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BOARD #109: The Journey of Korean Students in U.S. Colleges: Following Their Hearts to Become Computer Engineers and Scientists

Hyeree Cho
Woongbin Park, Purdue University at West Lafayette

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Abstract

This qualitative study investigates the factors influencing Korean international students' decisions to major in CS (Computer Science) and CE (Computer Engineering) at a U.S. university, as well as their academic experiences. Through semi-structured interviews with two female and two male Korean undergraduates, three core themes emerged: strong personal interest in computing, influences of parental beliefs and societal norms limiting female students (particularly affecting female students), and utility of major for future career. Findings show that while personal interest is a primary motivator, gender biases and parental beliefs can redirect female students from other STEM fields to CS. Additionally, participants cited dissatisfaction with Korea's public education system, and freedom and flexibility with U.S. education as reasons for studying abroad. The study underscores the need for reforms in K-12 computer and career education and for addressing gender biases to support informed major and career choices among students.

Introduction

Globally, there is a trend of students preferring computer-related majors within the STEM fields, with enrollment rates surpassing those seen during the dot-com bubble of the late 1990s [1, 2]. Furthermore, in East Asia, particularly in South Korea, the intense focus on education has led to an increasing number of students opting to study abroad due to dissatisfaction with the domestic educational environment [3]. Alongside this trend, we conducted research to understand the background of Korean students' decisions to study computer-related fields in the U.S. as well as their academic experiences after making those choices [4]. This qualitative case study explored how various factors, including their cultural influence, parental beliefs, and their own motivation, impacted Korean students' major choices in computer-related fields at a U.S. college and how they are navigating their academic paths. With this aim, we interviewed two Korean female and two Korean male students majoring in CS and CE, which are highly popular majors in Korea.

Literature review

As the number of students choosing computer-related majors has increased, Alexander et al. [5] quantitatively compared first-year university students majoring in computer related majors with those from other disciplines. Their findings revealed that computer-related major students mainly prioritize their personal interest in the field and tend to prefer flexible work environments and careers. Meanwhile, Lehman et al. [6] highlighted the underrepresentation of women in CS and explored the backgrounds of female students who chose this major. Their study showed that female computer science majors had lower high school grades, but higher SAT verbal scores compared to female students in other STEM fields. Additionally, these women often valued themselves lower on their academic and leadership abilities and struggled with deciding in clear

career plans. Research on promoting computer science as a major has frequently explored what types of students choose to major in the field.

On the other hand, there has been limited exploration into the backgrounds of international students who pursue computer-related majors in the U.S. Zheng [7] examined the motivations and reasons for international students choosing their study destination. While economic and social factors were all important, the study showed that aspects such as a country's economic prosperity and diplomatic relations had a particularly significant influence on the selection of the study destination. Oliveira and Soares [8] emphasized that when international students select a university, factors like personal, academic, and professional development play a significant role. Notably, those studies indicate that students prioritize a university's academic reputation and the quality of education. These findings indicate that international students consider not only personal factors but also a variety of socio-cultural elements when choosing their study abroad destination and major.

In response, this study aims to investigate the journeys of male and female international students majoring in computer science and engineering through interviews, to better understand the backgrounds that led them to choose their major. The research questions are as follows:

1. What factors have influenced international students in the U.S. when choosing CS and CE majors?
2. What are their experiences in their majors regarding motivation, academics, and career goals?

Method

Research design

This study employed a qualitative approach to investigate the background and experiences of Korean international students majoring in CS or CE in the United States. The primary goal of the study was to understand the thought processes behind their decision to pursue CS or CE majors and their academic experiences within these fields. To achieve this, the first author conducted semi-structured individual interviews with the participants, and the collected data were analyzed using thematic analysis [9]. The NVivo software was utilized for coding and analysis of the data.

Participants and context

Purposive sampling was used to recruit the participants, who were required to be Korean undergraduate students aged 18 or older. Participants were recruited from a large midwestern university. In total, 10 females and 10 males were participated in the study. Among the full sample, we focused on the participants (see Table I) who were majoring in CS (two females and one male) and CE (one male). To protect their identities, pseudonyms were used to all participants.

Table I. Participants

Participants	Majors	Grade	K-12 Overseas Study Experience
Dasom (20/Female)	CS	Sophomore	6-9th grade in U.S. Other years in international high school in South Korea
Sumi (24/Female)	CS, Statistics, and Mathematics	Senior	No
Jinbum (24/Male)	CE	Senior	High school in U.S.
Changsu (21/Male)	CS	Sophomore	High school in U.S.

Data collection and analysis

To collect the data, semi-structured interviews were conducted. Each participant took part in an in-person interview lasting 20 to 40 minutes. A semi-structured protocol was used to ask the students about the following topics: a) cultural and family background, b) parental expectations and support for education, d) motivations for choosing their major and their expected level of education and goals, d) parental beliefs about their major choice, as well as the anticipated level of education and goals. The interviews were audio-recorded and subsequently transcribed. The transcribed data were analyzed based on the research questions using the thematic analysis method proposed by Braun and Clarke [9]. The thematic analysis approach is outlined in Table II.

