A Career Preparation Course for Students in Mathematics and Computer Science

Donna Pierce, Peter A. Tucker
Whitworth University, Spokane, WA USA
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{ptucker, dpierce}@whitworth.edu

Abstract

As professors, we all want our students to succeed, and to be motivated to study. We all get questions from students that can be boiled down to, "What can I do with X degree?" Certainly, a quick answer is to point students to career websites, or to send them to career services department on campus. However, we want to do better than that. We want students to learn how to investigate these future directions, and to have them think about their future more holistically – not just an effort to find a job. To that end, we have developed a course at Whitworth University to help students in mathematics and computer science in their investigations. We help students to learn more carefully about their own strengths and values, and to find careers that match those strengths and values. We provide students with opportunities to consider many kinds of vocational options: industry, graduate school, and mission work. We push students to investigate how their life is affected and influenced due to these various career directions, and to think further than just how to get their first job. Finally, we encourage students to think more holistically about vocation, and how their own faith and ethical values play an important role in their vocation.

We have offered this course for each of the past five years. Each year we have made improvements. Last year, we discussed ways to improve how we encourage students to consider faith and ethical issues that might arise in a chosen vocation. In the past, we reserved a class session for faith discussions and a second for ethics discussions. The discussions were both good, but when we evaluated students' final projects, we didn't see the faith and ethics interactions that we had hoped for. It had, to a large extent, been forgotten. This semester we tried to add faith and/or ethics discussions at various points in the semester, rather than during one full session. The results suggest that students understood better how faith and ethics can play a role in vocation, at least more so than in past semesters. In this paper, we discuss the course and its components. When appropriate, we will also discuss how faith and ethics were considered in the components.

1. Introduction

"I like math, I just don't know what I would do with a math degree." "I like computer science, I just don't want to program in a cubicle all day." As math and computer science professors, we've all heard these statements, and have wrestled with a more comprehensive and personal response than just pointing the students to career websites and books. We want our students to explore their own strengths and values, to learn what kinds of vocational opportunities are available to students with their skills, and to learn how to prepare for a career consistent with their abilities and values. We also want our students to think beyond the first job.

We need a way to guide each student to ask more thoughtful questions, such as "What will my life look like, and how will my career fit into that?" We want them to think more holistically about a career, including work environment, personal values, faith, ethics, contribution to society, personal satisfaction, as well as financial considerations. In response to these challenges, the Math/CS Department at Whitworth University developed a 1-credit course entitled, "Preparing for a Career in Math and Computer Science." The course targets sophomores interested in majoring in math and/or computer science. Students learn how to assess their skills, interests and values and to match these to a possible career. Through readings, interviews and field trips, they have an opportunity to interact with people in careers to see "a day in the life" view of that career. Students are taught the skills to prepare for that career including pursuing internships, writing cover letters and resumes, and considering further coursework. We help students consider ethical issues and professional issues that can arise in that career, in order for students to get a holistic view of a discipline. Result? Our students are now making more guided career choices.

An important aspect of our course that hadn't seemed as meaningful as we would have liked was the faith-integration component. In response to that concern, we have explored with students how faith integrates with their discipline. We used four approaches. First, we asked students to read through and reflect on an article examining the difference between a vocation (or a calling) and a career. Second, as in past years, we asked students to consider their own strengths and values. We enhanced it, though, to have students consider how those strengths and values play out in the context of community. Third, we ask them to reflect on questions from literature regarding the integration of faith with their discipline. Finally, we ask students to ask others in their discipline about faith and ethical issues that they have encountered, and to look for real situations where their discipline interacts with culture.

In this paper, we lay out the components for our course, including readings, assignments, and infrastructure. For each component, we include student responses to help illustrate its effectiveness. In Section 2 we give details on the component for understanding the difference between vocation and career. In Section 3 we discuss ways for students to gather information on various vocational paths. We list ways to give students practical vocational skills in Section 4. In Section 5 we reflect on changes to better integrate faith and discipline. We discuss the final component in Section 6, and conclude in Section 7.

