

Socio-Cultural Challenges in Global Software Engineering Education

Rashina Hoda, *Member, IEEE*, M. Ali Babar, *Member, IEEE*,
Yogeshwar Shastri and Humaa Yaqoob

Abstract—Global Software Engineering Education (GSEE) is aimed at providing Software Engineering (SE) students with knowledge, skills, and understanding of working in globally-distributed arrangements so they can be prepared for the Global Software Engineering (GSE) paradigm. It is important to understand the challenges involved in GSEE for improving the quality and experience of educators and students. This paper reports the findings of an empirical study on the socio-cultural aspects of GSEE. A case study was conducted involving 14 participants from ten different universities in eight countries. The data was analyzed using Grounded Theory’s open coding procedure. The key contributions of this paper are the identification and description of six dimensions of socio-cultural distance that caused several significant challenges in the courses: 1) language differences; 2) concept of time; 3) attitude towards grades; 4) assumptions about national culture; 5) differences in autonomy; and 6) influence of the course lecturer. Recommendations from this study that are expected to benefit GSEE educators and students include: cross-cultural orientation of students prior to the course; use of various strategies to support better comprehension of different English accents (e.g., speaking slowly, replaying recorded video messages, text chatting); and educators familiarizing themselves and their students with the relevant GSE and GSEE literature.

Index Terms—Curriculum design, design projects, experiential learning, global software engineering, grounded theory, higher education, software engineering education, teamwork

I. INTRODUCTION

GLOBAL Software Engineering (GSE) has become an established paradigm of developing software with globally-distributed teams [1]–[3]. Given the increasing popularity of GSE, it is quite common nowadays to find Software Engineering (SE) professionals working in some sort of GSE setting, where the team is distributed across a city, country, or around the globe. Whilst GSE promises several benefits (e.g., reduced cost and a “follow the sun” strategy), it also presents several types of challenges caused by the well-known distances associated with GSE (e.g., geographical, temporal, and socio-cultural) [2], [4]. *Temporal* distance refers to the time zone differences between the various countries where the software development team members are located. *Geographical*

distance is signified by the ease with which the distributed counterparts can travel to each other’s locations. *Socio-cultural* distance is the perception that a team member has of his/her distributed counterpart’s culture, values and practices. Given that GSE is a relatively new model of software development and GSE is not specifically taught in many degree programs purported to prepare SE professionals, a large majority of SE professionals usually do not have the required training and experience of effectively and efficiently working in GSE arrangements; hence, they usually face a large number of challenges in GSE arrangements. One of the key strategies to mitigate these challenges is to train SE professionals in GSE work settings. While this type of training is usually provided on the job, it has become important for academic degree programs to train their SE graduates for working in GSE settings as part of “employment ready” initiatives.

Given the increasing popularity and reported challenges of GSE, some academic institutes have started to offer GSE courses [5]–[10]. Such initiatives fall under the category of Global Software Engineering Education (GSEE) aimed at providing students with opportunities to be exposed to different theoretical concepts, practical strategies, and tools for supporting GSE [1], [5]. Since GSEE is a challenging undertaking that requires extra overhead of designing and delivering courses in distributed settings, it is important that a body of knowledge on the various aspects of GSEE is available for interested educators. The empirical study reported here aimed to explore the views and experiences of educators involved in GSEE; this was done by holistically exploring and reflecting on the views and experiences of several educators, who reported on the challenges they faced and the strategies they adopted for their GSEE courses. As far as the authors are aware, no reported study has specifically focused on helping researchers and practitioners understand the socio-cultural challenges in GSEE.

An exploratory case study was designed and carried out. As part of the data collection, interviews were conducted with 14 academics in five different courses, offered by ten universities across eight countries: Australia, Canada, Italy, Denmark, Switzerland, Germany, Sweden, and Croatia. The focus was to study the socio-cultural challenges in GSEE using the following research question:

What are the socio-cultural challenges faced by academics and students involved in GSEE?

Grounded Theory’s open coding procedure [11], [12] was used to analyze the data to answer this question. The findings from this study are expected to provide educators and their institutional managers with useful insights for understanding and addressing the challenges that can be faced by the participants (i.e., teachers, students, and course managers) of a GSEE course. A set of recommendations on how to prepare for and address the socio-cultural challenges is also presented for the benefit of GSEE educators and students.

The rest of this paper is structured as follows: Section II reports the related work for building the context of the reported research findings. The details of the research design are described in Section

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R. Hoda, Y. Shastri and H. Yaqoob are with The University of Auckland, New Zealand, 368 Khyber Pass, Auckland 1023, New Zealand (e-mail: r.hoda@auckland.ac.nz; and {ysha962, hyaq414}@aucklanduni.ac.nz). M.A. Babar is with the University of Adelaide, Terrace Adelaide, South Australia 5005 Australia. He also holds an academic position with IT University of Copenhagen, Denmark, (e-mail: ali.babar@adelaide.edu.au).

