Comparison of Students' Math Achievement in Two Nordic Countries: Multi-level Analysis of PISA Results

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Abstract

The present study was aimed to investigate whether Finnish and Danish students' math achievement differed and which student-level factors, if any, explained the achievement gaps and whether teacher participation in decision making and teacher morale, among the school-level factors, explained the achievement gaps in Finland and Denmark. To this end, this study used both student- and school-level datasets of two countries from the Program for International Student Assessment (PISA) 2012 study and employed hierarchical linear models (HLM) – a fully unconditional, a partially unconditional, and a fully conditional model to address the hierarchical structure of research units and importance of predictors of math achievement at each level. Results indicated that Finnish students outperformed Danish peers in math achievement and that between-school homogeneity and gender equity were more salient in Finland than in Denmark. However, the findings of HLM showed that neither teacher participation in decision making nor teacher morale was associated with student math achievement in Finland and Denmark. The findings indicated that neither teacher participation in decision making nor teacher morale translated directly into improved student achievement among Finnish and Danish 15-year-old students, when adjusting for various student and school-level factors. Implications and future studies related to database linking and potential mechanisms, such as school principals' leadership traits and practices, in the relationships between teacher participation in decision making, teacher morale, and student achievement were briefly discussed.

Keywords: teacher participation in decision-making (TPDM), teacher morale, student achievement, PISA test, principals' leadership practices

1. Statement of the Problem

This study began by questioning why adjacent countries repeatedly showed different achievement results in largescale international assessment studies, such as the Program for International Student Assessment (PISA) and the Trends in International Math and Science Study (TIMSS). In this regard, this research focuses on two Nordic countries, Finland and Denmark, and their achievement gaps. Although the two countries have similar cultural backgrounds and welfare systems in addition to their geographic proximity, the PISA studies have consistently placed Finland at the top among the Nordic countries (Denmark, Finland, Iceland, Norway and Sweden) and in the top tier even among all PISA-participating countries. On the other hand, Danish students showed average or below-average performance, despite the interesting fact that Denmark is one of the countries with the highest expenditures on education (7.1% of GDP; OECD, 2004). Researchers have attempted to identify the factors contributing to Finnish students' remarkable academic performance and the lower within- and between-school achievement gaps. According to the research (Bastos, 2017; Sahlberg, 2011), the potential factors included Finland's abolition of school tracking in the mid-1980s, higher social value and prestige attached to the teaching profession, higher levels of teacher autonomy and teacher morale, and better working conditions. In this paper, we primarily

focused on teacher morale and teacher autonomy – teacher participation in decision making in schools to see whether the differences in academic performance between Finland and Denmark could be attributed to these factors.

First, this study explored the achievement gaps between the two countries using the PISA 2012 data. As is widely known, PISA is a system of international assessments that measures 15-year-olds' performance in reading, math, and science literacy every three years (Baldi et al., 2007). Each PISA study is an in-depth assessment administered on one of the three subjects for that assessment year. To enable a more focused discussion, this study chose math literacy as a target outcome measure to reflect the most recent assessment year in which math literacy was the main subject of the study, which was 2012. Therefore, the current study compared and analyzed students' math achievement in the two countries using student- and school-level data collected in the PISA 2012 study. To this end, the objectives of the present study were to investigate (1) whether Finnish and Danish PISA results in math achievement differed in 2012 and which student-level factors, if any, explained the achievement gaps; and (2) whether teacher participation in decision-making and teacher morale, among the school-level factors, explained the achievement gaps between Finland and Denmark.

