Rising With RadGrad: A Quantitative Study on Leveling Up Student Retention and Degree Success

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ABSTRACT

In the last few decades, there has been a steady decline in the diversity of students graduating with a Computer Science degree. The RadGrad project tackles this issue by providing an alternative perspective to the undergraduate degree program. The approach in RadGrad is to make extracurricular activities equal in importance to curricular activities when designing a "well-balanced" degree plan. To accomplish this, RadGrad presents an alternative to GPA with Innovation, Competency, Experience points also known as MyI.C.E. In addition, RadGrad is designed to provide a "knowledge base" about the discipline including topic areas (called "Interests") and Career Goals, Courses, Opportunities, (and in the near future), Internships.
The goal for this summer is to make RadGrad v2.0 ready for deployment into both the ICS Department and the Computer Engineering program starting in Fall 2021. This summer, we participated in the development and evaluation of the second major version of RadGrad. So far, we improved the functionality of the system, and made progress on the integration of InternAloha, a plugin designed to help students find internships. In addition, we conducted a pilot study to investigate ways to improve the system based on real-life student perspectives. The results of the pilot study will be used to improve the design of the system, and include such findings as: user experience issues and the lack of incentive of some features. Through this experience we learned various skills and techniques used to develop a moderately-sized application and conduct meaningful software evaluations while focusing on larger research issues surrounding diversity in Computer Science.

Keywords: Software Engineering, Diversity, Retention

INTRODUCTION

In the United States, women make up less than a quarter of those working in the Science, Technology, Engineering, and Mathematics (STEM) field [1]. In addition to this, women of color only make up approximately five percent of all STEM bachelor's degrees in the US [2]. Expanding the representation of women and people of color not only increases diversity, but it can also help with creativity and innovation within the STEM field [3]. However, this is easier said than done as there are many factors such as social, psychological, or environmental factors that influence the under representation in STEM [4]. For example, media images depicting men and women in traditional gender roles or with limited diversity negatively impacts the STEM career choices that women and minorities make [5]. These systemic gaps not only make a difference in the acquisition of education for women and people of color, it affects their opportunities of qualifying for internships, research, and club activities. Therefore, to remedy this problem an online application is necessary.

With the goal to improve engagement, retention, and diversity in Computer Science, RadGrad[6] was created to provide an alternative take on the undergraduate degree experience. While placing an emphasis on student innovation, competency, and experience, RadGrad provides guidance on interests, career goals, courses, extracurricular activities, research, and (in the near future) internships. With this students can create a strong four to five year degree plan based on their career interests. Although a high grade point average (GPA) is great to have, it is already a given that most job applicants will have a degree and a strong educational background.Consequently, having strong experiences or results from internship(s) or research might take you to the next level and make you stand out from the competition.

RELATED WORKS

STAR GPS

Currently, the University of Hawaii at Manoa employs the use of an online application tool called STAR [7]. STAR provides students with basic information on courses such as who is teaching the course or when the course was last offered. It's excellent for setting up a schedule for upcoming schedules as the site provides the required classes first and foremost depending on the major, then gives a set of recommended classes to take for extra flexibility. STAR also lists the different scholarships available for students based on major to provide them with the highest chance of receiving one. Although these tools that STAR provide are very beneficial, it lacks crucial information such as internships and extracurricular activities needed to make students competitive candidates for the job market. At it's core, it is an application simply to maintain and organize degree plans only. RadGrad not only aims to offer a degree planner that helps plan out future semesters, but also broadcast opportunities like internships, scholarships, and other extracurricular activities. Doing so allows for students to create a course of action that helps fit opportunities integral to success in the Computer Science field into the standard degree schedule.

Figure 2-1. An example of what that STAR offers students

Individual Learning Plans

Furthermore, the Individual Learning Plan (ILP) [8] is a tool similar to RadGrad. An ILP is a written document which outlines a student's current level of ability and specific goals. Most of the time ILPs are written with the student's cultural, linguistic, and social economic background into consideration. However, the key difference between this and RadGrad is the main target audience. ILPs are mainly used for students in primary education, K to 12. Therefore, the plan is created mainly between the student's counselor and guardian. On the other hand, RadGrad is mainly for college students to use for themselves. ILPs serve as a great framework for guiding students, however since most times ILPs are created by sitting down with a counselor or advisor and written out they rarely are changed. With RadGrad being a website, the student can change information as aspirations change in addition to the ability to refer to their ILP at any time.