III, and the results are reported in Section IV. A set of recommendations are drawn based on the discussion of the results and presented in Section V, and Section V concludes the paper.

II. RELATED WORK

This section provides a theoretical framework to help understand the motivation and findings of this study and contextualize its relevance. Prior studies have identified that the level of GSEE courses can vary widely, depending on the target audience and the level of course complexity [6], [13]. GSEE courses can cover the entire gamut from certificate-level courses to degree-level programs. Most of the GSEE-related courses incorporate project-based work [6] and soft skills training, such as cultural sensitivity and working in a team [3], [14]. The main focus of GSEE courses is to prepare students for the industry by simulating real-life settings of distributed software development teams. The courses' managers and lecturers have been reported to face challenges similar to those commonly reported in GSE studies [3]. Some of the main challenges identified in GSE and GSEE literature are presented here.

Given that GSE has become an established paradigm for software development, researchers and practitioners have published many papers reporting on various GSE aspects, such as development models, governance mechanisms, challenges of communication, coordination and collaboration, and strategies to address challenges [2], [8]-[10], [15]-[21]. Researchers have also defined protocols for [22] and conducted secondary and tertiary reviews of reported GSE challenges and strategies [3], [15], [16], [23], [24]. Two systematic literature review studies [23], [24] identified particular challenges faced in the integration of GSE with agile software development methods. Differences in time zones, trust levels, knowledge management, and communication were highlighted as the most significant challenges faced in their integration.

Other studies have identified language, cultural and time zone differences, and communication problems as the main GSE challenges [2], [3], [5], [17], [25]-[29]. Ågerfalk et al. classified these challenges into three main categories: temporal distance, geographical distance and socio-cultural distance [2]. Socio-cultural distance encompasses national culture, organizational culture, language differences, work practices, behavior of people and attitudes towards authority [2]. Despite the fact that many of the GSE challenges directly or indirectly stem from socio-cultural challenges, only a few GSE studies specifically address this topic. For example, a tertiary study of GSE risks [16] found only four studies that specifically cover socio-cultural risks. Other studies [8], [25], [30], [31], [23], [24], [28] have also identified socio-cultural distances as one of the GSE challenges. A literature review of GSEE [3] highlighted the importance of training in language and cultural differences for successful GSEE courses.

A key GSE challenge, mainly caused by socio-cultural differences, is communication. When people come from different cultural and socio-economic backgrounds, there is a high probability of miscommunication. Therefore, first, a brief review of the literature relevant to the communication challenges in GSE is presented, before discussing the literature on GSE challenges caused by socio-cultural distance, the main focus of this paper.

Matalonga et al. [28] conducted a review on the adoption of GSE in agile software development contexts. The 30 identified influencing factors were found to be most closely related to communication challenges (such as geographic distance.) Alzoubi et al. [27] conducted a systematic literature review involving 21 studies; they identified 17 communication challenges grouped under six categories: team configuration, distance difference, project characteristics, customer communication, organizational factors, and human factors. Distance difference in terms of geographic and time-zone differences was identified as the most researched category while project characteristics were the least

researched. The study called for further research on the sub-areas of the behavior of teams and social interaction – two topics closely related to the socio-cultural aspects of GSE.

Of the various socio-cultural challenges, a language barrier has been highlighted as a key challenge [32], [33]. Language differences can be due not only to people speaking entirely different languages, but also to differences in accents and interpretation between people who speak the same language [31], [34], [35]. Based on a joint course between USA and Mexico, Favela and Peña-Mora [31] identified the language barrier as a key bottleneck that prevented complete participation by the Mexican students in the initial stages of their joint projects with students from the USA. Based on an empirical study of several distributed software development projects, Holmström et al. [32] found that many of the projects suffered because of language barriers arising due to the limited vocabulary of non-native English speakers and different interpretations of English in different cultures. Layman et al. [36], in their case study of a distributed team in the USA and the Czech Republic, found that language posed a significant barrier in understanding technical aspects during the early stages of the project. The developers located in the Czech Republic spoke English as a second language, while the project management team in the USA could speak only English. The language barrier was also seen to inhibit participation in a GSE project in another study [37]. Dieters et al. [33], writing on their experiences of managing a long running GSEE course, observed that the choice of English as a common language hindered communication and led to the architecture team underperforming. A similar effect was observed in a multi-country GSE course where one of the project teams exited the course due to language differences [10].

Based on a study of a long-running GSE course between five universities from across the globe, Swigger et al. [38] identified cultural factors as having an impact on student performance. Another study showed that cultural diversity could lead to students adopting a more formal mode of communication [21], as was seen in the Indian component of a GSE course where the Indians preferred written communication over other modes such as video.