2. Literature Review

Several previous studies have examined the achievement gaps between Finland and Denmark (Andersen, 2010; Bastos, 2017; Klette, 2003). A qualitative study conducted by Andersen (2010) asserted that the achievement gaps between these two countries were derived mainly from the higher scores obtained by the lowest quartile of Finnish students compared to those of their Danish counterparts (See also Sahlberg, 2011; Sørensen, 2008). On the other hand, Hendrickson (2012) and Kupiainen et al. (2009) claimed that one of the reasons for Finland's outperformance in PISA lay in the absence of high-stakes tests. However, others looked closely into teacher-related factors, such as teacher participation in decision making regarding school curriculum and planning development or teacher morale, which could be affected by teachers' working conditions and school principals' or administrators' leadership traits and practices (Smylie et al., 1996; Taylor, & Bogotch, 1994). Except for a few studies, there is little literature examining the achievement gaps among the Nordic countries. This study explored and analyzed the factors that could be attributed to the achievement gaps in between Finland and Denmark, focusing in particular on teacher participation in decision making and teacher morale.

2.1 Teacher Participation in Decision Making

Definition. Teacher participation in decision making (hereinafter referred to as "TPDM") refers to whether teachers are involved in making decisions in schools, whether they be in school curriculum and instruction, school planning or management, school mission, or staff development. Teacher participation in decision making is also known as shared decision making (Taylor & Bogotch, 1994) or participative decision making (PDM) (McGregor, 1960).

Teacher participation in decision making and student achievement. Researchers have examined the relationship between TPDM and student achievement. However, the findings were mixed (e.g., Ramey, & Dornseif, 1994; Smylie et al., 1996 for a positive relationship but Black, 2001; Crockenberg, & Clark, 1979; Jones, 1997; Miller, & Rowan, 2006; Taylor, & Bogotch, 1994 for no evidence of any relationship).

Significant findings. By using data from a metropolitan K-8 school district in the midwestern US, Smylie et al. (1996). examined the link between TPDM and instructional outcomes in a five-year longitudinal study (1990-1994), while also investigating the mediating roles played by teacher autonomy and professional development. Regarding TPDM, the authors consulted previous studies of the social organization of schools and teacher work redesign (Glidewell et al., 1983; Rosenholtz, 1989; Smylie, 1992). The authors drew upon a conceptual model, in which TPDM would lead to a change in the mechanisms of control, motivation, and learning. They hypothesized that such a change in these mechanisms would give rise to improved instruction, which would in turn lead to increased student outcomes. The authors found that TPDM in schools was positively associated with instructional and academic outcomes. The authors also found that accountability and professional development opportunities served as important mechanisms in the relationships. Nevertheless, they warned that poorly implemented TPDM in schools could prevent students from benefitting from class instruction and activities. In a similar vein, Ramey and Dornseif (1994) investigated the effect of shared decision making on student achievement outcomes in 30 schools at the Seattle School District as part of the Schools for the 21st Century Consortium. They developed a 14-item shared decision-making questionnaire, which was given to 19 elementary school teachers in 1992 and 13 teachers in 1993. The authors found that shared TPDM had a positive effect on student achievement outcomes and led to a reduction of the ethnic gap in student achievement.

Non-significant findings. On the other hand, Jones (1997) used 400 teachers from 36 urban elementary schools in Texas, in which more than half of the students were minorities or of low socio-economic status (SES), to examine the relationships among teachers' perceived participation in decision making (also known as teacher participation in site-based management [SBM]), staff morale, and student achievement. The author used Ferrara (1992)'s Teacher Decision-making Instrument (TDI) to measure ten areas of school functioning. The author found that higher TPDM was associated with increased staff morale but not with student achievement. By using 637 teacher survey participants from 33 schools in a restructuring school district, Taylor and Bogotch (1994) examined whether TPDM was significantly related to school outcomes such as student achievement, student behavior, and student attendance. The authors used Bacharach et al. (1986)'s Teacher Involvement on 19 Decision Items, from which they could extract four factors, including relevant technology, management, teaching materials, and core technology. They used Alutto and Belasco (1972)'s discrepancy scores derived from the differences between desired participation and actual participation. Results indicated that TPDM was not significantly related to any of the student outcomes. In this regard, the authors claimed that restructuring models based on increased TPDM in schools should be reconsidered and re-evaluated. Similarly, Miller and Rowan (2006), drawing upon contingency theory, examined the relationship between organizational management and student achievement among primary and secondary school students using the Prospect data and the National Educational Longitudinal Study of 1988 (NELS: 88). The authors used three measures representing organizational management, one of whose subscales was teachers' control over main instructional decisions. Their findings indicated that teachers' control over main instructional decisions was not associated with student academic performance.

