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Larry E. Suter

Abstract: The Program for International Student Assessment (PISA) by the OECD measures student study time during formal school periods and during periods of out-of-school-time (OST). The purpose of these items is to account for differences in country to country achievement levels. However, analyses of the impact of additional study time on student achievement have produced conflicting results across countries. While more time given to a school subject within formal school is positively related to achievement in that topic, more time spent on OST is negatively related to average achievement between and within countries. The paper proposes a reconceptualization of OST and achievement by integrating theoretical frameworks of study time, student abilities, and student feelings of efficacy. The results of a descriptive and conceptual analysis of a set of new survey items in the 2015 PISA for 22 countries shows that students benefit from additional study time by having increased feelings of efficacy in a school subject (such as science) but not in measurable levels of achievement. While country to country levels OST participation rates are different, the patterns of relationships between OST participation, student achievement, and attitudes are similar.

Key words: PISA, comparative education, achievement, study time, attitudes

Introduction

The relationship between amount of study time and student learning has been a significant topic of a debate among education researchers for over 50 years (Gromada & Shewbridge, 2016; Karweit, 1984; Husén, 1972; Carroll, 1963, 1989; Farbman, 2012; Berliner, 1990). Most individuals and researchers assume that more study time would be associated with higher school performance (OECD, 2011b; Berliner, 1990). Public opinion also appears to support longer periods of study. For example, Long (2014) reports that 96% of adults in a Gallop poll thought that increased instructional time was an effective strategy for reducing the gap between high and low achievers (Long, 2014, p. 351). Thus, many educational policy bodies have urged schools and parents to increase student learning time in the United States and other countries (Benavot, 2004; Commission on Excellence, 1983; National Education Commission on Time and Learning, 1994). Nevertheless, such policies have been questioned by educational researchers (Husén, 1972; Karweit, 1984). In recent years, some countries have changed educational policies to reduce the burden of "cramming" for tests

(OECD 2017c; Bae & Jeon, 2013). Thus, the question of whether, and how, additional study time affects student performance is still an open question worthy of study and empirical analysis.

Evidence from the OECD's Program for International Student Assessment (PISA), an international comparative survey of 15-year-old students, shows that countries with longer periods of regular school time have higher achievement (OECD, 2011c, and 2017c); whereas, longer time spent in "additional study" is negatively associated with achievement or not associated at all (OECD, 2011b; 2016b, p. 209; Suter, 2016). No studies by OECD or others have provided a clear answer to the paradoxical finding about the relationship between additional study time and achievement (OECD, 2011b; 2011c; 2017c; Mori & Baker, 2010; Byun, Chung, & Baker, 2018; Bray, 2014). Often, the evidence reported in published studies directly contradicts results in other studies (Kuger, 2016; Bray, 2014; Farbman, 2012).

The thesis of this paper is that spending time in additional study is less likely to influence achievement in a school subject than it is to increase a student's level of confidence (efficacy). The reasoning of this proposition is based on educational theory of study time and learning and social-psychological theories of motivation (Carroll, 1963, 1989; Eccles et al., 1983). These theories provide a basis to hypothesize that study time outside of class (as OST or extra homework) does not lead necessarily to higher achievement levels but that ability levels interact with student self-beliefs to motivate attendance in OST which then functions to increase student feelings of efficacy in school subjects. The decision to take additional study in OST is determined by an interaction between a student's ability, their perception of their school performance, and their self-beliefs. Therefore, students of low achievement levels are more motivated to attend OST programs for a school subject if they are concerned with acquiring achievement levels equivalent to other students. Necessarily, the decision to engage in additional study is conditioned by the availability of opportunities for OST within the country.

Evidence for this hypothesis is presented from analysis of relationships of student achievement levels and perceived need for efficacy in a cross-national study of 22 countries. By comparing these relationships across countries, the level of generality for these relationships across differing educational and social conditions will be established.

Definition of Outside-School-Time

Many different terms have been used to refer to similar, but not necessarily identical, practices of student activities outside of formal school time (see review by Bray and Kobakhidze, 2014). Some of the terms include: after-school time, outside-school-time (Noam & Shaw, 2013), additional instruction (OECD, 2017b), extended learning (Fischer & Klieme, 2013), shadow education (Stevenson & Baker, 1992; Bray, 1999), private supplementary tutoring requiring payment (Bray, 1999), cram school, group learning, extracurricular activities (National Research Council, 2002), summer learning (Alexander, Entwisle, Olson, 2007). Other terms unique to a single country exist also. The term "outside-school-time" or "OST" will be used throughout the paper to refer to student self-reports of study time in any topic. Because this paper is an analysis of existing survey data, the scope of OST is confined by the set of items contained in the expanded PISA 2015 items on "additional study".

The PISA survey defines OST as student study time outside of regular school hours conducted on topics of formal school that are held in an organized setting with an individual, a group, or on-line (OECD, 2016a; Kuger, 2016). A high percentage of PISA 2015 respondents reported that their OST mathematics and science classes duplicated the content of the regular school (ranging from 77 percent in Denmark to 95 percent in Thailand) providing evidence that the PISA items significantly captured the study events that were intended by the study framework.

Selective Review of Research

Academic studies of student time use in addition to school hours have increased in the past 20 years reaching approximately 40 papers a year. The studies that are of most interest for this analysis are that that discuss theoretical definitions of study time, how social-psychological theories have been applied to OST study, and how international comparative studies have influenced informed knowledge of OST participation and effects. Many studies of OST are conducted with international comparisons or an analysis of one country's policies that would be of interest to other countries.

Study Time

The study of the relationship between OST and achievement is a subset of the general topic of hours of study time and learning and therefore these concepts should be conceptually linked. A broad and inclusive framework of learning, study, and social and psychological attitudes is necessary to improve our understanding of OST and its role with student achievement. Because PISA surveys include multiple measures of study time and regular school time, the conceptual framework must directly include reference to time itself.

A model of time-use was developed by John Carroll in 1963. He argued that student performance is a function of the initial ability status of the pupils, the curriculum objectives, and the time spent on actual learning (Carroll, 1963). He noted that not all students require the same amount of time to achieve the same level of learning. The model of time use developed by Carroll has provided a basic framework that has continued to influence the study of the relationship between study time and achievement (e.g. see Kuger, 2016). The model postulated that five basic classes of variables account for variations in school achievement: The student's aptitude or amount of time needed to learn a task; student's ability or amount of time to understand instruction; student's perseverance or willingness to spend time on tasks or instruction; the opportunity or amount of time allowed for learning; and the quality of instruction indicated by less need for instructor repetition (Carroll, 1963, p. 25). In Carroll's model, not all students are expected to achieve mastery, but all students require the necessary opportunity to learn, given their abilities and aptitude (see Berliner, 1990, for extended discussion). His conceptualization received empirical support from an analysis by Wiley and Harnischfeger who concluded that additional time should be provided for those who need it to achieve equal individual benefits of schooling (Wiley and Harnischfeger, 1974, p. 11). Thus, Carroll's model suggests that lower ability students may be more likely to acquire additional learning in settings outside of class time.

