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STUDENTS' REFLECTIONS ON COMPUTER SCIENCE, THE LIBERAL ARTS, AND THE GREATER GOOD

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Synopsis:

The presentation will describe an assignment used in a computer science capstone course to help students explore how they can use computing skills for the greater good and reflect upon how the core curriculum has prepared them for the profession. In addition to providing the assignment, an analysis of what students chose for their activities and the emergent themes related to the core curriculum will be provided. Students also completed an optional survey about how this activity prepared them.

Students' Reflections on Computer Science, the Liberal Arts, and the Greater Good

Abstract

Some educational theories identify reflection as an integral part of learning. Often, reflection is encouraged through course assignments and activities. This paper reports on a computer science capstone assignment that encourages students to holistically reflect on their general university education and computer science preparation. To assess the effectiveness of this assignment, we reviewed students' reflections for activities they chose to complete the assignment, the liberal arts connections they made, and their main take-aways. We also administered a survey to see how effective the assignment was for their professional development. We found that students chose a variety of activities, from podcasts to reading books to volunteering their time. Many themes emerged that connected to the university core curriculum. Popular take-aways from their reflections included technology's impact on the world, their roles in making ethical decisions as software developers, technology's impact on individual people, and the importance of human connections for mentorship and diverse representation in the field.

Keywords

Computer science, capstone, reflection, greater good

1. Introduction

Colleges and universities prepare adults to enter the workforce and make societal contributions that impact local and global communities. Many colleges and universities design curricula to provide breadth of knowledge about the world and depth of knowledge and skill in a student's chosen degree field. The main contribution of this paper is a capstone reflection assignment to help students reflect upon how the University's liberal arts core curriculum (breadth) connects to the computer science curriculum (depth). The CS and the Greater Good Assignment could be expanded or altered for use in any discipline and any core curriculum.

1.1 General Education and Computer Science Curricular Outcomes

Learning outcomes for K-12 education and higher education often include communication skills, equity and inclusion, and technology competence. For example, Miles and Wilson (2004) suggest learning outcomes for community college students that include communication, computation, community, critical thinking, information management, interpersonal, personal, and technology skills. The Partnership for 21st Century Skills include subject areas, topic areas, and skills. Among the skills are communication, critical thinking, creativity, collaboration, and technology (Battelle, 2022).

Employers agree with the necessity of many of these skills for the workforce. The National Association of Colleges and Employers have developed eight competencies (NACE, 2022):

1. Career & Self-Development *
2. Communication *
3. Critical Thinking
4. Equity & Inclusion *
5. Leadership
6. Professionalism
7. Teamwork
8. Technology *

Those marked with * are part of the CS and the Greater Good Assignment, which is described in more detail in Section 3.

National and international societies recommend that computer science curricula contain professional responsibilities. For example, the computer science accreditation commission of ABET includes the student outcome: "Recognize professional responsibilities and make informed judgments in computing practice based on legal and ethical principles" (ABET, 2022). ACM's computing curricula 2020 contains seven competencies for social issues and professional practice, with the specific example "Produce a document that is helpful to others that addresses the effect of societal change due to technology" (ACM, 2020). The CS and the Greater Good Assignment could be used for assessing these CS-specific curricular competencies.

1.2 Educational and Developmental Theories

A student's education does not stop at graduation; instead, students should have the skills to embark on their individual journey of lifelong learning. More broadly, reflection is an important part of the learning process, especially as it relates to personal growth (Rodgers, 2002). Rodgers states that reflection is a meaning-making process that moves the learner from one experience to another with deeper understandings of the connections (2002). Seniors are in the midst of moving from the college student experience to, usually, the worker experience. Offering students near graduation a time to reflect on their education as they transition to the professional world may remind them of their values, their responsibilities, and their passions. Rodgers builds upon the definition of reflection from Dewey's educational theory. Dewey viewed education as a verb, enacting change in both the learner and the environment: the world changes the learner and the learner changes the world (1933).

1.3 Reflective Practices in Higher Education

Some universities have a core curriculum with embedded, intentional courses to integrate knowledge and experiences across disciplines. For example, the University of San Diego (California, USA) has an integration experience toward the end of the student's undergraduate studies (USD, 2022). Students complete a core integration project or assignment that combines two fields, integrates with the community, or syntheses knowledge across many core curriculum courses. This is curricular-level design for intentional, reflective practice. The University where this study took place does not have this level of integration, so the project scope for the CS and the Greater Good Assignment discussed in this paper is at a much smaller scale.