All in all, the idea behind TPDM in schools was that with teachers actively engaged in making decisions on school planning, management, curriculum, and instruction, their teaching and student learning would benefit from their active TPDM. However, the research findings on TPDM and its relation to student achievement were divided, although slightly more research leaned towards there being no evidence of the relationship between TPDM and student achievement.

The following paragraphs discuss teacher morale in terms of how it is defined, what it consists of, and whether it was associated with student achievement.

2.2 Teacher Morale

Definition and contributing factors. Teacher morale refers to teachers' having pride in, feeling enthusiasm for, and finding value in their work and student learning. Researchers attempted to identify factors that could either increase or decrease teacher morale (Covington, 2010; Gadson, 2018; Howard, 2012; Romero-Lehrer, 2018; Sherwood, 2013; Willis & Varner, 2010). Some of the factors included teachers' school climate, administrative support, school belonging, accountability issues, workload, student discipline, relationships with school staff, common core curriculum, shared or distributed leadership, and decision-making procedures, to name a few.

Components of teacher morale. Cook (1979) identified five core elements of teacher morale: administrative leadership, administrative concern, personal interaction, opportunity for input, and professional growth. Bentley and Rempel (1970) considered teacher morale as something closely related to the professionalism and enthusiasm teachers demonstrate related to their job. Mackenzie (2007) asserted that teacher morale was composed of the combination of personal, school, and professional morale.

Teacher morale and student achievement. Researchers have also examined the relationship between teacher morale and student achievement (Abazaoglu & Aztekin, 2016; Black, 2001; Cook, 1979; Cook, 1989; Covington, 2010; Hopkins, 1980; Raines Evers, 2011; Sabin, 2015; Sheppard et al., 2010; Stevens & White, 1987; Vernadine, 1997; White & Stevens, 1986; Willis & Varner, 2010). While addressing the relationship between teacher morale and student achievement, Black (2001) underlined the importance of principals' roles in creating a favorable school climate and culture. The author claimed that low teacher morale would lead to indifferent and unhealthy attitudes toward students and their learning, which would eventually trickle down to worsened student academic performance. The author concluded her article by addressing the fact that that teacher morale tended to be higher at schools with more open, flexible, and harmonious atmospheres than at inflexible and rigidly administered schools.

Significant findings. Some researchers found a significant and positive relationship between teacher morale and student achievement (Abazaoglu & Aztekin, 2016; Crane & Green, 2013; Houchard, 2005; Howard, 2012; Miller, 1981; Romero-Lehrer, 2018; Tanriogen & Ermec, 2008; White & Stevens, 1986). Miller (1981) found a positive relationship between teacher morale and student achievement mediated through student attitude and learning. Namely, teacher morale was positively associated with student attitude and learning, which in turn led to improved student achievement. By using the PISA 2012 and TIMSS 2011 data, Abazaoglu and Aztekin (2016) investigated the

relationship between science and math teachers' motivation/morale and the academic achievement of students from Singapore, Japan, Finland, and Turkey. The authors found that teachers' motivation/morale was associated with increased student academic achievement as a whole, but the relationship was stronger in Turkey and Singapore than in Finland and Japan. They also found that the principals from the high-performing countries, Finland, Singapore, and Japan, reported higher levels of teacher motivation/morale when compared to Turkey. The authors also investigated research that examined the same relationship mediated through increased student motivation. White and Stevens (1986) used 804 teachers in grades two to eight to examine whether teacher morale was related to student achievement. They employed the Survey of Teacher Attitudes (White & Stanley, 1987) for teacher morale. The factor analysis of teacher morale resulted in five components: Classroom evaluation systems, teaching and learning, beyond the essential elements, salary and reward system for teaching, and motivation of teachers and students. The authors found that those five factors of teacher morale were associated with increased student achievement. Meanwhile, while pointing out the factors that could be attributed to a decline in teacher morale, such as abrupt changes in leadership, newly implemented curriculum, and increased enrollment, Romero-Lehrer (2018) identified a mediating role that could be played by teacher morale in the relationship between school leadership and student achievement. In other words, low teacher morale created an unfavorable school climate and a culture that prevented optimal teaching and student learning from taking place. While investigating the primary role of school leadership practices in teacher morale and student achievement, Houchard (2005) examined whether there were differences in teacher morale between high- and low-performing schools, each with 30 teachers, in Georgia, based on adequate yearly progress (AYP). The author used eight items for teacher morale which were student (mis)behavior, teacher workload, support from parents, teacher leadership, stress and burnout, administrative support, school climate, and teacher salary/benefits. The author found that teacher morale was higher at high-performing schools than at low-performing counterparts.