Culture also dictates the way in which people perceive and react towards authority. In an industrial GSE study on a distributed project across the USA and Ireland, researchers found distinct differences in how the Irish and American developers interacted with their managers [34]. The Irish developers had a more independent approach to authority while it was granted that the American developers would respect their managers. A similar instance was seen in a GSEE course conducted between a U.S.-based university and a Mexican university [31]. The American students had a very independent approach towards decision-making and were outspoken. In contrast, their Mexican counterparts were respectful of authority and hesitant to criticize the work of others. Additionally, the Mexican students' focus was on working as a group and not on individual responsibility. In a GSE educational collaboration carried out between a German and a Mongolian university, the German students were surprised to receive no criticism of their work from the Mongolian professors [18]. The researchers attributed this to an aspect of the Mongolian culture, which emphasizes preserving harmony between people. A related scenario was observed by Lago et al [17] on a GSEE course running across the Netherlands and Italy. The Dutch students were hesitant to reach out for support from their lecturers whereas the Italian students were quite open with their lecturers. Holmström et al. [32] identified that cultural issues, such as religion and political diversity, could also pose a challenge to the smooth functioning of software development projects.

While it may appear that challenges are the same for GSE and GSEE, there are several subtle differences in their nature and scale, and in the strategies to address them. It is important for GSEE educators to understand the socio-cultural challenges in the GSEE context. For example, the problems caused by language differences

in GSE may be different to those faced in GSEE; as is the case with the strategies suitable to address the challenges. One of the intended outcomes of this study was to provide a set of recommendations drawn from the findings to help GSEE educators and students better understand and address the relevant challenges.

III. RESEARCH DESIGN

This study used a case study research design, as being an appropriate method to explore a phenomenon in its real-life context, particularly when the border between the phenomenon and its context is blurred [39]. Case studies can be descriptive, exploratory, explanatory and evaluatory [39] and the selection of an appropriate type is dependent on the actual research focus. Case study research is useful to study human-intensive systems and helps answer questions such as ‘how’ and ‘why’. The case study approach used here was exploratory in nature as it explored the perceptions and experiences of the educators about the contextual settings, challenges, and strategies of GSEE courses in which they were involved.

A. Data Source and Collection

The authors identified a set of courses offered for students to acquire GSEE knowledge, experiences, and skills. A list of these courses was prepared, with their respective academics who were in various roles ranging from course designers to lecturers and senior teaching assistants. Email invitations to participate in the research were sent to these identified academics. Fourteen willing academics were interviewed. Extensive informal discussions were carried out with some of the interviewees before and after the formal interviews to motivate their participation, and to clarify their interviews and general observations on GSEE. The interviewees were involved in the offerings of five different courses at ten universities across eight countries: Australia, Canada, Italy, Denmark, Switzerland, Germany, Sweden, and Croatia. These courses also had teaching collaborators in several countries in Europe, Asia, and South America. Details of the setup of each of the participating GSEE courses are presented in Table I. These were codified to preserve the anonymity of the participating individuals. The first column gives a code for each of the five courses (GSEC1-5), followed by participant codes (P1-P14). The next column shows the role played by the participant in the course (e.g., lecturer, course coordinator, and so on). The fourth column, Previous Offerings, gives the number of times the course had been offered prior to this study. The next two columns give the organization and location of the participant and the other geographical locations collaborated with in the course. The last column, Level, indicates whether the course was offered to undergraduates, graduates, or both. The conclusions that can be drawn from this dataset are limited to the experiences of the academics who participated in this study and their representation of the student experiences.

All interviews were recorded and transcribed, with the participants’ permission. Seven interviews were conducted face-to-face and the remaining seven were conducted via teleconferencing. The interviewing researcher also took extensive notes of the discussions. Semi-structured interviews with open-ended questions were used to collect qualitative data to stimulate a variety of responses and to get an exploratory, ‘insider view’ of the situation. With the nature of the research being exploratory and qualitative, the interviewing instrument consisted of general questions covering various aspects of GSEE. Interviewees were allowed to detail their observations, experiences, and views on their respective GSEE courses. Very specific questions were rarely asked, except when an interviewee raised a point that warranted a specific question and brief answer. Each interview lasted between 45 and 60 minutes, on average. Some of the general questions to stimulate interviewees’ reflections and responses included:

- *What kinds of challenges/problems did you observe?*
- *What kinds of problems were reported by the students?*
- *What were the key strategies used for addressing the*

observed and/or reported challenges/problems?

