Instructional strategies in the EGRET course: an international graduate forum on becoming a researcher

Conference or Workshop Item

INSTRUCTIONAL STRATEGIES IN THE EGRET COURSE: AN INTERNATIONAL GRADUATE FORUM ON BECOMING A RESEARCHER

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ABSTRACT

In today's knowledge economy, graduate students in the field of Computer Science are increasingly required to develop sophisticated, multi-faceted knowledge of conducting research across multiple contexts and countries. This paper reports the experience of teaching a course to prepare Computer Science graduate students for conducting research in the international community. The course emphasized development of skills critical for a successful research career in computer science, and included construction of knowledge as well as hands-on application of instructional content. The intended learning outcomes included (a) gaining familiarity with research design and methodologies in computer science, (b) preparing and delivering research presentations, (c) reviewing the literature, (d) reading and writing research papers, (e) writing and evaluating research proposals, and (f) networking in the international research community.

In this paper, we describe an innovative instructional design that emphasized international collaboration with graduate students from another university on a different continent, namely the Open University in the UK. Our instructional strategies included (a) remote participation of graduate students across universities and countries in real-time, using technologies for synchronous computer mediated communication, (b) incorporation of collaborative activities using online tools scaffolding students' construction of sophisticated knowledge of key research activities, and (c) providing students with opportunities for hands-on practical application of concepts in collaborative research activities.

General Terms

Computer Science education, Human Factors

Keywords

Instructional design, computer-supported collaborative learning, computer science education

1. INTRODUCTION

In today's knowledge economy, graduate students in the field of Computer Science are increasingly required to develop sophisticated, multi-faceted knowledge of conducting research across multiple contexts and countries. From an educational perspective, academic programs for developing students' perceptions and understandings of conducting research across contexts are important resources in preparing students for academic and professional success; However, designing instruction to foster these skills is challenging within the constraints of traditional classroom contexts far removed from the authentic experience of conducting research in the international community.

This paper describes instructional strategies used in the EGRET graduate seminar course in the Department of Computer Science at the University of Victoria. The EGRET course was delivered between January and April, 2011 in the Department of Computer Science at the University of Victoria (UVic), Canada. In this paper, we begin by introducing the goals and structure of the course. We follow by describing an innovative combination of instructional strategies used in the course to achieve these outcomes. Subsequently, we discuss preliminary findings of assessment of course outcomes and conclude with recommendations for future researchers and course designers with similar educational goals.

2. ABOUT EGRET

The EGRET course was a twelve-week graduate class led by Prof. Daniela Damian at the University of Victoria. The course was a mandatory program requirement offered to students in their first year of graduate studies in the Department of Computer Science at UVic. The course consisted of two 90-minute lectures each week conducted in the UVic SEGAL lab (Software Engineering Global interAction Laboratory[1]).

Students enrolled in the EGRET course were 15 students at the MSc and PhD level. Course learning outcomes were related to the development of skills a researcher must possess for a successful research career in computer science and included (a) gaining familiarity with research design and methodologies in computer science, (b) preparing and delivering research presentations, (c) reviewing the literature, (d) reading and writing research papers, (e) writing and evaluating research proposals, and (f) networking in the international research community.

3. INSTRUCTIONAL STRATEGIES

In order to achieve course goals, our instructional design incorporated a combination of strategies to facilitate these learning outcomes. These strategies included (a) remote participation of graduate students across universities and countries using technologies for computer mediated communication, (b) incorporation of collaborative activities using online tools scaffolding students' construction of sophisticated knowledge of key research activities, and (c) providing students with opportunities for hands-on

[1] http:/segal.uvic.ca

practical application of concepts in collaborative research activities.

3.1 Participation Across Borders

Conducting research across multiple contexts in the international community requires students to construct knowledge of how research differs across contexts and international contexts. Thus, this course was run in collaboration with Prof. Marian Petre from the Open University (OU), UK and which made it possible to extend the participation in the course beyond the traditional population of students enrolled at UVic. In addition to the 15 graduate students enrolled in the course at UVic, six Open University PhD students mentored by Prof. Marian Petre participated in all course activities. Students from the OU were PhD students enrolled in a similar seminar course for the development of research skills and methods. In the first lecture of each week, Canadian students engaged in discussion of topics and activities. During the second lecture of the week, international OU graduate students from the UK and Germany joined the course remotely to discuss and participate in the same topics and activities.

