Using the Imagine Cup SDI as the Foundation for Computer Science Capstone Projects

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ABSTRACT
This paper describes the use of the Microsoft Imagine Cup Software Design Invitational (SDI) as a way to overcome some of the issues related to traditional or “closed” style capstone projects. Problematic issues with traditional capstone projects, as identified by literature, are discussed in conjunction with how the SDI addresses them. The main premise is participation in the Imagine Cup SDI can address the issues faculty wrestle with as they attempt to provide students with the best possible learning experience. Additionally, the authors present some of the advantages and challenges that they have noted from personal experiences using SDI as a part of a capstone course.

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1. INTRODUCTION
One of the biggest challenges to educators teaching computer science (CS) and software engineering (SE) capstone courses is developing a relevant, interesting curriculum that incorporates learning from all prerequisite coursework [2]. While capstone curriculum may take many forms, a common approach is to offer a pre-defined, traditional, “closed” project that lacks applicability outside the classroom, but allows the educator more control over the educational experience [1]. “Closed” projects are those projects that, while potentially complex, appear in a textbook and require no interaction with outside organizations. These type of projects also commonly come with a complete list of predefined specifications for the project. Many researchers have noted that closed projects present problematic issues. This paper focuses on three of the major issues and discusses how incorporating participation in Microsoft Imagine Cup Software Design Invitational (SDI) can overcome each. First, closed projects are problematic because students tend to spend the majority of their time focusing on grading criteria rather than developing valuable experience in determining actual client requirements leading to a techno-centric view of the project. Techno-centric means students consider the problem in terms of the technology or code needed to implement a solution prior to considering the client requirements or situation [1]. To combat this issue, many researchers have turned to projects that rely on partnerships with real-world organizations [1, 2, 3].

Second, closed projects do not necessarily teach the managerial and interpersonal skills graduates will require in the workplace. Some address this issue by integrating management skills such as quality assurance, project management, and the use of cross-functional teams into the capstone course [2, 3].

Last, traditional closed projects promote a lack of attachment or interest in student capstone courses in CS [1]. To counteract the student apathy, faculty have implemented some innovative approaches to the capstone course curriculum. For example, some have turned to integrating computer game projects [5, 8]. Others have students develop projects relevant to society, such as providing assistance to the disabled [1].

While each approach partially addresses the listed issues associated with traditional capstone projects, none addressed them all. This being the case, a need for a truly integrative capstone project framework in the CS curriculum still exists. The purpose of this paper is to offer the Imagine Cup SDI as a possible solution. The remainder of this paper contains the following components:

- A discussion of the structure and purpose of the Imagine Cup competition.
- An introduction to the SDI portion of the Imagine Cup competition.
- An analysis on how student participation in the SDI can overcome the issues with traditional CS capstone projects.
- Final closing remarks.
2. IMAGINE CUP
The Imagine Cup, as stated on its website (www.imaginecup.com), “… encourages young people to apply their imagination, their passion and their creativity to technology innovations that can make a difference in the world – today. Now in its eighth year, the Imagine Cup has grown to be a truly global competition focused on finding solutions to real world issues [7].” The theme for the 2010 Imagine Cup is “Solve the World’s Toughest Problems,” and focuses on providing innovative technological artifacts that address the United Nations eight Millennium Goals, presented in Table 1.

The competition invites participants to submit their work related to the above themes in different competition categories. These categories for the 2010 competition include the ones described in Table 2.

3. THE SOFTWARE DESIGN INVITATIONAL
The SDI portion of the competition is divided into multiple rounds with various deliverables associated with each. The United States holds three rounds culminating with the National Finals. The first place team advances to compete in the World Cup competition – in 2010 this competition will be held in Poland. The first round is a qualifying round and requires students to come up with an idea that addresses one of the millennium goals, form a team, and submit the deliverables for that round. The deliverables consist of a preliminary business plan – a wireframe or prototype is optional. Teams that submit the deliverables by the deadline are automatically entered into the national semi-final round.