Social Psychological Theory of Motivation

Many studies, particularly in the United States, discuss whether after-school study practices affect social and psychological well-being as well as academic achievement (Noam and Shah, 2013; Noam and Triggs, 2018; Mahoney, Larson, Eccles, & Lord, 2005; NRC, 2009, 2012; Bray, 2013). Among these frameworks is one developed by social psychologists who have theorized that student behavior may be predicted by the attributes of motivation: values and expectations. One of the influential theories of motivation and achievement is the "expectancy-value" model (Eccles et al., 1983; Wigfield & Eccles, 1995, 2002). That model proposes that student expectancies and values are the most direct predictors of achievement performance and behavior choice (Wigfield, 1994; Wigfield & Cambria, 2010). The theory proposed four major components of achievement task values: attainment value, intrinsic value, utility value, and cost. Values have both broad and task-specific definitions. Broader values have to do with an individuals' sense of what is appropriate to do to achieve a desirable end states of activities. Task specific values are values defined with respect to the qualities of different tasks and how those qualities influence the individual's desire to do the task. Attainment value is defined as the importance of doing well on a given task (such as science achievement). It incorporates identity issues (such as self-efficacy) which are tasks that are important when individuals view them as central to their own sense of themselves or allows them to express or confirm important aspects of self. These constructs are influenced by a variety of psychological, social, contextual, and cultural conditions outlined in a number of papers (Eccleset al., 1983). Research studies of motivation are mostly concerned with determining how expectancies, values, and their determinants influence choice, persistence, and performance. The content of items in the PISA survey permit an extensive analysis of how this theory might improve understanding about why students in different countries did or did not attend OST.

Competing Hypotheses

Testing the claim that students are more motivated by social-psychological aspects of their perception than achievement alone to increase OST participation requires examining several rival hypotheses. Four areas of possible rival hypotheses of relationship between OST and other behaviors will be discussed here and addressed in the analysis as much as possible. These are issues of OST measurement, family status levels, quality of instruction, and causal analysis.

Errors of Measurement

The validity of the analysis of the PISA survey depends on the reliability and validity of the survey items chosen by PISA. In order to create valid cross-country measurements, the basic nature of OST must be defined in a manner that could be understood by survey respondents in the same way across cultures and by all students within a country. No survey data are available to adequately answer questions of construct validity directly, but the relationships between the existing survey items of OST and student reasons for attending, and

their attitudes and achievement do provide insight into how OST is interpreted across different countries. Bray and Kobakhidze (2014) have documented methodological measurement issues with the PISA items such as quality of translation, misidentification of activities, lack of full definition, and insufficient concern with measuring the cost of additional study to the student or family that could affect the strength of conclusions from cross-national surveys. Thus, the interpretation of nation to nation differences in reported levels of OST must be checked by comparing the similarity of relationships to known factors, such as other forms of study. The interpretation of results must consider the possibility that observed relationships between variables found to be very different in only a few countries may be a signal that the items on OST are not reliable measures of a true difference in OST behavior for those countries. The PISA results for OST in Hong Kong and Korea, for example, are explored specifically for explanations of observed differences.

Social Status

A student characteristic that is known to affect student performance is the socioeconomic status (SES) of their families. Several studies have been published that claim that higher status families may give their children advantages by sending them to OST classes (Byrun, Shofer & Kim, 2012; Byun, et al., 2018; Matsuoka, 2018; Covay & Carbonaro 2010). An analysis of PISA surveys in 2012 and 2015 finds that the relationship between family status and student participation in OST varies considerably between countries. However, previous studies with the 2012 PISA survey did not show that status level differences within English speaking countries made a significant contribution to explaining differences in OST program participation (Suter, 2016). Since social status is an important factor in most educational activities, it must be considered as a rival hypothesis to the social-psychological factors proposed here.

Country Conditions

Another form of variation in opportunity structure for OST participation occurs at the country level. Large differences in country to country participation rates were noted in PISA 2009 (OECD, 2011a). Some international studies of time use have addressed how market forces of supply and demand of OST has affected the content of the study programs (Bray & Silova, 2006; Kobakhidze, 2018) and how OST affects a country's educational development (Byun, Chung, & Baker, 2018). These country level studies offer promising avenues for future research that enable the integration of knowledge of system level opportunities models of student social-psychological motivation as proposed here. To develop a full understanding of the function of OST, a comprehensive description of each country's system of OST would be necessary.

Quality of Instruction

Another obvious factor believed to affect student learning is the quality of the instruction itself (as discussed by Carroll, for example). Carroll noted that, "time as such is not what counts, but what happens during that time". He continued to say, "time is, in a sense, a psychologically empty concept" (Carroll, 1989, p. 27; Gage & Berliner, 1978). The measure-

ment of instructional quality of OST is a complex subject that was not attempted in the set of items prepared for the 2015 PISA. Thus, differences in quality of instruction from country to country, and within countries, is a potential rival explanation for differences in effectiveness of OST participation that cannot be dismissed. The survey did include student responses about their perception of the type of instruction received in OST compared with regular school that could not be examined for this study but will be explored in the future.

Methods

The method for analysis is to examine statistical relationships between responses to the OST items in the PISA 2015 survey on student ability, attitudes, reasons for attending additional study, and hours of homework study. The analysis will be conducted of a newly designed and executed set of items from the 2015 PISA survey about which little is known of the response rates or distributions of characteristics prior to analysis (OECD, 2016c, 2017a; Kuger, 2016). The analysis in this paper presents a selection of charts and tables that describe the size and shape of distributions of student conditions associated with OST participation within and among countries. Thus, analysis method will depend more on presentation of descriptive tabulations than on multivariate models to emphasize and display distributions of each variable. Such description is a necessary step toward proposing a more complete causal model. After experience was gained with the distributions of achievement, attitudes and OST practices, a multivariate regression model will be examined to test some of the rival hypotheses outlined here.

Previous researchers of OST have attempted to analyze large scale data bases using multivariate regression models across many countries (Bae & Hong, 2016; Byun, Chung, & Baker, 2018; Liao & Huang 2018; Stevenson & Baker, 1992). Some of these analyses make assumptions about the meaning of coefficients that may be incorrect because the underlying distributions are not linear or the relationships between two distributions are not homoscedastic. Or, interpreting a response by students in an unfamiliar culture may not reflect the reality of that culture (Bray, 2014).