Santa Clara University (California, USA) also has integration courses as part of the core curriculum (SCU, 2022). These courses include writing courses, experiential courses for social justice, and clusters of courses constituting a pathway. The CS and the Greater Good Assignment is most similar to Santa Clara's pathways choice. The Santa Clara University pathways assignment has students describe connections in pathways courses and their major courses, analyzing an issue from at least two perspectives, and reflect on the learning process itself.

Many universities have courses that include reflective writing assignments. Ithaca College uses reflective essays for students to demonstrate how they have met program-level objectives in the computer science major (Barr, 2020). There are many ways and many levels of reflection (across courses, within course, across a major) that students may encounter in a university curriculum.

Following the introduction, Section 2 provides an overview of the educational context for the CS and the Greater Good assignment. Section 3 provides the full-text of the assignment. Sections 4 and 5 summarize the study and the results based on students' work and survey responses. Sections 6 and 7 discuss the results and limitations and offer conclusions.

2. Educational Context

2.1 University Curriculum

This study took place at a private, Catholic university on the west coast of the USA in Spring 2021. The University enrolls approximately 3500 undergraduate students, of which 160 are computer science majors. The University's core curriculum is about one-third of the overall credit requirements for the BSCS degree. The core curriculum for the Spring 2021 cohort of 36 CS graduates was designed around the following questions:

- Who am I? Who am I becoming? Why am I here?
- How does the world work? How could the world work better?
- How do relationships and communities function? What is the value of difference?
- What is the role of beauty, imagination, and feeling in life?
- Who or what is God? How can one relate to God?
- What is a good life? What can we do about injustice and suffering?

Required courses in the 2017-2018 core curriculum (curriculum for Spring 2021 graduates) included: i) Introduction to Fine Arts, ii) Thinking Through Literature, iii) History (any course), iv) Mathematics (for CS majors, this is Calculus 1), v) Science (for CS majors, this is two semesters of Physics), vi) Introductory Philosophy, vii) Ethics, viii) Introduction to Theology, and ix) The Bible, Past and Present. Students chose two social science courses and an upper-division theology course to fulfill the remaining core curriculum requirements. The computer science degree is ABET-accredited, with the remaining two-thirds of the BSCS curriculum being engineering, math, and computer science courses.

2.2 Capstone Courses

All computer science students take a two-semester capstone course (usually Fall and Spring semesters). CS students take the engineering (EGR) capstone courses if they are working on multi-disciplinary projects in multi-disciplinary teams. CS students take the CS capstone courses if they are working on software projects. All capstone projects are completed in teams and most work

with an external client industry partner. In terms of capstone deliverables, about 80% relate to the capstone project and include a functional specification, kick-off presentation, reference guides, project demos, end-of-semester showcases, client meetings, code reviews, and a final report. The other 20% of the course prepares students for the profession and include the activities and assignments listed in Table 1.

The CS capstone course uses sprints to organize project timelines and deliverables. Each CS capstone team of three to five students meets with a faculty advisor once per week and meets with the instructor of the capstone course during class time once per week to conduct stand-up meetings. The capstone course meets Friday afternoons from 2:40 – 5:40pm, with the time usually split in half with a class activity (for example, guest speaker panels, resume reviews, class-wide project demos, and Odyssey plan sharing) and the other half of the class used for project work time while the instructor rotates among groups for stand-up meetings. Sessions for career fairs, mock interviews, the CS comprehensive exam, and the end-of-semester showcases take the full three-hour block of the capstone course meeting.

Table 1: Professional development activities in the computer science capstone courses, denoted as Fall or Spring activities. The activities annotated with * were also completed by CS students as part of the multi-disciplinary capstone courses.

Semester	Professional Development Activity or Assignment
Fall	Updating resume
	Peer review of resumes
	Mock interviews with industry professionals *
	Fall career fair *
	Odyssey Plan: Designing Your Life (Burnett & Evans, 2018) *
	Guest speaker panel: Recent alumni *
	Guest speaker panel: Mid-career alumni
Spring	Spring career fair *
	Guest speaker panel: Mid-career alumni *
	Guest speaker: Job offers and negotiation
	Guest speaker panel: Alumni in leadership positions
	CS and the Greater Good Assignment *

3. CS and the Greater Good Assignment

The focus of this paper is the CS and the Greater Good Assignment that CS students completed during the Spring semester of the capstone course. The assignment was designed to encourage students to think holistically about their education and to engage in using their time in service or learning about a topic related to computing and the world. Here is the text of the assignment:

Background

> *Your education has prepared you to be a successful software engineer. Your greater University education, including the core curriculum, has broadened your mindset*

and skillset about the world, society, service to others, and contributing to a community. This assignment is intended to integrate your liberal arts education with your CS mindset to think about computing and the greater good. This is an open-ended assignment, so if you have any questions about what fits, please reach out to the instructor.

