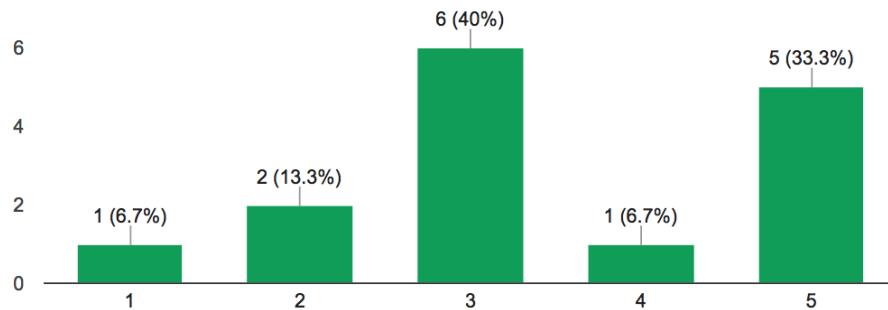


Figure 5.3: Results for prospective ICS Students survey

5.3 Current ICS Students

1. *Which of the following extracurricular activities, if any, pertain to you?* Survey results show that out of all the extracurricular activities, the most common was having an ICS related job (38 students), with a close second being doing an ICS-related project outside of class (35 students)(Figure 5.4). Participating in an ICS-related internship, hackathon, or open source project each had about 20 students (21, 22, and 20, respectively). Another 22 students hadn't participated in any extracurricular activities.

Another way to view this data is by the amount of extracurricular participation. In Figure 5.5, the results show the amount of extracurricular activities that each student participated in. A quarter of students (25.9%) participated in zero extracurricular activities. About a third

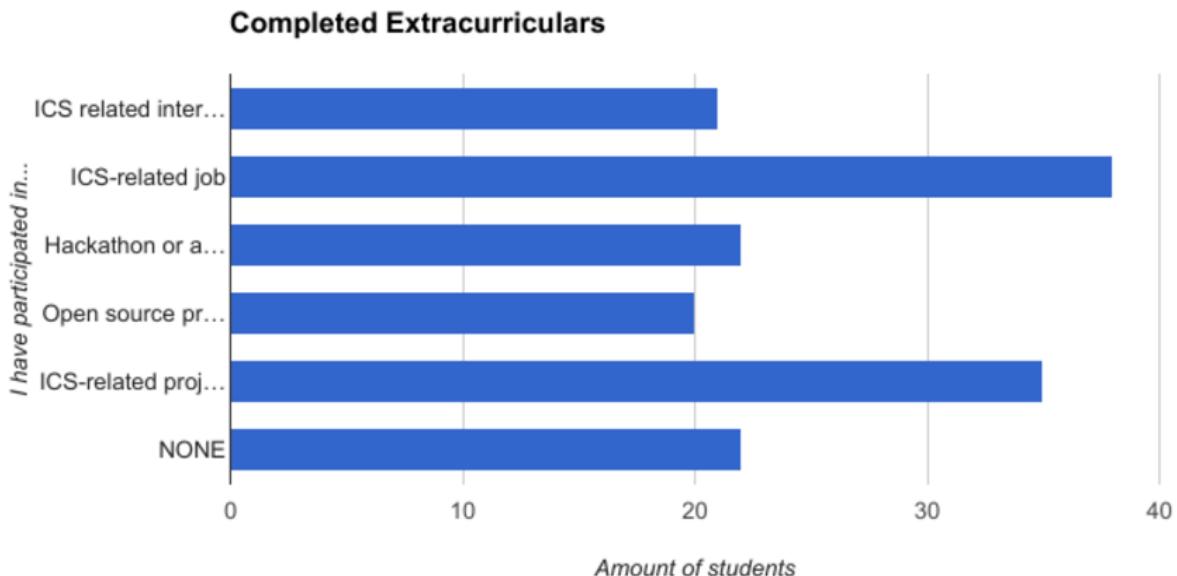


Figure 5.4: Results for extracurricular participation by event type.

of students (32.9%) participated in just one extracurricular activity. Overall, the amount of extracurricular activities is negatively correlated to the amount of students participating in them. To account for the fact that students in their first year of ICS are at a disadvantage when it comes to extracurricular participation (due to the lack of time and experience), Figure 5.6 looks at only those students who have completed at least 5 ICS courses. This graph shows that a majority of these students have participated in one extracurricular activity (40.6%). 21.9% of students have participated in two extracurricular activities, 15.6% of students have participated in 0 extracurricular activities, 15.6% of students have participated in five extracurricular activities, and 6.3% of students have participated in four extracurricular activities. While this data shows higher levels of participation with mid to graduating students, there are still a significant amount of students who are not participating in any extracurricular activities or participating in only one or two. Ideally, RadGrad will increase both the amount and diversity of extra curricular activities that each student participates in.

2. *Do you feel that you get enough support from others in the ICS department?* Survey results show that a majority of students (45 students) feel adequately supported in the ICS department (Figure 5.7). However, significant amounts of students desire more support in various areas. 25 students desire more support from professors, 19 students desire more support from their peers, 18 students desire more support from TAs, and 5 students desire more support

Amount of Extracurriculars (all students)

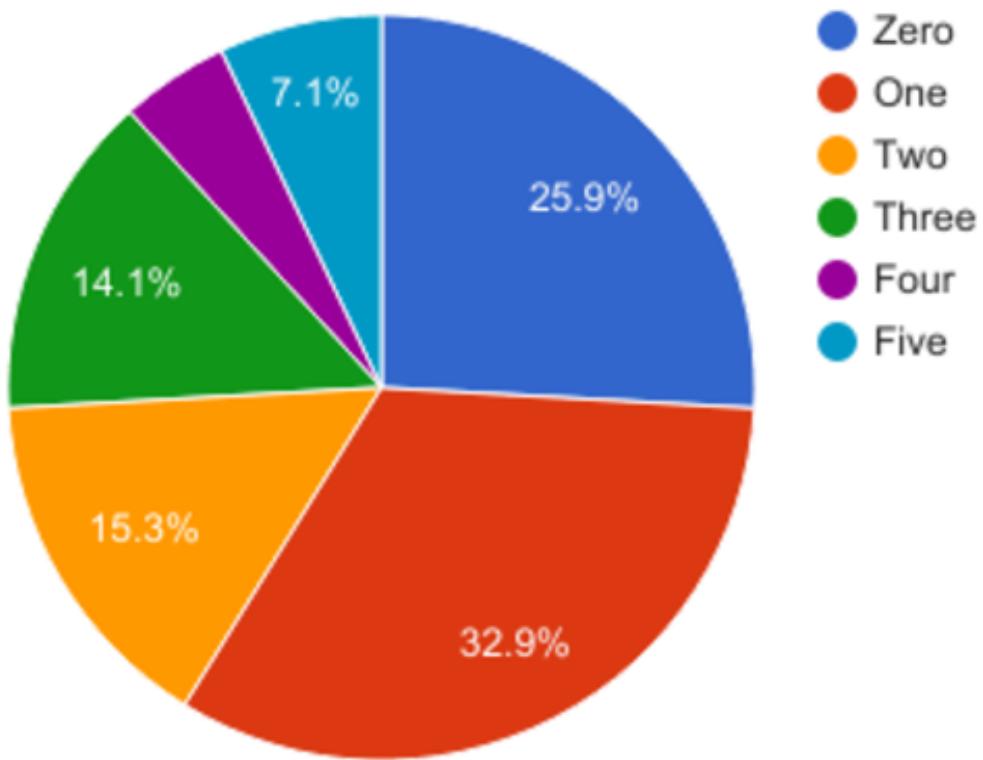


Figure 5.5: Results for extracurricular participation by amount of participation (all students).

from advisors. Additionally, 9 students stated that they often feel completely alone in the ICS department and only depend on themselves.

Another way to view this data is by the extent of the support requested. In Figure 5.8, the results show the amount of support requested by each student. This graph shows that almost half of the students did not request any further support (49.4%), while the other half requested further support from at least one group. 21.5% of students requested further support from one group, 13.9% requested further support from two groups, 13.9% requested further support from four or more groups, and 1.3% requested further support from three groups. Further studies could gather more information about exactly how students would like support to be given, and ideally after RadGrad, a majority of students will feel adequately supported, and less students will feel completely alone within the department.

Amount of Extracurriculars (mid to graduating students)

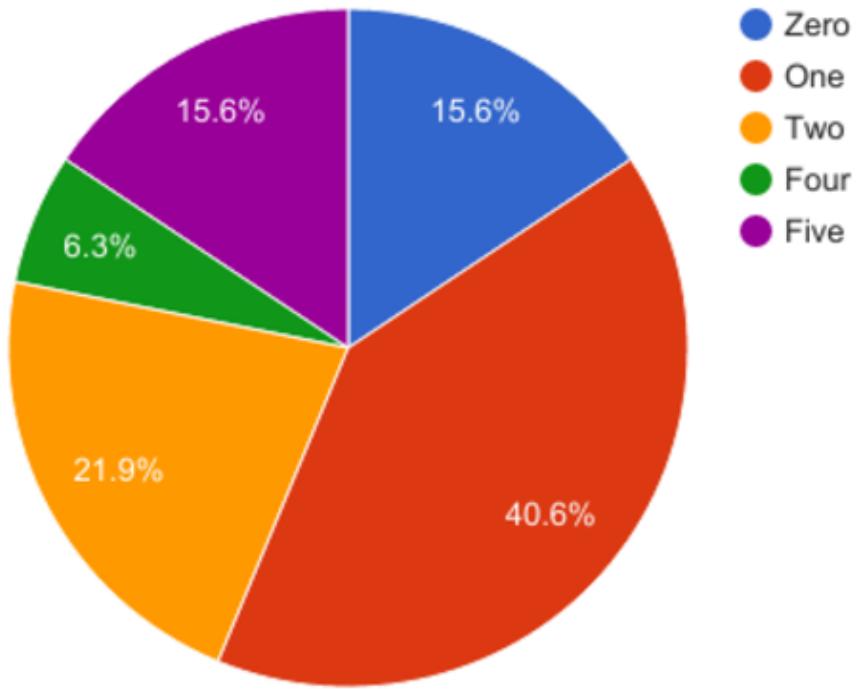


Figure 5.6: Results for extracurricular participation by amount of participation (mid to graduating students only).

3. As a student, do you feel like you have a voice to make changes within the department?

Results show that only a quarter of the students surveyed (24.7%) definitely felt like they have a voice to make changes within the department (Figure 5.9). Another quarter (24.7%) feel like they definitely do not have a voice to make changes, while about half (50.6%) only somewhat feel like they have a voice to make changes. While the current version of RadGrad does not directly address this issue, it may be addressed in future expansions on RadGrad, such as with the petition feature. In the future, further studies should be conducted to test whether RadGrad has an affect on whether students feel like they have a voice or not. Ideally, after RadGrad, more than 25% of the students will feel like they definitely have a voice to make changes within the department.