Throughout this paper the vocabulary of causality is occasionally used because the goal of social science research is to identify how and when one behavior affects others. But a more cautious approach to data analysis is conducted. The use of "cause" in this paper is restricted to a method of drawing inferences from evidence. It does not imply that statistical representation is necessarily capable of representing all conditions necessary to infer causality. To do so would require a complete model of human behavior with all rival explanations accounted. Explaining student practices of study time and achievement may not be possible with a single set of measured factors in a cross-sectional survey. The more modest aim of this analysis is to organize evidence of the conditions associated with OST behavior, to confirm or deny potential rival explanations and to improve the plausibility of claims about causal forces (Schneider et al., 2007, p. 140).

Operational Definition of OST

The publicly available PISA 2015 data base provides an empirical source for a meaningful study of some of the concepts of OST, additional study, homework, and extracurricular activities for national samples of 15-year-olds (Klieme & Kuger, 2016; Kuger, et al., 2016; Jude & Kuger, 2018; OECD, 2017b). The 2015 survey included an optional module (Educational Career module) that was answered by students in only 22 of the 106 participating economies that will be analyzed in this study. The survey items for OST measurement were developed for PISA 2015 after extensive planning (Kuger, 2016, p. 395; Jude and Kuger, 2018). The new survey design provides an opportunity to examine the effectiveness of the new framework for measuring student participation in OST (OECD, 2017b, p. 113).

OST was defined by the opening question that asked, "What type of additional science instruction did you participate in during this school year?". The PISA 2015 OST survey items address study time specifically related to school domain topics and omit reference to other "informal" experiences such as museum attendance, and activities during vacation from school. The PISA items were designed to identify practices such as "cram" schools and other forms of study frequently found especially in Eastern Asia.

Students reported the number of hours per week that they attended OST in nine domains: mathematics, language, foreign language, social science, music, visual arts, dance, sports and a catch-all category. The category included an option of zero hours. For analysis purposes, only students who answered 1 hour or more were counted as having attended OST last week. Because the survey allows multiple skip patterns, calculating participation rates in OST requires careful attention to the intended and unintended respondent. For example, the 10 subject domains are independent of each other; thus, the number of "eligible" students to report their OST activities is different for each subject.

Other items in the optional Educational Career module contain elaborate distinctions of OST types including questions for each domain about type of instruction (8 categories of tutoring, video instruction, and group study); reasons for attending or not (13 categories each); how the method of instruction in the program differed from regular school; and where the instruction was located in relationship to the school itself. The questions about the nature and motivation of the OST program were asked separately for the three main PISA subject domains, and responses to more than one subject area were allowed. These items produced 130 different data items on the public-use data base. The survey also included indicators of time spent on extra-curricular student activities such as sports, performing arts, visual arts and music. Many of these items were briefly examined prior to selecting a smaller set of topics for detailed analysis in this first analysis but are not summarized here. Instead, the data analysis has selected OST measures that are specifically intended to quantify student activities that may improve school performance in science, mathematics or reading. The study itself focused most attention on science learning so science achievement and OST attendance will be the most frequently discussed topic.

Findings

The overall 22 country response rates for all 10 OST domains are shown in Table 1. The table shows the ratio of students who attended for at least one-hour last week to the number of students who answered the domain item. The higher responses for mathematics, sports, science, and languages shows that these topics were understood by the students to be their most frequent OST activities. The rate shown here may be somewhat biased upward because non-respondents were excluded from the entire table. These participation rates should not be compared with other survey sources (such as previous PISA surveys) because of the nature of non-response categories to the 10 items.

Country Differences in Participation

Table 2 presents OST participation rates by country by combining 10 domains into three major categories: academic (science, mathematics, language, social science, and foreign language); arts (arts, painting, music); and sports. The population selected for the denominator of this calculation includes missing responses for individual items to provide the widest coverage of potential respondents and to maintain consistency in the base of the rate across different items. The participation rate in academic domains ranges across countries from 60 to 90 percent, except in Denmark that falls below half. Participation in the Arts programs are somewhat lower than attendance in the academic OST programs. Each country has a significant percentage of 15-year-olds participating in sports but only in Denmark and Iceland is the percentage in sports higher than OST in academic fields (sports participation is not significantly different from academic OST in Austria, Hungary, Belgium and Latvia). In general, countries that have high participation in one of the three categories of combined domains also have high participation in the other two.

Table 1. Percent Attending 1 or More Hours Past Week in 10 OST Domains: PISA 2015 ($N = 22$ countries)

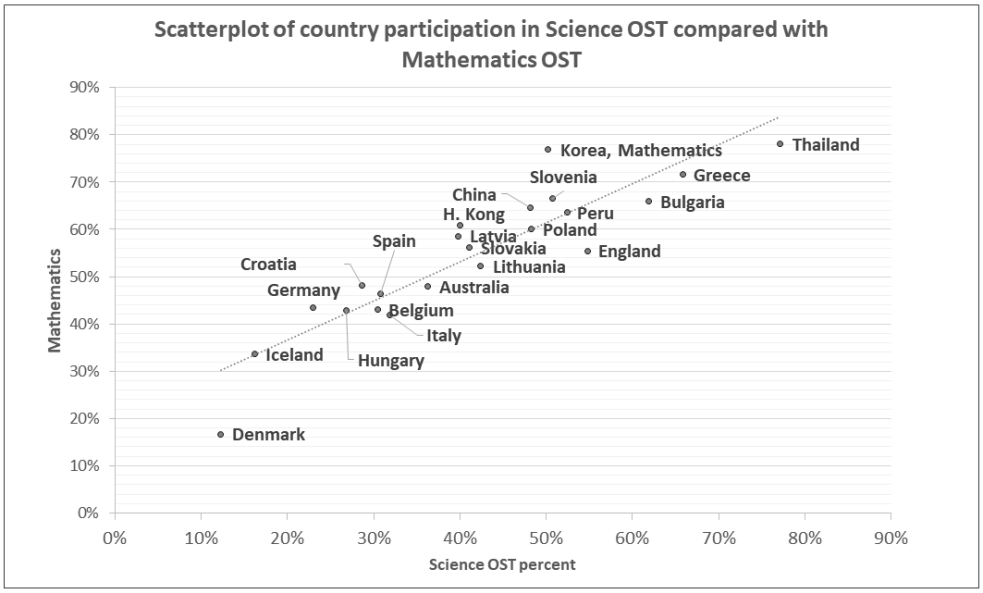
Mathematics	Sports	Foreign Language	Language	Science	Social Science	Music	Painting	Art	Other
54.5%	52.8%	45.8%	43.3%	41.9%	33.4%	29.1%	24.6%	22.1%	35.5%