It was found that most challenges and problems identified through these general questions related to socio-cultural challenges, which led to the main research question driving the thematic analysis of the data. Other follow-up questions included:

- *What kind of cultural impact did it have, because it seems like three universities [were involved]?*
- *If somebody were designing that kind of a course [in] a similar culture or similar arrangement, which of your experiences or reflections which could be used?*

B. Data Analysis

The data from interviews were analyzed using open coding – a Grounded Theory data analysis procedure [11], [12]. Open coding allows a thorough analysis of textual data resulting in the identification of patterns common across multiple sources, in this case interviews, and allows the most significant concerns or categories to emerge from a bottom-up analysis of the data. Open coding involves deriving key points [40] from the raw interview transcripts by summarizing one or two sentences into the short phrases. These are then further condensed into two to four words called *codes*. One key point can lead to multiple independent codes, depending on the number of unique ideas within that point. The next level of abstraction involves comparing codes from within the same interview against those from other interviews, to capture common patterns referred to as *concepts*. A similar grouping leads to the next higher level of abstraction where a set of similar concepts forms a *category*. In this study, the main concepts that emerged included: *language differences, concept of time, attitude towards grades, assumption about national culture, differences in autonomy, and influence of the course lecturer*. Each of these concepts combine to form the category “*socio-cultural challenges in GSEE*” and constitutes the six dimensions of socio-cultural challenges in GSEE contexts, captured in Table II and described in detail in the next section.

IV. RESULTS

The key dimensions of socio-cultural challenges in GSEE identified in this study include: *language differences* (P1, P5, P6 and P9-P14), *concept of time* (P1, P4, P9, and P13), *attitudes towards grades* (P1, P2, P11, and P12), *assumptions about national culture* (P1, P12, and P13), *different behaviors* (P8, P9), *work habits* (P11, P13), and *influence of the course leader* (P8). These are described in Table II, which provides the category name, and a brief description of each category in the first two columns. The third column presents the percentage of participants who mentioned the category, followed by the participant codes in bracket. For example, 64% of participants mentioned language differences as one of the socio-cultural challenges (P1, P5, P6, and P9-14). The fourth column presents the percentage of courses where a given category was identified. For example, the language differences category was identified in each of the five courses, i.e., 100%. This provides a sense of how significant the various categories were, as identified in the data. Each of these six socio-cultural dimensions is described below.

A. Language Differences

Language differences were noticed as a challenge by nine of the 14 participants (P1, P5, P6 and P9-P14). The language barrier not only affected students from different cultures, but also impacted students from countries where English was the first language. In the latter case, it was the difference in the accents and usage that posed a challenge. Students had problems understanding the other team due to the differences in their accents (P6, P9, P14), their English skills (P1, P5, P6, P9, P11, P13) or the differences in the English accent for different cultures (P6, P14).

TABLE I. COURSE SETUP AND PARTICIPANT DEMOGRAPHICS
(P = PARTICIPANT CODE, L = LECTURER, CC = COURSE COORDINATOR, TA = TEACHING ASSISTANT, R = RESEARCHER, AS = ADMIN SUPPORT)

Course Code	P#	Role	Previous Offerings	Organization and Location	Collaborating Locations	Level
GSEC1	P1	L	1	UTS, Australia	Canada, Australia, Italy	Both
	P2	R	1	UV, Canada	Italy, Australia	Both
	P3	L	1	Uni of Bari, Italy	Australia, Italy, Canada	Both
GSEC2	P4	L	1	ITU of Copenhagen, Denmark	Brazil, Denmark (Kenya, China)	Both
	P5	L	4	ETH, Switzerland	Several universities including universities in Asia (Korea, Vietnam), Europe (Switzerland, Italy, Russia and Hungary) and South America (Brazil, Argentina)	Graduate
	P6	AS	6	ITU of Copenhagen, Denmark	China, Kenya, Denmark, Brazil, Spain, Singapore	Both
	P7	CC (non-academic)	3	ITU of Copenhagen, Denmark	China, Brazil, Kenya, Switzerland, Denmark	Both
	P8	TA	3	ITU of Copenhagen, Denmark	Kenya	Graduate
	P9	L	1	ITU of Copenhagen, Denmark	China (Beijing)	Graduate
	P10	L	First time	Uni of Hannover, Germany	Germany (different locations)	Graduate
GSEC4	P11	CC	2	Uni of L'Aquila, Italy	Netherlands (Amsterdam) and Italy	Graduate
	P12	CC and L	2	VU, Amsterdam, Netherlands	Netherlands, Italy	Both
GSEC5	P13	CC	7	MDH, Sweden	MDH Sweden and University of Zagreb, Croatia	Graduate
	P14	CC	7	University of Zagreb, Croatia	MDH Sweden and University of Zagreb, Croatia	Graduate

If the language was completely different, comprehension suffered, as in GSEC2 where, coupled with technical problems, the English accent of the Chinese students made comprehension very difficult for the Danish team. Participant P14 pointed out that due to differences in English usage in different countries, audio communication was more important than video communication.

