SKJ Fellowship - Final Report

Adalbert Gerald Soosai Raj
Interdisciplinary program in Computer Sciences and Education
http://pages.cs.wisc.edu/~gerald/

My research primarily focuses on understanding the effects of using students' native language along with English for teaching and learning programming. I travelled to Chennai, India during the summer of 2018 to conduct my dissertation research. This was possible due to the generous support I received from Scott Kloeck-Jenson Fellowship. In this report, I summarize my experiences with my dissertation fieldwork during this summer.

I arrived at Chennai on June 13, 2018. I met with my research collaborators Prof. Saswati Mukerjee (Head of Information Science and Technology (IST)) and Prof. Arokia Xavier Annie (Assistant Professor in Department of Computer Science and Engineering (CSE)) at College of Engineering Guindy (CEG), Anna University. I discussed about the specific experiments that I wanted to conduct with both these professors and we finalized the details about which courses and staff I will be working with.

Before beginning any experiments, I got permissions from a few instructors to observe their classrooms. I observed 5 programming classrooms and got a sense of the different teaching methods used in these classes. These observations helped me to understand the current culture around teaching and learning at CEG and how it is different when compared to places like UW-Madison.

I conducted three interventions for studying the effects of native language for teaching and learning programming. The three courses I experimented with are as follows:

1. Placement training - How to solve problems in a coding interview
2. Unix internals - How does the Unix operating system (OS) work beneath the hoods
3. Learning modern C++ - How to use the C++ Standard Library for writing C++ programs

In each of these interventions, programming was taught to two groups of 50 students each. One group was treated as the experimental group and the other group was treated as the control group. Programming was taught using both English and Tamil (native language of students in Chennai, Tamil Nadu) to the students in the experimental group and it was taught using only English to the students in the control group. A pre-test was conducted before every intervention and a post-test was conducted after every intervention. A few students who were from a Tamil-medium background (i.e., studied their K-12 in a Tamil-medium school) were interviewed.

In the placement training course, I taught the process of solving coding interview problems. This was a new course that I proposed as this was not a part of their regular courses. The reason for choosing this course was primarily because the programming questions asked during interview require a deeper understanding of the concepts in programming. We hypothesized that the student may be able to learn programming with a deeper understanding for solving coding problems if their native language was used for teaching programming.

Unix internals is considered to be one of the most difficult courses in the undergraduate curriculum as it involved understanding a lot about the internal workings of the unix operating system. In this course, I proposed that we use xv6, a Unix-like operating system designed specifically for teaching purposes. I showed a demo of this OS to Prof. Saswati Mukerjee and she agreed to use this OS for teaching unix internals. My rationale behind using this OS was to see if the native language plays a major role when the code that the students interact with is as complex as the code of an operating system. Typically, the code of an operating systems is more difficult to read/understand when compared to the code of an application level program.

I worked with Ms. Ezhilarasi and Mr. Yuvraj, the two course instructors that were assigned to teach the unix internals course. I worked with them to get them acquainted with xv6 so that they can teach it to their students. I didn't want to teach this myself mainly because I wanted to test the effectiveness of the bilingual teaching methodology when different course instructors try using this method. I observed the classes as an observer and helped the teacher co-teach a few topics whenever needed. In these classes, I observed that the number of questions and the quality of the questions were more in the class where Tamil and English was used since students had a lot to ask as the topics we discussed were complex. On the other hand, in the classes where only English was used there weren't a lot of questions. Based on the interviews, I understood that students in the English-only classes didn't ask questions (even though they had a few questions that they wanted to ask) mainly because they were afraid that they wouldn't be able to frame the question correctly in English. Also, they were worried that if the teacher asks a follow-up question in English, they may not be able to understand it and answer it.

My third intervention focused on teaching modern C++ to two groups of students. These students had a regular C++ course this semester. In their regular C++ course, they were taught C++ using a bottom-up approach. I conducted a few additional classes in addition to their regular classes to teach them C++ using a top-down approach starting from the C++ standard library. Initially, an instructor (Dr. Prabhavathy) agreed to teach these classes but due to some unfortunate family events, she wasn't able to teach this course and so I ended up teaching this course. In this intervention, I conducted experiments using both within-subjects design and between-subjects design.

I interviewed a few students who studied in a Tamil-medium school during their K-12 and switched to a English-medium college (i.e., CEG) for learning Computer Science. These students shared the difficulties that they encountered during the initial few semesters in college. These students suggested that the language barrier that they faced could be easily overcome if the teachers spoke using both English and Tamil and if they gave the freedom to the students to use either English or Tamil within the classroom. A student felt very emotional during the interview and started crying because she felt that her classmates thought that she was stupid since she kept asking them questions on programming. She told "I used to ask a lot of questions to my classmates about the programming assignments discussed in class since I didn't understand completely what was told in class as the instructions were given in English. Because of this my some of my classmates thought that I didn't understand programming but in reality I was actually struggling with the language (English) in which they taught me programming."

I collected open-ended feedback from the students about the bilingual teaching methodologies. A quick glance at the feedback suggests that the students like that their native language (Tamil) is used for teaching programming as they were able to understand concepts in a better way when compared to teaching only in English. I'm planning to analyze all the data that I collected from my fieldwork during this semester. I plan to write my dissertation during the next semester and hopefully graduate by May 2019. My belief is that my dissertation research will make Computer Science Education more accessible to all students whose native language is not English.

I would like to thank Prof. Saswati Mukerjee and Prof. Arokia Xavier Annie for collaborating with me during this summer and for allowing me to work with their students and staff in India. I would also like to thank Scott Kloeck-Jenson Fellowship for helping me with my dissertation research. My fieldwork simply wouldn't have been possible without the generous support from SJK fellowship!