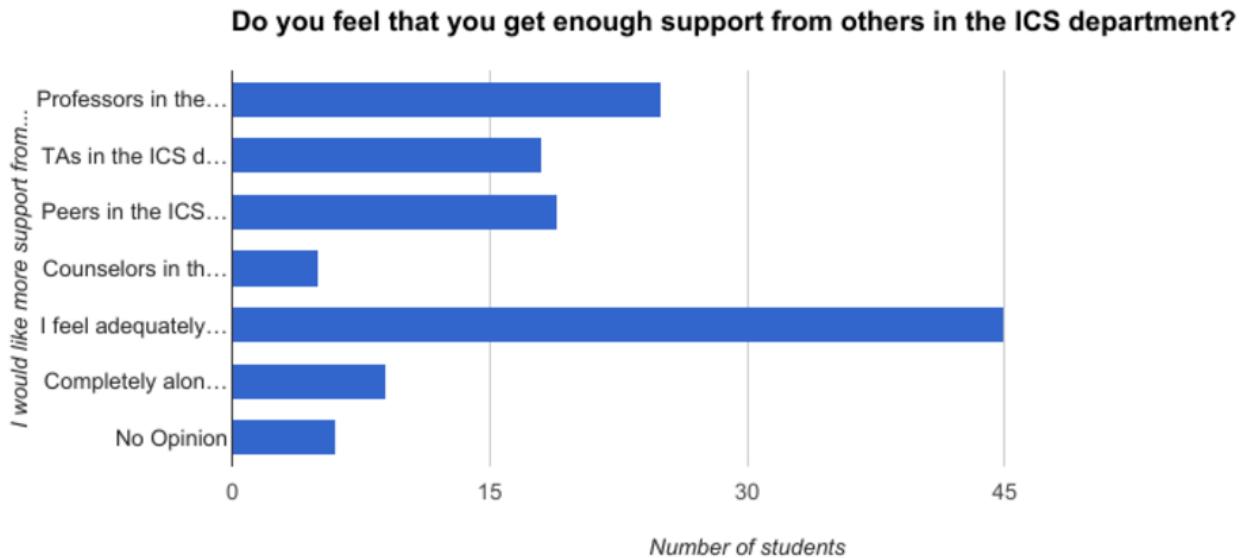


Figure 5.7: Results for support by types of support.

4. *What makes you proud to be a part of the ICS department?* Survey results show that a majority of students had at least one reason to feel proud to be a part of the ICS department. The most popular reasons (in order of decreasing popularity) were working on ICS related projects, associating with the people in ICS, surviving the rigorousness of ICS, and the prospect of finding a high paying job after graduation. The least popular reason, with only 11 students, was receiving ICS awards. Another 5 students chose “other” without giving a specific reason. Future studies can be held to see whether or not RadGrad increases the amount of pride within the ICS community. By enhancing the ICS experience overall, RadGrad will hopefully encourage students to view the department in a more positive way.

5.4 Current ICS Students: Influences

1. *To what extent have ICS alumni influenced your development in the ICS program?* Survey results show that a majority of students (58 out of 84 students) have not been influenced by alumni in any professional or academic way, while 20 out of 84 students have been influenced by an alumni to improve professional development, and 14 out of 84 students have been influenced by an alumni to pursue a major in ICS (Figure 5.11). This suggests that many current ICS students are not interacting with ICS alumni. Further studies should test to see if RadGrad adequately provides a way for more students to easily interact with and become influenced by alumni. In the future, this question could be changed to more broad in terms

How much support would you like more of in the ICS department? (Professors, Peers, TAs, Advisors)

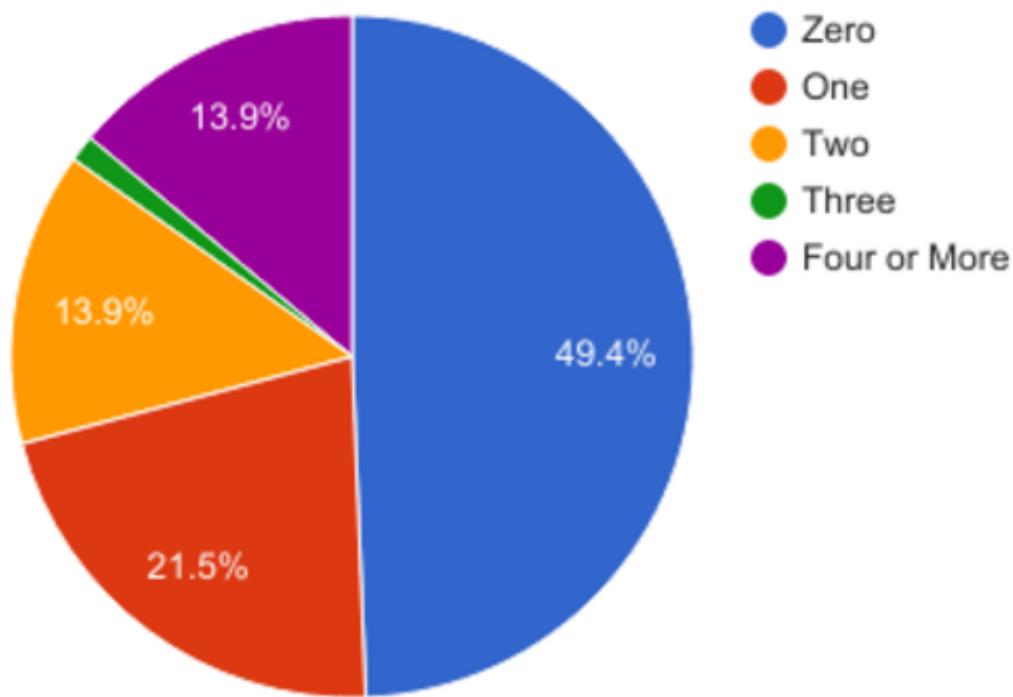


Figure 5.8: Results for support by amount of support desired

of academic and professional influence. Ideally, after RadGrad, a majority of students will have been influenced by alumni in either an academic or professional way.

2. *To what extent have ICS peers influenced your development in the ICS program?* Survey results show that a little less than half of students (37 out of 85 students) have not been influenced by their peers in any professional or academic way, while 33 out of 85 students have been influenced by a peer to pursue a major in ICS, and 29 out of 85 students have been influenced by a peer to improve professional development (Figure 5.12). This suggests that there is room for improvement when it comes to encouraging academic and professional collaboration among peers. Further studies should test to see if RadGrad adequately provides a way for more students to easily interact with and become influenced by each other. In the

As a student, do you feel like you have a voice to make changes within the department?

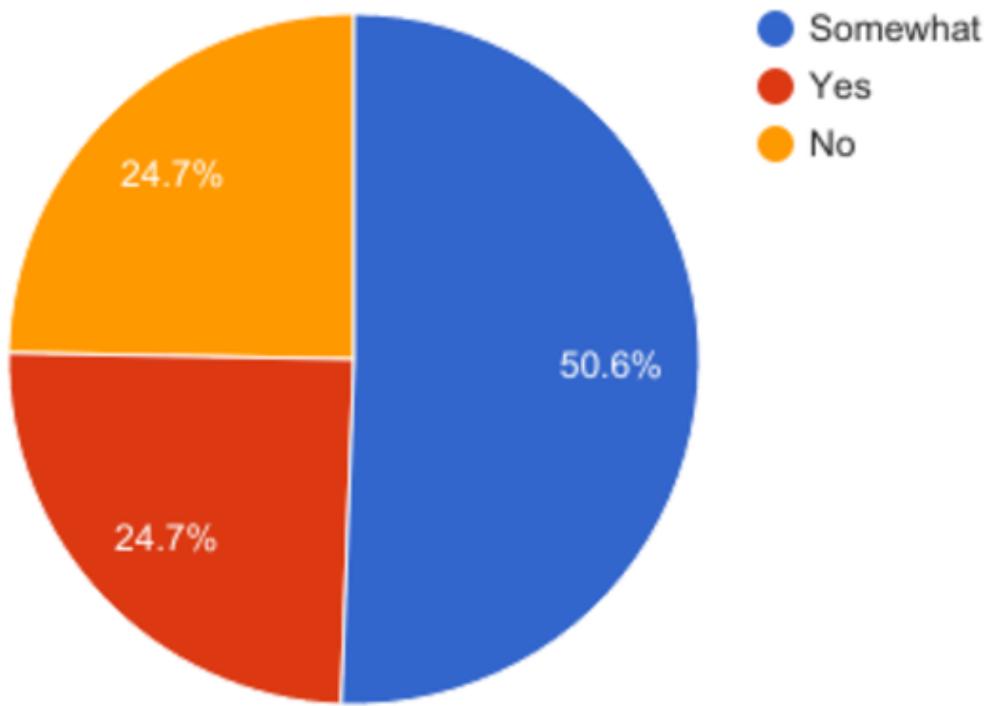


Figure 5.9: Results for feelings about having a voice to make changes.

future, this question could be changed to more broad in terms of academic and professional influence. Ideally, after RadGrad, at least 75% of students will have been influenced by a peer in either an academic or professional way.

3. *To what extent have you influenced your ICS peers development in the ICS program?* Survey results show that over half of students (49 out of 85 students) feel like they have not influenced their peers in any professional or academic way, while 27 out of 85 students feel like they have influenced a peer to improve professional development, and 25 out of 85 students feel like they have influenced a peer to pursue a major in ICS (Figure 5.13). This suggests that there is room for improvement when it comes to encouraging academic and professional collaboration among peers. Further studies should test to see if RadGrad adequately provides a way for more students to easily interact with and influence their peers. In the future, this question

What makes you proud to be a part of the ICS department?

85 responses

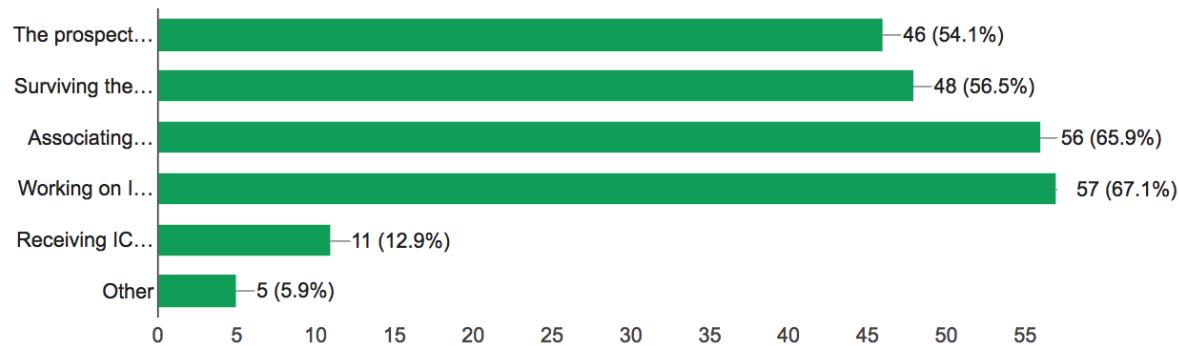


Figure 5.10: Results for reasons for being proud to be a part of the ICS department.

could be changed to more broad in terms of academic and professional influence. Ideally, after RadGrad, a majority of students will feel like they have influenced a peer in either an academic or professional way.

5.5 Graduating ICS Students

1. *Now that you are nearing the end of your ICS degree program experience, how well prepared do you feel to find a job after graduation?* Survey results show that only 20.7% of graduating students feel well prepared to find a job after graduation (Figure 5.14). 65.6% of graduating students feel adequately prepared, and 13.8% of students feel unprepared. This suggests that there is room for improvement when it comes to preparing students for the workforce in a way that makes them feel confident and prepared. Further studies should test to see if RadGrad's encouragement of collaboration and a well-balanced education (with both courses and opportunities) causes more students to feel well prepared to find a job after graduation. Ideally, after RadGrad, a majority of students will feel like they are well prepared to find a job after graduation.
2. *If you answered above that you feel unprepared to find a job after graduation, please explain why.* Figure 5.15 lists reasons that students have for not feeling well prepared to find a job after graduation. These reasons suggest that RadGrad could have a positive impact by encouraging students to pursue ICS related experiences outside of the classroom. Ideally, after RadGrad, the reasons given for not feeling well prepared will not focus on the lack of outside experience.

To what extent have ICS alumni influenced your development in the ICS program?