Learning and Growth

You may choose any activity that expands your experience or knowledge about computing and society. You could read a book regarding CS and society. You could volunteer your software development skills for an open-source project with a humanitarian focus. You could volunteer with an outreach program that introduces children to science, math, and technology. You could listen to podcasts or watch documentaries about computing and society. You could learn about contributors to computing who come from marginalized populations. You could volunteer at a computing conference or workshop (although this may be difficult during the pandemic). Choose something that will force you to think about an idea, a policy, history, or society and choose something that interests you.

You may ***not*** *choose an activity that replicates an assignment you have already completed in a prior course. You may* ***not*** *choose an activity assigned in another concurrent course. You may* ***not*** *choose an activity for which you are paid (mentor, tutor, internship).*

Some specific resources that you may wish to review for this assignment are in the appendix.

Reflection about Connections of Computing & Society

After completing the activity, you should write a 600 – 800 word reflection about what you did, how the activity expanded your thinking, and how the activity connected your computing mindset to the values and skills you learned through the University core curriculum. The reflection should be organized and use appropriate grammar and mechanics.

What to submit*: submit a pdf of your reflection to <the course management system>*

Deadline*: Friday, April 23 at 2:40pm.*

The assignment's appendix contained book references, podcast links, humanitarian software project sites, and volunteer opportunities (see Appendix A of this paper). This assignment was given during Spring 2021, a semester that was taught fully online due to the covid-19 pandemic. The greater good assignment was again assigned in Spring 2022 which was taught in-person. This study uses data collected from the Spring 2021 semester.

4. Study

4.1 Data

Two sources of data were used for analysis: students' assignment submissions (raw text) and an optional end-of-semester survey that asked about the effectiveness of the professional development activities listed in Table 1. The research study and survey instrument were approved by the University's Institutional Review Board. The end-of-semester survey questions are shown in Appendix B.

4.2 Research Questions

The following three questions guided the analysis for this assessment:

- RQ1: What activities did students do for the CS and the Greater Good Assignment?
- RQ2: What liberal arts themes appeared in their reflection submissions?
- RQ3: What were the central take-aways from students' reflection submissions?
- RQ4: How did this assignment contribute to their professional development, in relation to the other professional development activities in the capstone course?

4.3 Participants

In Spring 2021, 23 CS students were enrolled in the CS capstone course and 13 CS students were enrolled in the EGR capstone course. Recall that students completing software-only projects enrolled in the CS version and students on multi-disciplinary project teams enrolled in the EGR version. The greater good assignment was part of the syllabus for CS students in both sections. Of the possible 36 students, 34 students (21 in CS capstone and 13 in EGR capstone) completed the greater good assignment (94.4% response rate). Of the 34 who submitted reflections, 27 identified as male, 7 identified as female, and 0 identified as other.

The survey in Appendix B was administered online using the capstone course's learning management system pages. The survey had N/A options since the students in the EGR section may not have participated in some of the activities. Of the 36 CS students in the CS and EGR capstone courses, 16 completed the optional survey (44.4% response rate). Of the 16 who completed the survey, 13 identified as male, 3 identified as female, and 0 identified as other.

4.4 Data Analysis

All 34 reflections were part of the dataset to answer research questions 1 through 3. Each reflection was analyzed for activity type (for example, podcast, documentary, volunteering, etc.). Inductive descriptive thematic analysis to generate emergent themes was used to answer research question 2 (Smith, 2015; Maguire & Delahunt, 2017). The analysis followed the 6-step process: 1) become familiar with the data, 2) generate initial codes, 3) search for themes, 4) review themes, 5) define themes, 6) write up. Students' reflections could contain zero or more themes from the liberal arts. Each reflection was analyzed for the main idea in one-to-five sentences. Text from the main ideas were used to create a word cloud using freewordcloudgenerator.com (freewordcloudgenerator.com, 2022) to visualize the content of these main ideas.

5. Results

5.1 Activities

Students chose different activities to complete the greater good assignment. Many used the resources in the assignment's appendix (see paper Appendix A). Figure 1 shows the activities by number of students who chose the activity. Listening to a podcast was the most popular activity among students. Podcast sources included Code Switch, Society of Women Engineers, Linear Digression, Exponent, and Catalyzing Computing. Even though courses were on-line in Spring 2021 due to the covid pandemic, seven students managed to find volunteer activities: two tutored younger siblings or friends in AP CS high school courses, one hosted a Computing Ethics Night on zoom, two created STEM videos about robotics to get middle school students interested in the STEM fields, one gave free workshops about computers and privacy to the elders at a church, and one student contributed to an open-source software project to limit data collection in web browsers. The most popular documentary was *The Social Dilemma*, watched by three students. Many activities had ties to gender and diversity in technology, using data for corporate revenue, and bias in data models that make predictions or decisions.

