BOOT CAMP: A FIRST YEAR SEMINAR IN CS1 LABS

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ABSTRACT
This paper presents novel solutions to a persistent and widespread problem: efficiently bridging the gap between high school and college. The first year seminar implemented at Shippensburg University is designed to rapidly develop the professionalism, observation, self-management, and new-skill acquisition strategies necessary for college success. This "boot camp" also lays out the degree concentrations available in the Computer Science department and outlines long-term goals, enabling incoming freshmen to quickly choose a path that will provide the greatest satisfaction and a clear goal to cling to during the lengthy acquisition of core skills that are the hallmark of their freshman and sophomore years. Of specific interest are the elements of the program that creatively replicate the demands of the discipline of computer science and of industry: observation, problem solving, and professionalism. Finally, the challenges of this course are outlined and possible solutions are suggested.

BACKGROUND

The Computer Science faculty at Shippensburg University chose the most appropriate model for the first year seminar by referencing the extant literature to address the specific needs of their student population and adding elements that appear to be unique to our course. Institutions of higher education have long recognized the importance of helping students make the transition from high school into college academic and social life [6, 7]. In addition to an orientation program taking place over the summer before fall semester or in the week before the start of classes, many institutions have begun to include credit-bearing first year seminars. These have been especially popular in engineering schools and programs. Some first year seminars, like those at Brown University [8] and Bucknell University [9], focus primarily on the academic skills needed to be successful in a rigorous program. Other programs, such as those at Grand Valley State University [10], present a blend of academic content, study skills and time management skills, and ethics. A third approach, as used at Norfolk State University [11], seemed geared more for our students. This program focuses primarily on "the basic survival skills needed to be successful in college" such as study skills, critical thinking, time management, financial planning, and exam preparation. The faculty added unique programs for our student population to develop observation skills and new skill acquisition.

CS1 LECTURE & LAB DIVISION

The Computer Science faculty of Shippensburg University needed a way to provide a required first year seminar without adding any additional required credits; this was accomplished by designating an extra hour within a pre-existing lab structure specifically for majors.

Previously, CS1 was a 4-credit course with a mix of lecture and active learning labs, taught in small sections with major and non-major students mixed throughout. In AY 2011, the course was restructured to accommodate a first year seminar for computer science majors, while still serving the needs of the non-majors who are required to take CS1 for another program.

The restructured course packages conceptual material into a traditional 3-credit lecture designed to accommodate many students, and a small- sized 1-credit lab focusing on active learning material. The non-major lab sections met for two continuous hours a week and covered the traditional lab material. The major labs met for three continuous hours a week: two hours identical to the non-major sections and an additional hour nicknamed "boot camp". By splitting the lecture material from the lab material, we were able to continue to deliver the same content with more time each week devoted to individual attention.

BOOT CAMP COURSE CONTENT

The goals of the boot camp material were twofold: to address the "soft skills" that our freshmen lacked, and to provide graduation plans based on a thorough understanding of the department's programs. In AY 2011, topics included professionalism, new skill acquisition, observation skills, time management, study skills, and awareness of campus resources. In a 14-week semester, these topics, along with detailed discussions of the programs offered in the computer science department and degree planning, were addressed with different in-class exercises, lectures, and guest speakers.

Professionalism

The professionalism grade provides a mathematical model for a critical career skill: reputation. Reputation starts high for a new hire, diminishes rapidly after a few mistakes, and is very difficult to repair. To model this phenomenon, each student's grade is divided into two parts: professionalism and quality. Professionalism reflects conscientiousness, and quality reflects material output. The professionalism part of the student's final lab grade begins at 100% and goes down, but the quality part begins at 0% and goes up. Since reputation influences the perception of someone's work, the student's final grade consists of the professionalism score multiplied by the quality score. Because their grade is the product of these two scores, students cannot pass the course unless they are both conscientious and productive.

Table 1 was included in the course syllabus, demonstrating the profound influence that the professionalism portion of the grade has over the final course grade. Students were given some opportunities to earn back lost professionalism points by doing activities that reinforced the skills that were the focus of boot camp. These activities are mentioned in the following sections.