Figure 2-2. An example of an Individual Learning Plan (ILP)

LinkedIn

Another popular platform for undergraduates seeking to apply for internships or employment is LinkedIn [9]. One of the reasons that makes LinkedIn popular is that it allows users to connect with existing contacts. For example, a user interested in a certain career field may communicate with someone already in that field. This similar element can also be found in RadGrad. For instance, when a student is going through the different interest or career goals, not only can the user see other students also interested in it, but they can also see the faculty or staff members too.
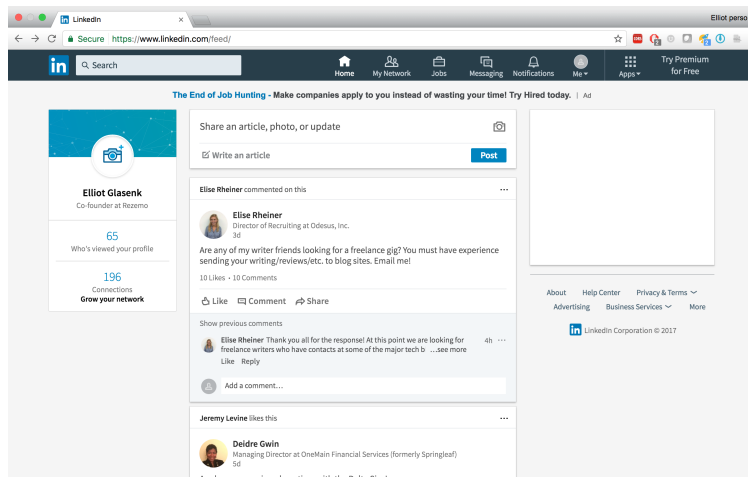

Figure 2-3. An example screenshot of the LinkedIn Page.

However, one of the major cons with LinkedIn is that being noticed is difficult with the amount of users on it. One must dedicate the time to update their profile on a regular basis and write blog posts. To relieve stress from the students, RadGrad incorporated a level system. The level system is based on the ICS courses and ICS activities you take on. The higher the level the student has, more likely they will be noticed by professors and will be qualified for many jobs.

METHODOLOGY

Since Radgrad is an online application designed to augment the undergraduate experience, we sought guidance from students about the strengths and weaknesses of the system. More importantly, questions were asked to see whether RadGrad delivered its promise on providing undergraduates with a stronger degree experience regardless of personal background. Each researcher (summer Research Experience for Undergraduates interns) carried out pilot studies on two to three subjects and recorded data from the subject through a Google Form. Each pilot study was managed by two to three researchers. The pilot study took place over Discord or Zoom and the subjects were asked to share their screen to help detect any underlying issues. The researchers were tasked to guide the subject through the RadGrad system and ask questions in the process. Afterwards, the collected data

was used to evaluate any changes needed to be made to RadGrad and the pilot study protocol.
The following questions were asked:

1. *Before we show you the system, we want to find out a little bit more about you. First, do you consider yourself a freshman, sophomore, junior, or senior?*

2. *Have you ever used RadGrad before?*

   - *Yes*

   - *No*

3. *If you used RadGrad before, when was the last time you remember using it?*

4. *If you remember using RadGrad before, what was your general sense of your impression of its utility?*

   - *Useful*

   - *Not So Useful*

   - *Somewhere In Between*

   - *Don't remember/ Never used RadGrad*

5. *What are your initial thoughts about the landing page and are there things we could improve?*

6. *Now that you understand the High Priority Items, does the Medium Priority items make sense to you without any further explanation? What is confusing and how could we address them?*

7. *For the Visibility Page, do you have any concerns about sharing any aspects of your profile to other students in the system?*

8. *Were you able to create a Degree Plan with plans for 100 innovation, 100 competency, and 100 experience points? If not, what got in the way?*