A low level of proficiency in communication due to language issues could impose an additional work overhead onto the course. This resulted in students having to spend more time translating, as was observed during meetings in GSEC3 by P10, and was observed when revising documents in GSEC4 by P11.

In GSEC4, participant P11 reported that as much as 10-15% of the students' time was spent in translating documentation and in dealing with synchronization issues. It was also noticed that students were hesitant when participating in meetings because of a lack of confidence in their English skills. The Danish students on GSEC2 had problems understanding different English accents of non-native speakers, as they were familiar with the American English accent.

"For example, working with China and Brazil, you don't necessarily have people who are very fluent in English and of course, I mean, a basic requirement is that they ... they do speak some English. Danish students are not necessarily very used to all sorts of different accents in ... spoken English. They like it to be clean American, then if it isn't then [they] think it's wrong." – P6, Administrative Support, GSEC2.

Language differences were not only limited to teams from different continents but were also observable in countries which were geographically and culturally close. For example, P5, who was a course coordinator on GSEC2, remarked that even teams from countries like Russia and Switzerland, which are in similar time zones, exhibited distinct language differences. This observation was supported by P11 who remarked that even students from Western nations such as Canada and Australia exhibit distinct differences in English accents and styles. Another participant, P1, highlighted accent differences between the Canadian and Australian teams.

A workaround suggested by P10 was if the course were in the students' native language, it would obviate the issues around translation and comprehension. However, such setups are impractical in a GSEE context. To help deal with the language differences it was suggested by P14 that it is important for the students to have audio and/or video contact with the other team. P13 and P9 suggested that students should speak slowly and take time to actually understand what is being said by the other team before responding.

"In the beginning that's one thing which we warn them on...for example, say you should speak slowly, think about that, prepare your presentation and such things, we also say ok, if it's difficult with oral communication, write." – P13, Course Coordinator, Sweden.

P14 suggested that minutes can be taken during meetings so that the meeting's discussions can be reviewed later on, while P6 advocated the use of video messaging, so students could replay the message for better understanding. Another workaround adopted to overcome the language barrier was to conduct all communications via written chat, where there were less chances of misunderstanding. P13 observed that this mode of communication was adopted by students in GSEC5, as all the participants were non-native speakers of English.

B. Concept of Time

The different expectations of time and time keeping in different cultures were reported to have an effect on the interaction between the teams (P1, P3, P4, P9, P12, and P13). In GSEC5, the Asian team was frequently late for meetings, which offended their counterparts. A similar instance was seen in GSEC2 where the Chinese students rarely showed up for the meetings. P9 remarked that if a schedule change was needed for the meeting, the Chinese students did not communicate this to the Danish team. It is unclear whether this was a symptom of the Chinese students losing interest in the project or whether it was due to some other cause. Whatever the reasons, changes in schedule were not communicated.

TABLE II. SOCIO-CULTURAL CHALLENGES IN GSEE

Socio-Cultural Challenge	Description	% of participants	% of courses
Language Differences	Differences in languages, dialects and accents.	64% (P1, P5, P6 and P9-P14)	100% (GSEC1-GSEC5)
Concept of time	The way in which participants view time and time keeping.	36% (P1,P3,P4,P9,P12, P13)	60% (GSEC1-2,GSEC5)
Assumptions about national culture	Preconceived notions held prior to interacting with distributed counterparts.	21% (P1,P12, P13)	60% (GSEC1,GSEC4-5)
Attitudes towards grades	The amount of importance students attach to course grades.	29% (P1,P2,P11,P12)	40% (GSEC1,GSEC4)
Differences in autonomy	The behaviors of submissiveness or assertiveness displayed by students.	21% (P8,P9,P13)	40% (GSEC2,GSEC5)
Work habits	The manner in which students distribute their workload.	14% (P11,P13)	40% (GSEC4,GSEC5)
Influence of Course Lecturer	The influence of the lecturer on the students' motivations towards the course.	7% (P8)	20% (GSEC2)

In GSEC4, the Dutch team expected the Italian team to be available during the day for meetings. The Dutch team had fewer classes during the day, and expected the same to apply for the Italian students. However, the Italian students had a busy course schedule during the day, which meant evenings were the only suitable time for meetings. This led to difficulty in finding a common meeting time.

“For instance, some cultures have no problem working during the weekends or working in the evenings, and some others do. And for instance in Italy, the schedule is very heavy; they have many more lectures, classes than we do have here. So they really had physically no free time during the day, and they would expect the Dutch colleagues to work in the evenings, whereas the Dutch colleagues have less [fewer] classes and they expect much more to work during the day itself.” - P12, Course Coordinator, GSEC4.