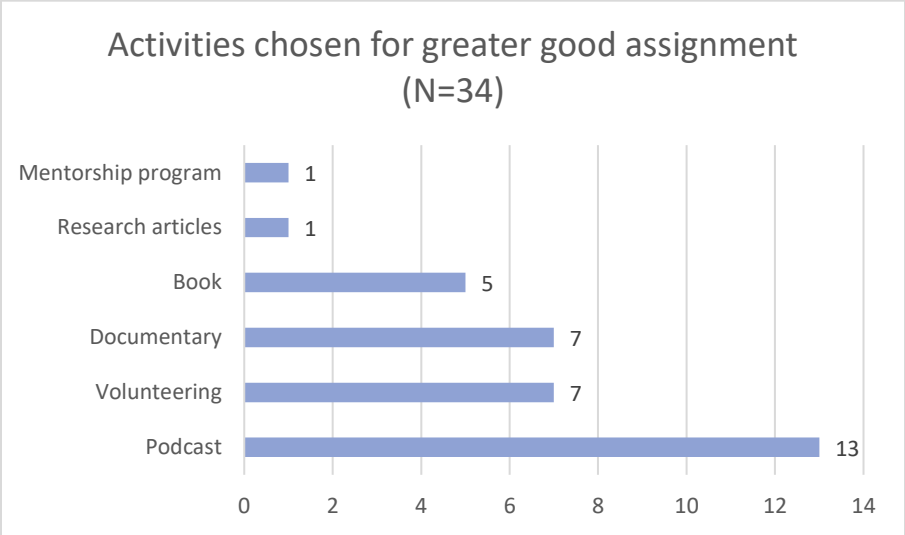

Figure 1: Activities chosen for the CS and the Greater Good Assignment, ranked least popular to most popular.

5.2 Liberal Arts Themes

Several themes related to the liberal arts emerged when analyzing the students' reflections. A single reflection could have more than one theme, so the total number of theme appearances exceeds 34. Figure 2 shows the themes by count. Ethics was the most popular connection to the liberal arts curriculum.