2. Distinguish Between "Career" and "Vocation"

The goal of the first component is to help students understand the difference between "career" and "vocation". Sittser's book (Sittser, 2002) has a chapter entitled, "Distinguishing Between Calling and Career" that we ask the students to read before attending the first class session. We spend that first day going over the course structure and then discussing the text. We also use Buechner's quote regarding vocation, "The place where God calls you to is the place where your deep gladness and the world's deep hunger meet," then asked students to form small groups and discuss how that quote related to the discussion from Sittser. Students have useful initial discussions on this topic, but they are generally at a high level. We are more interested in their ability to use these ideas later as they consider vocational paths in later assignments. We give illustrations from students' comments later to show that students were able to see this distinction, and were able to reference it in considering how their lives would look after graduation.

2.1 Getting to Know Yourself and Your Strengths

We next used a worksheet from University of Washington (University of Washington 2008) that asked students to focus on what they considered their "good experiences", and then to try to determine their personal strengths from those good experiences. We coupled that worksheet with an online strengths and values set of tests from Sigi^3 (http://www.sigi3.org). One thing we noticed from this exercise is that students were able to think holistically about their good experiences, and were not simply focused on scholastic achievement. Good experiences included doing well on class projects and receiving academic recognition, but also included achievements in athletics, personal relationships, learning new skills, and performances.

In order to help students see more clearly the relationship between their strengths they found in their good experiences, and the strengths and values identified through the Sigi^3 tests, we asked students to form small groups with other students they knew at least fairly well (2-3 per group). People who know us well can see patterns and strengths in us that maybe we take for granted and don't recognize as strengths. We have found that grouping students with others who know them can foster this sort of discovery.

2.2 Reflecting on Your Findings

Finally, we asked students to reflect on their findings, reflections, and discussions, using the following questions:

- Now how do your gifts/strengths tie into the idea of vocation (as opposed to just a career)?
- How do we live out our vocation as part of a community (i.e. a part of the body of Christ, or a part of a neighborhood)?
- How might your talents, interests, personality and values contribute to this community?

We were able to find three distinct kinds of responses: First, some students looked at how their career path could reflect their values and strengths. For example, being a professor matched up with a few students' needs to help and educate others. Another student mentioned that their strengths in art and computer science could be used in a career as a web site developer. Another student saw how his interest in economics could be used to fight poverty.

A second kind of response we saw was that some students considered vocation more generally. One student saw her vocational calling as "contributing knowledge, teaching others, helping others. The body needs visionaries, people who guide, invoke ideas, inspire others to discover/develop their gifts. The world has a hunger for knowledge and I have a deep gladness in knowledge, learning." One student reflected on the relationship between strengths, values, and vocation: "What we like tends leads us to our strengths which in turn helps form our values and personality and in how we want to impact the world. This then leads us to a career we might want to pursue and through this pursuit there is a good chance we will find our calling in life." Still another student pointed out, "I think it's important to remember that your skills can be used in places other than your career. You can use skills for services other than furthering your career. For example, I want to use my soccer skills to coach a young team later in life."

Finally, we saw some students struggle with trying to fit their strengths and values into how they considered vocation and calling, but that they wanted to resolve that struggle. One student wrote, "I think my values are completely opposite of contributing to society. The only thing I think would link to helping my community would be possibly my artistic personality and

initiative." Another student wrote, "Living out a vocation involves using my skills to help and serve others. Having little ambition, I could use my skills to help others succeed, perhaps. That might be working for a company, maybe a non-profit organization, ..."

These reflections really helped us to see that students were understanding the holistic nature of vocation that we wanted them to see, and the importance of trying to find how one's strengths and values contribute to vocation.

3. Career Possibilities – Gathering Information

The second component of our course exposed students to a variety of directions available to them as majors in mathematics and computer science. Students sometimes assume that all math majors end up to be teachers and all computer scientists must be programmers stuck at a keyboard all day long in a Dilbert-style cubicle. Our approach in this section of the course is to expose students the many different vocations others with their degrees have taken. This exposure takes place through website exploration, guest lectures, and a field trip.