Table 2. Participation Rates in Academic, Art and Sports OST Domains, by Country (ranked by level of participation in academic domains): PISA 2015

Country	Unweighted Cases	Any of Five Academic Domains	Music, Art, or Painting	Sports
Thailand	7,882	90.3%	77.4%	76.4%
Korea	5,547	89.9%	67.4%	69.7%
China	9,813	89.6%	80.7%	81.7%
Peru	6,952	89.6%	81.6%	84.5%
Poland	4,449	89.1%	74.9%	82.1%
Greece	5,487	87.4%	63.2%	74.3%
Hong Kong	5,265	86.1%	74.5%	73.5%
Slovenia	6,174	83.4%	73.9%	78.8%
England	5,242	83.1%	63.2%	71.3%
Latvia	4,684	83.1%	75.2%	80.0%
Slovakia	6,089	82.3%	72.0%	77.6%
Lithuania	6,198	81.8%	75.2%	76.5%
Bulgaria	5,746	80.7%	69.4%	73.5%
roatia	5,658	76.1%	60.0%	66.2%
Hungary	5,417	75.1%	67.0%	75.0%
Spain	6,622	74.7%	54.5%	69.6%
Germany	5,339	70.5%	56.4%	62.6%
Italy	10,915	70.2%	53.6%	63.9%
Belgium	3,242	68.3%	51.4%	65.8%
Australia	12,445	66.4%	55.2%	66.0%
Iceland	3,289	60.8%	54.1%	65.5%
Denmark	6,629	48.5%	42.6%	57.6%

The scatterplot in Figure 1 shows that countries with high levels of participation in science OST are also the most likely to participate in mathematics OST. The Spearman rank correlations of OST participation between three school domains of mathematics, science and reading (local language) across 22 countries range between 0.89 and 0.93 supporting the conjecture that high participation in one domain is associated with participation in other domains within countries. The chart also shows that some countries have higher levels of OST participation in mathematics than in science (Korea and Hong Kong are especially more likely to be in mathematics than science as shown by their distance from the regression line). Many researchers have discussed the Asian practices of emphasis on study (Bray, & Lykins, 2012; Byun, Shofer, & Kim, 2012; Byun & Park, 2012; Komatsu & Rappley, 2018). However, the variation among these countries suggests that OST participation is less of a cultural pattern shared by geography and more a result of the unique history of development of educational institutions in each country. Explaining country to country differences in OST participation would require having more knowledge of the businesses and government policies about OST programs for each country.

Figure 1. Scatterplot of Country Participation in Science OST Compared with Mathematics OST



Participation in OST and Student Ability

A summary of the relationship for the aggregate of students from all 22 countries in the 2015 PISA is shown in Table 3 for OST science participation and achievement in science to demonstrate the strong overall negative relationship between science ability and participation in OST. The correlation coefficients between student science achievement and hours for OST within the 22 countries are low and negative (ranging from -0.02 to -0.24). Since a regression equation assumes that the relationships are linear, the distribution of science achievement was divided into four categories to allow additional analysis of distribution of participation rates within different levels of achievement.

Differences in OST participation rates were computed (not shown separately) for four ability levels by country. In 18 countries, OST participation rates increase evenly between each ability level. However, in 6 countries (Greece, Thailand, Hong Kong, Korea, Bulgaria and Slovenia) ability level was not a significant distinguishing factor in participation rates. Participation rates in Greece and Thailand were over 60 percent in each ability category while students in Hong Kong attended at about the same percentage at all levels but at a much lower level (around 40 percent). The largest differences in participation rates occurs between the lowest and second lowest ability levels; a smaller difference is found between the two top levels (a few countries have decreasing rates between the top two levels). The conclusion of this analysis is that the relationship between ability and OST participation is curvilinear with largest changes occurring at low to medium levels of ability and smaller

changes among student above the average. The level of difference between ability categories is affected by the overall participation rate in the country. Larger differences occur among countries with low OST participation (however, the true size of within country differences is affected by a ceiling effect in high participating countries; once participation rates reach 80 percent overall, differences between achievement levels within those countries country are limited to a smaller range than in low participating countries).

Table 3. Percent of Students in 22 Countries who Reported Attending OST Classes in Science as No-Hours or 1-Hour-or-More in the Past Week by Level of Science Achievement
(This table includes missing responses in one or more domain in the denominator.)

Achievement Quartiles	No-Hours Last Week	1 hr.-or-More Last Week
Total	25.4%	42.0%
High ability	39.9%	31.6%
Medium high ability	29.9%	36.1%
Medium low ability	20.8%	44.4%
Low ability	11.9%	58.2%

Student Science Efficacy

Student decisions to increase study time are motivated by perceived needs for higher achievement. They are motivated as much by personal feelings of confidence in a subject matter as by actual performance. To test the significance of self-efficacy in science, the PISA scale on science self-efficacy and achievement are applied to this analysis to enable an inspection of the interaction between ability and motivation on OST participation. The PISA research program includes measurement scales of student attitudes in self-efficacy in science, enjoyment of science, and beliefs that science has instrumental values. The scale of science-efficacy is the most relevant for this analysis because it represents the student's own conception of their ability. A student's level of science-efficacy is positively correlated with their achievement level, but at a relatively low level (r=0.18) indicating that students do not have precise self-knowledge of their performance. The OST participation rates by science self-efficacy and science achievement levels in Figures 2a and 2b show that each has an independent influence on participation.

Figure 2a. Percent who Attend Science OST for Self Improvement with Science Achievement on (Achievement on X axis)