9. *Next, we want to get your impression of RadGrad Explorers. Pick whichever one you want: Interests, Career Goals, Courses, or Opportunities. When you browse the items in that Explorer, can you find something interesting you didn't know about before? If so, what is it?*

10. *There is a "Details" page associated with each Explorer. Please pick an entity of interest, and click "See Details" to see more. Does the resulting page provide you with interesting information? How could we make it better?*

11. *Do you think it provides value to ICS students? What are 1-2 strengths and 1-2 weaknesses of the system?*

At the end of the Spring 2021 semester, students majoring in Computer Science were contacted by Professor Phillip Johnson and were asked if they were interested in participating in the pilot study. After the student participants were collected, a student intern directly contacted the participating student to schedule the online study. The pilot study interview was held between July 5 and July 11, 2021.

RESULTS

This section presents the responses from the subjects to each of the questions. Also, comments and issues noticed by the researcher during the pilot study. For some of the questions, minor grammar and misspellings errors were fixed to improve the readability.

Before we show you the system, we want to find out a little bit more about you. First, do you consider yourself a freshman, sophomore, junior, or senior?

- Freshman: 0

- Sophomore: 1

- Junior: 1

- Senior: 3

Have you ever used RadGrad before?
- Each of the pilot study participants have used RadGrad before.

If you used RadGrad before, when was the last time you remember using it?
- Spring 2019: 1

- Spring 2020: 1

- Fall 2020: 1

- Spring 2021: 1

- Summer 2021: 1

If you remember using RadGrad before, what was your general impression of its utility?
- Useful: 3

- Not Useful: 1

- Somewhere in between: 1

- Don't remember never used: 0

What are your initial thoughts about the landing page and are there things we could improve?
- The landing page looks better than the first version of RadGrad. It is now much clearer and gives better detail on what RadGrad is and what it stands for. No comments/questions on improvements for the landing page.

- Buttons don't work unless you click directly on the text, but other than that it generally looks good.

- Likes the design and the card showcase with the different entities(careers/interests/opportunities/etc.) that are on the site. Very good introduction of what the system can have. However, the drop-downs are unresponsive at times and the button is hard to press in order to login.

- The landing page looks very clear and intuitive. It's good that the page advertises the specifics of what goes into the site. Small critique on having the reading to get started at the bottom instead of being at the top to be more clear. But if the intent is to read everything first, it's completely fine. Maybe the get started button should be in the middle of the page.

- Very aesthetically pleasing. Gives a hefty first impression with all the information that it shows and gives a nice idea of what is in store for the site. Likes the slideshow style of the different listings available on RadGrad. For improvements, there might be too much open space between the About Us and Contact button at the footer. Looks like a spacing bug or perhaps something is missing. There is also a bug where after logging in, it stays at the landing page and you need to click the Student Home button to go to the RadGrad priority page.
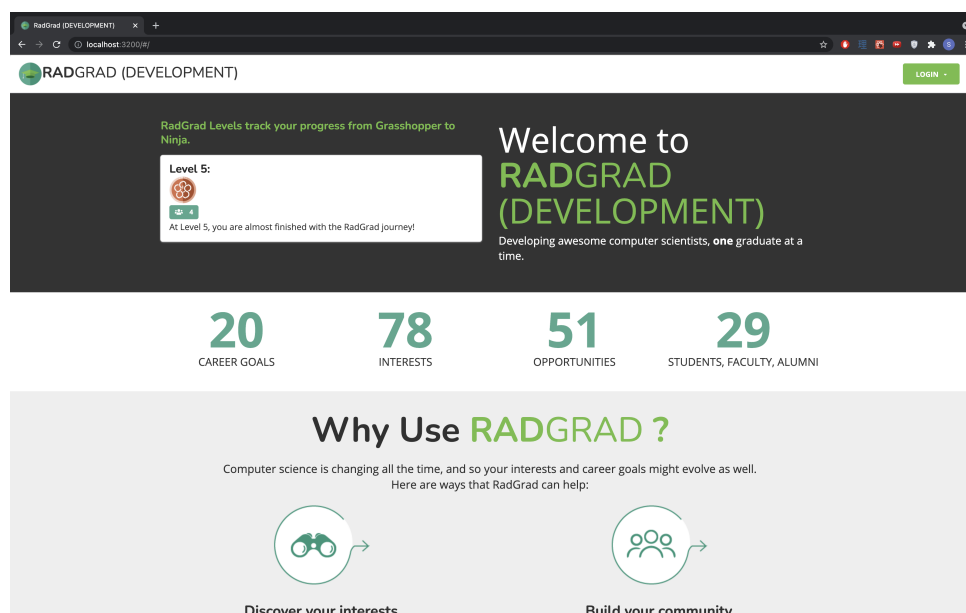