3.1 Career Exploration

First, there are a number of web sites available to students where they can read and reflect on career or job profiles related to their Sigi[3] and strengths exploration results (we've used career exploration pages from ACM, IEEE, SIAM, the Sloan Career Cornerstone Center, Association for Women in Mathematics, and Mathematical Association of America, among others). We ask students to read at least three such posts and write about what they learned, and why they were interested in each posting. This sort of assignment helps to make a job more personal to each student – they learned about why the person chose their career, what their day-to-day life looks like (pros and cons of the job), and what training and skills they needed to obtain for that job (to help our students identify "next steps"). Reading and reflecting on these career profiles was useful in helping our students begin to think about what a particular career might look like.

However, few of the online career profiles consider faith or ethical issues people experience in their career. We want our students to have that discussion. Therefore, the next step is to go out and meet with someone in one of their chosen career paths and either job shadow them for a day or do an informational interview. Before they set up the shadow or interview, we spent some time in class discussing informational interviews, including drawing up a list of questions to ask. With our encouragement, many students included faith and ethical questions in their interview questions. This assignment made a number of students more nervous than the previous one. The career profile web pages are accessed remotely, allowing students to learn about the career remotely and anonymously. The informational interview or job shadow required students to put a more personal investment in what they learned. The students then wrote a paper reflecting on their experience, including what they had learned, advice they had received, and the next steps they might take.

One question we are often asked is, how do you find good candidates for informational interviews or job shadows? We do not allow students to use people they are close to, including immediate or close family members. We hold this rule as important because we want students to step out of their comfort zone. Most job interviews will be conducted by people students aren't familiar with, and so learning how to handle such a situation is very useful. Another selling point

for students is that, by meeting someone new, they are able to increase their contacts as they get closer to graduation. In fact, occasionally an informational interview has turned into an internship interview. Students are allowed to use contacts found through family or friends, but we stress the importance of meeting new people in this exercise. We will help students find interview candidates in their chosen field through our own contacts and through our alumni department. (We have found in general that alumni are very willing to help our current students. They are often very happy to come back for guest lectures or to meet with current students.)

This process of reading and reflecting on career profiles and doing an informational interview has helped students envision ways that they could use their skills and strengths in a particular field. Students found the interviews enjoyable and enlightening, and sometimes inspirational in terms of how they could be preparing for the future. Some students heard reassurances that they could hold true to their values and priorities while pursuing a career. Student comments include: "In fact, this interview was very eye-opening for me, and even inspired me to be a better student and try to go above and beyond the typical offerings of a college education;" "After talking to ....., I discovered that there are a lot of math applications in economics....It has definitely piqued my interest in pursuing math and economics together;" "Most importantly this interview just gave me a good idea of one of my possible career plans." Students received advice on courses to take, projects to work on, and activities to be involved in while in school. They heard about the importance of loving what you are doing, balancing work and family, fitting in with the climate of a company, knowing various aspects of your company, and meaningful work. For some, this component of the course helped them to look at careers they had never previously considered.

3.2 Graduate School

Exposure to graduate school, research, and non-profit agencies also caused students to reconsider these options. Many students found that graduate work was a prerequisite in the career path they were investigating. Yet many students knew little about the ins and outs of graduate school: different kinds of programs, application process, funding, work load, and so on. We have taken a couple of different approaches here. In the past we've taken students to universities with graduate programs in math and computer science, to meet with faculty and graduate students. Our students get to see the different kinds of research directions people are taking, as well as experiencing a graduate school environment. This year we had alumni as guests on a "graduate school panel" for our students. One panelist was in his fourth year of graduate school, pursuing a PhD. Two other panelists were senior math majors. Both had been accepted to more than one school and were in the process of choosing a school to attend. The final panelist was an alumnus who had just started the process of applying to graduate school. It was a very good mix of panelists, and our student had a very meaningful conversation with them. Our students also conducted their own Internet search for graduate programs that matched their own interests. They collected information on at least three schools, including the degrees offered, interesting research directions and advising faculty, including a recent research article/publication from a faculty member, and the application process.

Students who said that they had never thought about graduate school before now saw it as a viable option. One student wrote, "It has made graduate school more appealing." Another student said, "I also came to the conclusion that a mathematician could have a lot to contribute to economics. A strong math background doesn't just help you in getting your PhD, but can lead you to areas of new research in economics. ... I'm planning on taking elective courses in

economics beyond principles to get a good taste for it. And applying to both math programs and economics programs for my PhD may be in store in the future."