Exposure to new perspectives. There were key differences between the two groups of students that made this an appealing collaboration. First, while students at UVic were enrolled in their first year of their graduate program, the OU research skills course continues throughout the PhD program. Thus, course participants were at varying stages of their research and varied in terms of research experience. Second, the OU research community is an international one that addresses cultural differences in discourse as part of its research seminars. As such, OU students were particularly knowledgeable and attentive to differences in research cultures and contexts. By incorporating international participation in this course, Canadian students and OU students had the opportunity to interact on a weekly basis with both the instructors (Profs. Petre and Damian) as well as each other. In particular, the course schedule of one local lecture and one international lecture per week allowed groups to 'compare notes' with students at another university in another country and gain valuable knowledge regarding differences in how research unfolds.

Computer mediated Communication. Second, remote participation of graduate students from the OU gave EGRET students valuable experience with computer-mediated communication (CMC). Use of CMC tools in distributed groups is becoming widespread in organizational, research, and educational settings [1,5]. As travel to distributed locations is often not possible, computer-mediated communication allows remote teams to meet efficiently and frequently. Thus, a critical aspect of graduate training is providing students with opportunities to gain knowledge about the strengths and weaknesses of computer-mediated tools for various collaborative purposes [5,6].

In the EGRET course, international participation using CMS tools was made possible by conducting the course in the SEGAL lab (Software Engineering Global interAction Laboratory) at UVic. This lab provided a unique setting and infrastructure to conduct this course due to its advanced and state-of-the-art collaboration technology. The SEGAL lab is equipped with multimedia large-format displays and AccessGrid technology[2] to enable a rich presentation and interactive environment for geographically distributed interaction. The AccessGrid technology, used with eight videocameras in the lab, allow the transmission as well as receiving of multiple video feeds to and from remote sites. In addition, use of AccessGrid technology was complimented with Skype video chat for smaller group discussions. The OU students participated from four different locations: (a) a similar research facility at the Open University (equipped with large displays), and (b) three personal AccessGrid nodes installed at students' homes (two in UK and one in Germany). Figure 1 shows the collaborative setup in SEGAL in which the OU students interacted with students at UVic. Four different video feeds are shown on the SEGAL displays.

Discussion and activities in the EGRET course allowed students to try out these tools in educational environment. Furthermore, prior to the EGRET course, students at UVic had limited experience with computer-mediated communication for research and academic purposes. However, as the OU is a distance education university, many of their activities take place online. Thus, incorporating this type of international participation in the course allowed UVic students to benefit from other students more experienced with these tools.

Figure 1. SEGAL Setup during the EGRET course.

3.2 Collaborating for Learning

Second, we incorporated multiple opportunities for face-to-face as well as online collaboration in weekly course activities in the EGRET course. This collaborative aspect of the course was integrated for two purposes. First, to provide students with opportunities for learning and maximizing academic potential through working with others [8], and, second, to provide students with remote teamwork experiences often not part of the conventional curriculum in educational environments [2] since successful careers in computer science increasingly entails distributed projects leveraging expertise from different locations.

In the EGRET course, four international groups were formed, each consisting of 3-4 UVic students and 1-2 OU students. The group activities were performed either synchronously during class time, using the communication technologies available in the classroom, or asynchronously, via email, in between classes. Two types of collaborative activities were used in the course: (a) collaborative knowledge construction activities, and (b) hands-on collaborative assignments in which students applied course concepts.