For the national semi-final round, students must develop and refine their idea into a product viable in the global marketplace. They do so by further developing the initial business plan submitted in the qualifying round to include a detailed description of the solution, an explanation of how the solution addresses a specific UN Millennium goal, an analysis of the competitive marketplace, feedback from potential users, preliminary information about the application’s acceptance in the market, and financial analysis of start-up costs. They must also develop an alpha prototype with minimal functionality. The final submission for the national semi-final round includes a 3-5 minute video that introduces the team, describes why the application is important, how the application is relevant to the competition theme, and provides an overview of the alpha application.

At this point, the semi-final round submissions are reviewed by a panel of judges at Microsoft Corporation. The top 10 submissions (five each from the Fall and Spring semester rounds) are then invited to present their solutions as well as more functional “beta” (at least 80% functional) versions of their solutions to a group of judges consisting of Executives from Microsoft and other public and private sector organizations. From the 10 competitors, three national finalists are chosen and they will make a final presentation to a panel of judges and an audience of invited guests. The first place team will then go on to represent the United States in the SDI global competition. The intellectual property associated with the solutions is retained by the submitting teams. All teams submitting applications are encouraged to consider making their solutions viable commercial products (either non-profit or for profit). During the national round, investors are invited to review the applications and talk with the teams. This gives students a sense of whether their application is addressing a
problem where a solution is needed, quality feedback regarding the marketplace viability of their application, and an outstanding opportunity to interact with corporate executives in a very real and unparalleled fashion.

3.1 How the SDI Addresses Issues with Traditional Projects
This paper argues that the SDI addresses all of the traditional CS capstone project issues mentioned earlier. The SDI addresses the issue of students viewing the projects from a techno-centric perspective by structuring the problem as a social problem-solving competition. This allows students to focus more on the problem they have selected and the design appropriate to the application, rather than just focusing on what coding elements need to be included to achieve the grade they desire. During the process, students must plan, analyze, and design the specification for their application rather than taking specs provided by someone else. In addition, the focus must be on an application that has a global impact not just local. Students can be encouraged to link up with local non-profit organizations to create an application that will benefit the local community since they will ultimately need local support for proof of concept. The richness of the learning process from focusing on how to use technology to make a difference in the lives of others is much greater than that of simply figuring out how to simply code for a grade.

The lack of the managerial and interpersonal skill development in the traditional project method is also addressed by the SDI. Managerial skills are developed as students work to create a full entrepreneurial business plan for their solutions. To stay on track with the intensity of the project and the deadlines imposed by Microsoft, they must also develop and maintain a project schedule. The intense group work required to create their solution, the interactions they have with their faculty and/or industry mentors, and the presentation skills that they develop as a result of the project all serve to help develop their interpersonal skills.

Finally, allowing students to select a societal issue they are passionate about increases interest and excitement in the project. This passion can translate into increased involvement because not only are they being allowed to leverage their creativity to generate a solution to a problem they believe is important, they are also providing real world solutions that help others. So now, instead of the results of their project helping some fictitious company or some problem that will never leave a lab, they have the real potential to make a difference in the world.

4. IMPLEMENTING THE SDI IN THE CLASSROOM
Implementing the SDI in the classroom has advantages to instructors as well as providing some challenges. The primary advantage is the SDI provides structure to the capstone course. The SDI guidelines/competition requirements provide standards for deliverables in the course. The result of this is that the instructor does not have to focus so much time and effort on designing the course and they have a standardized manner in which to manage the diversity of projects generated by their students.