Figure 4-1: The Landing Page of RadGrad

Please take care of your current high priority To Do list items to you. Were there any items that were confusing to you and needed additional explanations?

- There is a priority list now which makes things easier. Was not comfortable using RadGrad at first because there was no guidance on what needs to be done.

- Wish there is an order such as an alphabetical or meaningful grouping for the issues that should be done. Other than that, it is self explanatory or well explained based on the cards on what needs to be done.

- Some of the tabs are hard to distinguish and overlooked.

- Need to see an explanation on the difference between high and medium priority items.

- Very self explanatory, really great to have color coded tasks to push for necessity.

Now that you understand the High Priority Items, does the Medium Priority items make sense to you without any further explanation? What is confusing and how could we address them?

- Looking at the Medium Priority items, everything makes sense. Did have a comment where the priority items should be sorted (ex. alphabetically).

- Would like to see what makes the difference between the high and medium priority items.

- Overall they are very self explanatory and they don't seem too imperative. None of the items needed additional explanation.

- The medium priority makes a lot of sense; they are definitely not as important as the rest.

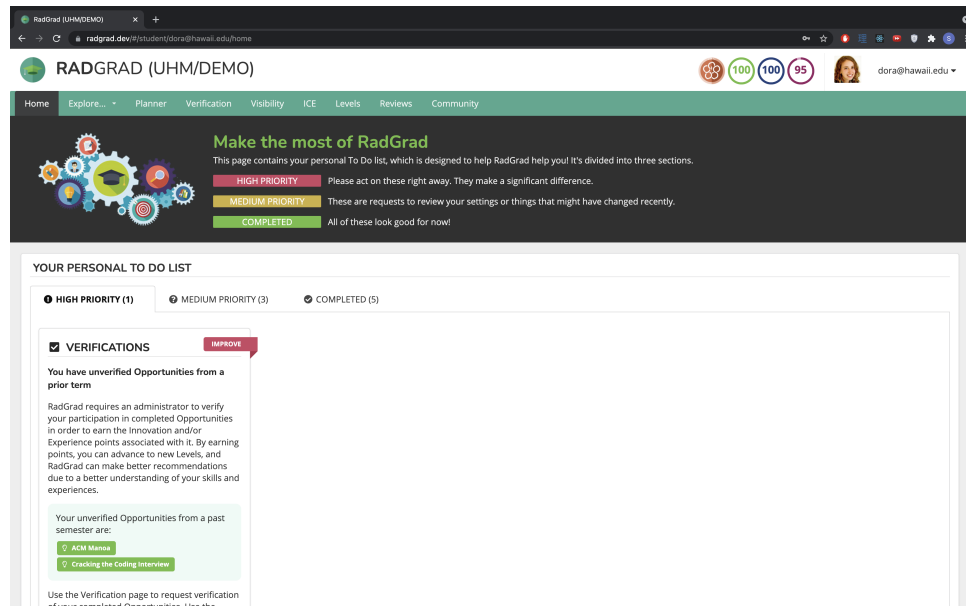- After doing the high priority, the tasks seem easy to do as long as you read the instructions.

Figure 4-2: The Logged In Home Page

For the Visibility Page, do you have any concerns about sharing any aspects of your profile to other students in the system?

- The formatting of the page could be better. The size of the visibility checklist was a little bothersome. They felt like it should be bigger/centered since it is the biggest part of the Visibility page.

- Likes how the visibility page allows you to control what other users see. The page is intuitive and straightforward. ICE points aren't all rendered as circles, some are shaped as oval.