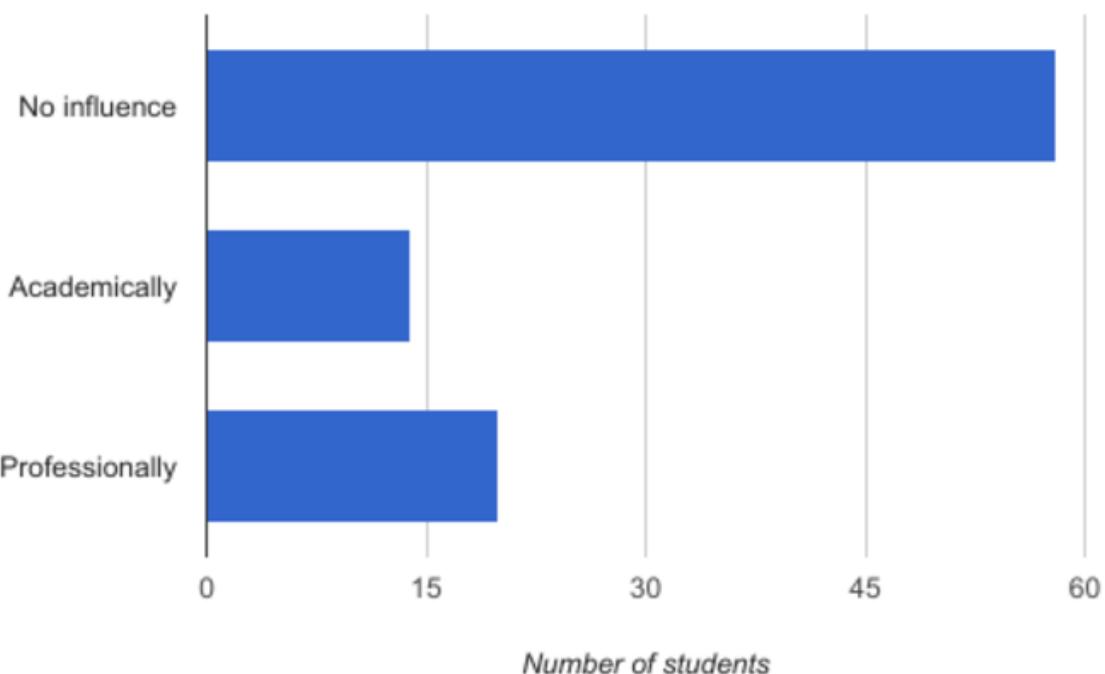


Figure 5.11: Results for alumni influence

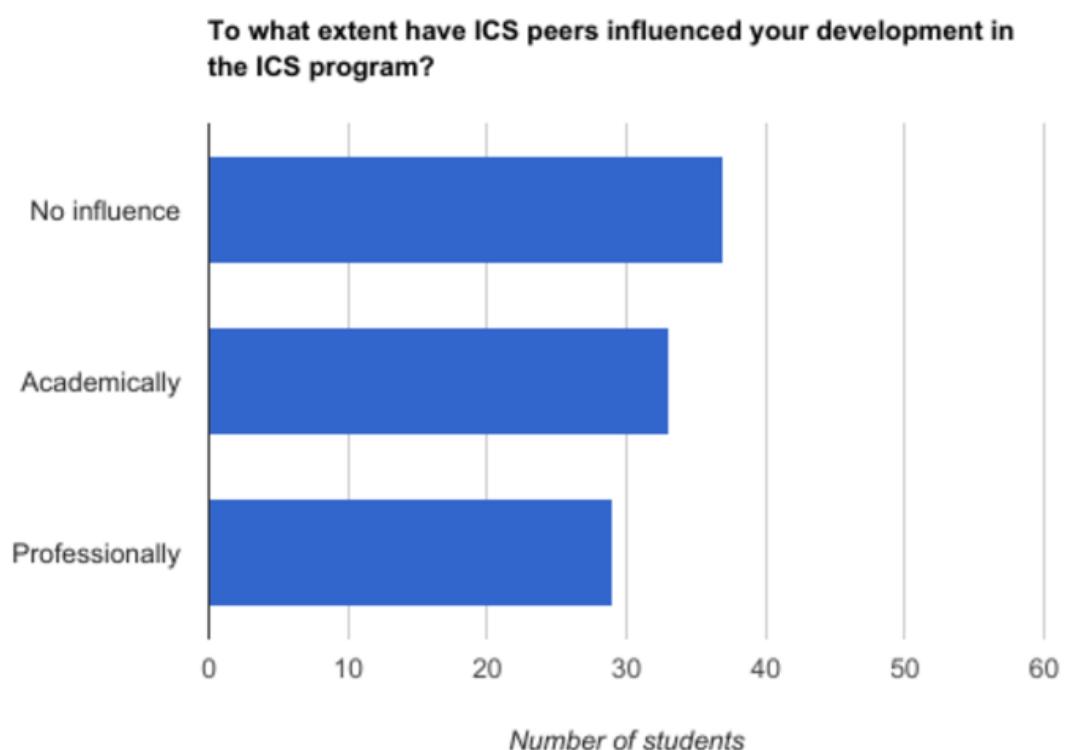


Figure 5.12: Results for peer influence

To what extent have you influenced your ICS peers' development in the ICS program?

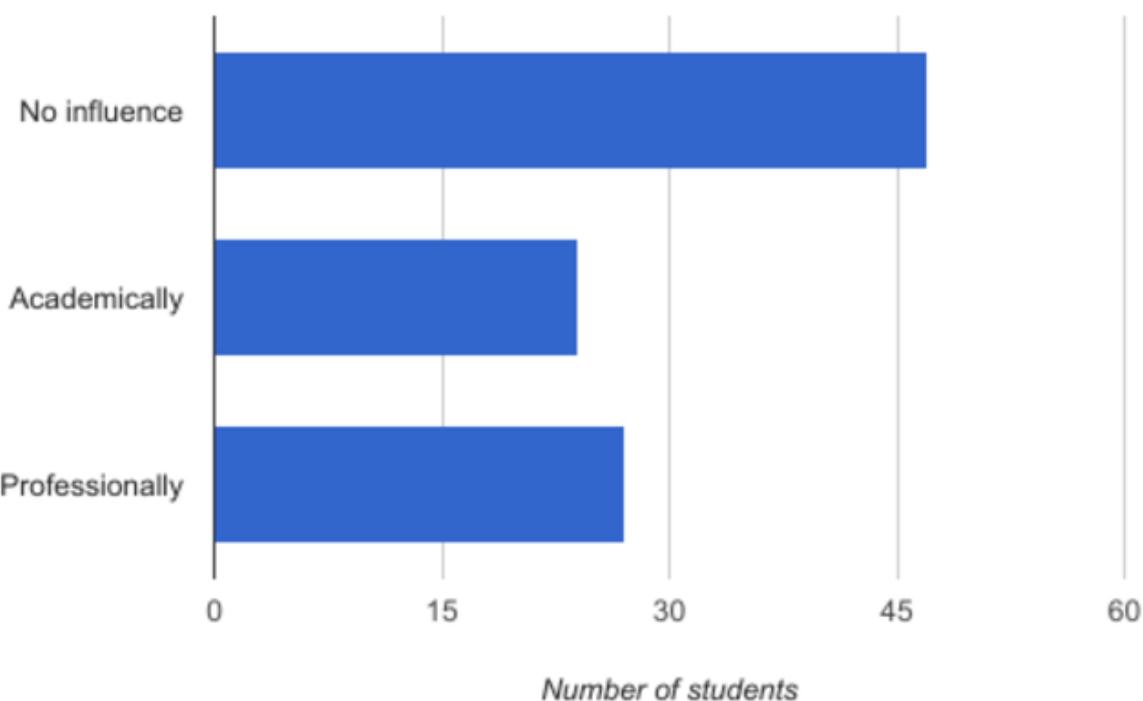


Figure 5.13: Results for student perceptions of their own influence

How well prepared do you feel to find a job after graduation?

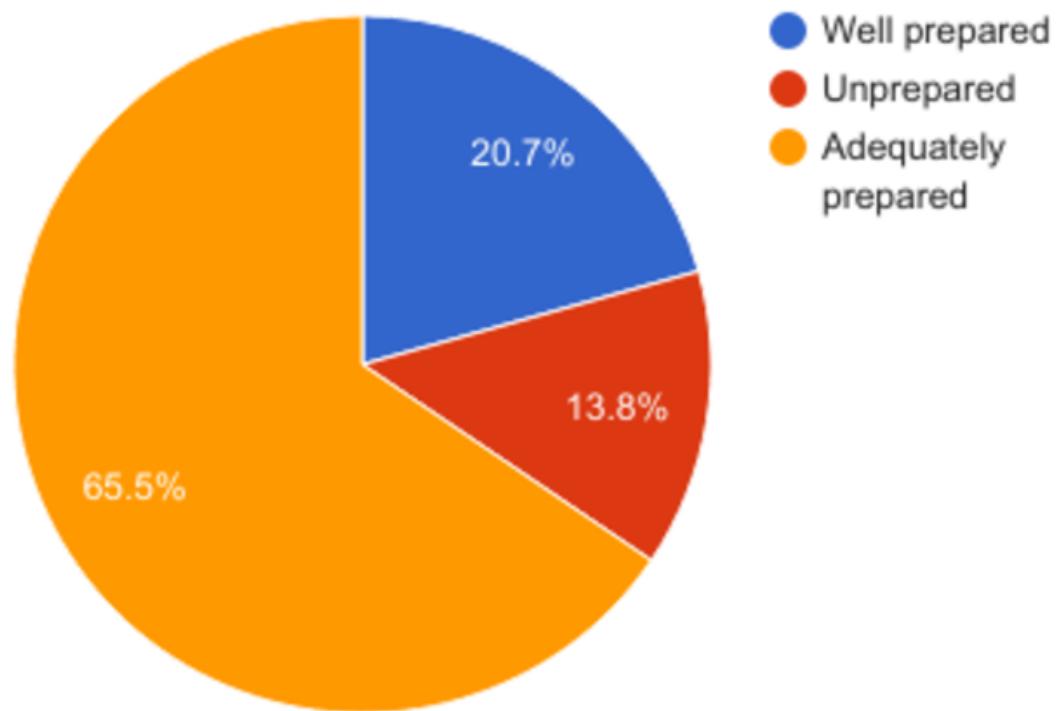


Figure 5.14: Results for graduation preparedness.

Slow coder

A lot of jobs require masters degrees or a high level of c++ knowledge.

No internship experiences, No big projects, No solid programming language skills (learned little bit of everything), Not much on resume :(

I've been so busy with school and obligations at home that I haven't had time to look for employment after.

Unprepared because of interviews and lack of coding ability

The ICS program lacks classes that drill the core concepts of data structure manipulation for interviews. I also would like an undergrad systems design course. The ICS program needs work. It also does not teach Angular or React which are sought by many companies.

Quality expected in jobs may not be what was expected in classes

After taking a year long LOA, I have less interest in my once desired field of software engineering. I haven't pursued any internships and it would become more difficult post grad. However my advisors and teachers have given me many tools necessary to be prepared so it is much more the fault of my own.

Feel like there's a little more to like resume building and networking

Figure 5.15: Reasons for not feeling prepared for graduation.

CHAPTER 6

SYSTEM RESULTS

6.1 Development

6.1.1 Frameworks and Environments

RadGrad was built using the Meteor JavaScript web framework. Meteor is integrated with MongoDB and uses the Distributed Data Protocol and publish-subscribe pattern to create real time, responsive code that automatically updates data changes to the client. On the client side, RadGrad uses jQuery and Semantic UI to design and create the user interface. Due to excellent Meteor integration, RadGrad was developed using IntelliJ IDEA. In an effort to create clean and uniform code, RadGrad uses ESLint to conform to the AirBnB Javascript Style Guide.