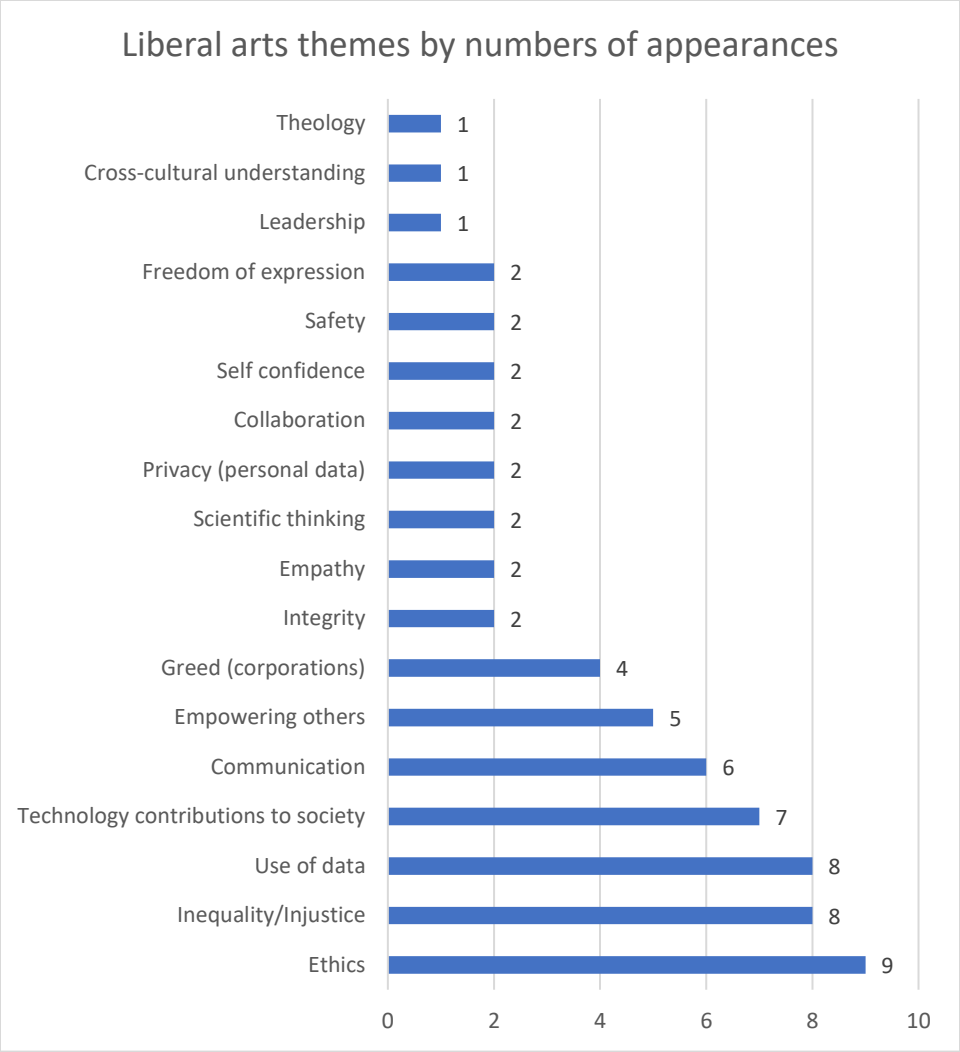

Figure 2: Liberal Arts Themes that Emerged from Analyzing Students' Reflections

Let's review the core curriculum guiding questions:

- CC1: Who am I? Who am I becoming? Why am I here?
- CC2: How does the world work? How could the world work better?
- CC3: How do relationships and communities function? What is the value of difference?
- CC4: What is the role of beauty, imagination, and feeling in life?
- CC5: Who or what is God? How can one relate to God?
- CC6: What is a good life? What can we do about injustice and suffering?

We mapped the themes in Figure 2 to the six core curriculum guiding questions; results are shown in Table 2. Note that all six questions had a related theme, so, collectively, the students reflected on all six core curriculum questions, perhaps indirectly. The assignment prompt did not re-state these six questions, so students may or may not have reviewed these questions in the University academic catalog when completing the assignment.

Table 2: Mapping of core curriculum questions to themes in students' reflections

	CC1	CC2	CC3	CC4	CC5	CC6
Theology					x	
Cross-cultural understanding		x	x			
Leadership	x	x	x			
Freedom of expression		x	x			
Safety		x	x			x
Self confidence	x			x		
Collaboration	x		x			
Privacy (personal data)		x	x			
Scientific thinking		x				
Empathy	x			x		x
Integrity	x					
Greed (corporations)		x	x			
Empowering others	x		x			x
Communication	x		x			
Technology contributions to society		x				
Use of data		x				
Inequality/injustice			x			x
Ethics			x			x

5.3 Central Take-Aways

The one-to-five sentence main ideas were extracted from each student reflection. The text was uploaded to create the word cloud shown in Figure 3. The size of the text corresponds to frequency of that word appearing in the main ideas, so "people" was the most popular word in the main ideas. Example main ideas from students' reflections can be found in Appendix C.