- Would like to see a link or text to show that the user should add that appropriate field in their profile similar to the high priority tasks

- Having 0's for the ICE in the visibility page shows the circles as ovals. The pictures must be cropped. It would be good to have an option to hide your email by default since some people would tend to not have it shown at all.

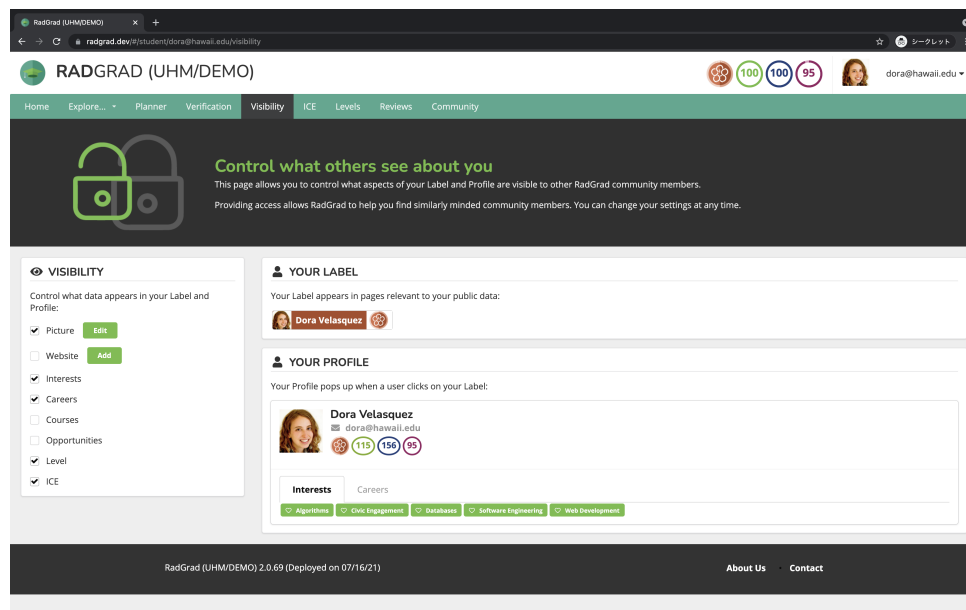- They are quite nice, a little bit of spacing issue, but it's overall clear.

Figure 4-3: The Visibility Page for a student named Dora.

Were you able to create a Degree Plan with plans for 100 innovation, 100 competency, and 100 experience points? If not, what got in the way?

- Some things that got in the way were finding opportunities/internships to apply for and getting accepted.

- Would like to see a mini explanation or a link to what ICE is or have a task on the high priority to have the user to see what ICE system is.

- It seems a bit difficult to get 100s on everything due to already being so far into their ICS career, so it might be too difficult or hard for late starters. Isn't able to get to 100 I and E, and doesn't find trying to get ICE points a motivating factor for adding courses or opportunities. Also thinks it is hard to get 100 of each even though he added one to two opportunities.

- Thinks that it's possible to get 100s as long as people take the time adding everything in. But it is all in the matter of how much people are willing to go back through all the semester to specifically put their activities that they've done and overall it seems too taxing for him.