[2] http://www.accessgrid.org

Knowledge construction activities. Each week, the EGRET course provided students with opportunities to work together to construct sophisticated knowledge of multiple types of research tasks critical for conducting research in the international community. Theories of self-regulated learning (SRL) contend that accurate and complete task perceptions are critical for success as they are the foundation upon which students set goals and make plans for tasks, evaluate progress, and make changes to optimize engagement and performance when needed [13, 14]. Hadwin [3] further suggests constructing accurate and complete task perceptions is a difficult undertaking as it requires students to analyze and synthesize multiple levels of task information including (a) explicit task information overtly provided in written task instructions such as task criteria, (b) implicit task information extrapolated from the explicit task descriptions, such as the purpose of the task, and (c) contextual task information such as knowledge of values, beliefs, and expectations for the task specific to contexts and disciplines (Figure 2). While sophisticated task perceptions predict performance, research suggests students often struggle with this process and often overlook implicit and contextual task information that particularly critical in successfully adapting task engagement across contexts [4,7,10,12]. As such, supporting students to engage in active analysis of research tasks is a valuable, yet rarely emphasized aspect of graduate training.

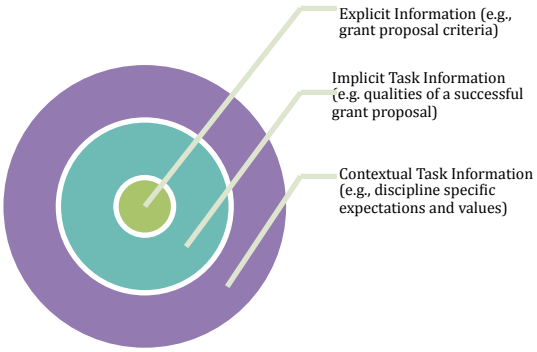

Figure 2. Example of select layers of task understanding in a grant proposal task.

In the EGRET course, we supported students to collaborate in active task analysis by incorporating three pairs of small group discussions about three research tasks: (a) research paper, (b) research proposal, and (c) research presentation. In the first lecture of each week, each group of UVic students collaboratively analyzed a research task. In the second lecture, each international group collaborated via videoconference or Skype video chat to analyze the same research task. This allowed students to bring together varying perspectives and knowledge about each task in their analyses. The structure of task analysis discussions is illustrated in Figure 3.

Furthermore, to aid students in developing sophisticated task knowledge of multiple layers of task information, we scaffolded each groups' task analyses using an online tool. Based on Hadwin's Task Analyzer Questionnaire [4,12] the task analysis tool was comprised of open-ended questions asking students not only to define explicit task information, but also to interpret and explain implicit and contextual task information critical for conducting successful research across contexts. During each discussion, the task analysis tool was delivered using collaborative editing tools (e.g., Google Docs) shared amongst all group members. This allowed groups to co-construct their responses across international borders in real time during discussion. An example of item included in the task analysis tool administered during groups' discussions of research proposals is provided in Table 3.

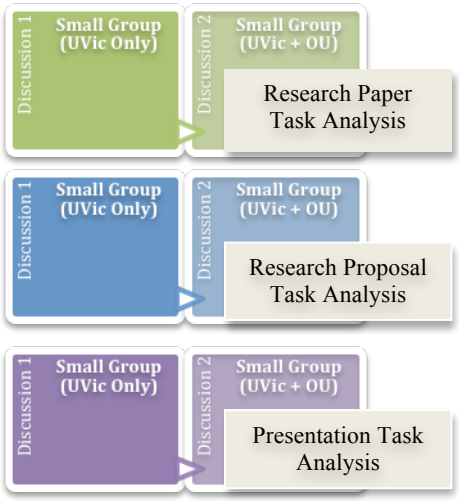

Figure 3. Collaborative Task Analysis Discussions

Table 3. Task Analysis Tool for Research Proposal Discussions

Collaborative Task Analysis 2 (Research Proposal)
1. What are the key components of a research proposal
2. What is the purpose of writing a research proposal
3. List important resources for writing a research proposal
4. What are the distinguishing features of an excellent research proposal
5. How might writing a research proposal be different across disciplines, agencies, universities, etc.

Collaborative Applied Assignments. Finally, we facilitated students' application of knowledge of critical research tasks in a series of hands-on collaborative activities. Applied assignments often involved both individual and group components and gave students the opportunity to apply concepts discussed in the course in activities resembling the authentic research activities required of a researcher in the field of computer science.