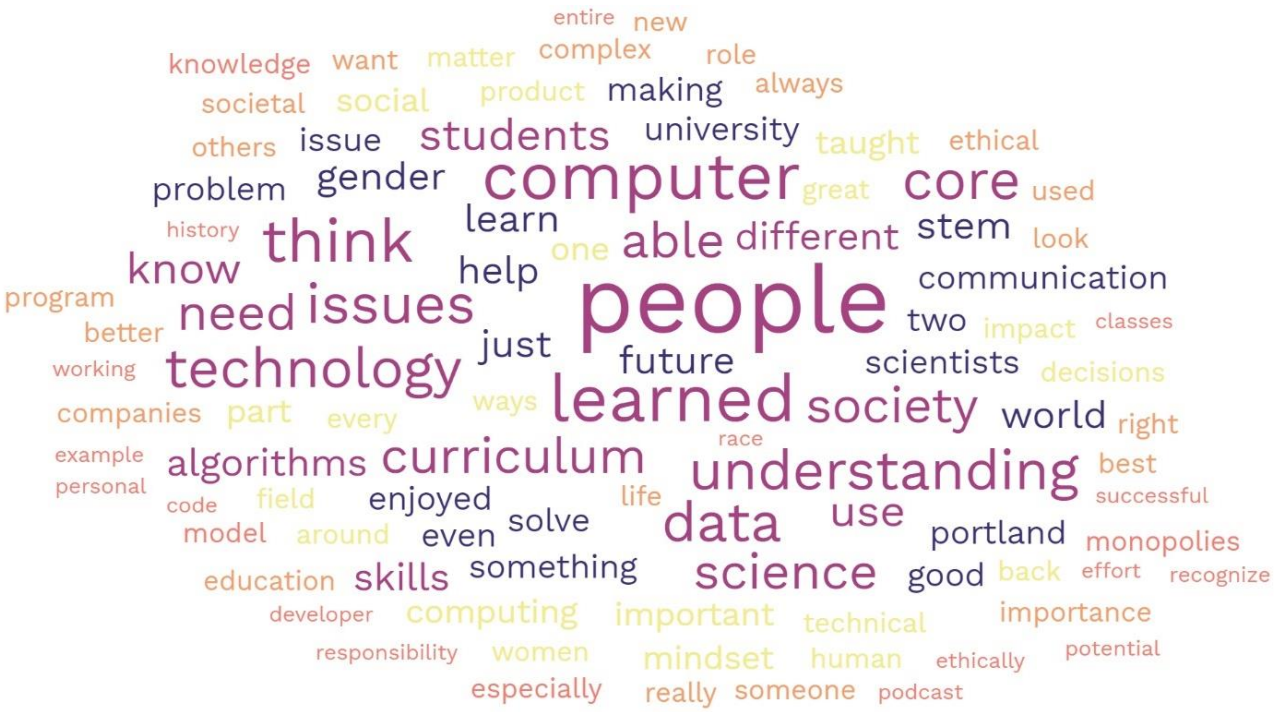

Figure 3: Word cloud generated from main ideas from students' reflections

5.4 Contribution to Professional Development

To see how students deemed the effectiveness of professional development opportunities, the first three questions of the survey responses were analyzed (see Appendix B for survey questions). Just one student stated the CS and the Greater Good Assignment was most helpful in the free-response to Q1 of the survey. Just one student stated the CS and the Greater Good Assignment was not as helpful in the free-response to Q2. Q3 responses are shown in Table 3. Overall, the greater good assignment ranked in the bottom half of activities in terms of weighted averages. The weighted average uses the weights of 1=not, 2=minimally, 3=somewhat, 4=mostly, 5=very. N/A did not contribute to the weighted average. All survey respondents stated the CS and the Greater Good Assignment supported their professional development at least minimally. Guest speakers were more popular in helping with students' professional development.

Table 3: Number of responses about the statement "The capstone course activity supported my professional development." (N=16) Some survey responses were blank for the statement.

Assignment	Not	Minimally	Somewhat	Mostly	Very	N/A		Weighted average
Resume (Fall)	1	0	2	5	5	1		4.00
Resume peer review (Fall)	1	1	4	4	2	2		3.42
Mock interview (Fall)	1	2	1	1	8	1		4.00
Fall career fair	2	1	4	1	3	2		3.18
Spring career fair	1	1	2	2	5	3		3.82
Odyssey Plan (Fall)	1	3	2	4	4	0		3.50
CS and Greater Good (Spring)	0	2	4	7	1	0		3.50
Fall Guest Speakers: recent alumni	0	2	4	7	1	0		3.50
Fall Guest Speakers: mid alumni	0	0	1	6	6	1		4.38
Spring Guest: job offer and negotiation	0	0	3	4	7	0		4.29
Spring Guest Speakers: mid alumni	0	0	2	5	6	1		4.31
Spring Guest Speakers: alumni leaders	0	0	2	6	5	1		4.23

6. Discussion and Limitations

The results of this study show that the CS and the Greater Good Assignment provides students an opportunity to holistically consider their education and the connections between computer science and society. By giving students freedom to choose their own activity, they could explore what was most meaningful for their professional development. This type of assignment could be adapted to any discipline and to any university general education curriculum. Students may see a curriculum as a set of courses, perhaps disjoint or as a chain of similar courses. This assignment encourages

them to think across disciplinary boundaries to see that disciplines and knowledge are actually quite connected and to reflect on the mission and purpose of higher education. One student wrote "While I may not directly be working with data and algorithms in this manner, the responsibility of a developer still holds. I have the responsibility of understanding the impact my code will have. This involves understanding the history and structure of our society and being able to ethically assess decisions. For example, when developing an app, there are ways to take advantage of the user." [s02] Another student connected to the higher-level mission of education: "Imagine how much faster our civilization would evolve if we allowed every human being to flourish to their greatest potential. If I learned anything from listening to the podcast, it's that only with a personal connection to a problem, will we feel the need to enact change. We need to recognize that the race issue isn't a problem of a select few, but instead a problem for the entire human race." [s03] A third student saw the purpose of education is to ignite passion: "I have learned many things at [the university]. The core curriculum taught me how to examine the world around me and determine what causes are worth fighting for. On the other hand, Computer Science taught me how to leverage technology to make things. This project bridged that gap, teaching me how to use that ability to make in order to fight for those causes." [s32]

The instructor for the course found grading this assignment quite enjoyable, getting some insight as to what issues students think are most important to them as they enter the profession. It was also interesting to see how students view the core curriculum in developing them as people. It seemed that students valued the liberal arts alongside their training and development in computer science.