In GSEC2, the Brazilian students began to fall behind in terms of the coursework as national festivals like the Carnival meant they were on holiday for extended periods of time. National culture could also affect the amount of time students stayed in a meeting. A case in point was that of the Italian students in GSEC1 who would leave the meetings early to watch football matches. In Italy football is part of the national culture, but the Canadian counterparts were not aware of its importance.

“This is a funny story, that sometimes if the meeting was going after one hour, there were some students saying, “I have to go, I have to go”. The Canadian students were asking, “Why” and then they were saying “There is the football, the soccer match [on] television, the championship league.” And the Canadian students found this funny, but in Italy it’s important, soccer is important.” - P3, Lecturer, GSEC1.

C. Work Habits

The stage of the project at which students expended the most effort was also identified as being affected by national culture (P11, P13). For example, one of the participants, P11, who was also a course coordinator for the Italian side of GSEC4, noted that the Italian students tended to backload their course work and exert their maximum effort in the last stages of their course, while students from countries such as the Netherlands favored a more even distribution of their workload. A similar case was seen in GSEC5, where while the Swedish students evenly distributed the project workload throughout the course, their Croatian counterparts tended to leave things till the end. This led to a mismatch in expectations where one team expected the other to deliver steadily while the other team expected long working hours towards the end of a project.

“But for our Croatian students, [they] would work [at a slow pace], ok we have enough time, so, but then when it comes to the end of the project they will work like 24 hours a day. They will expect the Swedish side would work at 3[am] in the night or 8[pm] in the

evening which the Swedish would find completely “crazy.”” - P13, Course Coordinator, GSEC5.

D. Attitudes Towards Grades

Institutional and national culture also led to differences in attitudes towards grades, which directly translated into the students' competitiveness towards their counterparts (P1, P2, P11, and P12). This was also accentuated by the difference in educational levels, i.e., undergraduate and postgraduate. In GSEC1, the undergraduate students chose the project idea, which was part of the coursework, without consulting their distributed counterparts. The primary motivation for this was their concern about scoring good grades, which in turn was perceived to be rooted in their national and institutional culture. A similar observation was made in GSEC1, where the Australian students were found to be very competitive and focused on achieving high grades. This observation was also supported by another participant, P11, who observed that the national culture can influence the level of competitiveness of students.

“For example, what I remember in Amsterdam, students are typically not very competitive. Just because they don’t really care about the grade. They just want to get the job and to go. And there’s plenty of jobs in the Netherlands....In Italy, I think there is more personal competition.” - P11, Lecturer, GSEC4.

The Dutch students were perceived to be more relaxed in terms of their concern for grades, as the booming job market in the Netherlands meant that graduates had a very high probability of getting a job after finishing their degree. This effectively disincentivized the need to gain very high score in a course. On the other hand, in the Italian team, the competition was more within the team than with the Dutch team. This was also observed by the P12, who reported that different cultures had a different perspective about grades achieved in any course. Some put a premium on being in the top scorers, while others participated more for the experience. This fact was also observed in GSEC1, where the Canadian and Italian teams were identified as enjoying the learning experience, rather than being focused on achieving high grades. However, even within similar national cultures, there were subtle gradations. Thus, P1 the lecturer in charge of GSEC1, felt that the Canadians were more competitive and committed as compared to the Italian students. The Australian undergraduate students, on the other hand, were noted as being fiercely competitive compared to the other two nationalities.

E. Assumptions about National Culture

National culture could also lead students to make certain assumptions about their distributed counterparts as has been described in the *concept of time* section earlier with regards to national festivals (e.g., Carnival in Brazil) and national sports (e.g., football in Italy.) In GSEC4, P12 observed that this could include things such as European students assuming their Asian peers to be available round

the clock via mobile phones or email. When this expectation was not met, due to technological and cultural constraints, this led to a misunderstanding between the teams.

“And also in few cases, especially between European and Asian students, I noticed that there were some difficulties in actual... synchronous communication, so for instance some cultures assume that colleagues are available 24/7, so they are reachable via phone or online, or via SMS, these types of things. And whereas, some other students, maybe they don't have a mobile phone. If they have, they switch it off, so they couldn't in many cases, they couldn't mix because, one person was not reachable and was not responding to emails promptly ...” - P12, Lecturer, GSEC4.

This could also lead to the students ignoring the effect of cultural differences on their interactions with the distributed counterparts, as was seen in the case of Croatian students in GSEC5. The solution adopted by one participant, P13, was to arrange a special lecture for the Croatian team on the importance of recognizing cultural differences. Commonly-held perceptions about national cultures could turn out to be deceptive, as was seen in GSEC1. The Australian undergraduate students were initially assumed to be more relaxed and laid back than their Canadian and Italian peers. However, this assumption was quickly overturned when the Australian students proved themselves to be rather ambitious.