Non-significant findings. On the other hand, other researchers found that teacher morale was not associated with student achievement (Cook, 1989; Covington, 2010; Hopkins, 1980; Hughes, 2013; Raines Evers, 2011; Sabin, 2015; Stevens & White, 1987). By employing the data from a Fulton County middle school in Georgia, Covington (2010) examined whether teacher morale was related to student achievement. The author used the Employee Morale Quiz (Roche, 2001) for teacher morale and the Georgia Criterion Competency Test (CRCT) for student achievement, and found that teacher morale was not related to student achievement. Meanwhile, Cook (1989) focused on the relationships among school climate, teacher morale, and student achievement by studying 58 South Carolina schools with randomly selected fourth and fifth graders. The author used the Purdue Teacher Opinionnaire (PTO: Bentley & Rempel, 1970) for teacher morale and the Organizational Climate Description Questionnaire for school climate (open vs. closed), and found no relationship between school climate and student achievement, or between teacher morale and student achievement. Hopkins (1980) used the survey data of teachers and administrators from 54 urban, minority, low SES primary schools in a Houston school district to examine whether school characteristics consisting of administrator behavior (measured by the Leader Behavior Description Questionnaire [LBDQ: Halpin, 1957]) and teacher morale (measured by the PTO) as well as teacher absenteeism and teacher turnover predicted school success, in terms of student achievement gain. Based on student achievement gain, the author classified the schools into more successful (N = 22) and less successful schools (N = 32). The author found that there were no differences in administrative behaviors, teacher morale, or teacher turnover between the more successful schools and the less successful schools, although there were higher frequencies of teacher absenteeism in the less successful schools than in the more successful schools. Stevens and White (1987) surveyed 191 teachers from 15 school districts to examine the relationships among locus of control, teacher morale, and student achievement. For teacher morale, the authors used the Survey of Teacher Morale (White & Stevens, 1986), from which three factors were identified via factor analysis: evaluation, potency-activity, and activity factors. Their findings indicated that locus of control and teacher morale measured by the three factors (evaluation, potency-activity, and activity) were not significantly related to student achievement. Sabin (2015) used the NC Teacher Working Conditions Survey (Hirsch & Emerick, 2007) data of fourth and fifth grade teachers in three schools with low SES in North Carolina to examine the relationships among teacher morale, student engagement, and student achievement growth. On the whole, the author could not find significant relationships among them. Raines Evers (2011) used the data from primary schools in Mississippi to examine the relationships among principals' leadership traits, teacher morale, and student academic performance. To measure teacher morale, the author used two subscales from the PTO, which were rapport with principals and job satisfaction. Results indicated that principals' leadership traits and teacher morale were not associated with student academic performance, although principals' leadership traits were positively associated with teacher morale. Hughes (2013) randomly selected six high-performing and six low-performing elementary schools in South Carolina to examine the relationship among school leadership practices, teacher morale, and student achievement. Utilizing the

ten PTO items for teacher morale, the author found that teacher morale was higher at low-performing schools than at high-performing ones, which was somewhat counter-intuitive.