- They are more or less able to create a plan for 100's in each of these, but it is just very taxing to go through all of it. Would like to see the EE courses that they took as a ICS 400 level elective.
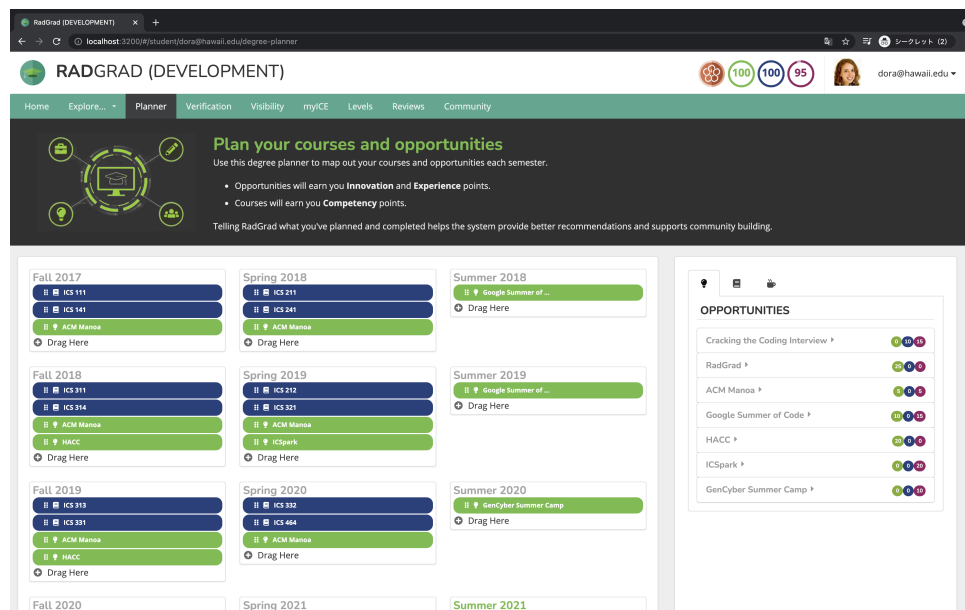
Figure 4-4: The Logged In Home Page

Next, we want to get your impression of RadGrad Explorers. Pick whichever one you want: Interests, Career Goals, Courses, or Opportunities. When you browse the items in that Explorer, can you find something interesting you didn't know about before? If so, what is it?

- They pick the opportunity page, as one of the reasons they stopped using RadGrad is the outdated events for the opportunities. Having the general month or season of the event of the card might be helpful for students to plan in the degree planner.

- Confused and wondered if we plan on making it two buttons since if the user already knows he/she wants to add it to their profile, then it should just be added right away instead of redirecting you to another page.

- Unsure of what "Most Recent" filter means on the explorer pages and when explained, doesn't think that that information is relevant overall to users.

- Add to profile button should be present on the explorer page cards to allow users to do so without navigating to the details page. There is no "back" button present on the details page which means users have to use the browser back button to get back to the explorer page. Both of these issues make it tedious to add subsequent courses/interests/opportunities/careers in succession.

- Thinks the tag system and the highlighting is pretty neat. They find the club ACM to be interesting and wants to explore more. Explorer pages should implement a search bar so that users don't have to scroll throughout the whole page looking for a specific item. Finds the Recommended filter the most useful as it matched things with their interests.

- Startup Co-Founder is an interesting item in the Career Plans that they saw.

- Finds UX Designer to be interesting because of the labels and descriptions on the card. Also, they find it interesting that there is similar classes associated with UX Designer in the Details page.
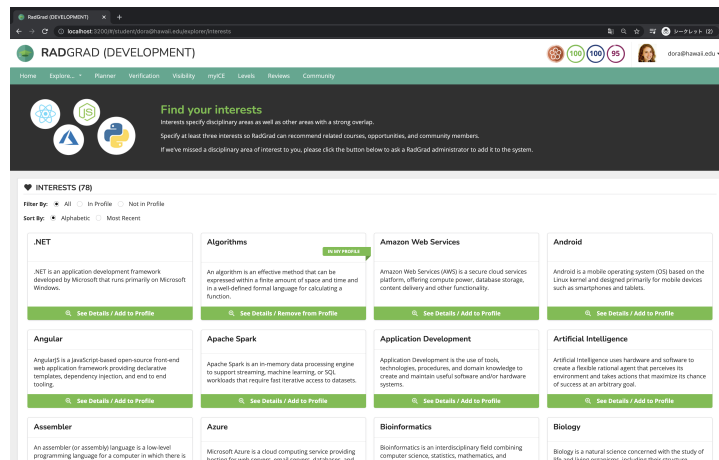
Figure 4-5: The Explorer Page For All The Interests

There is a "Details" page associated with each Explorer. Please pick an entity of interest, and click "See Details" to see more. Does the resulting page provide you with interesting information? How could we make it better?

- For the Related Courses Components on the internship page, the student is under the impression that they have to accomplish all of the related courses to a certain internship. Therefore, having a warning message to notify the students that not all courses are necessary would be great.

- Likes how it displays the upcoming dates now and associated courses that relate to it and differentiates based on if it is finished.

