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## International Journal of Educational Research

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# Curriculum standardization, stratification, and students' STEM-related occupational expectations: Evidence from PISA 2006



Seong Won Han\*

University at Buffalo, The State University of New York, USA

## ARTICLE INFO

*Article history:*

Received 28 October 2014

Received in revised form 23 March 2015

Accepted 27 April 2015

Available online 12 June 2015

*Keywords:*

Curriculum standardization

Stratification

STEM

International

PISA

## ABSTRACT

This paper uses data from the Program for International Student Assessment (PISA) 2006 to examine the associations between characteristics of national education systems (the standardization of curriculum, the number of school types available to 15-year-old students, and early tracking) and students' STEM occupational expectations. Results show that the associations between characteristics of national education systems and students' STEM occupational expectations differ by gender as well as across STEM subfields and academic performance levels. Students' computing and engineering occupational expectations are not associated with the characteristics of secondary education. The negative association between a standardized education system and students' health service occupational expectations is stronger for students at the bottom of the performance distribution than students at the top.

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## 1. Introduction

There is a growing interest in cross-national differences in student STEM career aspirations and expectations as well as cross-national differences in math and science achievement. Prior research has shown that students' occupational plans in high school are strong predictors of educational and occupational attainment in STEM fields (Morgan, Gelbgiser, & Weeden, 2013; Tai, Liu, Maltese, & Fan, 2006; Xie & Shauman, 2003). Given the importance of STEM occupational expectations for future educational and occupational attainments, cross-national research in education has examined which students want to pursue science-related careers in the future (Organisation for Economic Co-operation and Development, 2012, 2009c). These studies have found that in several countries students strongly desire science-related careers. A 2012 Organization for Economic Co-operation and Development (OECD) report showed that, on average across OECD countries, about 55 percent of students planned to work in high-status occupations such as legislators, senior officials, corporate managers, and professionals, and about 60 percent of those students planned to work in science-related professional careers (Organisation for Economic Co-operation and Development, 2012). However, in a number of countries such as Korea, Turkey, and the Slovak Republic, science-related careers were relatively less attractive to 15-year-old students. For example, in Korea, about 61 percent of students planned to work in high-status occupations, but only about 34 percent of those students planned to work in science-related careers (Organisation for Economic Co-operation and Development, 2012). Prior studies have shown

\* Tel.: +1 7166451080; fax: +1 7166452481.

E-mail address: [seongwon@buffalo.edu](mailto:seongwon@buffalo.edu)

that academically strong students are more likely than low-achieving students to report specific future career expectations (Sikora & Pokropek, 2011), and students who are academically strong in science have higher levels of interests in pursuing science-related careers than other students (Organisation for Economic Co-operation and Development, 2009c). Across OECD countries, an average of 61 percent of top performers in science reported that they would like to work in a career involving science; however, this proportion varied significantly across countries. For example, in France and Spain, 77 percent of top performers in science reported wanting a career involving science, while in the Czech Republic only about 39 percent of top performers in science were interested in a science-related career. High-performing students in Japan (43 percent), the Slovak Republic (45 percent), and Finland (47 percent) fell between these two extremes. This OECD report (2009c) concluded that while educational systems in the focal countries have had significant success teaching scientific knowledge and skills, they have had less success fostering science-related career aspirations among academically strong students; the report also suggested that STEM career expectations may be linked to the features of national education systems. However, there is a lack of empirical research on the link between features of education systems and science-related career aspirations and expectations.

A large amount of research in education has focused on the extent to which individual- and school-level factors, including math attitudes, self-assessments, and math and science achievement, predict STEM educational and occupational expectations (Correll, 2001; Riegle-Crumb, Moore, & Ramos-Wada, 2010; Xie & Shauman, 2003). Cross-national studies have also examined the extent to which individual- and school-level factors are associated with students' STEM occupational expectations (Buccheri, Gurber, & Bruhwiler, 2011; Sikora & Pokropek, 2012b).

Recent cross-national research in education has shifted from a focus on individual- and school-level factors to a focus on country-level factors, primarily the stratification level of secondary education systems, in examining students' science-related career expectations (Sikora & Pokropek, 2012a). Stratification indicates the degree to which students are selected into separate school types with clearly differentiated kinds of school curricula (e.g., academic versus vocational tracks). Researchers have also proposed that standardization, the degree to which school curricula are standardized nationwide, is another key feature of the organization of national education system (Allmendinger, 1989; Kerckhoff, 2001). However, there is a lack of empirical research on the link between standardized education systems and STEM occupational expectations. In the current study, I investigate the extent to which the features of national education systems are associated with national-level differences in students' STEM occupational expectations by considering both standardization and stratification as features of national education systems. The study also examines whether the associations between features of national education systems and STEM occupational expectations remain consistent by gender and across different levels of science performance. To address these questions, the study used data from the Program for International Student Assessment (PISA) 2006, which was administered in OECD member and partner countries.

## 2. National education systems and students' STEM occupational expectations: a comparative perspective

Over the past decade, cross-national studies on students' educational and occupational expectations have shifted their focus from individual- and school-level factors to country-level factors (e.g., national education systems) as well as the interactions between individual characteristics and macro-level educational contexts (Buchmann & Dalton, 2002; Buchmann & Park, 2009; McDaniel, 2010; Sikora & Pokropek, 2011, 2012a). These studies have employed the stratification–standardization framework proposed by Allmendinger (1989) to classify national education systems. In this context, standardization refers to “the degree to which the quality of education meets the same standards nationwide” (Allmendinger, 1989, p. 233). Standardization is generally higher when the central government controls curricular, learning, and assessment standards (Kerckhoff, 2001). Countries with highly standardized education systems (e.g., Japan and Korea) have national curriculum standards or courses of study that define the content to be taught by grade and subject. In Allmendinger's framework, stratification (also called differentiation) refers to “the degree to which systems have clearly differentiated kinds of schools whose curricula are defined as higher and lower” (Kerckhoff, 2001, p. 4). Stratified educational systems most often include tracking, streaming, or grouping *between* secondary schools. Compared to comprehensive (unstratified) educational systems, stratified systems are more likely to provide diverse vocational education programs for secondary students. Stratified systems tend to sort students into different tracks (programs) at early age. Within the standardization-stratification framework, for example, the U.S. education system is characterized by low levels of both standardization and stratification, while the Japanese education system is characterized by high levels of standardization but low levels of stratification (Shavit, Müller, & Tame, 1998).

Prior research has focused specifically on the stratification of educational systems as a potential explanation for cross-national variation in educational and occupational expectations among youths (Buchmann & Park, 2009). Researchers have found that students in highly stratified educational systems tend to have more realistic occupational expectations than those in undifferentiated systems (Buchmann & Park, 2009). This pattern may be due to the greater restriction of students' options for educational and occupational trajectories at the secondary level in highly differentiated systems.

Recently, cross-national research on students' occupational expectations has expanded its focus to specific occupation-based expectations. In particular, a number of studies have reported significant cross-national differences in students' science-related career expectations (Martin, Mullis, Gonzalez, & Chrostowski, 2004; Mullis, Martin, Gonzalez, & Chrostowski, 2004; Organisation for Economic Co-operation and Development, 2007, 2009c). Because PISA 2006 focused on assessments of scientific literacy, students' attitudes toward science, and students' expectations of the jobs they would hold at age 30,

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