

Developments in Global Software Engineering Education

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Abstract—An ITiCSE 2015 conference working group report has recently delivered a comprehensive systematic review of the literature addressing the challenges and solutions in teaching global software engineering courses. In this panel session, a group of authors of that report will review the findings, and present their own views on teaching such courses, the pros and cons and their own motivations and experiences, together with strategies that have proven effective. We argue that these courses are critical for preparing students for practice as software engineers in today's global settings, but they are certainly not for the faint-hearted. After the review and presentation of position statements by panelists there will be a question and answer session with the audience and a discussion elaborating on the next frontiers in research and practice for global software engineering education.

Keywords—Global Software Engineering Education; Distributed teams; Authentic learning.

I. OVERVIEW

Preparing Software Engineering students for the realities of current Software Engineering (SE) practice is challenging. This is especially so, when that practice increasingly involves globally distributed teams forced to surmount the challenges posed by the many forms of global distance (temporal, geographic, cultural - including institutional and linguistic aspects). Addressing this new reality in the classroom presents its own challenges that go beyond the global distance problems encountered in SE and include issues such as institutional

collaboration, student skill differences, classroom management difficulties and other complications.

This panel brings together six participants who have participated in a Working Group at the ITiCSE 2015 conference, which has resulted in a major report on Global Software Engineering Education (GSE-Ed) [1], titled:

Challenges and Recommendations for the Design and Conduct of Global Software Engineering Courses: A Systematic Review.

The Working Group Report is accompanied by a supporting protocol available online [2].

The challenges of GSE-Ed can be categorized as the working group report has demonstrated, yet, at the same time, experiences tend to be unique based on the characteristics of the participating institutions, the background of students and faculty participants, and the areas of SE addressed. As a result, the challenges of GSE-Ed are best presented from a variety of perspectives, which this panel will provide.

The panellists will share their own experiences in teaching software engineering courses and in globalisation initiatives, and provide their personal perspectives on the challenges and solutions in providing such courses. These insights will be backed up by the findings from the panel members' report, as a recent and major review of the literature, that will be summarised for participants. After discussions with the audience, the panel will conclude by identifying emerging topics and recommendations for future developments in Global Software Engineering Courses.

II. POSITION STATEMENTS

A. Tony Clear

Tony has had more than 18 years of involvement in courses involving global collaboration, collaborative technologies and global software engineering. These have spanned countries as diverse as New Zealand, Sweden, Vietnam, China and USA. Prior to his academic career Tony worked as a software developer and manager and was engaged in a number of globally distributed projects. He is presently supervising PhD students investigating aspects of global software development traversing New Zealand, Pakistan, USA and Canada. He also serves on the ICT Strategic Steering Committee of the Auckland University of Technology.

Tony was co-chair of the ITiCSE 2015 international working group which worked on the report reviewed by the panel. This has given him a broad set of perspectives from which to view the phenomenon of GSE-Ed, and the global nature of software engineering practice facing today's practitioners and tomorrow's graduates. He firmly believes in the need to develop intercultural competency as a positive step for a more peaceful and harmonious world based on mutual respect and understanding. He also believes in the need to expose students to authentic and challenging experiences, which are complex and fraught without single simple answers and require students to work together in novel, demanding but exciting settings. He hopes this will produce more thoughtful, generous spirited, technically capable and adaptable graduates.

B. Sarah Beecham

For the past seven years Sarah has been conducting research into various aspects of Global Software Engineering (GSE) to include project management, software engineer motivation, the impact of global distance, and scaling agile and lean processes. Of particular relevance to this panel session is Sarah's supervision of a PhD student who developed an e-learning tool (called 'VENTURE') for GSE teams [3]. VENTURE uses 'chatbots' to simulate real-life interactions between team members who are based in different countries. The learner communicates with an avatar representing a team-member from a different background and culture to themselves. In this way, the student quickly learns the importance of recognizing and respecting cultural differences. VENTURE is shown via field trials to increase knowledge in areas of GSE and cultural awareness.