Table 1: Grade Distribution

		Quality %										
		100%	95%	90%	85%	80%	75%	70%	65%	60%	55%	50%
Professionalism %	100%	100.0	95.0	90.0	85.0	80.0	75.0	70.0	65.0	60.0	55.0	50.0
	95%	95.0	90.3	85.5	80.8	76.0	71.3	66.5	61.8	57.0	52.3	47.5
	90%	90.0	85.5	81.0	76.5	72.0	67.5	63.0	58.5	54.0	49.5	45.0
	85%	85.0	80.8	76.5	72.3	68.0	63.8	59.5	55.3	51.0	46.8	42.5
	80%	80.0	76.0	72.0	68.0	64.0	60.0	56.0	52.0	48.0	44.0	40.0
	75%	75.0	71.3	67.5	63.8	60.0	56.3	52.5	48.8	45.0	41.3	37.5
	70%	70.0	66.5	63.0	59.5	56.0	52.5	49.0	45.5	42.0	38.5	35.0
	65%	65.0	61.8	58.5	55.3	52.0	48.8	45.5	42.3	39.0	35.8	32.5
	60%	60.0	57.0	54.0	51.0	48.0	45.0	42.0	39.0	36.0	33.0	30.0
	55%	55.0	52.3	49.5	46.8	44.0	41.3	38.5	35.8	33.0	30.3	27.5
	50%	50.0	47.5	45.0	42.5	40.0	37.5	35.0	32.5	30.0	27.5	25.0

Professionalism points could be lost being late to class, turning in lab assignments late, missing class, failing to practice the recorder, *etc.* For more detail about the professionalism grading scheme for seniors, the inspiration for the grading scheme in this course, see [11].

Students were continually reminded of this system: in the syllabus, on the first day of class, and frequently during the semester. Grades posted online always showed the score breakdown, revealing the impact that their professionalism had on their overall grade in real time.

New Skill Acquisition

Many of our freshmen labor under the misconception that "knowing what" is the same as "knowing how". Observation suggests that they are well prepared to learn fact-based material which can be memorized and regurgitated for a test, but they have had little experience learning a new skill in a formal setting. Moreover, most freshmen do not recognize that programming is a skill, and they waste the semester trying to apply fact-learning techniques to the material.

To demonstrate the difference between learning new facts and acquiring a new skill, students were required to learn to play the recorder. At home practice and in class performance demonstrated for students many key phases of skill acquisition: being an unskilled beginner, overcoming frustration, practicing over time, and demonstrating improvement. Familiarity with these phases is intended to give students personal reference points about their own learning process so that they can avoid becoming unduly discouraged when a programming skill does not come easily and instantly.

Knowing that this exercise could be intensely frustrating, every consideration was given to facilitating skill acquisition. The recorder was chosen because it is inexpensive, durable, and portable. More importantly, a user friendly, multi-modality learning system was discovered for this instrument. Gary Turner's recorder instruction book [4] includes a musical CD as well as a DVD with a video of each song. The videos are shot in a three-way split screen with a live demonstration, a light-up fingering chart, and scrolling musical staff. This way, a student could learn to play by ear, by watching someone else, memorizing the fingering, or reading the music.

Learning and performing a new skill can feel awkward and embarrassing, so the course instructor also learned to play the recorder and performed with and for the students in class. Watching the instructor fumble and make mistakes helped emphasize that the only way to learn a new skill is to practice and that nothing comes instantly. This component of the course was vital, as many students were nervous about the experience.

Weekly Activity: 15 to 25 minutes of performance time.

Professionalism Bonus: Play a selection solo or by preparing material not found in the text.

Observation Skills

Many of our freshmen mistook the ability to identify an object or a phenomenon for deep analysis. This is problematic in computer science because there are skills and concepts so subtle that they can only be understood through experience. For example, it can take a long time to truly appreciate the importance of elegant code or clear documentation.

Several observation exercises addressed this issue in class. Many of these exercises were tailored for class from [4]. While a few exercises in observation can not be expected to develop strong observation skills, students were encouraged to consider the benefits of the deeper knowledge gained from these exercises and to utilize observation to optimize their learning experience.