6.1.2 Project Management

We developed RadGrad using GitHub issues and GitHub projects. Development tasks are created as a GitHub issue, and each issue has an assigned developer and assigned branch. Each issue also resides in a GitHub project, which groups issues together to mark larger milestones. When the developer begins actively working on the issue, they will move the issue in the milestone from a “Backlog” column to an “In Progress” column. Once the developer completes the task in the specified branch, they will close the issue and move the issues in the milestone from the “In Progress” column to the “Done” column. The RadGrad developers typically communicate through Slack and in person meetings twice a week.

6.2 Data Model

6.2.1 Career Goals

Career goals represent possible ICS related careers that ICS students can aspire to get after graduation. Each career goal has an associated name, slug, description, related interests, and an optional URL for more information. Students can choose as many career goals as they want. Faculty and mentors can choose career goals that they would like to be associated with as well.

6.2.2 Courses

Courses represent all past, present, and future ICS courses. Each course has an associated name, short name, slug, course number, description, credit hours, related interests, a syllabus URL, a URL for more information, and associated prerequisites. The course name is the official name

Data Scientist	Database Administrator	DevOps Engineer
Full Stack Developer	Game Developer	Graduate School
Information Security Analyst	Information System Manager	IoT Architect
Mobile App Developer	Network Engineer	Research Scientist
Robotics Engineer	Software Developer	Startup Co-Founder
Teacher	UX Designer	VR/AR Engineer

Table 6.1: List of RadGrad career goals as of April 2017

appearing in the UH registration guide, and the course short name is used for display purposes. Students may add as many courses as they would like to their degree plan.

Course instances represent individual instances for each student. Each course instance has an associated semester, course, whether it has been verified or not, whether it came from STAR or not, grade, credit hours, note, student, and associated ICE points. A past course instance is always considered verified if it is from STAR. Course instances from STAR from the current or future semesters are not considered verified yet since there is no official grade. Special courses that are manually input (not from STAR) could also be considered verified by an advisor. A course instance has a note if it is not an ICS course. It is important to note that course instances on RadGrad are only valid on RadGrad, and students must use other methods to officially make UH course registration changes.

6.2.3 Desired Degrees

Desired degrees represent all past, present, and future ICS degrees. Each desired degree has an associated name, short name, slug, and description. Students can only choose one desired degree at any given time. However, they are free to switch desired degrees as many times as they want. It is important to note that desired degrees on RadGrad are only valid on RadGrad, and students must use other methods to officially change their declared degree at UH.

6.2.4 Degree Plan

Degrees plans represent all past, present, and future ICS degree plans. Each degree plan has an associated degree, name, effective semester, amount of courses per semester, and list of courses. Students can view degree plans if they would like a more specific focus than just a broad BS or BA degree. Examples of degree plans are “BS in Computer Sciences Security Sciences”, “BA in ICS Security Science Focus”, and “BA in Computer Sciences IT Focus.” Students can look at any plan at any time to see what they would need to do to fulfill it. It is important to note that these degree plans change over time, and a “BS in Computer Sciences Security Sciences” may be different in 2016 than in 2018. This is why both year and plan name must be chosen when selecting a plan.

6.2.5 Feeds

Feeds represent select actions of RadGrad users. Each feed has associated users, opportunity, course, semester, description, time stamp of the action, picture, and feed type. A feed could have one or multiple users. There are currently six different feed types: a new RadGrad user is added, a new course is added to RadGrad, a new opportunity is added to RadGrad, a user has been verified for completing an opportunity, a new course review has been added, and a new opportunity review has been added. These particular actions have been selected because they could be useful and of interest to other RadGrad users.

6.2.6 Feedbacks

Feedbacks represent recommendations and warnings for students. Each feedback has an associated name, slug, description, and feedback type. There are currently two feedback types: recommendation and warning.

Feedback instances represent individual instances for each student. Each feedback instance has an associated feedback, user, description, and area. There are currently four different areas: interests, ICE, STAR, and degree plan. Each time the student's plan changes, feedback instances in these areas are deleted and recalculated.

6.2.7 Help Messages

Help messages represent guidance for a particular RadGrad page. Each help message has an associated route name, title, and text. The text can contain actual text, images, and formatting. Each page (route name) can have at most one help message. These help messages are displayed at the top of the specified page, in a collapsible pane.

6.2.8 ICE

ICE represents a student's ICE points. Each ICE has an associated number for "I", "C", and "E." There are two types of ICE points: earned and planned. Earned "I" and "E" points are calculated by adding the "I" or "E" points for each verified opportunity in the student's plan. Earned "C" points are calculated by adding the "C" points for each verified course in the student's plan. The amount of earned points for each course depends on the grade that the student received; A's represent more points than B's. Planned "I" and "E" points are calculated by adding the "I" or "E" points for each unverified opportunity in the student's plan. Planned "C" points are calculated by adding the "C" points for each unverified course in the student's plan. A student's earned and planned ICE points are updated each time there are changes to the student's degree plan.

6.2.9 Interests

Interests represent possible ICS related interests that RadGrad users could have. Each interest has an associated name, slug, description, interest type, and a URL for more information. All RadGrad users may choose to be associated with as many interests as they would like.

.NET	Algorithms	Android
Application Development	Artificial Intelligence	Assembler
Bioinformatics	Biology	C and C++
C#	Civic Engagement	Cognitive Science
Computer Architecture	Computer Ethics	Computer Graphics
Computer Vision	Cryptography	Data Science
Data Visualization	Databases	Entrepreneurship
Game Design	Graphic Design	Hardware
High Performance Computing	Human-Computer Interaction	IT Management
Java	Javascript	Linux
Lisp	Machine Learning	Mobile Computing
Networks	Operating Systems	Parallel Programming
Perl	Prolog	Psychology
Python	R	Research
Robotics	Ruby	Software Development
SQL	Security	Sustainability
Teaching	Theory of Computation	Unity
Virtual Reality	Web Development	iOS

Table 6.2: List of RadGrad interests as of April 2017

6.2.10 Levels

Levels represent a student's RadGrad level. There are six possible levels, from Level 1 to Level 6. A student's level is calculated based off the amount of ICS courses they have passed, the amount of opportunities they have done, and the amount of reviews they have contributed on RadGrad. Levels can be recalculated for all users at any time through the administrator pages.

6.2.11 Advisor Logs

Advisor logs represent an interaction between an ICS advisor and a student. Each advisor log has an associated student, advisor, text, and date created. A new log can be created by the advisor whenever they have a meeting with a student. Advisors and students can use these logs to keep track of when meetings were held, and what occurred at these meetings.

6.2.12 Mentors

The mentor data model includes three parts: mentor profiles, mentor questions, and mentor answers. Each mentor profile has an associated mentor, company, career, location, LinkedIn, and a message about what motivated them to become a mentor. Each mentor will have exactly one mentor profile.

Each mentor question has an associated title, slug, student, whether it is moderated or not, whether it is visible or not, and moderator comments. Students can create as many mentor questions as they would like. However, each question needs to be approved by moderation in order to be visible to the public. Advisors and administrators have the ability to moderate questions. If a question is declined by moderation, the moderator can add reasons for the decline in the moderator comments field. The student can then see the feedback, and they are able to either edit their question and send it back to moderation, or simply discard the question. There is no limit to how long the back and forth process between student and moderator can go on.

Each mentor answer has an associated question, mentor, and text. Each mentor question can have any amount of mentor answers, but each mentor answer can answer at most one mentor question. Each mentor question can only be associated with exactly one mentor. There is no moderation process for mentor answers, and submitted mentor answers are automatically visible on RadGrad.

6.2.13 Opportunities

Opportunities represent all past, present, and future ICS related opportunities. Each opportunity has an associated name, slug, description, opportunity type, sponsor, related interests, icon URL, semesters available, event date, whether it is an independent study or not, URL for more information, and ICE points. Currently, there are five opportunity types: club, event, internship, online learning, and project. The opportunity sponsor is any faculty member who is the point of contact for the opportunity. If the opportunity occurs on a semester basis, it will have associated semesters. If the opportunity occurs on a specific date, it will have an associated event date. The amount of ICE points varies depending on the nature of the opportunity, and is determined by RadGrad administrators.

Opportunity instances represent individual instances for each student. Each opportunity instance has an associated semester, opportunity, whether it is verified or not, student, and ICE points. An opportunity instance can only be verified by a RadGrad advisor or faculty. Two students that each have an opportunity instance for the same opportunity could have different ICE points depending on the extent of their involvement in the opportunity.

6.2.14 Public Stats

Public stats calculate 24 different RadGrad statistics from the current database. The statistics calculated are: total courses, total career goals, list of career goals, total desired degrees, list of desired degrees, total interests, list of interests, total opportunities, total project opportunities, list of project opportunities, total users, total students, total faculty, total mentors, list of mentor professions, list of mentor locations, total course reviews, list of courses reviewed, total level one students, total level two students, total level three students, total level four students, total level five students, and total level six students. Public stats are automatically recalculated once each day at midnight.

6.2.15 Reviews

Reviews represent all course and opportunity reviews written by students on RadGrad. Each review has an associated slug, student, review type, reviewee, semester, rating (Figure 6.1), comments, whether it is moderated or not, whether it is visible or not, and moderator comments. There are two review types: course and opportunity. The reviewee refers to the course or opportunity that is being reviewed. Each review must have a rating from one to five stars. Each student may review a course once the semester they have taken it in has passed. Each student may review an opportunity once the opportunity has been verified. Each student can review each course or opportunity at most once. Each review is visible to the public by default, but can be removed by moderators. Advisors and administrators have the ability to moderate reviews. If a review is declined by moderation, the moderator can add reasons for the decline in the moderator comments field. The student can then see the feedback, and they are able to either edit their review and send it back to moderation, or simply discard the review. There is no limit to how long the back and forth process between student and moderator can go on. A student can also update their review at any time, but this will mean that the review will go through the moderation process again.

6.2.16 Roles

Roles represent the different user roles allowed in RadGrad. There are currently six roles: faculty, student, admin, alumni, advisor, and mentor. Currently, users are allowed to have exactly one role. All users except for admin and advisor can view only their own RadGrad pages. Advisors can also view student RadGrad pages, and admin can view all RadGrad pages.

6.2.17 Semesters

Semesters represent an academic semester at the University of Hawaii. Each semester has an associated term, year, number to sort by, semester number, and slug. There are three possible terms: Spring, Summer, and Fall. The number to sort by easily allows chronological comparisons

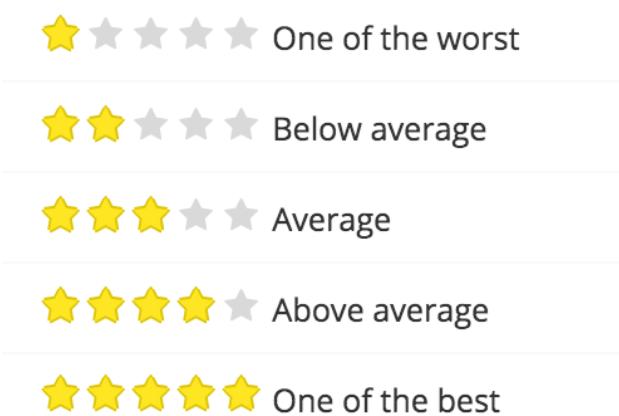


Figure 6.1: Course and opportunity review ratings.

between semesters. Semester number is another number used for sorting semesters, using 2010 as the earliest year.

6.2.18 Slugs

Slugs are strings used as part of a URL to uniquely identify an entity. These strings do not change with different instantiations of the database like docIDs do. Slugs are used in the RadGrad data model to represent relationships between different entities. Therefore, only collections that need to be referenced by other collections contain a slug.