- If there are too many tags on the left side, there needs to be a "show more" button. For example, ACM (Association for Computing Machinery)has all the classes tied to it, so there's too much on the side. Besides some text spacing for some of the descriptions, it's overall fine. Didn't notice the add to profile button at first. Found the related courses component to be quite long and daunting with how many courses were displayed. Bullet points for the "dates" section of the description are formatted weirdly.

- Overall everything that is needed especially related classes for certain items is such a good ease of access and great. Small margin problems with the description and the students participation boxes. The details page was nice, so some padding could be improved.

- The page provides them a better understanding and a hefty amount of information that's helpful for people to check how it relates to other aspects of the explorer.
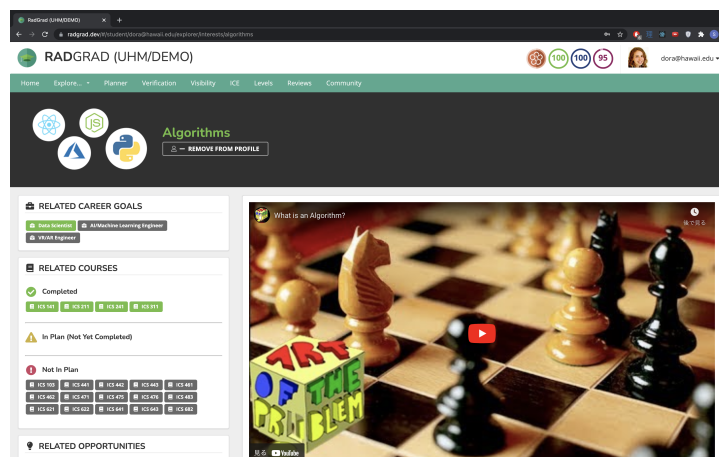

Figure 4-6: One of the Details Page explaining what Algorithm is.

Do you think it provides value to ICS students? What are 1-2 strengths and 1-2 weaknesses of the system?
Strengths
- New system has a better time connecting students to what they are interested in and makes them more involved. Better prepares them for things they want to do later and plan out things a lot better. Connects students more easily to resources already provided by the department.

- Likes the interface of the website and looks "professional" with how it keeps it a consistent look throughout the website. Finds the student reviews of courses to be one of the most useful features of RadGrad.

- The sorting is the most useful part of searching each explorer page, especially the recommended filter as well as feeling like the system is self explanatory with good direction.

- Finds that version 2 definitely is a lot stronger with much more detail and direction to push students in what to do and is much cleaner to look at and understand.

- The opportunities are the most useful element of RadGrad as it provided them a list of internship and club activities they could do based on current level of skills as well as finding the site organized and easy to navigate.

Weaknesses
- Depends on the overall involvement in this website (i.e. it is not going to work if there are no users). Mentions how there is going to be a lot of work to update opportunities (in terms of dates/events) and internships.

- The large todo list at the start makes it feel like there is a lot of "onboarding" work for users to do before they can actually use the website. Organized buttons and some more explanations on what to do for each thing would be helpful since some things are unclear right now.

- Found it tedious to scroll through explorers to find a specific item and would like a search functionality. Also, it is very hard to hit 100s on ICE when you're really late into the system.

- The ICE system is not explained clearly as to why it is a necessity to fill up to 100 for every category. The top bar explanation isn't enough reasoning as to the point and the end result of having a high ICE level. In the eyes of most students, it might seem unnecessary to even try ICE if there's no point to do so. It is explained in levels, but most people might breeze over it without knowing. There's also quite a steep curve from level 3 to 4 since most people won't be able to plan out 100 points for everything even by the time they graduate. It also doesn't help that the high priority doesn't push for tasks towards the ICE system as a useful metric system.

- The cards being in explorer seems to be tedious to check back into explorer pages in order to add and remove them. In other words, not being able to add and remove items straight from the explorer and having to navigate to a whole new page to do so is quite cumbersome.

CONCLUSION

Despite the significant improvements that returning users have noted, feedback indicates that there is further room for improvement. Some of the suggestions given have small overhead, but can be deemed useful to add as functionality while others are noteworthy problems that will take significant overhead to accomplish.