3.3 Non-Profit Agencies/Mission Opportunities

Many of our students found through their Sigi[3] and strengths explorations that "contribution to society" was of high value to them. Several of our alumni have gone on to work in non-profit agencies and we wanted our students to be aware that this was a viable option for them. Students heard two Whitworth alumni working in non-profit agencies discuss why they chose this career path, including advantages/disadvantages. One common theme from both alumni was that they wanted a vocation that was "meaningful" to them. This later led to a discussion of "What is meaningful work?" Again we referred students back to the idea of vocation and calling. Could a calling to work in a for-profit agency be as meaningful as working in a non-profit agency? Could a calling to work in a for-profit agency be considered part of a vocation? Referring back to the discussions on graduate schools, are there research directions that are more meaningful than others? Many students responded that almost any kind of work could be meaningful, depending on your attitude and reason for doing it.

Related to the discussion on meaningful work, and in light of the discussion we had on graduate school, we also asked students what meaningful research was. Again, students thought that almost any kind of research could be meaningful, depending on your attitude and reason for doing it. Acknowledging that some research has immediate applications and others is seemingly more theoretical, the students could see value in both, though if funding were scarce, immediate practical research should get top funding.

3.4 Field Trip – The Highlight of the Class

The purpose of the field trip is to get out and see what it's like in the real world. We want students to hear from a variety of people about their experiences. We want students to see what professionalism in a discipline looks like. Since this class is largely sophomores, it is also important that we create a sense of community within the class, and field trips are great for encouraging that. Finally, field trips are fun!

The activities of the course vary from year to year. We always try to include a math activity and a computer science activity over a weekend trip, and we require students from each discipline to participate in both activities. Students find overlap between the two disciplines and often report that they gained so much from the information they received from both activities. In the past we have included visits to industry (SAGE Software, Microsoft and Adobe), attendance at PNW MAA Conferences and visits to graduate school (Portland State University and Washington State University). We always try to have some kind of panel presentation where students can hear from a variety of people about their vocational journey. Often the panel consists of current employees at the company or current faculty and students at the graduate school. One thing that we've noticed from the panels is that there are generally a number of different responses to each question, so the students get a number of thoughts to work through. When possible, we try to include alumni on the panel as well. Alumni often have a unique perspective, including some appropriate "next steps" the students can take while they are still at Whitworth, since they are familiar with the transition from Whitworth to where they are now. They can also more readily address faith and ethical issues they face in their job.

Students are responsible to drive the panel discussions. The course professors largely stay out of the panel conversation. We don't want to put any extra burden on the panelists to have to

prepare anything beforehand. The students are to ask the questions that are on their minds, and the conversation builds. Usually these panels last 2-3 hours, and the conversations are quite lively.

For us, the most fun is often the drive back home. The students have a new energy toward what they are learning, and a number of the panelists' responses are still fresh in their minds. We will often be asked questions such as, "What did the panelist mean when they said ...?" and "Did you hear how the two panelists seemed to contradict each other on my question?"

When we return, we give students a chance to reflect on topics and ideas brought up by the panelists. This past year, one panelist explained what he called "gracious professionalism", and another panelist asked "Whom do you think you work for?" We gave students time in class to reflect on these thoughts in small groups. One student thought that gracious professionalism "... means bringing good character to work." Another student saw the ethical issues of the question "'whom do you work for?' are not just found in industry. Teaching could have this issue with curriculum vs. what the kids really need to learn." Finally, another student stated, "Some of the ethical issues involved in this question is how much the bottom line takes precedence over needs of people, the environment, etc. A company works for money, society, the environment, the product, etc. The issue of ethics is in how one prioritizes these aspects and how various aspects affect each other."

4. Practical Skills for Preparing for a Vocation

4.1 REUs and Internships

Certainly, we have heard from people in industry, graduate school, and from our own Career Services Department about the importance of internships. Internships are a way not only to prepare for a career, they help you experience your field of interest and decide whether it "fits" or if instead you want to change direction. Internships also often lead to a job after graduation. Yet many of our students do not know how to find an internship. Similar to internship experiences are Research Experiences for Undergraduates (REUs), but again we find that students are unaware of what these are or how to pursue one. In fact, REUs are even less understood by our students than internships. We devote a class session to discussion on the importance of these and the logistics involved. We then have students find three internships or REUS that they might be interested in pursuing. They are to gather pertinent information on these, in a similar way to the graduate school investigation we conducted earlier.