Table II. Data Analysis Procedure

Procedures	Description
Familiarizing with data	During this process, all student interview data were transcribed, and repeated readings were conducted to form initial ideas. The overall data were recorded in the NVivo program.
Generating initial codes	All data were coded, focusing on content related to the research themes. For example, the interview statement, "I just decided maybe the Engineering wasn't my thing and I discovered how hard it will be for me to transfer my major like change my major in that college that I was accepted to," was coded into each category such as "Personal Interest" and "Transferring Majors."
Searching and reviewing themes	The generated codes were compared and analyzed, taking into account their relationships, and grouped into three representative themes. These three themes were: a) strong personal interest, b) Influences of parental beliefs and societal norms limiting female students, c) utility of major for future career. Subsequently, these themes were reviewed to ensure they accurately reflected the interviews and research questions.
Defining and naming themes	Each theme was named appropriately and succinctly. These analyzed and organized themes were used to describe the experiences of Korean international students, including their decisions to study abroad and their current academic lives.

Results

We identified three core themes based on semi-structured interviews with the four participants related to their major selection and experience in their college majors.

Strong personal interest

An inherent interest in computers was the primary reason the four participants chose computer-related majors. Changsu, who was a CS major, chose computer science given the problem-solving nature of the field ("Those like logical things mixed with problem solving, I guess, is what I really like about it."). Passion for their academic or career aspirations was also associated with their personal interests. For example, Jinbum, a CE major, reported "I'm thinking about the master's in computer… either in computer science or engineering because I want to get into machine learning and artificial intelligence as master's."

Influences of parental beliefs and societal norms limiting female students

Gender bias that parents had was an obstacle to STEM pipeline entrance for female students. Surprisingly, computer science emerged as an alternative to traditionally male-dominated STEM fields, such as electrical engineering. The gender bias beliefs ingrained in the society influenced parental belies about STEM majors, which had a significant impact on students' major decisions.

> Sumi: "Actually it's because of my daddy. And then…actually I like more of electrical engineering, but my daddy is like doing his own business and he's doing about the manufacturing or kind of company. And then he has so many friends like who is owner of the company and then as he feels…for women electrical engineering is kind of hard in Korea to work. These days it's more changing but like…like when you go to company or factory there is like one or two girls. Most of them is men so he actually does not like me to study the electrical engineering. I think it's because of kind of Korean culture. In Korea most people are guys in the engineering field. And then like…also he says like…, you like computer and computer is more like women…deeply women in the field. And then I also feel like computer science is kind of similar as electrical engineering, so that's why I chose computer science."

Utility of major for future career

With respect to participants' experiences in their programs, the high utility of their majors for future careers was a dominant theme. Dasom perceived computer science as a practical major that could contribute to the future. She specifically mentioned artificial intelligence and various related areas, noting that they are applied in diverse ways across industries. She believed this would also benefit her career.

> Dasom: "Whenever I see new technology it's pretty cool and like I… by majoring in computer science I want to like… contribute to in the near future. I am still deciding on whether to go to graduate school or not but if I go to graduate school then I might…. I

would want to work in like artificial intelligence or those kind of fields in companies… If you study well and graduate, then I think it will help me on the… on my career."

Discussion

Implications from the findings

Our findings suggest that students' individual interest was a primary influence on their selection of computer science or computer engineering majors. However, gender bias beliefs instilled in society and parents' belief systems had an impact on a female students' decision to major in computer science. Regarding students' experiences in their computer majors, they are finding the usefulness of their majors in terms of achieving their career goals or succeeding in the job market.

It is noteworthy that participants in the interview decided to study abroad due to the lack of support for their individual interests in the public education system in Korea. They sought private education opportunities to learn coding in depth because the public education system did not offer sufficient resources or specialized programs to meet their needs. Furthermore, they were unsatisfied with the absence of career exploration opportunities in Korea, which led them to study abroad in the U.S. pursuing their interests in computer majors. In accordance with the previous literature, gender bias beliefs were barriers to female students' STEM major selection. Even though female students entered the STEM pipeline in our study, one of the students had to balance her interest and parents' gender-biased beliefs, which diverted her from her original passion. Educators need to consider how to dismantle gender bias beliefs to help parents and students make informed decisions regarding their major choice and career goals.

Future directions

We suggest improving public education to enhance K-12 computer and STEM career education and challenge gender biases. South Korea mandates computer and career education as part of its curriculum. Nevertheless, students reported dissatisfaction with the computer education, citing insufficient opportunities for in-depth or advanced exploration of the field and connections to future careers. Students' challenges imply that computer education should go hand in hand with reforms in career education. Instruction in computer education should move away from one-size-fits-all education and aim for differentiated education meeting diverse needs, skills, and interests of students.

Although students ultimately chose computer-related fields as their majors, some students transferred from other STEM fields due to the lack of information about STEM majors at the college level. Therefore, we propose that public K-12 education must provide high-quality instruction not only in computer science but also in STEM fields in an integrated manner. To achieve this, improvements in STEM education should be in conjunction with reforms in career education. Career education revisions include support for students to overcome traditional gender role beliefs, along with detailed information about various STEM careers. Revisions are required at the college level in addition to the K-12 level. In order for STEM programs to attract students, they need to provide extensive information about the curriculum in a fashion that high school

students can make knowledge-based decisions considering their STEM career paths without the dominance of societal biases.

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