F. Differences in Autonomy

Two factors seen as having a profound effect on whether the students were submissive or assertive were their national culture and the institutional culture. This was seen to be the case in GSEC2, where the Kenyan students were more submissive to their lecturers than were the Danish students. In this case, P8 identified both national and institutional culture to be responsible for the student's attitude towards authority.

“I think that Kenya is the other extreme where students don't question I would say that's more cultural ...” - P8, Teaching Assistant, GSEC2.

National culture could also lead to teams trying to take over the reins of a project. This was seen in GSEC2, where the Danish team took over the leadership role from their Kenyan counterparts, who consequently assumed a passive spectator role. The behavior of the Danish students was attributed by P8 to their national culture, which was seen as more independent and democratic, while the Kenyan students were accustomed to unquestioningly follow the instructions of their lecturers. To prevent an “outsourcing” situation arising, where the Danish students took the decisions while allocating the tasks to the Kenyan students, P8 emphasized to the Danish team the importance of collaborating with their Kenyan counterparts. An additional check introduced was the linking of a substantial percentage of coursework credit to the amount of collaboration that the Danish team did with the Kenyan team. Another innovative workaround was to limit Skype meetings held just between team leaders from each side, and instead involve all the members of both teams.

A similar problem was observed with the Chinese students in the same project. P9, the lecturer for the Danish team, observed that because compliance with authority is ingrained in Chinese national culture, Danish students had to be extremely careful that their suggestions were not misconstrued as commands by the Chinese students.

The effects of the national culture on student behavior, in terms of ownership and accountability in the courses studied, varied from student to student (P13). In GSEC5, the Swedish students were more individualistic, where individual performance or non-performance was identified explicitly, and there was no attempt to attribute the shortcomings of an individual to the group. One participant, P13, remarked that this was in contrast to other cultures, particularly the

Croatian one, where an individual's shortcomings were made up by the larger project group.

“Swedish students they tend to show like it is, there is no kind of solidarity, which may appear on (the) Croatian side and for international students, which means if one student does not work well, the other students cover (for) him. They say “Ah all of us worked as we could,” they will never say “this guy does not work at all.” - P13, Course Coordinator, GSEC5.

G. Influence of the Course Lecturer

The motivation and personality of the lecturers and course coordinators were seen as having a big impact on the behavior of the students. In GSEC2, participant P8 observed that the performance of the Chinese students was also seen as being linked to the involvement and motivation of their lecturer. Additionally, it was important that the different course leaders should get along well as this seemed to affect students' level of interest in a project. Conversely in the Brazil-Denmark collaborative strand of the course, the Brazilian students were set upon following a particular course of action that had been charted out by their supervisors. This led to conflicts with the Danish team who preferred a more independent approach to the project.

V. DISCUSSION

GSE literature has highlighted the language barrier as a significant part of socio-cultural distance in GSE contexts [2], [31], [32], [35]-[37], [41]. This study has uncovered the same for GSEE contexts. It was found that the language barrier between native and non-English speakers had serious impacts, such as problems in comprehension, misunderstandings between the distributed teams, and disruption in the project flow. This was further accentuated by technical problems with communication overheads and tools.

Another important finding that emerged from this study was that students from different cultures had differing concepts of time. The Asian and South American students had an elastic concept of time while their European counterparts were very particular about keeping meeting times. The differences in the concept of time in different national cultures was also pointed out by Swigger et al.[38].

This study found that the individualistic behavior and group behavior exhibited by students were also linked to their national cultures. Culture was also found to be a key shaper of students' personalities and their behavior towards their distributed counterparts. Thus, teams located across the globe exhibited differing behavior such as assertiveness and submissiveness in their mutual interactions. In cultures where compliance to authority was ingrained, the personality of the lecturers had a profound effect on students' involvement in a course. These findings are supported by the experience reported by Favela and Pena-Mora [31] and by Beier et al. [37].

The present study has also uncovered the effect culture can have on students' attitudes towards the final outcomes of a course in terms of the grades achieved. These attitudes were found to depend on their national culture, maturity and the level of education. It was also evident that national culture influenced time management in terms of students' inclination to spread the coursework evenly or leave it until the last minute.

Recommendations for GSEE educators to better organize and run GSEE courses and implications for practice with regards to improving student abilities to address the socio-cultural issues include:

1. *Cross-cultural training:* As seen in the study, confusion can arise from the lack of knowledge and assumptions made by the students about each other's cultural norms and practices. Course coordinators should consider organizing cross-cultural orientation via formal sessions for students in advance such that students at different sites can understand and appreciate each other's cultural influences on various project aspects, such as concept of time and work habits. Additionally, specific cultural issues encountered in

the past can be highlighted during such sessions so that the students can identify and avoid them. This points to the need for additional preparation time and effort in setting up GSEE courses to prevent some of these challenges from arising. Giving formal credit for demonstrating knowledge and skills in socio-cultural issues is strongly recommended to motivate the students to take these seriously.