Activities

Week 6: *Introduction to Observation*: Students were given an interesting object, and the instructor coached them on using all of the senses to gather information about the object. Students were then pretended that they were explorers from an alien world and describe the object and explain its purpose to another being from their home planet.

Week 7: *Describing the room*: Students started class out in the hallway where they wrote a detailed description of the classroom for 10 minutes. Then they compared their descriptions with the actual classroom.

Week 8: *Mindful Eating*: The instructor brought in samples of food. Students were given 3 pieces of the treat. They ate the first bite as they normally would. Then they were coached through mindful eating of the second bite and asked to note the differences in the experience. Lastly they ate the third bite normally and asked to see if there was any difference in the experience of eating the third bite after mindful eating.

Week 9: *Describe the Room II*: Before class began, the instructor had "hidden" some items in the room (leaving notes on the white board, putting a sandal on a window sill *etc.*). After a break, students wrote a description of the room in the hallway. Students then were asked to see how many changes they included in their description of the room.

Week 10: *Stretching*: Students were coached through some very basic stretching exercises. Stretching increases blood flow and helps improve attention.

Week 11: *Breath Meditation*: After an introduction about the utility of secular meditation, students listened to [5]'s breath meditation. Meditation compliments observation and encourages clear thinking.

Time Management

Casual student interactions revealed that a significant portion of our population has never managed their own weekly schedules or to do lists. When asked how they managed the demands of high school, answers ranged from "I just did my homework in the class before it was due" to "My parents managed my schedule" to "It's no problem, I can just keep it all in my head". For most, their previous time management methods broke down within the first few weeks of their freshmen year, leaving them no idea what to do next.

Our students have free access to at least two time management tools, the Google Mail Calendar application and Microsoft Outlook. Students were coached in how to use the Google Calendar, but also reminded that the same techniques could be used with most digital calendars and paper day planners. Throughout the course, students were prompted to check their calendars to help develop the habit of making regular use of this planning tool.

Activities

Week 1: *Setting up the calendar*: Students added their mandatory, fixed weekly obligations. For most students, these obligations included class, work, and team sports practice.

Week 2: *Adding assignments and planning "free time"*: Students brought all the course syllabi they had received in the first week of classes and added these deadlines to the calendar. Students scheduled in a minimum of 25 hours a week for study time. Students also set aside time for regular meals, club meetings, and other regular weekly activities such as the gym, travel to and from campus, weekly worship service, or volunteer activities.

Week 3: *Using a task manager, setting reminders, importing other calendars, and other digital calendar features*: Students were introduced to the most useful of the additional features of the Google Calendar.

Study Techniques

Anecdotal evidence suggests that a significant portion our students have never had to develop strong study skills. Students often struggle when they realize that their previous approach to studying no longer yields acceptable results.

Tony Buzan's book [1] was listed as a recommended, but not required, text for the course. Three lectures were given summarizing the key material from the book on note taking using Mindmapping[1], study skills, and test preparation skills.

Activities

Week 3: *Mindmapping*: Lecture on Mindmapping. Students then made a Mindmap of a three-minute talk. For homework, students were required to make Mindmaps for three lectures and/or reading assignments over the upcoming week.

Week 4: *Study Skills*: Lecture on the studying technique presented in [1].

Week 5: *Test Preparation*: Lecture on the test preparation technique presented in [1]. This lecture was timed so that it came one week before the first large exam.

Professionalism Bonus: Students could earn back lost professionalism points by creating additional Mindmaps of lectures or readings.

Awareness of Campus Resources

All students are given a thorough overview of the campus's resources during summer orientation and move-in; however, these orientation periods can be overwhelming and filled with useful information that students often miss. Representatives from two important campus offices suggested resources for quick, high-yield performance improvers.

Activities

Week 8: *Eating for Optimal Brain Performance*: The attending M.D. from the campus health center gave a talk on eating to get the most out of the brain *today*.

Week 9: *What can the Learning Center do for you?* A representative of the campus Learning Center gave a presentation outlining the services provided at the center and described how students could become involved in tutoring themselves.

Professionalism Bonus: Go to a "well visit" with the campus doctor. Go to a tutoring session at the Learning Center.