Sarah co-chaired the ITiCSE 2015 international working group tasked with reviewing all the literature on GSE Education. A synthesis of the literature highlighted the complexity of running software development projects with students based at different universities. GSE in an industrial setting suffers from problems associated with 'global distance' typically described in terms of *cultural*, *temporal*, *linguistic* and *geographic* distance. Course leaders embarking on GSE with students need to also consider distances created by differences in *student skills*, *technical infrastructure*, *marking schemes*, *expectations*. A successful inter-university collaboration requires a lot of patience and commitment on the part of the course organizers, and a great deal of pre-planning.

It is questionable whether the effort is worthwhile, given the many pitfalls, and lack of evidence that the students really gained from the experience.

C. John Barr

John has over 20 years' experience teaching software engineering, working in international software project development, and teaching in various locales around the world. He has found, and the data that was gathered for the working group report indicate, that performing or teaching software development in a global environment magnifies the challenges found in both teaching and GSE. Institutional cultures, differences in teaching styles across cultures, varying student skill sets and work habits, and differing expectations among faculty and students in different cultures bring an added dimension to the challenges of GSD and teaching software engineering.

There is no one solution or technique for overcoming all these challenges. Each of these new challenges requires a careful consideration of the institutions, individuals, and cultures that are involved and requires approaches and solutions that are unique to the actors. John will be highlighting some of the challenges that he has encountered or that were highlighted in the literature that the working group report surveys and will discuss some of the approaches and solutions that have been successful (or not) and how they might be modified and employed in other situations.

D. Mats Daniels

Mats has had almost 20 years of involvement in courses involving global student collaboration. These have spanned courses in New Zealand, Sweden, and USA, with students from many more countries participating as exchange students. The involvement stems from a desire to make international experiences available to most students based on personal positive experiences from being an exchange student in the US. This desire resulted in landing a grant proposal to develop and evaluate a student collaboration between students in Sweden and the US, the Runestone project. This project still runs, although now with students from Sweden and Finland, and for some years with students from China.

Mats defended his PhD in 2011 investigating using Open-Ended Group Projects as a pedagogical concept with a special aim to assess professional competencies in international student collaborations [4]. He has run the IT in Society course from 2005 as an international student collaboration in which Swedish and US students work during a semester to do the first stages in a global software engineering process in the health sector. There have been numerous challenges over the years that have been addressed in an action research manner [5].

Mats's particular interest in running international student collaborations has evolved to encompass issues regarding development of professional competencies. His work has addressed motivation and learning in a global software engineering context where, for instance, cultural aspects have been prominent and where becoming prepared for a professional life with complex and multi-faceted contexts has to be understood.

E. Michael Oudshoorn

Michael has had 10 years' experience with recruiting and mentoring international students while serving as the Associate Dean (International) at the University of Adelaide, Australia and the chair of the Computer Science department at Montana State University. In addition to bringing international students to campus, Michael was responsible for a number of twinning and articulation agreements in Singapore and Malaysia where students took courses in their home country with instructors from Australia, or took courses developed in the home institution and delivered by local instructors at the host institution. He has also developed twinning programs with Turkey and a joint PhD program in Morocco. In addition, Michael worked at the University of Texas in Brownsville for 4 years. This is a minority serving institution where English is a second language for many of the students.

These experiences have provided Michael with a perspective on cultural integration and appreciation, language barriers and challenges, difficulties brought about by the diversity of educational background and experiences, and the challenges associated in working across time zones, geographic separation, varying levels of technical support at remote locations. Michael believes that the global nature of modern corporations, the global applicability of computer science degrees, and the increased mobility and diversity of the general population makes it imperative that students learn the skills necessary to effectively work in distributed teams. While such opportunities expose students to real-world challenges, they also permit students to exercise their creativity, become more multi-cultural in their outlook, and appreciate what others bring to the table as they collectively work on a project. The challenges also extend to the faculty that are teaching the course as there is a need to collaborate strongly in order to produce a valuable and enriching experience to the students.

Michael is currently working with partners in Europe, Australia and South Africa to introduce a Global Software Engineering experience to his current institution.