This study has some limitations. It took place at a single institution within a single major and cohort of graduating students. It may be interesting future work to see how students in other disciplines, STEM and otherwise, would reflect on their major within a liberal arts education. Because the institution is teaching-focused with small classes, students get many opportunities to discuss and debate topics. That could influence the way students reflect on their college education. This study took place when all courses were offered online in 2020-2021, so students may have had more time to complete the activities for the greater good assignment. In-person activities were more difficult to access during the pandemic, but some students managed to tutor and one student helped teach technology skills in-person to a church community. Not all students completed the optional end-of-semester survey, so those results may not be fully indicative of the entire 2021 graduating class of computer science students.

7. Conclusions

Reflection is a key skill for life-long learners and continued success in one's career and job performance (Nobel, 2014). The CS and the Greater Good Assignment discussed in this paper is one strategy to get students to reflect on how computer science and societies interact with one another. Writing is one method to combine multiple perspectives to produce insight. This assignment encouraged Ryan's first key element of reflection: allowing students to make sense of material/experience in relation to oneself, others, and contextual conditions (2013). Reflective practices are not new to educational theories and practices. John Dewey identified reflection as a key component to personal learning almost 100 years ago (1933). Especially in STEM fields where content coverage may push out reflective practices, offering students an opportunity to look back in order to look forward can help them during the transition from college to post-college life.

Perhaps other institutions and other disciplines can adopt this greater good assignment to encourage reflective thought, life-long learning, and the integration across disciplinary knowledge.

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Appendix A: Appendix for CS and Greater Good Assignment

Books:

- Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy, by Cathy O'Neil
- Algorithms to Live By: The Computer Science of Human Decisions, by Brian Christian, et al.
- Data Democracy: At the Nexus of Artificial Intelligence, Software Development, and Knowledge Engineering, by Feras A. Batarseh and Ruixin Yang
- Algorithms of Oppression, by Safiya Umoja Noble
- Race After Technology, by Ruha Benjamin
- Data Feminism, by Catherin D'Ignazio and Lauren F. Klein
- Black Software: The Internet & Racial Justice, from the AfroNet to Black Lives Matter, by Charlton McIlwain
- Turning Point: Policymaking in the Era of Artificial Intelligence, by Darrell M. West and John R. Allen
- The Queens of Animation: The Untold Story of the Women Who Transformed the World of Disney and Made Cinematic History, by Nathalia Holt
- Recoding Gender: Women's Changing Participation in Computing, by Janet Abbate and William Aspray
- Rise of Rocket Girls: The Women Who Propelled Us, from Missiles to the Moon to Mars, by Nathalia Holt

Podcasts:

- Catalyzing Computing Podcast, https://cra.org/ccc/podcast/
- Society of Women Engineers Podcast, https://soundcloud.com/swepodcasts
- Code Switch, https://www.npr.org/podcasts/510312/codeswitch
- Exponent, https://exponent.fm/

Humanitarian Software Projects:

- The Humanitarian FOSS Project, http://www.hfoss.org/
- Humanitarian, opensource.com, https://opensource.com/tags/humanitarian
- OpenMRS, https://openmrs.org/
- Humanitarian Toolbox, http://www.htbox.org/about

Volunteer Opportunities:

- Girl Scouts, https://www.girlscouts.org/en/about-girl-scouts/girl-scouts-and-stem.html
- Code for Fun, https://www.codeforfun.com/volunteering
- Code.org, https://code.org/volunteer
- Hour of Code, https://hourofcode.com/us/how-to/volunteers
- Columbia River Section of SWE, http://columbiariver.swe.org/volunteer-opportunities.html

Appendix B: End-of-Semester Survey

Q1: The capstone course included several professional development activities, including guest speakers, mock interviews, career fairs, and assignments to help you think about yourself, your plans, your professional career, about the core curriculum and the greater good. The professional development assignments included: resume and resume review, the Odyssey plan (5-year plans, 10-year plan, prototype), and the CS and the greater good assignment.