If there is one common critique we hear from students, it is that we don't conduct the investigation of internships and REUs soon enough in the semester. Actually, since we have offered this course only in the spring semester, we really can't conduct this investigation in time for many summer positions. As we target sophomores in our class, we feel that this is acceptable. Generally, sophomores aren't as ready for internships and REUs as juniors are, so if we get sophomores thinking about these in the spring semester, they are more likely to start the application process the following fall. The good news is that, since students want to hear about these opportunities sooner, they are seeing how important internships and REUs are. We've done this component of the course for several years now. Awareness, as well as hearing the importance of doing an internship from alumni, panel members, and informational interviews, has had an impact. More of our students are doing internships (almost expected in CS) or

participating in REUs (has gone up from about one student every few years to about 5-6 students per year).

4.2 Resumes and Cover Letters

We want to equip our students with the necessary practical skills in pursuing a job or internship. One important practical piece is the development of a resume and cover letter that reflects the student's experiences and skills. The Career Services Department at Whitworth has supported us in this goal by helping our students to identify the necessary components of a good resume, what type of information to include (or not include) and how to organize that material. We invite them to come to our class to speak on resumes and cover letters, and they willingly meet with our students individually to go over resumes and cover letters. Over the years we have also brought in Human Resource personnel from industry to highlight what they look for in a resume. One thing that students find quite useful in this section is to look at examples of good and bad resumes. They see what pieces are important, and what kinds of things are not helpful, or can even hurt a resume. For example, students learn that they should use a professional email address (such as one that mostly consists of their name) rather than an email address that contains goofy names (such as iwannapizza@hotmail.com).

5. Faith and Ethical Issues to Consider

The goal of next component of this course is to help students see the intersection between faith and vocation. We have tried a couple of different approaches to integrating faith and ethics in this course. In the past, we devoted one class session to reading and discussion on faith-related articles in math and computer science, and a second session to reading and discussion on ethics-related articles in math and computer science. While the conversations were often good, we felt as though students forgot about those conversations as they considered their vocation.

This past semester we made two significant changes. First, we used faith and ethics at various points in the course, to keep those thoughts fresher in their minds. First, as mentioned earlier, we discussed the vocation chapter from Sittser. Second, we asked students to consider their results from Sigi[3] test and reflect on how those gifts will be used to benefit community. Third, we had students look at and reflect on some articles exploring faith and ethical issues in math and computers science. Details on this approach are given below. Fourth, we had students ask questions to people in various vocations regarding faith and ethics and to look for issues in the news, which we discuss below.

Second, we changed how we approach discussing articles on faith and ethics. In the past, we've facilitated discussions as a large group, but found many students were hesitant to engage in these personal discussions. This time, we asked them to consider two to three of those question in small groups (2-4 students), and then later gather as a full class for reflection on the small group discussion as well as to consider other discussion questions. We found that students seemed more willing to engage in a large class if they had a chance to "try out" some ideas in a smaller group setting. We looked through the final papers and comments to see how well students understood the connection to faith and ethics. We found that many students did a very good job of integrating faith in their discussion of vocation, and were able to identify potential ethical issues that may arise as part of their chosen vocation.

5.1 Discussion on Articles Focus on Faith and Ethics

In taking a holistic view of vocation, it is important to help students become aware of faith and ethical issues in their discipline, and the way those issues play out (and have effects) in the real world. Students read from a selection of four articles (Brabenec, 1978; Bradley, 2003; Gray, 2005; Schuurman 2007): two regarding mathematics and worldview, and two others involving computer science and worldview. For each article, they were asked to think about how their discipline impacts the world around us and peoples' worldviews. As before, we provided students with initial discussion questions to get them started, though certainly they were not limited to those questions. They each came to class prepared to discuss two of these articles for discussion in class. (Note: There is a need for more articles like these. Students really seem to engage in these conversations when given some initial direction.)