To sum up, the logic behind the assumption of a positive relationship between teacher morale and student achievement was that teachers' higher enthusiasm, pride and satisfaction would positively lead to better classroom instruction and student learning. However, the findings in this regard have historically been mixed. What was notable in several studies was the examination of the role that school principals' leadership traits or practices played in the relationship between teacher morale and student outcomes.

Given what has been discussed in the literature, the present study aimed to address the following research questions:

1) Are there differences in math achievement between Finnish and Danish students in PISA 2012? If so, which student-level factors, if any, explain the achievement gaps between Finland and Denmark?

2) Do teacher participation in decision-making and teacher morale, among the school-level factors, explain the achievement gaps in Finland and Denmark?

3. Methods

3.1 Research Design and Data Analysis Procedure

The research design of this study considers the hierarchical structure of research units (i.e., students nested within schools). Hence, we take a multi-level approach to address the charaterisitics of data structure.

This study is based on secondary data analysis. That is, this study used the datasets of the two Nordic education systems from the PISA 2012 study that was administered and curated by OECD, which are open sources (i.e., no permission needed for download). Once the datasets were obtained, we set up three types of hierarchical linear models: a fully unconditional, a partially unconditional, and a fully conditional model. In line with the literature review, the relevant measures were subsequently included in the models.

3.2 Participants and Data

This study used both student- and school-level datasets and their variables. The final number of participants used in this study at each level was 4,809 students and 240 schools for Denmark and 6,682 students and 250 schools for Finland. Table 1 shows descriptive statistics of variables at each level and education system. Our main focus was placed upon the math literacy results from the PISA 2012 survey since math was the focus subject in 2012, with reading, science, and problem-solving as minor subjects of assessment (OECD, 2014a).

Table 1. Descriptive Statistics of Student- and School-level Variables for Denmark and Finland

Level	Variable	Country			
		Denmark (N=4809)* (n=240)**		Finland (N=6682)* (n=250)**	
		Mean	SD	Mean	SD
Student level	Female	.50	.50	.51	.50
	ESCS	.29	.90	.36	.82
	Family structure	.83	.38	.83	.38
	PV1Math (outcome)	492.19	83.22	514.24	86.11
School level	Sector	.21	.40	.06	.25
	% qualified math teachers	70.48	27.94	56.81	31.08
	Afterschool	.41	.49	.60	.49
	Size	466.09	247.65	424.38	191.00
	Ratio	37.30	16.44	89.18	58.51
	Participation	.07	1.02	.19	.89
	Morale	.31	.95	.38	.81
	Aggregated PV1Math (outcome)	488.54	42.36	516.24	36.55

* Number of students

** Number of schools

3.3 Measures

One of the plausible values of math scores (PV1Math) was used as an outcome variable. Originally, there were five plausible values in the data, which indicated math literacy for each participant. The values were produced by different multi-dimensional scaling models. Without loss of generality, this study simply chose the first plausible value.

As the student-level predictors, this study used students' gender; economic, social and, cultural status (ESCS); and family structure. Gender was dummy coded, 1 for female and 0 for male. The components of ESCS are comprised of home possessions, including books in the home; the highest parental occupation; and the highest parental education expressed as years of schooling. A zero value of the ESCS indicates the score of an average OECD student. If a student's ESCS score is unity, then his/her economic, social, and cultural status is assumed to be one standard deviation above across all participants from equally weighted OECD countries (OECD, 2014b). The variable of family structure was dichotomized, whether a student is living in a two-parent family or not (in a single-parent family or not living with any of their parents).

School-level covariates used in this study included the following: Sector (either private or public), % qualified math teachers (the proportion of qualified math teachers who majored in math to the total number of full-time and part-time teachers in a school), Afterschool (an indicator of whether a school offers math courses after the regular daily lessons), Size (measured by the total number of enrollments in a school), Ratio (student/math teacher ratio), Participation (a scale score of the items involving teacher participation in decision making at school that is intended to gauge school autonomy), and Morale (a composite score of the items regarding teacher morale and commitment).