One example of an applied assignment in the EGRET course was the Research Funding Activity. In this activity, each student was required to write an individual research proposal fulfilling requirements of a selected research funding agency (e.g. NSERC for Canadian students), and submit the proposal to an online repository created for the class. Subsequently, each group was assigned 3-4 proposals written by students in another group in the class. Individually, each group member applied knowledge gained during the course regarding successful research proposals to evaluate the merits of each assigned proposal. Third, group members discussed and compared their individual evaluations of the proposals. Discussion took place during one course lecture in which OU students participated via teleconference or Skype video chat. During this discussion, the group collectively made decisions about which proposals to fund and ranked each

proposal. Finally, each group presented their funding decisions to the class, justified their funding decisions, and described the process they engaged in to make these decisions. Key components of the Research Funding Activity are summarized in Table 2.

Table 2. Overview of Research Proposal Funding Activity

Activity components	Type
Research proposal submitted in paper review system	Individual
Review assigned research proposals in paper review system	Individual
Discuss and agree on funding a limited number of proposals	Small group collaboration
Presentation about funding decisions	Small group collaboration

4. COURSE OUTCOMES

Our preliminary analysis of students' perceptions of collaboration with international students indicates that students in the EGRET course benefited from the interaction with the students from the OU by gaining exposure to new perspectives from students with different levels of experience, different backgrounds, and different knowledge about key research tasks. Specifically, we examined students' perceptions of their experiences collaborating with international students during the EGRET course using a collaboration reflection questionnaire administered in Google Docs. Examination of students' responses to the open-ended question asking students describe specific ways in which collaborating with international students was beneficial revealed four general themes: (a) students noted that exposure to others with different levels of experience in research and practice was helpful; (b) students found that exposure to students with diverse backgrounds (i.e., other fields of study and institutions) was also helpful; (c) students found collaboration gave them access to different perspectives and ideas than their own; (d) a number of students attributed these types of benefits to collaboration with others of different backgrounds and experiences regardless of country. We are now analyzing the changes in students' perceptions of tasks after international collaboration and intend to describe the results of this analysis in future publications.

5. CONCLUSIONS

Overall, our findings indicate that, in the EGRET course, remote participation of international students, providing opportunities for collaboration, and using tools scaffolding development of sophisticated task perceptions were useful tools in facilitating development of skills and knowledge graduate students require for successful careers in the international research community. As findings are preliminary, they bring to light new questions regarding how these strategies contributed to development of students' perceptions such as more in depth investigations of how international collaboration contributed to changes' in students' task perceptions in terms of the specific explicit, implicit, and contextual information. This is particularly relevant in light of research linking perceptions of implicit and contextual task information in particular to task performance [10,12].

Based on our experiences with the EGRET course, however, we make four recommendations for designing instruction that adequately supports the development of research skills for the conducting research in the international community. First, we suggest that, whenever possible, inclusion of other participants from geographically removed contexts whether it be delivering the course in collaboration with a similar course in a different context, such as was the case with the EGRET course or incorporating other types of participation such as guest speakers, etc. Access to other perspectives, especially to other students with varying levels of research expertise and experiences conducting research across different contexts and countries may help to enrich students' knowledge and perceptions of what it means to conduct research in the international community and expand perspectives beyond those that develop within the singular graduate program in which students are trained.

Second, since use of computer- mediated communication (CMC) tools in distributed groups is becoming widespread both in organizational, research as well as educational settings [1,5], we recommend adequately preparing students for successful research careers should include providing students with opportunities to use these tools in educational environments especially in light of the fact instruction in graduate programs is often face-to-face and few students have the opportunity to develop skills for computer-mediated communication for research and academic purposes during their academic careers.

Third, we recommend that incorporating both online and face-to-face collaborative activities into coursework is beneficial for students in both (a) facilitating students in maximizing academic potential through working with and gaining access to the perspectives and expertise of others, [8] as well as (c) providing students with teamwork experience often not part of the conventional curriculum in educational environments [2] especially since successful careers in computer science increasingly entails distributed projects leveraging expertise from participants in geographically removed locations.

Finally, we suggest that instruction of key research activities should facilitate students in gaining knowledge of critical research tasks beyond explicit task requirements, but also actively support them to develop knowledge of implicit and contextual task information with which students often struggle. Whether instructors choose to do this using tools scaffolding students perceptions such as in the EGRET course or using other methods, we think this is a particularly important facet of instruction in light of research linking these deeper levels of task information with task success.

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