6.2.19 Teasers

Teasers represent short videos that advertise an ICS opportunity. Each teaser has an associated title, slug, author, URL, description, duration, related interests, and opportunity. Any member of RadGrad can be an author of a teaser. Teasers are typically less than a minute long and function as a sort of quick advertisement to get potential students interested in participating in that particular opportunity.

6.2.20 Users

Users represent anyone who has created an account on the RadGrad system. Each user has an associated username, first name, last name, slug, email, password, UH ID, career goals, interests, desired degree, picture, level, website, hidden courses, and hidden opportunities. The user's RadGrad username is the same as their UH email name. This, along with their email, cannot be changed once the user's account is created. Only student users will have a desired degree and a level. Hidden courses and hidden opportunities are used to keep track of courses and opportunities

that students have actively “hidden” from their page. By keeping track of these hidden courses and opportunities, students can have the option to make them visible again.

6.2.21 Verification Requests

Verification requests represent a request from a student to get verification and ICE points for completing an opportunity. Each opportunity has an associated date, status, verifier, and feedback. There are three possible statuses: accepted, rejected, and open. The verifier is the user who has verified the event. Only advisors, faculty, and admin can be a verifier. If a request is rejected, the verifier can add reasons for the rejection in the feedback field. The student can then see the feedback and the results of the verification. If the verifier wishes to reopen the verification request, they may do so at any time. A student who would like to reopen a request will need to contact the verifier.

6.2.22 Academic Years

Academic years represent an academic year at the University of Hawaii. Each academic year has an associated year, spring year, student, and semesters. Since academic years start in the Fall and end in the Summer, they span two years: year, and spring year. A student on RadGrad must have an academic year for each year, or portion of a year, that they are enrolled in an ICS course or participated in an ICS opportunity.

6.3 Testing

6.3.1 Interactive Testing

RadGrad uses interactive server-side testing with Mocha test runner and Chai Expect Assertions during code production in order to maintain correctness. Each collection class from the data model has tests in a corresponding testing file. These tests include checking if a new collection entity can be defined, if a collection entity can be removed, if a collection entity can be dumped from the database, and if a collection entity can be restored from a dump file to the database. If the collection class includes additional functions specific to that collection, the test file includes tests for those functions as well.

6.3.2 Personas

In order to ensure that a wide variety of students will be able to use RadGrad effectively, we created five personas, where each persona is represented with a student user account on RadGrad. Each persona represents a student at a different part of the degree program. Below are brief descriptions of each persona.

1. Ella Zwick: Ella is a Freshman who has just declared her BA ICS major. She has not taken any ICS courses yet, and she does not have a RadGrad degree plan yet either. She is at Level 1. Her career goal is to be a web developer, and her interests are in civic engagement and web development.
2. Charley Sherry: Charley is a Freshman who is in his second semester of the BS CS curriculum. He is currently enrolled in ICS211 and ICS241. He is at Level 2. His career goal is to be a data scientist, and his interest is in bioinformatics. He has at least 12 competency points for completing ICS111 and ICS141 during the previous semester.
3. Betty Keanu: Betty is a Junior who has completed the BS CS core curriculum (ICS111, ICS141, ICS211, ICS241, ICS311, ICS314) and is currently taking 300+ courses to fulfill the rest of her degree plan. She is at Level 4. Her career goals are graduate school and data scientist, and her interests are big data, visualization, and research. She has completed a few opportunities, and has at least 30 innovation points, at least 36 competency points, and at least 30 experience points.
4. Abigail Kealoha: Abigail is a Junior who is two semesters away from graduating with her BS in CS. She is Level 5. Her career goal is to be a web developer, and her interests are security and software engineering. She has completed several opportunities, and has at least 80 innovation points, at least 80 competency points, and at least 80 experience points. Abigail has also contributed one course review on RadGrad.
5. Alfred Persona: Alfred is a Senior in his last semester of the BS CS curriculum. He is at Level 6. His career goal is a software developer and his interests are in game design, hardware, and virtual reality. He has completed many opportunities, and has at least 100 points for each of the ICE categories. Alfred also contributed 6 course reviews on RadGrad.

6.3.3 Beta Testing

In Spring 2017, after completion of the major Student, Advisor, and Administrator components and pages, we held RadGrad beta tests, which invited selected students and an advisor to view and use the system for the first time. The main goals of these tests were to identify user problems, identify common aspects users like, assess if parts of the user interface are more intuitive or more difficult to use, if there are missing features that should be implemented, if certain features could be improved, and to get a feel of whether users feel that they would use RadGrad and that it would improve their engagement in the ICS degree program. We hoped this data would help us decide if the system so far is going in a promising direction.

6.3.3.1 Student Beta Testing

Student subjects were solicited over email, and were selected in a way that provided us with a wide range of student levels. Each student was given \$20 as compensation for 30 minutes of their time. Prior to the testing session, each subject provided their name and UH account, completed ICS courses, completed opportunities, interests, and career goals. Using this information, the student's RadGrad account was set up prior to the session. Each session involved one student and two RadGrad developers (an evaluator to lead the session, and an observer). At the start of the session, the evaluator briefly went over the basic ideas of the system and the different parts that they can interact with. During the second part of the session, the student was allowed to peruse the system and explore or comment on anything they found particularly interesting. During the third part of the session, the evaluator asked the student to describe what they liked about the system, what they disliked about the system, and whether or not they think they would use this system if it were available to them. See Table 6.3.

6.3.3.2 Advisor Beta Test

It was easier to solicit an advisor for the beta test, since Gerald Lau is currently the only ICS advisor. During his session, the evaluator briefly went over the system from the point of view of both students and the advisor. While Gerald did not actually get to interact with the system himself, he was able to see how it would be used, and he was able to give feedback about his perceived usefulness of the system. Gerald's response was positive overall, and he seemed interested in integrating it into future advising.

6.4 Student Mode

6.4.1 Degree Planner

6.4.1.1 Degree Planner

The student degree planner is the main place that students will go to view and make changes to their entire degree plan. Students can view up to four academic years at a time, but they can view additional past or future years by clicking on the green arrows at the bottom. Semesters that are in the past are greyed out and cannot be changed by the student. Any present or future semesters can be changed by dragging and dropping courses or opportunities into that semester pane. The grades for a course can be changed with the drop down menus. This page also includes an inspector pane on the top right hand corner, which the student can use to view brief details about a course or opportunity while planning their degree. The in-depth course and opportunity explorer pages can be accessed through the inspector, but the short descriptions in the inspector allows for quick and convenient assistance within the same view as the degree planner itself. The student can choose a

course or opportunity to inspect by either choosing from the green dropdown menu at the top of the inspector, or by clicking on the course or opportunity name within the plan.

Below the inspector is the academic plan pane. In this pane, students can select a year and an academic plan name (i.e. B.S. in Computer Science Security Science) to indicate the degree plan that they would like to follow. The pane then displays the required courses for this plan, organized into the recommended semesters, and color coded (green for classes in the student's plan, and red for classes not in the student's plan). Students can use this display to easily drag their missing courses onto their plan.

Figure 6.2: Degree Planner page.

6.4.1.2 Recommendations and Warnings

The student degree planner automatically generates warnings and recommendations on the bottom right hand corner. These warnings and recommendations change as a student's degree plan changes. Each time a student adds, moves, or removes a course or opportunity through the degree planner, explorer, or student home page, the warnings and recommendations will regenerate.

On the student home page, students can see details about recommended courses and opportunities as soon as they log in. These are chosen based off the student's chosen interests and career goal related interests. If a student is interested in a particular course or opportunity, they can choose to view more in the explorer, add it to their plan, or leave it there to decide what to do

with later. If a student knows they are not interested in a certain course or opportunity, they can choose to hide it by clicking the "hide" button. If the student later changes their mind, they can view and unhide the course or opportunity by clicking "Hidden Opportunities."

6.4.1.3 Career Goal, Course, Desired Degree and Opportunity Explorers

The screenshot shows the RadGrad software developer career goal explorer page. At the top, there's a navigation bar with 'RADGRAD' logo, 'HOME', 'DEGREE PLANNER', 'EXPLORER' (which is highlighted in green), and 'MENTOR SPACE'. On the right, there are user icons for 'ABIGAIL REAUCHA' and a 'referrals' button. Below the navigation, a dropdown menu is open under 'Career Goals' showing 'MY CAREER GOALS' (Data Scientist, Software Developer) and 'ALL OTHER CAREER GOALS' (Database Administrator, DevOps Engineer, Full Stack Developer, Game Developer, Graduate School, Information Security Analyst, Information System Manager, IoT Architect, Mobile App Developer, Network Engineer, Research Scientist, Robotics Engineer, Startup Co-Founder, Teacher, UX Designer, VR/AR Engineer). The main content area is titled 'SOFTWARE DEVELOPER' and contains a 'Description' section with text about the career goal, related interests like 'Application Development' and 'Software Engineering', and links to 'More Information' and 'Software Engineers'. Below this, there are four sections: 'STUDENTS - 29' (with a grid of student icons), 'FACULTY MEMBERS - 8' (with a grid of faculty icons), 'ALUMNI - 0' (empty), and 'MENTORS - 8' (with a grid of mentor icons).

Figure 6.3: Career Goal Explorer page.

Students can access the career goal, course, desired degree, and opportunity explorers to help them plan their degree. These explorers can be accessed through the "Explorer" top menu on the student home page. The specific explorer can be chosen using the dropdown menu on the left side.

The career goal explorer lists all RadGrad career goals on the left side. These career goals are arranged by "My Career Goals" (career goals that the user has added) and "All other career goals" (career goals that the user has not added). The user can click on a career goal to view details about that career goal. These details include a description of the career goal, related interests, related courses and/or opportunities, a link for more information, interested students, interested faculty, interested alumni, and interested mentors. On this page, the user can also add or remove the career goal by clicking on the green button at the top right corner.

The course explorer lists all RadGrad courses on the left side. These courses are arranged by "Courses in my Plan" (all past, present or future courses in the student's degree plan) and "All Other Courses" (courses not in the user's degree plan). The user can click on a course to view details about that course. These details include course number, a link to the syllabus, credit hours, a description of the course, prerequisites, organized into three categories (completed, in plan but not yet completed, and not in plan), and a list of students with this course in their degree plan. On this page, users can also view course reviews from other students and add or edit their own course review. The user can add or remove this course from their degree plan by clicking on the green button at the top right corner. If the user has already taken and passed the course, they cannot add it again.

The screenshot displays the Course Explorer page of the RadGrad system. At the top, there's a navigation bar with links for HOME, DEGREE PLANNER, EXPLORER (which is the active tab), and MENTOR SPACE. On the right side of the header, there are icons for academic degrees (90, 120, 45) and user profiles (Betty, Meau, and a green 'Edit' button).

COURSES IN MY PLAN

- Algorithms
- Bioinformatics I
- Comp Sci I
- Comp Sci II
- Data Processing
- Data Visualization
- Databases I
- Discrete Math I
- Discrete Math II
- Microprocessors
- Probability & Statistics
- Program Structure
- Programming Languages
- Software Eng I

ALL OTHER COURSES

- AI Programming
- AI for Games
- Analytics Models
- Application Frameworks
- Artificial Intelligence
- Bioinformatics II
- Cognitive Science
- Comp Sci Concepts
- Computer Architecture
- Computer Graphics
- Computer System Security
- Computer Vision
- Concurrent Programming
- Cryptography I
- Data Networks
- Databases II
- Design for Mobile Devices
- Digital Tools
- Ethics for LAI
- Game Design
- HCI
- Hypermedia
- Independent Study
- Intro to CS
- Intro to Web Programming
- Machine Learning
- Networks
- Operating Systems
- Parallel Algorithms
- Robotics
- Science of Systems Design
- Scripting
- Security & Ethics
- Security & Trust I
- Security & Trust II
- Software Eng II
- Special Topics
- Special Topics: Security
- Systems Programming
- Theory of Computation

DISCRETE MATH II (Discrete Mathematics for Computer Science II)

Course Number: ICS 241 **Credit Hours:** 3

Description: Program correctness, recurrence relations and their solutions, divide and conquer relations, relations and their properties, graph theory, trees and their applications, Boolean algebra, Introduction to formal languages and automata theory.