For Participation, school principals were asked to answer twelve items seemingly representing the magnitude of teachers' involvement in decision making. They were as follows: 1) hiring teachers; 2) dismissing teachers; 3) setting up teachers' starting pay; 4) deciding teachers' salary raises; 5) setting up school budgets; 6) deciding how school budgets should be allocated; 7) setting up the policies related to student disciplines; 8) setting up student assessment policies; 9) making decisions on student admissions; 10) determining what textbooks should be used; 11) setting up course content; and 12) determining course offerings. For these items, if a school principal indicated that teachers have substantial responsibility for each school task, the item was coded as 1, otherwise 0. The internal consistency for this index was .85 for Denmark and .73 for Finland (OECD, 2014b). Morale was based on the ratings of school principals asked four questions with a 4-point Likert scale (1 as "Strongly agree", 2 as "Agree", 3 as "Disagree", and 4 as "Strongly disagree"). The items used included: 1) The morale of teachers in this school is high; 2) Teachers work with enthusiasm; 3) Teachers take pride in this school; and 4) Teachers value academic achievement. The internal consistency for Morale was .73 and .69 for Denmark and Finland, respectively (OECD, 2014b). All items were reverse-coded so that higher values represented higher levels of teacher morale and commitment.

3.4 Analytic Models

The ordinary least square (OLS) methods using the aggregates of variables at a higher-level overestimate statistical significance of each variable due to underestimation of the corresponding standard error. Hierarchical linear models (HLM) increase statistical accuracy of estimates by taking into account weights of residual variances at each level via the number of samples within groups (Raudenbush & Bryk, 2002). For this reason, this study applied multi-level regression models to the PISA 2012 data. Also, the HLM software (version 6.0.8: Raudenbush, Bryk, & Congdon, 2009) was used for data analysis and the two weight variables (W_FSTUWT and W_FSCHWT), which represent sampling weight for the level-1 unit (student) and the level-2 unit (school), were used throughout the analysis. This study ran a fully unconditional model (One-way random effects ANOVA model), a partially conditional model (Random coefficients model) and a fully conditional model (Intercepts and slopes as outcomes model), in turn. Below are the model equations at each level, which identically apply to both countries.

Level-1 (Student-level)

$$Y_{ij} = \beta_{0j} + \sum_{k=1}^{3} \beta_{kj} Z_{kij} + r_{ij} \quad (1)$$

where Y_{ij} is math literacy of student i in school j, Z_{kij} denotes the respective student-level predictor (k=1, 2, 3; Gender, ESCS, and Family structure). r_{ij} is assumed to capture student-level variability around the school average after the demographic adjustments and to be normally distributed with a mean of 0 and variance of σ^2. Note that all the student demographic characteristics variables are group-centered such that β_{0j} is meant to be an average math literacy across all students in school j regardless of their gender, ESCS, and family background.

Level-2 (School-level)

$$\beta_{0j} = \gamma_{00} + \sum_{l=1}^{7} \gamma_{0l} W_{lj} + u_{0j} \quad (2)$$

$$\beta_{kj} = \gamma_{k0} + u_{kj} \; (k = 1, 2, 3) \quad (3)$$

where W_{lj} represents school characteristics variables (l=1, 2, …, 7; Sector, % qualified math teachers, Afterschool, Size, Ratio, Participation, and Morale). u_{0j} is assumed to vary across schools around the grand mean (γ_{00}) after holding constant the school-level covariates and to follow normal distribution (i.e., $u_{0j} \sim$ NID (0, τ_{00})). Likewise, u_{kj}'s (k=1, 2, 3) are assumed to be normally distributed with means of 0 and variances of τ_{kk} (k=1, 2, 3). However, this level-2 model incorporates school characteristics variables only into the intercept equation (i.e., for β_{0j}). This is not only because of the model simplicity but also because of the insignificant variability of all the level-1 slopes. Through running the partially conditional model, we found that the slopes for Gender, ESCS, and Family structure (i.e., for β_{1j}, β_{2j}, and β_{3j}) did not vary significantly across schools in the respective countries. Here at the level-2 model, each of the seven school characteristics variables was centered around its grand mean.