Understanding the CS Programs & Degree Planning

The long series of difficult and demanding courses, though necessary and valuable for the BS in computer science, can be daunting for students who cannot see the eventual rewards. Chris Drew's article in The New York Times points to the "math-science death march" [2] as one of the main reasons for attrition among STEM freshmen. To give students a better picture of their exciting future as competent juniors and seniors, several weeks were spent discussing available CS degree programs and allowing students to build personalized four-year graduation plans.

Further streamlining this process, the department created a spreadsheet containing the list of required courses for each of the CS department's two possible degrees and four possible concentrations and a table for every semester and summer for the next four years. This sheet also included a space for notes about employment, extracurricular activities, and personal notes for each semester to assist in future resume building and to help students understand what factors may have helped or hurt their performance in a given semester. Students were required to upload this document and share it with their advisors via GoogleDocs, providing a common working document to reference and annotate during advising sessions.

Activities

Week 11: *Understanding the CS degree & Degree Planning*: Lecture on the overall degree and the areas of concentration. Show students where to find important planning documents on the department's website.

Week 12: *Computer Engineering and Software Engineering concentrations & Degree Planning*: Guest lectures by the faculty members heading the engineering concentrations. Using the degree planning tool, add transfer credits, current courses, and then plan courses for the upcoming semester.

Week 13: *Computer Graphics & Related Discipline concentrations & Degree Planning*: Guest lecture by the faculty member heading the graphics concentration. Lecture about the related discipline concentration. Using the degree-planning tool, students plan courses for sophomore year.

Week 14: *Senior Research Proposal Presentations & Degree Planning*: Guest presentations by students in the senior capstone course. Fill in the required core courses, math courses, and general education courses for junior and senior year.

CHALLENGES

There are a small number of significant challenges that come with this kind of first year seminar course. They include instructor temperament, rotation of the new skill activity, managing the time demands of the boot camp material with the active learning lab material, and student attendance in the large CS1 lecture.

The course works best when the instructor is willing to learn a new skill along with the students. Taking the same risks that they are, failing, facing frustration, and looking silly concretizes the learning experience in a way that mere explanation simply cannot. Students actually see that no one starts out good at something and that everyone has to struggle to achieve mastery. This practice also cultivates empathy by reminding the professor what it felt like to learn a new skill. This also means that the instructor must constantly rotate the skill activity so as not to get too good at it from one semester to the next. The new skill must also not put an excessive financial burden on the students. Current ideas for skills in addition to the recorder are calligraphy, juggling, yo-yo, and knitting.

The instructor for this course must be able to motivate students to tackle activities that may seem well outside of students' expectations. This is particularly true for the new skill portion. The course instructor had to address more than one email before classes started from students "appalled" that they would be expected to learn the recorder in a computer science course. It is important to note that the course instructor was explicit about the purpose of learning the recorder, and constantly reminded students to observe their learning process. Most students quickly came around to understanding the point of the exercise and many students genuinely enjoyed the experience.

Given the exciting nature of many of the boot camp activities, it can be difficult to fit them into only one hour. It can be challenging to insure that students also receive the full time for lab activities so that they are not at a disadvantage compared to their non-major classmates.

The last major issue encountered with this course was attendance in the large lecture sections. This challenge was unexpected, but it is may be explained by the size of the lecture section. It is possible that students felt they had the cover of anonymity in a section of 60 or 70 students and would not be missed. Attendance in the small lab sections was consistently higher than attendance in lecture sections. Those students who did not attend the lecture section struggled on homework assignments, exams, and lab activities. Changes are being made to the grading policies in the lecture section to encourage student attendance.

FUTURE WORK

The long-term goals of this course include increased retention and early voluntary retention. While it is not the intention of the department to "weed out" students, it is important that students settle on a major as soon as possible to maximize their chances for long-term success. For

example, students sometimes start the computer graphics concentration without understanding the difference between our degree and the graphic design concentration offered by the art department. Some students do not realize the difference until their junior year, when it is difficult and expensive to change majors. Both long-term goals will be measured over the next several years to assess the impact of the first year seminar.

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