Despite the benefits to students and instructors, the SDI does come with some challenges. One challenge is that the SDI competition is a time-intensive endeavor. This can prove to be rather problematic when a single faculty member is managing multiple teams with projects that are vastly different. One way to overcome this challenge is to enlist the aid of professionals in industry to become secondary or even primary mentors to the project teams. The authors obtained mentors through referrals from Microsoft and by contacting professionals in the local business community. As far as soliciting help from local business, contacting members of the departmental advisory board is an excellent place to begin. Another source for soliciting help is area non-profits. Contacting the non-profits that have information relating to the type of project student teams want to pursue and those that might be able to benefit from a joint venture is the best place to start. For example, if a team wants to do a project related to the health of diabetic mothers, contact the local American Diabetes Foundation.

Another challenge is the variety of directions student projects can take from a technical perspective. While students will likely use the technologies they have been taught in prior coursework, many times they may also need to use technologies that were not part of their curriculum in order to deliver their solution. This serves as an excellent learning opportunity for the students since they will have to learn to use unfamiliar technology when entering industry. However, it also requires the faculty mentors have the time and ability to “gear-up” on these technologies rather quickly to assist the student project teams. Again, the authors found one way this can be accomplished is by bringing in industry professionals familiar with the technology to provide tutorial sessions to students and faculty or to serve as project team mentors. Microsoft also provides online learning modules to project teams and their mentors on various technologies.

A common concern is what happens if the team does not make it to the national finals? One option is to require students to continue with their project as though they had been selected and have them present their solution to the members of the local advisory board or to local industry professionals. This will allow them to get experience speaking in a business forum, provide a critical evaluation of their project, and provide them feedback on how they can improve the solution. If a sufficient number of teams are submitting at the local level, a campus (or campuses) might consider holding a local competition of their own complete with prizes.

Assessing project deliverables can be challenging. Depending on how a course is structured, students may receive both individual and team grades for the project deliverables. If the group’s project is chosen as a national finalist, the grade decision is easy – the group receives an “A” – after all, top executives have judged the product and determined it is among the best in the country. If they are not selected, then the group project will need to be evaluated by the instructor and possibly industry professionals for a grade assignment. Individual assessment can be accomplished in multiple ways. One way is to have the students claim responsibility for certain portions of the overall project, grade those deliverables separately, and assign a grade to the individual responsible. Another way to assess individual performance is to allow the group members to assess the contributions of their group mates and then assign each student a percentage of the group score based on the
average of the ratings they received. For example, if a student had an average rating of 9 or 10 on a scale of 1 to 10 with 10 representing a superior effort, they would receive all of the points for the group’s effort. However, if a student received an average score of an 8, then they may only receive 95% of the group score. The scale would continue with lower average peer scores resulting in the student being awarded a lower percentage of the points earned by the entire group.

The advantages and challenges reported here are based on the experiences of the authors from their first year of participation. Continued participation in SDI will produce additional data from which actual research findings may be analyzed and reported. While the authors believe the advantages of the SDI will be common to most programs, those who choose to implement the SDI may have similar challenges or entirely new ones. Additionally, the reported methods for overcoming these challenges may not be effective in all cases. They are only provided here as a possible solution for those who wish to use the SDI as a part of their course.

5. CONCLUSION
This paper advocates the use of the Imagine Cup SDI in the capstone course for CS and SE majors. The primary reason for so doing is that it addresses issues previously identified with traditional “closed” capstone projects, or at least the issues identified in this paper. It overcomes the techno-centricity of some traditional projects by allowing students to focus on solving a problem rather than simply meeting grading criteria. Creating the SDI deliverables helps to build the managerial and interpersonal skills needed in the workplace, something not addressed in most CS or SE projects. Finally, it increases student interest in the project because the problem is relevant to the real-world, the solution has the potential to impact human lives, and it is one the students have selected because they feel passionately about it.

Implementing this type of project in the capstone course can be challenging. It requires a good deal of time and energy on the part of the instructor to manage the projects and to become quickly knowledgeable on various technologies. Despite these challenges, the benefits competing in the Imagine Cup SDI provides to students makes its inclusion as a part of the capstone curriculum worthwhile.

6. REFERENCES