Students brought up a number of faith-related questions that interested them. One student asked a number of questions, "How does the idea of multiple infinities influence the idea of an infinite God? And, What is the effect on non-Euclidean geometries an absolute truth, relative truth? And finally, What's the limit to the extent and kind of man's knowledge?" Another student asked, "Could hardware and software replicate the brain? Could a machine become self-aware?" His response: "No to both things I'd say. There is some element of the mind that makes it distinct from a machine. Hardware may someday be able to mimic the exact function of the brain, but it won't be a mind."

5.2 Identifying Current Faith and Ethical Issues

The final step we added for integrating discussion on faith and ethical issues was to ask students to listen to and look through the news for 7 days and find at least one article or story each day that dealt with faith or ethical issues involving math or computer science and technology. Certainly these kinds of articles can be found in many places. The students brought one of their stories to class, shared it within a small group (2-3) and identified i) the ethical issues; ii) the people involved; and iii) the conflicts that arise from different concerns/interests. They were then asked "What does your faith suggest how one should approach the situation?"

Again, the conversations among students were very good. Many brought in articles that produced emotional reactions from other students (e.g. a morally-questionable application developed for iPhones, downloading and sharing of copyrighted material, and an article describing the development of using prosthetic arms on monkeys, which raised the question, "Are we interfering with God's plan by allowing disabled people to do stuff, should we try to improve everyone's lives?"). While the ethical issues were often apparent to students, we did find that they had a hard time bringing a discussion of how their faith influences their response to the issue.

6. Sharing the Vocational Journey with Others

The final requirement for the class was for students to imagine themselves five years after graduation in a chosen vocation. The paper is generally four to six pages long, and must address the various components of the class discussed earlier. Students do a very good job of drawing from the information they've received, and applying it in a specific direction. We compile the papers into a booklet, which is then handed out to the students on the last day of class. In this way, students get a lot of information about a variety of vocational directions. Certainly, they'll

be more interested in some directions than others, but most papers have good information about the requirements and expectations that students can learn from.

One thing we noticed in these final papers is how much influence other people had in helping students make their vocational decisions. Many students referred back to what they had read from career profiles, their conversations during information interviews and the panels, as well as conversations outside the class with family or friends regarding vocation. From that, many current students want to be able to have the same influence on future students. In response to that realization, a number of students mentioned in their final paper that they would like to return to Whitworth after graduation, to participate in a guest lecture or panel, in an effort to help guide other students.

We have been compiling the booklets every time we've offered the course, and they have been improving each time. One specific improvement is in how much better students each year are able to take a more holistic approach to vocation – more and more they are able to say "this is who I am, this is why I'm choosing this vocational direction, and this is how I'm going to use my vocation to impact others." They are more able to see how their deep hunger meets with the world's needs.

We have found that, in addition to helping our students, the booklets also help faculty in our department. When students come to visit, asking about vocational directions in math and /or computer science, we can point them to this booklet for many ideas. We have used it as a recruiting tool, to help students consider math and/or computer science as their major. Finally, when prospective students come with their parents to visit our school, they often ask about how we prepare students for life after graduation. Showing them this booklet and allowing them to look through it even briefly helps them to see how seriously we take such questions.

7. Conclusion

In this paper, we have presented our work on a course to help guide students in considering vocation. We wanted students to get beyond trying to find their first job, and think earlier about how to start a career path, and to think holistically about how that career path will coincide with their own strengths and values. We guided students through investigations of strengths and values, then guided them in learning about various career directions that matched well with those, and finally helped them to consider faith and ethical issues that can arise in those directions. We discussed a number of components that make up our course, and how they fit with the course goals.

For our next offering, we plan to consider other ways to incorporate faith and ethics in this course. One idea is to have the students look for ethical issues in the news and on the web, and to bring such a story every week for discussion. In our most recent offering of the course, though, it seemed that students understood many of the ethical issues, but had a hard time finding how faith played a role in reacting to those issues. A second idea is for professors to model more carefully in our discussions on ethics how faith influences our reactions. Finally, the papers we used on faith and ethics were quite useful. There is a need for more such papers. Students are able to engage in good discussions based on the ideas from these papers.

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