Which of the professional development activities were helpful to your learning/development and why? [comment box]

Q2: Which of the professional development activities were not as helpful to your learning/development and why? [comment box]

Q3: For each activity listed below, select the most appropriate statement for each course activity:

- Not descriptive of this activity
- Minimally descriptive of this activity
- Somewhat descriptive of this activity
- Mostly descriptive of this activity
- Very descriptive of this activity

Statement: The capstone course activity **supported** my professional development.

[list of each professional development activity in Table 1 with radio buttons to choose statement]

Q4: If you could design the course, what activities would you include to help students with professional development? [comment box]

Appendix C: Sample main ideas from students' reflections

- While I may not directly be working with data and algorithms in this manner, the responsibility of a developer still holds. I have the responsibility of understanding the impact my code will have. This involves understanding the history and structure of our society and being able to ethically assess decisions. For example, when developing an app, there are ways to take advantage of the user. [s02]
- Imagine how much faster our civilization would evolve if we allowed every human being to flourish to their greatest potential. If I learned anything from listening to the podcast, it's that only with a personal connection to a problem, will we feel the need to enact change. We need to recognize that the race issue isn't a problem of a select few, but instead a problem for the entire human race. [s03]
- There are multiple occasions where working as a group or collaborating with others is vital to completing a goal or accomplishing a mission. [The University] does a great job at letting students learn and improve the interpersonal communication aspect of that, which will help all students perform better in a real life situation for a future job. As I become a leader in the military, I want to place focus on any minority group. It's important to know what hardships people are going through and to recognize that. I want to ensure that there is no trace of minorities being put in even harder situations, not only because of what I went through but what I was able to learn through Society of Women Engineers. [s10]
- One quote that really stuck with me was when one developer described algorithms as, "opinions that are embedded in code, and that algorithms are not objective." It was pretty sad to watch this part and to see how damaging and selfish computer science can be, but it was important to be exposed to this reality. There are so many algorithms out there that are written to make services more addicting, no matter what harm is being done to the user's mental health. [s12]
- Finally, the last E, empowerment, is all about networking and making sure you take care of the people around you because you never know when they might help you out in the future. I think this is the quality I am the best at because I always want people to succeed and even overshine me because if the project is the best it can be then I do not mind what my part is. [s13]
- I enjoyed reading this book and definitely would suggest it to individuals looking to learn more about feminism and the importance of data in our world. I think it points out how complex data can be and how we as computer scientists or data scientists must look at the nuances and methodologies we use when collecting and analyzing data. [s16]
- This is a crystal clear example of connecting [the university]'s core curriculum with our computing mindset. By connecting the discussion of technology to monopolies and whether the business model is good or not, the students fully engaged in the technological, ethical, societal, and business worlds to discuss the current events. Are monopolies reasonable in the technology space? Should larger companies be broken up to protect against abuses? How much should the government intervene against companies who are abusing monopolies? This critical thinking was the ultimate goal of the event, as shaping the way students think about the world they are going into is extremely important. [s19]
- As someone who is both interested in data science and security, I find this to be an interesting conundrum of which society will only see more of – a careful balance of societal improvement and personal rights, a clash which has always been in place. In addition to

the constant technical challenges the CS world presents us, it offers no shortage of social challenges either. [s20]

- However, software is often developed for a wide range of consumers, meaning it can be offered to both free and authoritarian governments. As with my decision to look carefully at a company's history, I intend to keep track of how my future projects might be used. An important skill that I learned in the [university core] curriculum is communication. The need to be able to effectively make use of it became known through a majority of the computer science classes, as labs and projects require teamwork to be successful. [s21]
- This is far from the utopia that technology promised, and in many ways the issues that technology has created are harder to solve than before technology was big. This means that we have to learn from the past and use technology responsibly and educate everyone on the short comings of technology. [s26]
- Another value that I learned from the UP core curriculum is the importance of practice and passion. [s27]
- Using social media in a modern society is inevitable and we need to learn how to strengthen and maintain our self-control. The hardest part is to know when we need to stop and take a break. [s28]
- Ideally, all students should have a set of standards relating to education. However, if there were to be a conflict between two principles, we must decide which one takes priority. [s31]
- I have learned many things at [the university]. The core curriculum taught me how to examine the world around me and determine what causes are worth fighting for. On the other hand, Computer Science taught me how to leverage technology to make things. This project bridged that gap, teaching me how to use that ability to make in order to fight for those causes. [s32]
- In the core curriculum, I learned a lot about teaching more effectively through my experience learning from many different professors about many different topics. I also gained knowledge about many new topics and gained skills in researching. [s33]