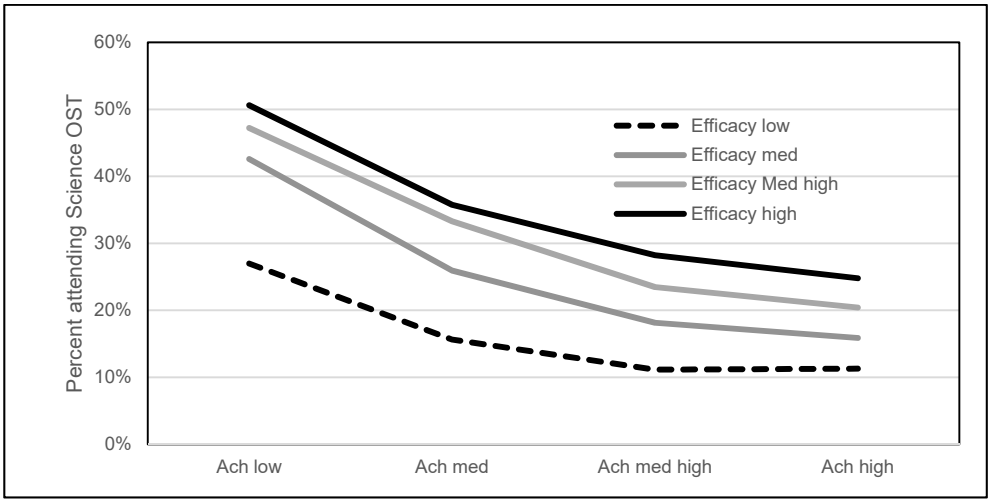
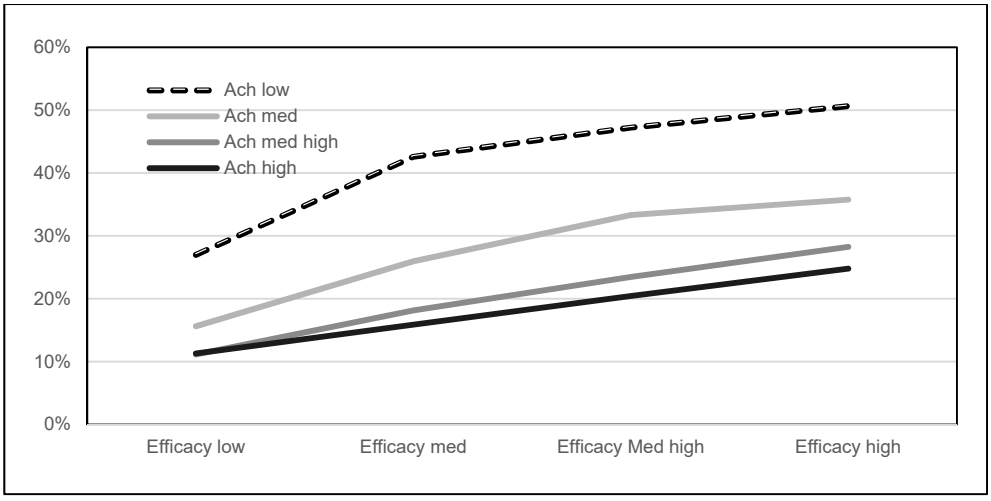


Figure 2b. Percent who Attend Science OST for Self Improvement by Science Achievement and Efficacy (Efficacy on X axis)



OST participation rates decline between low and high ability levels but increase between low and high levels of science efficacy. The relationship between levels of science efficacy and taking additional study in science is stronger at lower levels of ability than at higher levels of ability (Figure 2a). Students with high ability and low confidence in science are the least likely to attend science OST. Two versions of the same participation rates are presented in Figures 2a and 2b to illustrate the magnitude of differences in attitude and ability on decisions to attend OST (the x and y axes in Figure 2b are flipped from those in Figure

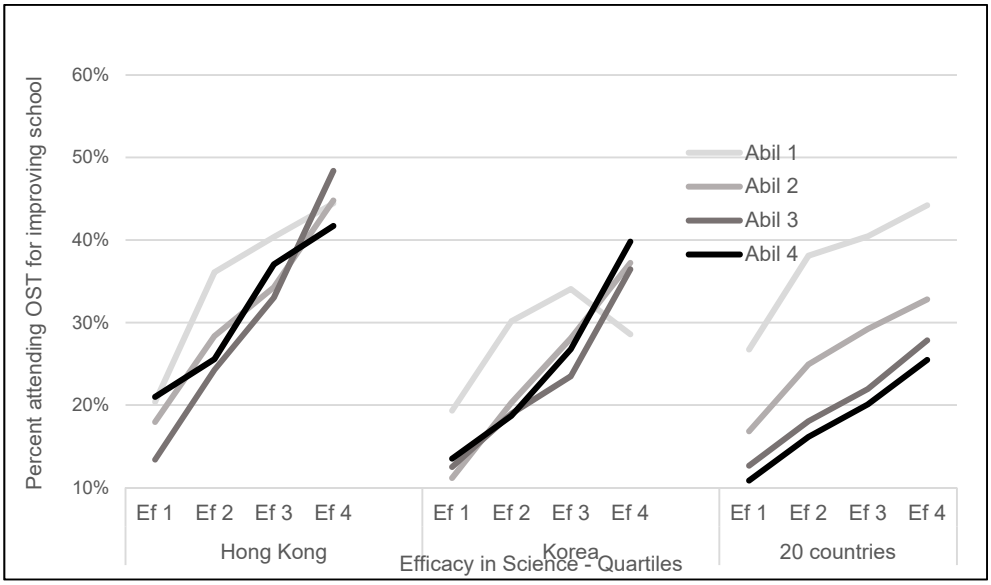
2a). These results are consistent with previous studies that found low correlation coefficients between hours of OST and achievement and high coefficients with attitudes toward science in English speaking countries from PISA 2012 (Suter, 2016). To some extent, the level of science-efficacy overcomes achievement levels as influences on decisions to enter OST (best illustrated in Figure 2b which shows higher OST participation rates at higher efficacy levels within each category of ability). This finding supports the inference from Carroll's model that student's perceptions of ability, as well as their ability (measured by PISA test in science), affects decisions for further study. The main lesson from this discussion is that consideration of both ability and attitude is necessary to comprehend student decisions to enter additional study classes.

Hong Kong and Korea

The science OST participation rates in Korea and Hong Kong stand out from the other 20 countries for having small differences in participation rates by ability level. While ability may not be a strong influence on whether students attend OST or not, the student's feelings of efficacy in their science knowledge may be more important. To test whether the participation rates in these two countries are like other countries Figure 3 was created to compare the countries in participation rates for ability level and science efficacy levels. To assure that the student responses in all three country categories, the rates of science OST attendance was restricted to students who were attending OST to improve their school performance. Each line in Figure 3 presents the rate of attending science OST for one ability quadrant. Each quadrant is labeled Abil 1 for lowest ability to Abil 4 for highest. OST participation rates are computed for the 4 ability quadrants of the PISA science efficacy scale (labeled EF1 for lowest efficacy to Ef4 for highest) creating 16 points of measurement for each country.

Differences in the height and slope of the lines represent the level of participation for each level of science efficacy within an ability quadrant. The OST participation rates increase by about the same amount across the science efficacy levels. Students with the lowest level of science ability have the highest participation rates in each country set, but the participation rates within Korea and Hong Kong for the other three ability levels are similar. The rates of attendance for students of high ability levels in the remaining 20 countries (on the right side of the graph) are much lower than for low ability students and the differences by science efficacy levels within ability levels are less pronounced. Thus, the comparison of Korea and Hong Kong to the 20-counry set shows that level of student feelings for science efficacy is more effective than ability level is for altering their tendency to participate in science OST.