4. Results and Discussion

While students in both countries share common background characteristics (i.e., Gender, ESCS, and Family structure), their math achievement differed: Danish students performed lower than their Finnish counterparts, on average (Table 1). Further, the results of multilevel analyses revealed that Finnish schools were more homogeneous than Danish schools. The intra-class correlation coefficients (ICC) for both countries were .178 for Denmark and .062 for Finland. Therefore, about 17.8 and 6.2 percent of the total variation in student math achievement arises from between-school variation in Denmark and in Finland, respectively. Although there were significant random effects within and between schools, the explanatory power of both level-1 and level-2 predictors was low (about 12-14% in Denmark and 5-8% in Finland). For the fixed effects, the student background factors were significant (with the exception of family structure). Male students performed better in Denmark, but there were no gender differences in math achievement in Finland. Student ESCS was a strong indicator both in Denmark and in Finland. In contrast, the patterns of school effects were less consistent than those of student-level background characteristics. In Denmark, school sector and size were significantly related to students' overall math literacy, meaning that the students enrolled in private and larger schools in Denmark had higher math literacy. Except for the Afterschool variable (having math lessons after the regular class hours), there were no school factors explaining student achievement in Finland.

The findings of this study indicate that Finnish students outperformed their Danish peers in math achievement, and that between-school homogeneity and gender equity were more salient in Finland than in Denmark, and the current findings are partially consistent with previous findings (e.g., Bastos, 2017, p. 807 for between-school homogeneity). The possible reasons for between-school homogeneity in terms of math achievement may be attributed to Finland's abolition of tracking in the mid-1980s, along with the absence of high-stakes tests (Bastos, 2017; Hendrickson, 2012; Kupiainen, Hautamaki, & Karjalainen, 2009). Based on the results of descriptive statistics, despite having common cultures and geographic proximity, teacher morale and teacher participation in decision making in Finland and Denmark turned out to be different. Finnish teachers showed higher teacher morale and teacher participation in decision making (e.g., Abazaoglu & Aztekin, 2016) than their Danish counterparts. Teachers in Finland have been well-known for their occupational pride and autonomy.

However, the findings of an adjusted multilevel analysis showed that neither TPDM nor teacher morale were associated with student math achievement in Finland and Denmark, which was also evidenced in previous findings (e.g., Jones, 1997; Miller & Rowan, 2006; Taylor & Bogotch, 1994 for TPDM and Covington, 2010; Hughes, 2013; Raines Evers, 2011 for teacher morale). The findings indicated that neither TPDM nor teacher morale translated directly into improved student achievement among Finnish and Danish 15-year-old students, when adjusting for various student- and school-level factors. Albeit exhibiting similarly non-significant findings, other studies (e.g., Jones, 1997; Taylor & Bogotch, 1994) differed from the current study in that they used somewhat different domains of TPDM that focused mainly on teacher participation either in site-based management in urban elementary schools (Jones, 1997) or in technology embedded instructions (Taylor & Bogotch, 1994).

Table 2. HLM Results

	Denmark	Finland
Fixed Effects		
Level 1 Model		
(Student)		
Female	-18.86***	-1.71
	(2.63)	(2.73)
ESCS	29.82***	24.57***
	(2.04)	(1.78)
Family	8.21	7.70
Structure	(4.95)	(4.01)
Level 2 Model		
(School)		
Sector	49.61***	15.07
	(12.66)	(9.46)
% qualified math teachers	.03	-.06
	(.20)	(.07)
Afterschool	.37	-8.19*
	(12.92)	(3.96)
Size	.09***	.02
	(.02)	(.01)
Ratio	.05	-.02
	(.28)	(.04)
Participation	-3.48	.06
	(4.81)	(1.94)
Morale	-9.04	.80
	(8.67)	(2.28)
Random effects		
Within-school (level-1) variance	4787.13***	5695.17***
% Variance explained by level-1 model	13.00	7.27
Between-school (level-2) variance	1162.41***	410.49***
% Variance explained by level-2 model	12.52	4.61