Conclusions Regarding Ease of Use

Reviewers noted numerous points of improvement to make the system easier to use. One of the notable recurring suggestions is to implement an "add to profile" button on explorer cards to circumvent the need to go through the details page in order to do so. It's a small change with little overhead but is a vast improvement to efficiency.

Another notable suggestion given is to add a search bar as another layer of filtering to the explorer pages. Although the filters we have suffice, having a direct filter for users who know what they are looking for will improve ease of use immensely. Some of the reviewers suggested that search filters can be based off of the titles and tags.

There are other minor improvements that can improve usability immensely. One small but notable improvement is improving the logging in experience. In the current system users are not redirected to their personal home page after logging in. Most users had trouble finding where to go after logging in since most are unaware of the login button being replaced by the home button. Other small changes were bug fixes and minor design improvements.

Overall, none of the suggestions regarding ease of use takes any significant overhead to accomplish, yet show to have the biggest impact on user experience. They are not high priority tasks that need to be implemented, but can be easily done in tandem with other significant changes to RadGrad.

Conclusions Regarding the MyICE System

One of the prevalent comments between the reviewers is that the myICE system is confusing. One suggestion is that maybe it would be beneficial to the students to add a high priority task to read through the myICE page. For instance, one of the students mentioned that they were submitting opportunities without the complete understanding of what or how the myICE system worked.

Another comment is that attaining high myICE points should not be a priority due to the fact that they do not see direct benefits from them. Currently, students can receive stickers based on their myICE level but this alone proves to not be enough incentive for students. One of the suggestions is having a page or segment where users can see how myICE benefited a recent Computer Science alumni. Thus, by having these testimonies students can see the importance of earning myICE points.

Conclusions Regarding EE and Other ICS Alternatives

Reviewers from the pilot study noted that many classes that are alternatives to required ICS classes do not show within the explorer pages nor the degree planner. As the bulk of these classes come from the EE category, it is suggested that students be able to see them so that they can determine if they want to replace some of their ICS classes with EE and other alternatives instead. This deems to be a great improvement to student semester scheduling and overall clarity for students who have taken such alternatives already.

Conclusions Regarding the Degree Planner

Returning users see the new and improved degree planner as a significant improvement to the scheduling system of the first RadGrad system. However, some felt that it's a system that still can't be used on its own yet. It is a system that in most ways still must be used in tandem with STAR GPS for best usage. Improvements that were suggested in order to reach a level of independence include:

- Adding a recommendations tab so that students can surmise which classes to take for upcoming semesters.

- A requirements list that shows the remainder of needed ICS classes to graduate.

- Forced restrictions so you can't put classes in semesters that don't have them.

There is a lot of overhead that can be seen in taking on these improvements, but if we want to bring the degree planner to a more usable state, these are high priority.

Conclusions Regarding Radgrad and Diversity

Although RadGrad's goal to increase retention, diversity, and engagement within the field of computer science is quite daunting, it's no insurmountable task that can't be accomplished. For RadGrad to pursue these goals, there needs to be more involvement in the community as well as increased motivation to use the system. These issues must be addressed by the ICS department with a larger plan of action that RadGrad can be one part of. Some of the suggestions include:

- Cordially offering recognition to students that reach Level 6 in RadGrad each semester.

- Integrating RadGrad into the advising process by allowing advisors to have direct access to student's profiles and career plans.

- Courses giving extra credit to students who attend certain opportunities and verify that they attended through RadGrad in a given semester.

- Linking the appropriate RadGrad details page to upcoming opportunities in the ICS newsletter/mailing list.

- Having more professor involvement in RadGrad (becoming sponsors of related opportunities, post projects that they are working on, encourage usage of RadGrad in class).

Implementing these suggestions could incentivize students to use RadGrad more with the hopes of increasing retention and diversity in Computer Science as a result. Through its involvement in the ICS department, RadGrad will be seen not only just as a tool but a guide to help students succeed. In addition, RadGrad will have the possibility to expand their existing community by implementing designs such as mentor/mentee programs and advisory boards from existing students and alumni. At the end of the day, RadGrad is a continuously evolving system and the changes, both on the supplementary and high level are the next steps towards a complete system.

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