Figure 3. Percent of Students Attending Science OST by Science Efficacy (Ef) and Ability (Abil): for Students in Hong Kong, Korea and 20 Countries who Attended to Improve School Performance



The fact that ability conditions how strongly self-efficacy affects OST participation in these two countries provides evidence that self-perceptions of ability is an influential factor in student behavior (compared with influence of teachers, family or friends) that should be considered in all studies of OST participation. It appears that low ability students expect to benefit most from their attendance in OST. Exactly why the effect of student efficacy has an especially strong influence on OST participation in these two countries requires more information about the structure of OST in all countries and a more complete model of family, social, and psychological factors not considered in this exploratory analysis. An improved model of the determinants and effects of attendance in OST programs could be created with evidence from longitudinal measures of changes in achievement and attitudes.

Family Social Status

One factor not yet discussed is the influence of family social status on student attendance in science or mathematics OST programs. Detailed analysis of these relationships is beyond the capacity of this paper to consider fully because of the complexity of measurement of status across cultures and the interactions with other student characteristics. A brief examination of PISA tabulations of participation in science and mathematics OST programs by ability and social status for Korea and Hong Kong suggests that student participation in OST within these two countries are more likely to be conditioned by family status then in other countries. However, the relationship is complex and dependent on the subject matter of the program. For example, in both countries the students of lowest ability are about

equally likely to attend science or mathematics OST within 4 status levels. But at higher levels of ability, students of higher status attend more frequently than those of lower status. In Korea nearly all students attend a program in mathematics OST regardless of ability or status. In Hong Kong, attendance in either mathematics or science OST declines at higher levels of ability; but within ability levels, higher status families are more likely to attend. Thus, cultural patterns among high status families in each country appear to affect student choices differently at different ability and domains of study. The matrix created for this brief analysis are not included in this paper because of size.

This brief exploration of the conditional effect of status on the effect of ability on student participation in two subject areas shows that future international comparative studies of OST participation should consider the multivariate interaction of OST subject area, status levels, ability levels and attitudes. This topic deserves a separate detailed analysis from the brief presentation prepared for this exploratory paper.

Students' Reported Reasons for Attending

The 2015 PISA survey includes a second method of indicating the student reasons for attending OST programs. The self-reported reasons for attending or not were summarized into 4 categories: self-reasons (whether needed to improve performance or not); or were given advice by parents, teachers, or friends). Figures 4 and 5 show the reasons given by students for attending or not attending OST classes in science or mathematics by 4 levels of ability. Whether the student felt a personal need to prepare for regular school topics was the most common reason students gave for attending or not attending science or mathematics OST (labeled "self" in Figures 4 and 5). Students of lowest ability levels were most likely to give self-related reasons for attending or not attending OST in each subject. Students considering science OST were about twice as likely to give self-related reasons for not attending as they were for mathematics within each ability level. indicating that students recognize that the study of mathematics is more important. The finding that the level of reporting self-related school-performance reasons for attending OST is higher among low performing than high performing students in both subjects is consistent with the prediction that attendance in OST is a function of student ability. Students of highest ability are most likely to report that they "do not need" additional study.

Friends, teachers, and parents play a more significant role in decisions to take additional study among lower achieving students than high achieving students. However, in mathematics, positive encouragement was most likely to come from parents than from friends or teachers. The higher levels of reporting influence from friends for students choosing not to participate in science OST, compared with not participating in mathematics OST, is an indication that social factors generally are small but are may plan a slightly higher role among high performing students. Again, evidence from these tables show that ability levels of students alters the reasoning of students for taking OST.

Figure 4. Percent of Students who Attend or do not Attend OST Classes in Science by who Influenced Decision and by Ability Level

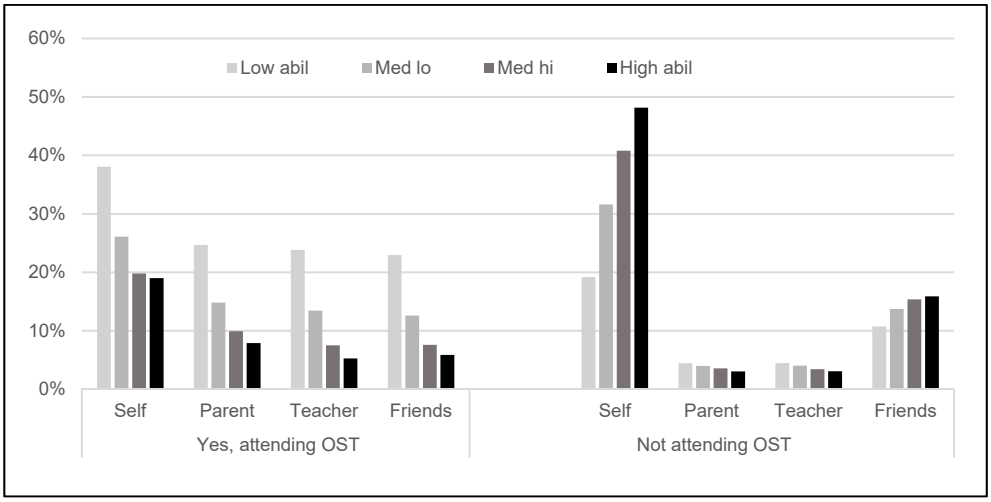
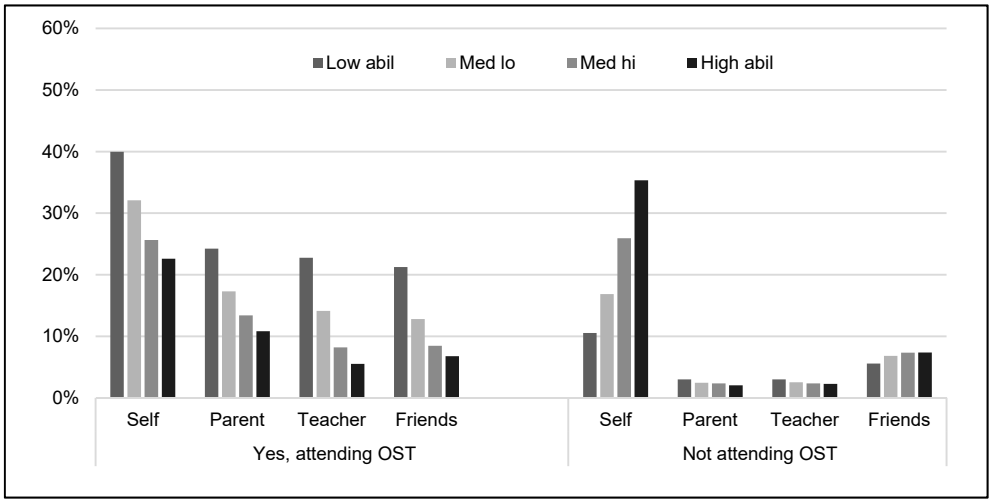