Note. * $p < .05$; ** $p < .01$; *** $p < .001$

Concerning the low explanatory power, more variables both at the student and school levels germane to math achievement and school leadership traits, such as hours spent doing homework and school leadership practices, should be added into the models. The Danish findings favoring private and larger schools in terms of math achievement stand in contrast to the Finnish findings showing school sector and enrollment having no relationship to math achievement and the previous findings showing an inverse relationship between school size and student achievement (Cleary & English, 2005). Interestingly, having math lessons after the regular class hours in schools was associated with decreased math achievement in Finland. Such an inverse relationship may be due to the fact that those studying after school were taking math lessons as part of remedial programs.

5. Implications and Future Studies

As shown in the findings, the Finnish principals reported higher teacher participation in decision making and teacher morale than did their Danish counterparts. Such findings could be easily deduced from the fact that teachers were given higher social status, value, prestige, and better working conditions in Finland than in Denmark. However, these two focal variables did not serve as functions of student achievement in further analysis. It is likely that there are other mechanisms that need to be further studied such as examining the school restructuring model in its entirety by including school principals' leadership practices in addition to teacher participation in decision making and teacher morale. Teacher participation in decision making is closely related to school principals' leadership traits and practices, whereas teacher morale is a socio-psychological phenomenon (Betts, 2001) that can be improved, particularly through school principals' well-oriented leadership practices. As other researchers have indicated (Gadson, 2018; Xiaofu & Qiwen, 2007), as ways to improve teacher morale and school outcomes, schools or school principals should make teachers feel valued, that they can participate in decision making procedures in school, and that they have a voice. However, this information should be applied cautiously, since teacher participation in decision making and teacher morale were principal-reported, not teacher-reported, and as such there may be some discrepancies between how principals and teachers perceived decision making and morale.

This study attempted to identify student- and school-level factors that could explain how student math achievement varied within and across schools. For future research, national-level factors should be considered when it comes to explaining the achievement gaps between Finland and Denmark. Potential reasons for such gaps should be explored in future research. This can be done, for example, by linking the OECD Teaching and Learning International Survey (TALIS) to PISA datasets by using school ID, as illustrated by Kaplan and McCarthy (2013), since TALIS datasets encompass considerably useful variables that can be used for teacher characteristics. Meanwhile, school principal leadership practices have gained importance when it comes to teacher morale, teacher participation in decision making, and student outcomes. Research indicated that the leadership styles of principals measured by principal trust and leadership satisfaction were positively associated with teacher morale and student achievement, which would also lead to a decrease in student discipline referrals (Hindt, 2012). Thus, future studies should also examine the roles of school principals to see whether their strong school leadership could create a school climate and culture that would promote teacher motivation/morale (Huysman, 2008; Mackenzie, 2007) and teacher participation in decision making at schools (Black, 2001; Vernadine, 1997). To this end, Willis and Varner (2010)'s recommendations for improving school culture are noteworthy: Curtailing teacher workload, allowing teachers to set time aside for preparation, providing administrative support, showing recognition for teachers, and providing promotion opportunities for teachers. Meanwhile, further research is guaranteed, in that other subjects such as reading and science, in addition to or separately from math, could be used as outcomes to examine whether the findings of this study would hold.

6. Conclusion

In conclusion, Finnish students performed better than Danish peers in math achievement. Male students outperformed female counterparts among Danish students, whereas no discernible gender differences in math achievement were found among Finnish students. However, student ESCS was equally important for math achievement in both education systems. Among the school factors, TPDM and teacher morale did not play a decisive role in student math achievement among Finnish and Danish students at least from the PISA 2012 data, albeit there were differences in math achievement between these two education systems. Henceforth, other factors or mechanisms (particularly malleable ones at teacher or school levels, such as school leadership practices and climate, or principals' attitudes toward TPDM and teacher morale) attributable to the differences in math achievement between Finland and Denmark need to be further identified. Likewise, further research should be done to see whether similar findings are to be ascertained in other subjects and from other data sources.

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