Prerequisites:

✓ Completed	△ In Plan (Not Yet Completed)	▢ Not in Plan
Discrete Math I	None	None

COURSE REVIEWS

You have not reviewed this yet. [Add Review](#)

Alfred Persona Spring 2014

Erik Huang Spring 2013

Joshua Wiedick-Myers Spring 2013

Anh Lam Fall 2016

Russell Ome Fall 2015

Zachary Koenig Fall 2016

IN DEGREE PLAN - 9

Figure 6.4: Course Explorer page.

The degree explorer lists all possible ICS degrees on the left side. These degrees are arranged by “My Desired Degree” (the student can only have one desired degree at a time), and “All Other Degrees” (degrees not currently chosen as the user’s desired degree). The user can click on a degree to view details about that degree. These details include a description, where to go for more information, and a list of students who have this degree listed as their current desired degree. On this page, users can set a new degree goal by clicking on the green button at the top right corner.

The interest explorer lists all possible RadGrad interests on the left side. These interests are arranged by “My Interests” (interests that the user has added), “Career Goal Interests” (interests that have automatically been added due to their association with one or more of the user’s chosen career goals), and “All Other Interests” (interests that the user has not added and are not related to any of the user’s career goals). The user can click on an interest to view details about that interest. These details include a description of the interest, related courses and related opportunities, both organized into three categories (completed, in plan but not yet completed, and not in plan), and

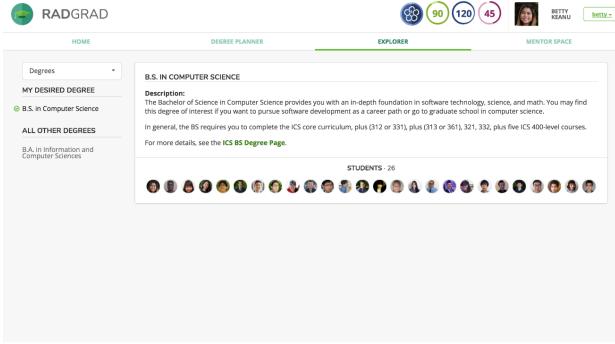


Figure 6.5: Degree Explorer page.

students, faculty, alumni, and mentors who have added this interest. On this page, users can also add or remove the interest by clicking on the green button at the top right corner.

The opportunity explorer lists all ICS opportunities on the left side. These opportunities are arranged by “Opportunities in my Plan” (all past, present or future opportunities in the user’s degree plan) and “All Other Opportunities” (opportunities not in the user’s degree plan). The user can click on an opportunity to view details about that opportunity. These details include the opportunity type, semesters offered, event date, faculty sponsor, a description of the opportunity, related interests, a teaser video, and a list of students with this opportunity in their degree plan. On this page, users can also view opportunity reviews from other students and add or edit their own opportunity review. The user can add or remove this opportunity from their degree plan by clicking on the green button at the top right corner. Unlike courses, users can add an opportunity to their plan as many times as they would like.

6.4.1.4 Teasers

Teasers are short (around 30 seconds) YouTube videos created by members of RadGrad to advertise their opportunity to the rest of RadGrad. Faculty members can create a teaser to help give students an idea of what their current research is about, and students can create a teaser to help give students an idea of what their club or event does and why other students should participate. These teasers supplement the textual opportunity descriptions in the explorer, and appear on the student’s home page based off matching interests.

6.4.2 Social Network

6.4.2.1 Avatars

RadGrad quietly reminds users that they are not alone in using the system—they are part of a large and diverse network of real people. One of the ways RadGrad does this is by incorporating user avatars around the site. These avatars appear on the student home page, explorer pages, the

Figure 6.6: Opportunity Explorer page.

user explorer, the student levels page, and the MentorSpace page. These avatars appear to show users related to a certain interest, career goal, course, opportunity, degree, and level. They also are associated with feed items, reviews, and MentorSpace answers. All avatars can be clicked on to navigate to the user's profile in the user explorer.

6.4.2.2 Feed

Another way RadGrad reminds users that they are not alone in using the system is by providing a feed on the student home page. The feed is one of the first things that a user sees when they log in. Through this feed, users can see events occurring throughout RadGrad such as a new user joining RadGrad, a new course or opportunity is added on RadGrad, a user is verified for an opportunity, or a user has written a new course or opportunity review. The feed provides a single place for students to go to when they want to see what has changed since they have last logged in, and it

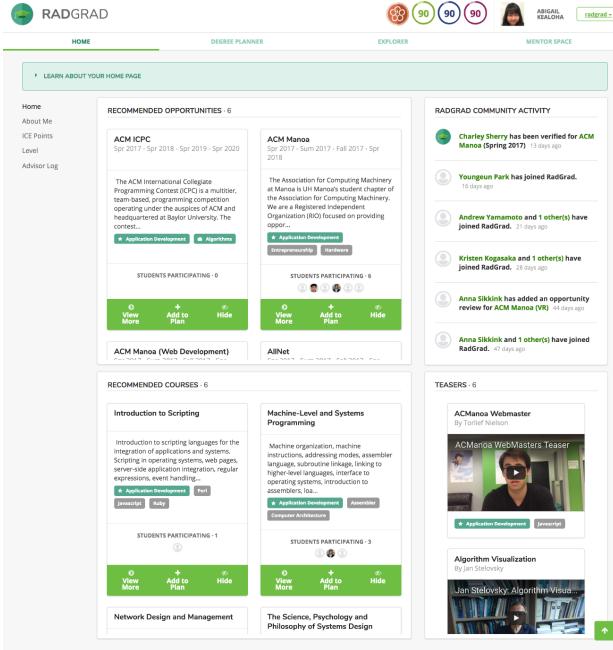


Figure 6.7: Student Home page with Teasers, Feed, and Recommended Courses and Opportunities.

constantly keeps students updated with the latest changes to the system. Since the feed also allows students to see what other students have been doing, they may be able to get a quick sense of what opportunities are popular among their classmates.

6.4.2.3 Mentorspace

Mentors and students can interact with each other on the MentorSpace page. The mentors are listed in the Mentor Directory on the right side of the page. Students can explore who the mentors are by expanding their profile and viewing information about their current company, current location, current job title, email address, LinkedIn, and a description about what inspired them to become a RadGrad mentor. On the left side of the page, students can submit new questions that they have for a mentor. Once the question has gone through moderation (by Administrators), it will be posted on the MentorSpace for everyone to see. If a question is rejected, it can be edited and resubmitted as many times as desired. A question may be rejected if it contains profanity, is unclear, or is unrelated to ICS. Once a question is posted, mentors can leave an answer for the rest of the community to see. If a student has a specific question for a specific mentor, they can instead contact the mentor through the provided email rather than posting on MentorSpace, which is reserved for questions that can benefit the general ICS student community.

Figure 6.8: MentorSpace page.

6.4.2.4 Advisor Log

Advisors and students can interact with each other on the Advisor Log page. When an advisor holds a meeting with a student, he can leave notes from the meeting on the student's Advisor Log. Each log includes a date, the name and avatar of the advisor, and the meeting notes. Advisors can use the log to keep track of their interactions with each student, and students can refer back to the log whenever they can't remember details about what their advisor had said.

6.4.2.5 Reviews

Students can post two different types of reviews: course reviews and opportunity reviews. Students can leave reviews for a specific course or opportunity on the course or opportunity explorer page. Students can leave a 1-5 rating and reasons behind their rating. Students can edit or delete their review at any time. Any new or edited reviews immediately appear on the explorer page, but when they go through moderation, they may be removed if they do not abide by the guidelines. Reviews cannot be anonymous, which forces students to take full responsibility for whatever they decide to post. This, along with the fact that all users on RadGrad can view reviews, allows for full transparency between professors and students. Students can view other students reviews to get additional, first hand and anecdotal information about a course or opportunity before they decide to add it to their plan. Faculty and advisors can view reviews to gather feedback about how to improve the ICS program.

The screenshot shows the 'LEARN ABOUT THE ADVISOR MEETING LOG' section. It lists several entries:

- Wed Jan 11 2017**: Results from the meeting with Gerald. Updated RadGrad STAR data. Keep up the good work! Still on track to graduate Spring 2018.
- Tue Aug 30 2016**: Results from the meeting with Gerald. Updated RadGrad STAR data. Congratulations on leveling up to Level 5!
- Tue Jan 26 2016**: Results from the meeting with Gerald. Updated RadGrad STAR data. Congratulations on leveling up to Level 4! I recommend you check out the GenCyber Internship for this summer.
- Fri Nov 06 2015**: Results from the meeting with Gerald. Make sure to sign up for ICS212 and ICS321 next semester to fulfill prerequisites for upper level courses.
- Mon Aug 24 2015**: Results from the meeting with Gerald. Updated RadGrad STAR data. Congratulations on leveling up to Level 3!
- Fri Jan 09 2015**: Results from the meeting with Gerald. Updated RadGrad STAR data. Congratulations on leveling up to Level 2! Keep up the good work.
- Tue Aug 25 2014**: Results from the meeting with Gerald. Set up RadGrad account. Congratulations on your Level 1 RadGrad sticker! Check out the Greyhats meeting every Friday afternoon if you are still interested in learning about security.

Figure 6.9: Student Advisor Log page.

The screenshot shows the 'CHOOSE USER' section. It lists users categorized by type:

- Advisors**: Kyungmin B..., Eda Biag... (selected), Kim Blisted, Henri Cas...
- Alumni**: David Chin, Martha Cr..., Philip Jo..., Jason Leigh...
- Faculty**: Dapeng Li, Ulyssew Lim, Dusko Pav..., Goyaline ...
- Mentors**: Scott Roth..., Peter-Mil... (selected), Nodari St..., Jon Steele...
- Students**: Suzanne S..., Kaitao Sug..., Daniel Su...

Details for the selected user, **Eda Biagioni**, are shown on the right:

- EDUCATION**: Graduate School, Research Scientist
- EXPERIENCE**: Network Engineer, Mobile Computing, Networks, Research
- INTERESTS**: Graduate School, Network Engineer, Research Scientist, Mobile Computing, Networks, Research

Figure 6.10: User Explorer page.

6.4.2.6 User Explorer

The user explorer lists all RadGrad users with their first name, last name, and avatar. Users are arranged in tabs by user type (Advisor, Alumni, Faculty, Mentor, Student) and then listed alphabetically by last name. The current user can click on a user to view details about that user. For student users, these details include desired degree, email, level, taken and planned courses, and completed and planned opportunities. For faculty users, these details include their email, a link to their website, and interests. For mentor users, these details include their email, their MentorSpace answers, and their interests. For advisor users, these details include their email and their interests. Students can use this explorer to learn more about other members of the RadGrad community, and figure out who might be beneficial to talk to (i.e. a higher level student with matching interests and interesting completed opportunities, or a faculty member with matching interests, or a mentor

working at the student's dream company).