Figure 5. Percent of Students who Attend or do not Attend OST Classes in Mathematics by who Influenced Decision and by Ability Level



Homework and OST

To test whether study time itself is a key determinant in student achievement, a comparison of study time in homework with OST was conducted to observe whether the same student factors influence amount of time use in both types of study. If the need for achievement

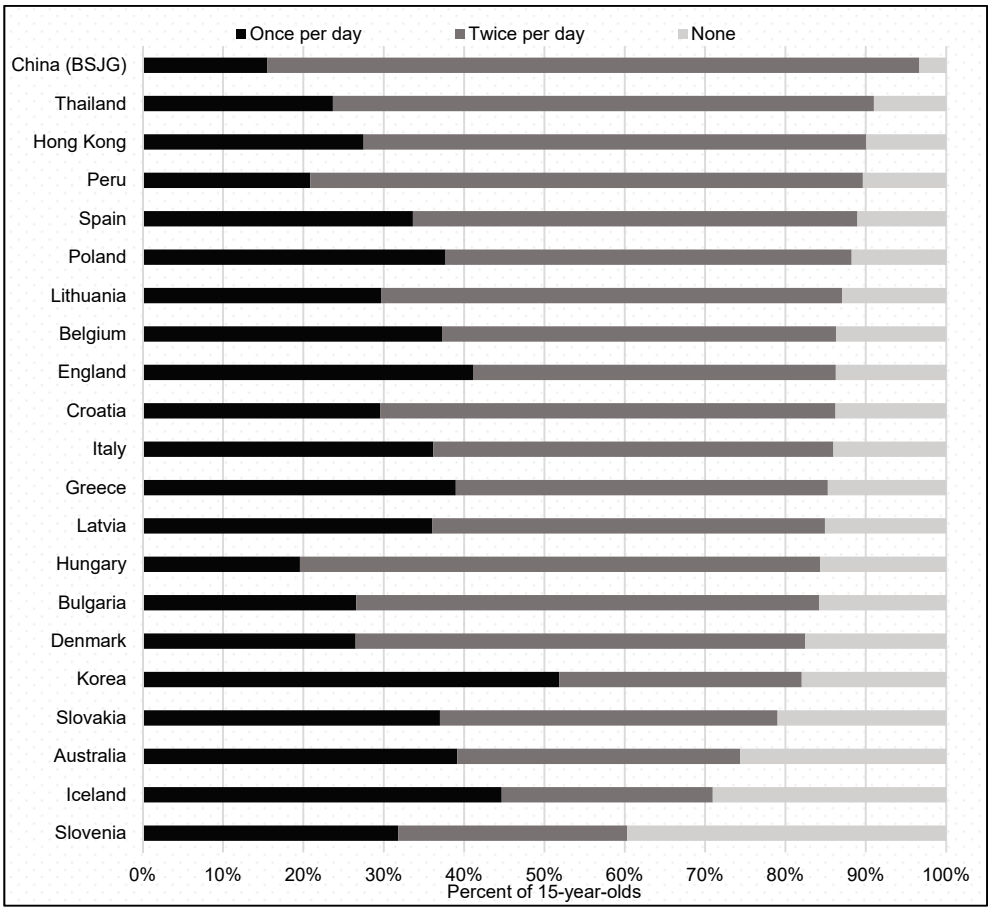
among lower performing students is a significant factor in student's decisions to spend time on OST study, then student time spent on homework should reflect that relationship.

Homework time and attending OST classes both require students to schedule time outside of the regular school day; but with the difference that OST is optional while homework is assigned by teachers and is not voluntary. Unfortunately, the PISA survey does not include a measure for the number of hours of homework conducted weekly. It does include measurement of frequency of homework per day (once a day, twice a day, or not at all). This indicator is sufficient for this investigation as shown by a study of students in Germany. Trautwein has shown that hours of study are less important than the frequency of homework; therefore, the PISA indicator of homework frequency may be the most reliable indicator of the effects of homework (Trautwein, 2007). In every country, conducting homework at least once a day is ubiquitous; 60 to 96 percent of students performed daily homework at least once a day in the 21 countries that reported homework (Figure 6). The highest percentage of students performing no homework daily are Australia, Slovenia, Slovakia and Iceland. Countries with the greatest percentage of students completing homework are China, Thailand, Hong Kong, Spain, Peru and Poland (notice that these do not represent a single region). Korean students were ranked 18th out of 21 and reported the highest proportion conducting their homework only once a day and were among the lowest 3 countries conducting homework twice a day. There is a tendency for the lowest and highest performing countries to be most likely to report conducting homework twice a day (a curvilinear relationship between achievement and homework frequency).

The relationship between ability and frequency of homework forms a pattern somewhat similar to the participation in OST. Countries that rank high or low in achievement have the highest percentage of students reporting homework while countries with average achievement have no particular pattern of homework relationship to achievement. Within each country, students of lower ability are more likely to study their homework twice a day than are students of high ability because students of lower ability students appear to take additional sessions to complete their homework; whereas students of high ability are more likely to finish homework in one sitting.

The frequency of conducting homework is not associated with level of` attendance at OST in science across the 21 participating countries (one country did not report all information). Spearman rank order correlations between frequency of homework to percentage taking OST within 5 ability groupings ranged from -0.12 to a positive 0.20 within 5 ability levels; not statistically significant at the $p<.05$ level. Thus, it cannot be concluded that study time in assigned homework is extended to other forms of study (OST) across countries. These forms of study are independent of each other. The only relationship between ability and study time that is consistent across most countries (with exceptions in Thailand and China) is that low ability students are more likely than high ability students to participate in OST and to conduct homework more frequently than are high ability students

Figure 6. Percent Conducting Homework Each Day for 21 Countries



If study time is effective for the students, their level of feelings of efficacy in a school subject should be higher for those who study most. Figure 7 displays the average level of science efficacy by level of science ability in relation to their amount of homework and attendance at OST programs. As expected, students with highest test scores have higher levels of science-efficacy and low performing students have lower efficacy. Attending OST classes and conducting additional homework somewhat elevate the student's self-confidence as the efficacy averages are slightly higher. Students who frequently do homework have higher science efficacy within the same ability category. Students who attend an OST science class also have higher levels of science efficacy than those who have not attended, even within the same ability level. Low ability students have especially low confidence in their science ability particularly if they did not conduct their homework or were not in an OST program.