F. John Noll

John Noll has over 17 years experience in software engineering education and research in both Europe and North America. For the last seven years his focus has been on various challenges arising from Global Software Development, including challenges to GSD-Ed. He is co-author of a highly-cited survey of barriers and solutions to collaboration in global software development, and was a member of the ITiCSE 2015 international working group that reviewed the current literature on GSD-Ed.

Based on that review, as well as anecdotal evidence from instructors and students, it appears that the best way to teach Global Software Development is to re-create the GSD context in a multi-institution, multi-nation, multi-culture project class that gives learners first-hand experience with the issues involved in collaborating across geographic separation, different timezones, and cultural distance. However, it is also clear that conducting such a class is a resource- and time-

intensive endeavor that places high demands on the instructor as well as the students, which may be prohibitive in many cases.

Fortunately there are less costly alternatives. A class can be tasked with contributing to an open source software project, requiring learners to interact with remote project contributors who may be from numerous different countries and cultures; this has many of the benefits of a multi-institutional class without the administrative overhead. Also, many aspects of GSD can be learned through simulations; for example, the VENTURE role-play simulator allows a learner to interact with a "virtual colleague" from a different culture, to gain experience with cross-cultural communication. The GSD Sim game [6] places the learner in the role of project manager, where he or she can see how distance and culture affect collaboration. Even *developing* games that simulate aspects of GSD require learners to understand GSD well enough to implement the game simulator.

So, while a multi-institutional GSD project class might be the best way to learn about GSD, for situations where this approach is too costly, there are alternatives that still provide an active learning experience. And, simulators especially have the advantage that they are a safe learning environment where learners can make and learn from mistakes without serious consequences.

III. CONCLUSION

The panel format will involve the members presenting their position statements, then briefly reviewing the working group report and its commentary on common pitfalls to be encountered plus a distilled set of recommendations on practice. Discussions with the audience on the issues raised and future directions for the research will then follow. In addition to these aspects, the panel hope to bring to the discussion the latest thinking through fresh insights from a planned *Workshop on Global Software Engineering Education (GSE-Ed'16)* to be held this August, at the *International Conference on Global Software Engineering* <http://www.icgse.org/>, where current and future issues in the field will be canvassed

REFERENCES

- [1] T. Clear, S. Beecham, J. Barr, M. Daniels, R. McDermott, M. Oudshoorn, *et al.*, "Challenges and Recommendations for the Design and Conduct of Global Software Engineering Courses: A Systematic Review," in *Proceedings of the Working Group Reports of the 2015 on Innovation & Technology in Computer Science Education Conference*, N. Ragonis and P. Kinnunen, Eds., ed New York: ACM, 2015, pp. 1-39.
- [2] S. Beecham, T. Clear, J. Barr, and J. Noll, "Protocol for Challenges and Recommendations for the Design and Conduct of Global Software Engineering Courses: A Systematic Review," Limerick, Ireland (ITiCSE Working Group One: Technical Report No. Lero_TR_2015_01) (ITiCSE Working Group One: Technical Report No. Lero_TR_2015_01), 06092015 2015.
- [3] Monasor, M. J., Vizcaíno, A., Piattini, M., Noll, J., and Beecham, S. Simulating global software development processes for use in education: A feasibility study. In EuroSPI 2013, Dundalk, Ireland, June 2013.
- [4] M. Daniels, Developing and Assessing Professional Competencies: a Pipe Dream? Experiences from an Open-Ended Group Project Learning Environment, Digital Comprehensive Summaries of Uppsala

Dissertations from the Faculty of Science and Technology, nr 808, Acta Universitatis Upsaliensis, Uppsala. 2011.

- [5] M. Daniels, Å. Cajander, A. Pears, and T. Clear, "Engineering Education Research in Practice: Evolving Use of Open Ended Group Projects as a Pedagogical Strategy for Developing Skills in Global Collaboration," in *International Journal of Engineering Education* 26, 4, 795-806 2010.
- [6] Noll, J., Butterfield, A., Farrell, K., Mason, T., McGuire, M., and McKinley, R.. GSD Sim: A global software development game. In *Workshop on Methods and Tools for Project/Architecture/Risk Management in Globally Distributed Software Development Projects (PARIS '14)* (co-located with ICGSE 2014), Shanghai, China, August 2014.