6.4.3 Gamification

6.4.3.1 ICE

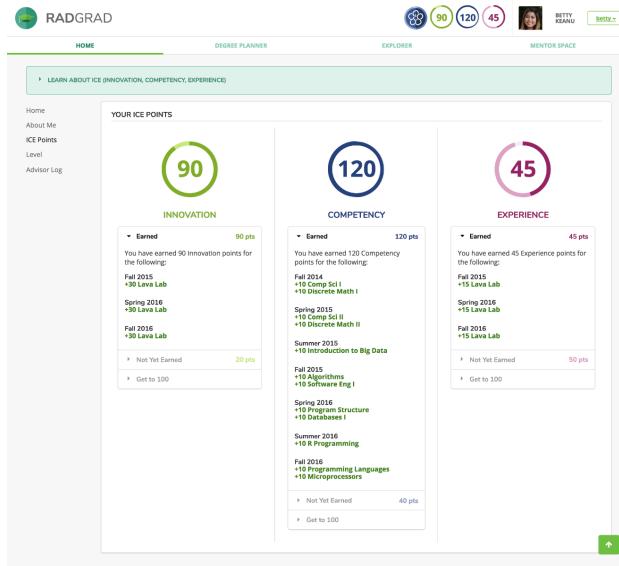


Figure 6.11: ICE page.

The student ICE page displays three circular graphs: one each for innovation, competency, and experience. The number in the center of each graph represents the current amount of points earned for that category. The dark fill in the graph represents the same number. The light fill on the graph represents the amount of planned points. In addition to the student ICE page, these ICE graphs also appear in the top right corner of the menu bar.

ICE points are also represented for specific courses or opportunities. These ICE points are represented using three filled circles: one each for innovation, competency, and experience. Each circle has a number in the center which represents the amount of points that course or opportunity is worth for that particular ICE category. Students can use these ICE representations to decide which courses or opportunities they should add to their plan, in order to improve their ICE score. These representations appear on the degree planner inspector pane and in the course and opportunity explorer pages.

6.4.3.2 Levels

Students can view their current level badge on the student level page. This page also includes leveling up hints and a list of other students who are at the same level (listed with avatars).

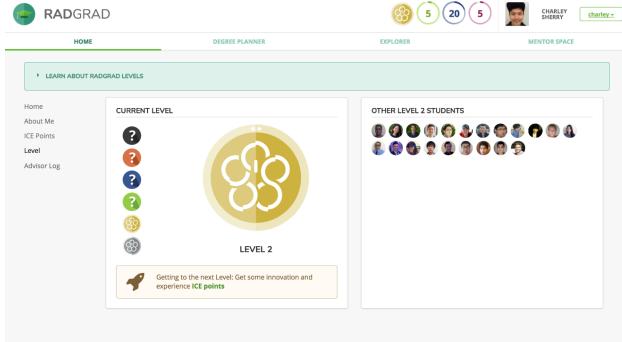


Figure 6.12: Levels page.

Levels also persist physically off of RadGrad in the form of stickers. These stickers can be obtained from an advisor or a RadGrad administrator, and a student will receive a new sticker each time they achieve a new level. Students are encouraged to display these stickers on their laptop, as a subtle way to communicate their current standing to their classmates. Using these stickers, students can more easily identify students who are at the same level as them to mingle with, identify students at a higher level than them to get advice from, and identify students at a lower level who could use some peer mentoring. These stickers can also be used to identify current or former ICS students while off campus. In this way, these physical manifestations of RadGrad help to create a sense of ICS community offline as well.

6.5 Advisor Mode

6.5.1 Student Configuration

On the student configuration page, advisors can add new students or update existing students. Existing students are listed alphabetically by last name. Advisors can update a student's first name, last name, picture, website, role, career goals, interests, desired degree, declared semester, level, year, academic plan, and plan starting semester from this interface. (Slug, email, and UH ID cannot be changed once the student has been added to RadGrad). On this page, advisors can also add advisor log comments and view any past advisor logs for a particular student. Advisors can also use this page to upload new star data and view past star data uploads.

6.5.2 Verification

Advisors can verify a student's completion of an opportunity in two ways: with a pending verification, and with an event verification. If an advisor is physically at an event, and needs to quickly verify a large amount of students, he can use the event verification. In this interface, the advisor simply chooses the event from a dropdown selection of recent events, and then types in the student's

The screenshot shows the 'STUDENT CONFIGURATION' tab selected in the RadGrad interface. At the top, there's a navigation bar with tabs: STUDENT CONFIGURATION, VERIFICATION REQUESTS, EVENT VERIFICATION, COMPLETED VERIFICATIONS, MODERATION, and ACADEMIC PLAN. A user profile for 'GERALD LAU' is at the top right. Below the tabs, a green header bar says 'LEARN ABOUT STUDENT CONFIGURATION'. The main area has several sections: 'STUDENTS' (listing students like Westbeck-Meyers, J., Wilson, Mark, and Zerbe, Eva), 'UPDATE STUDENT & DEGREE PLAN' (form fields for First Name, Last Name, Slug, UH ID, Email, Picture, Website, Role, Career Goal(s), Interest(s), Desired Degree, Declared Semester, Level, Year, Academic Plan, Plan Starting Semester, and Generate Degree Plan), 'ADVISOR LOG' (Comments section with 'ADD COMMENTS' button and 'Past Advisor Logs' note), and 'UPLOAD STAR DATA' (STAR CSV file upload and LOAD STAR DATA button).

Figure 6.13: Advisor student configuration page.

UH account name and clicks “Verify Attendance.” If an advisor is not physically present, a student can send a verification request through RadGrad. These requests show up as pending verifications. Advisors can choose to accept or decline these verifications. If they decide to decline, they can leave feedback for the student, and the student can resubmit as many times as they choose. Advisors can view Completed Verifications to either simply check past verifications or to reopen a verification.

6.5.3 Moderation

The screenshot shows the 'MODERATION' tab selected in the RadGrad interface. The main area is divided into three sections: 'PENDING COURSE REVIEWS', 'PENDING OPPORTUNITY REVIEWS', and 'PENDING MENTORSPACE QUESTIONS'. Each section contains a summary of a post (e.g., student name, review title, rating, comments) and a 'Moderator Comments' text area with 'ACCEPT' and 'REJECT' buttons below it.

Figure 6.14: Advisor Moderation Page.

Advisors can use the moderation page to moderate course reviews, opportunity reviews, and MentorSpace questions. Advisors can choose to either accept or deny these posts. In the case of denial, advisors can leave reasons for denial so that the student can edit and resubmit their post accordingly.

6.5.4 Academic Plan

Figure 6.15: Advisor Academic Plan Page.

The academic plan page is the only place on RadGrad that allows the user to build academic plans. There are two tabs: Viewer and Builder. The viewer allows the advisor to choose a year and a plan name, and view the four year plan for that plan. To make any edits to an existing plan or add a new plan, advisors can go over to the builder, which allows them to name a new academic plan with a degree, name, and year. The advisor can then build the four year plan easily by dragging and dropping possible courses onto the initially empty plan. Some plans have more complex requirements than a single courses (i.e. a student must take one course from one of the four groups: ICS312 or ICS331, ICS 313 or ICS361, ICS351 or ICS451, or ICS355). For requirements like this, advisors can easily create groupings by dragging courses to the box with the link icon. Once a complex requirement is completely built, it can be dragged directly onto the plan. If an advisor no longer needs a certain requirement, they can delete it by dragging it to the trash can icon.

6.6 Faculty Mode

6.6.1 Profile

Faculty can use the profile page to view and edit their profile, which reflects how others will see them on RadGrad. On this page, faculty can update their photo and information about their website. Faculty can personalize their profiles in a way that accurately communicates their background and research to students.

Figure 6.16: Faculty profile page.

6.6.2 Manage Opportunities

Faculty can use the manage opportunities page to easily view, add, edit, or delete their sponsored opportunities. They can also view other opportunities, but they can only edit their own. Faculty can edit their opportunities at any time.

6.6.3 Verification

Faculty have the same verification interface as advisors, except they can only view their own verifications for their own sponsored opportunities.

6.6.4 Explorers

Faculty view the same explorer as students, except they cannot add courses or opportunities, and they cannot leave any type of review. However, they can use the explorer to add interests and career goals. Also, the opportunity explorer conveniently shows the faculty's sponsored opportunities at the top of their opportunity list for quick access.

6.7 Mentor Mode

6.7.0.1 Profile

Mentors can use the profile page to view and edit their profile, which reflects how others will see them on RadGrad. On this page, mentors can update their photo and information about their

Figure 6.17: Faculty Manage Opportunities page.

website, company, job title, location, LinkedIn, and motivation for becoming a mentor. Mentors can personalize their profiles in a way that accurately communicates their background and willingness to help to the students.

6.7.0.2 MentorSpace

Mentors view the same MentorSpace that students do, except each question has an “Answer this question” or “Edit your answer” button. Clicking on this button brings up a form at the top of the page, which mentors can use to either submit a new answer or revise their existing answer.

6.7.0.3 Explorer

Mentors view the same explorer as students, except they cannot add courses or opportunities, and they cannot leave any type of review. However, they can use the explorer to add interests and career goals.

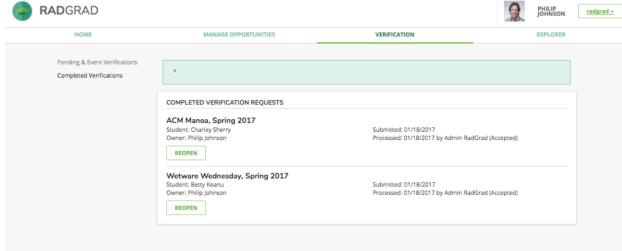


Figure 6.18: Verification Page.

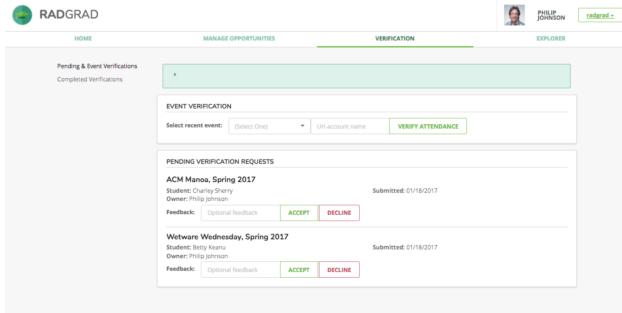


Figure 6.19: Pending Verifications Page.

6.8 Administrator Mode

6.8.1 Retrieve User

On the Administrator home page, an administrator can access any user's account. Users are organized by role (on tabs) and then alphabetically by last name. Clicking on the user's name will lead to their profile. Administrators can use this for testing or troubleshooting purposes. On the student tab, there is also a button to update student levels. Clicking this button will automatically recalculate and set the levels for all of the students.

6.8.2 Data Model

The data model page allows administrators to view, add, edit, and delete items from the data model. The menu on the left lists all collections. When an administrator clicks on a collection, they will see a form, which they can use manipulate items in that collection. Below the form, they can view a list of all existing collection items.

6.8.3 Data Base

The database page allows administrators to easily run an integrity check on the database, dump the database, and restore the database. The integrity check tests every item in the database to make sure that all parts of it are valid. Dumping the database saves the current state of the database

The screenshot shows the RADGRAD Mentor profile page for Aaron Kagaawa. The top navigation bar includes links for HOME, MENTOR SPACE (which is active), and EXPLORER. The profile section displays a circular profile picture of Aaron Kagaawa, his name, and email (akagaawa@liveaction.com). Below this, under 'INTERESTS', are six categories: Application Development, Data Visualization, Entrepreneurship, IT Management, Software Engineering, and Civic Engagement. The 'CAREER GOALS' section lists: Data Scientist, DevOps Engineer, Graduate School, Information System Manager, Software Engineer, and Startup Co-Founder. The 'EDITS IN INTEREST EXPLORER' link is shown. The 'PROFESSIONAL WEBSITE' field is empty. The 'CURRENT JOB TITLE' is Software Engineer, and the 'LINKEDIN' URL is aaronkagaawa. The 'CURRENT COMPANY' is LiveAction, located in Honolulu, HI. The 'MOTIVATION' is described as: 'As an IC Undergrad and graduate student, I know how important networking can be to your career, and I hope I can help future IC grads get off to a great start.' A green 'Edit Profile' button is at the bottom.