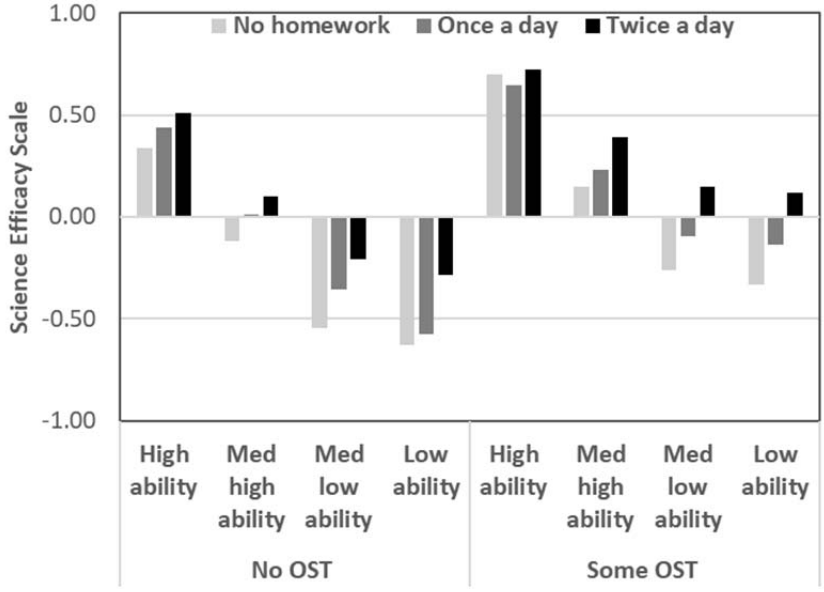
This analysis shows that time conducting study of school subjects outside of the classroom, either as homework or in an OST class, is similarly related to ability and efficacy.

Both forms of study activities are likely to increase self-efficacy in science of students with low ability. The relationships shown in this analysis could be explained by two opposing conjectures: 1) higher amounts of study time (with homework or OST) increase student confidence, or 2) students with low self-efficacy perform greater amounts of study time independent of actual performance. While no test of a causal claim can be derived from the cross-sectional PISA survey on either the effect of study on self-efficacy or on achievement, this analysis has provided evidence and a process to eliminate other competing claims.

Multivariate Analysis

One further test of these relationships was conducted by computing a multi-variate regression analysis of several factors at once within each country: student's family background, hours of OST, ability level in science, and two measures of attitudes (self-efficacy in science and level of instrumental value in science). Although the relationships may not be perfectly represented by a linear model, as shown in previous analysis, identifying the ideal equation in a multivariate set of dimensions is a time-consuming effort of trial and error. The finding from the linear model is that students of high science-efficacy overcome low ability and low social status by attending OST frequently in nearly every country. Self-efficacy in a school subject is higher for students who perform extra homework or attend OST programs that are designed to prepare for schoolwork. The analysis supports earlier conclusions that efficacy appears to be a more significant factor influencing attendance at OST than is ability. The logic of the efficacy scale suggests, but cannot prove, that efficacy may be a product of addition study either of homework or in OST classes, rather than a causal force. But the true reason for the strong relationship between attitudes and ability and choices for study will have to wait for additional information about how students change their attitudes or behavior over a period of time. The clear message from the PISA surveys is that student attitudes toward science are very significantly associated with additional study experiences, either as a determinant or as a result of their participation in afterschool study.

Figure 7. Average Science Efficacy Scale by Ability, Homework Frequency, and Attendance at Science



Discussion and Conclusion

The goal of this paper is to explore a new set of measures of 15-year-old participation in outside-school-time programs to identify the source of a negative relationship between student achievement (or ability) and OST participation. This study relied on the self-reports of 15-year-old students in 22 national level surveys conducted in 2015. The publicly available PISA 2015 survey permitted a thorough analysis of students who attended OST programs or not. The extensive survey information also permitted an analysis of survey results student reported reasons for attending OST, attitudes such as science efficacy, family status levels, science and mathematics ability, homework study, and country differences. This paper examined the statistical relationships between responses to the OST items in combination with multiple student characteristics to identify any potential relationships without making assumptions of linearity. Because non-participants were an important aspect of the analysis, some characteristics of OST participation, such as hours of participation, could not be considered in the same models.

Although the PISA surveys attempted to account for international differences in achievement with measures of additional study time, the survey items have failed to provide new answers about how the highest achieving countries achieved the level they have (Bray, 2014). The expectation that study time is an explanatory variable is understandable and has been supported by many independent conjectures (see a review by Komatsu & Rappleye, 2017). However, the results from repeated OECD surveys have not provided empirical evidence for a causal connection. Student reports of level of feeling of efficacy in

a subject matter were discovered to be strong indicators of how attitudes interact with ability to determine levels of attendance in OST courses. This logic reverses the anticipated causal direction of additional study to achievement frequently assumed and suggests that low achievement is a motivator for attending OST when low ability is associated with feelings of high self-efficacy.

This analysis of the 2015 PISA special items illustrates how complex the forms of additional study are around the world. Simple one-variable analyses do not capture the interactions among social and psychological norms and values. The influence on student choices that mattered the most was whether the student studied for self-improvement. Thus, future international comparative studies of after-school time should continue to ask students who attend or not attend OST to provide reasons for their choices. The relationship of OST participation to self-motivation and desire to attend additional instruction fits with the expectancy-value theory of motivation that a student's choice to take an OST class depends on interactions among of their self-developed goals, the value of the task at hand (utility, costs, and interest), and expectations for success (Wigfield & Cambria, 2010). This analysis has shown that these social-psychological conditions are influenced partially by student's ability. While the full model of expectancy value was not applied to this analysis of OST, the empirical evidence available is consistent with the theory.

Cross-national surveys of student behavior have introduced forms of evidence that appear to go against general beliefs and expectations of the influence of study time. Future surveys of study time should address all possible outcomes of OST such as student well-being and the measurements should identify specific actions might reasonably be expected to influence cognitive processing (Mahoney, Larson, Eccles, & Lord, 2005; Noam & Triggs, 2018; Covay & Carbonaro 2010). The analysis of cross-national differences in student achievement and patterns of attendance in OST has been limited by the insufficient information about the differences in OST programs of each country. More qualitative studies of the forms of additional instruction in various countries could provide a rich source of improved hypotheses about the function and structure of individual country student study practices. A global data base of student organized time for all participating countries is needed to conduct a truly deep analysis of international differences.

Author's Note:

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