2. *Supporting different English accents:* To overcome the differences in English due either to students' having different native languages or, for native English speakers, different accents, students can apply strategies such as: speaking slowly; taking meeting notes; using text-based chats to augment verbal communication and avoid misunderstanding; and using video messages that can be replayed for better comprehension. GSEE students should be encouraged to expose themselves to different accents and pronunciations styles to improve verbal communication with teams during a GSEE course. Students can be motivated to invest extra time and effort in gaining skills in understanding different accents to increase their employment readiness for companies engaged in GSE.
3. *Lecturer coordination:* Given the powerful influence of lecturers on student motivation towards the course, having lecturers across sites coordinate their own motivations and assumptions beforehand will likely have a cascading effect on the students. While project-based courses in general require some preparation time, GSEE courses are likely to require additional effort for cross-site coordination between the lecturers. If possible, GSEE courses should be coordinated by lecturers who have some collaborative history or common research interests. Otherwise, it may be difficult for two academics located in different education systems and different socio-cultural settings to collaborate smoothly on designing and offering a course in an distributed arrangement prone to challenges for the educators and students.
4. *Single-level courses:* Mixed classes of postgraduates and undergraduates are not recommended, as differences in their academic levels and experiences can lead to differences in motivation and attitudes towards courses and grades. Hence, GSEE coordinators should strive to offer single-level courses, despite their institutions' likely preference for combining undergraduate and post-graduate students in one course.
5. *GSE(E) knowledge of educators and students:* Most GSEE educators may be content specialists but may not have sufficient knowledge of the GSE domain. It is recommended that educators familiarize themselves with the GSE literature. This paper has identified several secondary and tertiary studies that can be starting points for identifying and reading the relevant material on GSE/GSEE. In fact, educators may decide to incorporate some papers on GSEE/GSE in the course reading material, especially if the course is offered at the postgraduate level and/or run in-class interactive games to support fundamental GSE concepts [9].

Other useful strategies for achieving efficient teamwork in GSEE settings based on prior literature include: setting up a central team to coordinate across sites [21]; including a project manager role responsible for monitoring and reporting team progress and identifying issues [8], [10]; allocation of tasks based on specific background of students while ensuring knowledge transfer [29]; creation of dedicated communication channels between sub-groups and members working on same assignments [8], [10].

VI. CONCLUSION

The key contribution of this research is the identification of six dimensions of socio-cultural challenges faced in Global Software Engineering Education (GSEE) courses: *language differences; concept of time; attitude towards grades; assumption about national culture; differences in autonomy; and influence of the course lecturer.* An understanding of these challenges, as well as some of

the strategies used to overcome them, will benefit both educators and students by enabling them to better prepare for, and execute, GSEE courses. Case study research is largely bound by the contexts studied; given the specific universities, courses and participants involved the authors do not claim to generalize their results to all different types of GSEE courses. Instead, it is hoped that detailed and valuable insights have been provided into settings where students are working in globally-distributed contexts similar to those studied. Other countries and contexts are likely to exhibit different challenges or facets of socio-cultural issues. Recommendations for GSEE educators and students include: cross-cultural orientation of students prior to the course; use of various strategies to support better comprehension of different English accents (e.g., speaking slowly, replaying recorded video messages, text chatting); and educators familiarizing themselves and their students with the relevant GSE and GSEE literature. Future work can explore students' perspectives of the challenges and focus on identifying challenges related to providing students with valuable and industry-relevant GSE education.

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Rashina Hoda is a Senior Lecturer in Software Engineering and the Director of the SEPTA research group in the Electrical and Computer Engineering Department of The University of Auckland, New Zealand. Her research papers have been published in premier peer-reviewed conferences and journals such as IEEE Transactions on Software Engineering (TSE), IEEE Software, ICSE, IST, JSS, and Empirical Software Engineering (ESE). More at www.rashina.com

Muhammad Ali Babar is a Professor in the School of Computer Science, the University of Adelaide, Australia. He is also an honorary visiting professor with the Software Institute University of Nanjing, China. He has authored/coauthored more than 180 peer-reviewed research papers at premier software engineering journals and conferences such as ACM Trans. on Software Engineering and Methods (TOSEM), IEEE Software, and ICSE. More at <http://malibabar.wordpress.com>.

Yogeshwar Shastri is a Ph.D. student in the Department of Electrical and Computer Engineering at The University of Auckland, New Zealand. He received his Master's degree from the University of Sheffield, UK and his Bachelor's degree from Amravati University, India. He has worked in various project management roles over the last decade.

Humaa Yaqoob is a software developer at Xero, Auckland, NZ. She completed a Bachelor of Engineering degree in computer systems Engineering from the Department of Electrical and Computer Engineering at The University of Auckland, New Zealand.