Figure 6.20: Mentor profile page.

The screenshot shows the RADGRAD Mentor MentorSpace page. The top navigation bar includes links for HOME, MENTOR SPACE (active), and EXPLORER. The left sidebar has a 'ANSWER A QUESTION' section with a question: 'Question: What aspects of your undergraduate degree experience has proven most useful to you?'. It includes a 'Submit Answer' button and a 'Cancel' button. Below this are four questions listed in a grid: 'I'm interested in a career in data science. What should I be doing as an undergrad to prepare?' (2 answers), 'What aspects of your undergraduate degree experience has proven most useful to you?' (1 answer), 'What mistakes do CS students make during interviews?' (1 answer), and 'What do you look for when hiring a new graduate?' (2 answers). To the right is a 'MENTOR DIRECTORY' sidebar listing seven mentors with their names, titles, and companies: Robert Brewer (Software Engineer, Tableau), Jennifer Gais (IT Specialist, UH), Austin Ho (Software Engineer, Bonobos), Aaron Kagaawa (Software Engineer, LiveAction), Patrick Kjerulff (CEO, Slickage Studios), George Lee (Developer, Hobnob), and Daniel Leuck (CEO, Kayzo). Each entry includes a small profile picture.

Figure 6.21: Mentor MentorSpace Page.

to a JSON file and downloads it to your computer. Restoring the database deletes the current database and reloads an earlier version from a JSON file. Administrators can use this in backup and testing situations.

6.8.4 Moderation

Administrators have the same moderation page as advisors.

Figure 6.22: Administrator Retrieve User page.

Figure 6.23: Administrator Data Model page.

Figure 6.24: Administrator Data Base page.

Positive Feedback	Problems with System
Recommended opportunities are useful because otherwise students are only notified by Gerald's emails	ICE points display was confusing
Reduces the amount of work currently needed for students who try to find ways to succeed beyond the classroom.	List of opportunities was hard to view because it was partially off the screen
Degree planner helpful for visualizing pathway	Annoying to have to scroll to see all possible review ratings
Likes the levels and ICE gamification	Confusing to find some things without some kind of tutorial
Level stickers can help students see who they might want to talk to	Performance issue with page loading times
RadGrad and ICE are good at stressing the importance of activities outside of courses	Wish there were notifications for when new opportunities come up
RadGrad provides extra details about courses and opportunities that were previously unknown to the student	Recommended Courses and Recommended Opportunity widgets on the student home page have non-intuitive scrolling behavior
RadGrad helps degree plan to feel less "random"	Wish there were notifications for when new opportunities come up
Likes how RadGrad helps students understand the benefits of internships, which they learned too late would be helpful	Students should be allowed to opt out of showing their current and future courses and opportunities
RadGrad is a good way to keep track of a degree plan, which a student previously wrote on a paper and misplaced it	Wish there were notifications for when new opportunities come up
STAR does not work adequately for many students, and RadGrad could be a good supplement for that	Wish there was less unnecessary clicking while altering the degree planner
Student easily navigated degree planner UI with only some guidance	Wish there were support for specific focus areas
Mentorspace could help students to get an idea of what they can actually do with their degree after graduation	Would like to know ahead of time when certain courses are being offered
The fact that RadGrad helps you plan even if you have no idea what you want to do, whereas with STAR, you have to know what you want to do beforehand	Manual edits to one student's generated plan caused empty extraneous years in the degree planner
Rating courses seems helpful in planning	One student's STAR data included a long gap between years, which wasn't handled well in the degree planner without manual intervention
Liked how degree plan could be generated rather than manual	
Liked the idea of an individual ICS online space	

Table 6.3: Student beta test results

Warnings	Recommendations
A prerequisite course is missing	Course recommended based upon interests
Semester appears overloaded (more than 3 ICS courses)	Opportunity recommended based upon interests
A required course is missing	Recommendation for ICS innovation points
Course is not offered in chosen semester (future implementation)	Recommendation for ICS competency points
	Recommendation for ICS experience points
	Move towards achieving the next level
	See your ICS advisor to upload STAR data

Table 6.4: Automatically generated warnings and recommendations as of May 2017

CHAPTER 7

CONCLUSIONS

The main goal of this thesis is to find evidence of a problem, gather more concrete evidence of this problem, and attempt to solve the problem with the initial design and implementation of a system. When I initially gathered TechHui data about the pros and cons of being an ICS student at UH Manoa, I found the first evidence of a problem: over the past eight years, students were not fully satisfied with the ICS experience. I then designed and implemented an ICS experience survey, which surveyed 100 current ICS students and asked more specific questions about their ICS experience. The results of this survey gave more concrete evidence that there is room for improvement in the ICS department when it comes to encouraging and enabling students to participate in extracurricular activities, giving students the support they need from all members of the department, and encouraging and enabling students to interact with each other and ICS alumni on an academic or professional level. Along with the rest of the RadGrad team, I have helped to design and implement a system called RadGrad, which aims to address many perceived deficiencies within the ICS department. By combining degree planning, social networking, and gamification, RadGrad aims to improve the ICS student experience on academic, professional, and social levels.

With the current implemented features, RadGrad aims to solve the following five out of the ten categories from the TechHui data. The social networking features aim to solve numbers 1, 4, and 5. The review feature has the potential to solve number 2. The degree planner system, interests, career goals, and opportunities will help students become more aware of the degree focuses that are offered, and allows students to create their own customized ICS experience based off their own interests and career goals, which solves number 3. Although RadGrad doesn't currently address all of the problems that students have, it could potentially cover more issues in future deployments.

1. The ICS department needs a better sense of community.
2. Some of the professors in the ICS department need to improve their teaching.
3. The ICS department should offer more focused areas of study.
4. ICS courses should involve more group work
5. ICS should encourage more interaction among students.

After completing this thesis, RadGrad development will continue, and is scheduled to be deployed within the ICS department in Fall 2017. Future studies will be necessary to test whether or not RadGrad is adequately addressing problems within the department. After students have integrated RadGrad into their life for at least one semester (the time needed to go through once registration process and have enough time to participate in opportunities and courses), future studies

may want to conduct another survey with ICS students. This survey could include similar questions to the survey conducted in my survey, which can then be used to compare and contrast pre- and post-RadGrad results. This survey could also include more RadGrad specific questions, to get an idea of how students feel about using the system. Furthermore, gathering usage statistics could possibly add valuable insight into how users are actually responding to and interacting with the system. Based on the results of these studies, RadGrad could either be further improved to better solve the perceived problems, or discarded if there is no evidence that RadGrad has any positive impact on the ICS community.

Assuming that RadGrad is successful within the ICS department, future possible expansions include integration into other departments at UH Manoa, being established as a staple UH system that will get its own funding and staff positions, being integrated at other universities, and finally being integrated in other environments, such as within tech companies.

This thesis marks the beginning of the RadGrad journey, and will hopefully be the first of many studies. After completing this thesis, the overall results suggest that RadGrad is progressing in a promising direction, and if it continues on that path, it will have the potential to positively revolutionize the lives of future students in many different ways.

APPENDIX A

BASELINE ASSESSMENT

ICS Student Experience Questionnaire

This questionnaire will ask you about your ICS degree program experience so far, in order to improve the program for future students.

* Required

What is your gender? *

- Male
- Female
- Other :

What is your current status in the ICS degree program? *

- Completed 0 ICS courses
- Completed 1-2 ICS courses
- Completed 3-4 ICS courses
- Completed 5 or more courses and expecting to graduate within 3 or more semesters
- Completed 5 or more courses and expecting to graduate within 2 or less semesters

NEXT

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Figure A.1: Baseline Assessment: Section 1.

ICS Student Experience Questionnaire

Prospective ICS Students

We are gathering information about the initial feelings of prospective ICS students. Please answer the following questions as honestly as possible. Current ICS students may skip to the next section.

How EXCITED are you about entering the ICS program? Rank from 1-5.



How INTIMIDATED do you feel about entering the ICS program? Rank from 1-5.



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Figure A.2: Baseline Assessment: Section 2.

ICS Student Experience Questionnaire

Current ICS Students

We are gathering information about the experiences of current students in order to ensure that the ICS department provides what students need to succeed. Please answer the following questions as honestly as possible. Prospective ICS students may skip this section.

Which of the following extracurricular activities pertain to you?

We are trying to ensure that our students are getting the best and most well-rounded preparation for their future. For each of the following activities, please check the box if you are currently doing the activity OR have done it in the past. Check any that apply.

- An ICS related internship
- An ICS-related job
- A hackathon or any other type of public computer science challenge
(i.e. cyber security competitions, programming related contest)
- An open source project
- An ICS-related project outside of class (i.e. personal project, extension of class assignment, working under a professor or graduate student)

Figure A.3: Baseline Assessment: Section 3.

Do you feel that you get enough support from others in the ICS department?

Check any that apply.

- I would like more support from professors in the ICS department.
- I would like more support from TAs in the ICS department.
- I would like more support from my peers in the ICS department
- I would like more support from the counselors in the ICS department
- I feel adequately supported by others while pursuing my degree in the ICS department.
- I often feel completely alone in the ICS department and thus only depend on myself

As a student, do you feel like you have a voice to make changes within the department?

- Yes
- Somewhat
- No

Figure A.4: Baseline Assessment: Section 3.

What makes you proud to be a part of the ICS department?

Check any that apply.

- The prospect of getting a high paying job
- Surviving the rigorousness of the curriculum
- Associating with people in the ICS community
- Working on ICS related projects.
- Receiving ICS related awards.
- Other: _____

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Figure A.5: Baseline Assessment: Section 3.

ICS Student Experience Questionnaire

Current ICS Students: Influences

We are interested to know more about who has influenced you in your ICS degree experience, and who you might have influenced. Prospective ICS students may skip this section.

To what extent have ICS alumni influenced your development in the ICS program?

Check all that apply. Influences include giving advice, answering questions, job recommendations, course recommendations, etc.

- I have not been influenced by any ICS alumni.
- An ICS alumni influenced me to pursue a major in ICS.
- An ICS alumni influenced me to improve my professional development.

To what extent have ICS peers influenced your development in the ICS program?

Check all that apply. Influences include giving advice, answering questions, job recommendations, course recommendations, etc.

- I have not been influenced by any ICS peers
- An ICS peer influenced me to pursue a major in ICS.
- An ICS peer influenced me to improve my professional development

Figure A.6: Baseline Assessment: Section 4.

**To what extent have you influenced your ICS peers' development
in the ICS program?**

Check all that apply. Influences include giving advice, answering questions, job recommendations, course recommendations, etc.

- I have not influenced any ICS peers.
- I have influenced a peer to pursue a major in ICS.
- I have influenced a peer to improve their professional development.

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Figure A.7: Baseline Assessment: Section 4.

ICS Student Experience Questionnaire

Graduating ICS Students

We would like to know how you feel about your overall experience in the ICS degree program in order to make improvements for future graduates. If you are graduating this semester, please answer the following questions as honestly as possible. All other ICS students may skip this section.

Now that you are nearing the end of your ICS degree program experience, how well prepared do you feel to find a job after graduation?

Well prepared
 Adequately prepared
 Unprepared

If you answered above that you feel unprepared to find a job after graduation, please explain why.

Your answer

[BACK](#) [SUBMIT](#)

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Figure A.8: Baseline Assessment: Section 5.

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