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Abstract

Data from a large study (PISA, 2015) involving more than 132,000 children and 22,000 of their teachers, in 16 nations, were used to investigate how teachers convey self-efficacy to students when they teach and whether this is culturally grounded. Using a multilevel data analysis framework, we aimed to: (1) test a path linking teacher and student self-efficacy; (2) examine teaching practices as mediators of the links between teachers and student self-efficacy; (3) evaluate the moderating roles of cultural values on those links. Results indicated that teacher and student self-efficacy were linked indirectly through the use of teaching practices, more strongly through inquiry-based practices. We found cross-cultural differences on the associations between student-perceived teaching practices and student self-efficacy that were moderated by two country-level cultural values: individualism and uncertainty avoidance. This study highlights that, although academic self-efficacy is considered universal, we found cultural differences in its sources and manifestations.

Keywords student and teacher self-efficacy; teaching practices; cultural values; multilevel modeling; PISA

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Research Data Related to this Submission

There are no linked research data sets for this submission. The following reason is given:
The PISA datasets are publicly available at : <http://www.oecd.org/pisa/data/2015database/>

HIGHLIGHTS:

- We examine the link between teacher and student self-efficacy across 16 nations
- The relationship between teacher and student self-efficacy is fully mediated by teaching practices
- Cultural values moderate the role of teaching practices on self-efficacy between nations
- These results broaden our understanding of self-efficacy in a culturally-relevant manner

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Running Head: CULTURAL VALUES AND SELF-EFFICACY

The role of cultural values in teacher and student self-efficacy:

Evidence from 16 nations

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The role of cultural values in teacher and student self-efficacy:

Evidence from 16 nations

1. Introduction

Being persuaded of one's own capacity to succeed is a central determinant of human behavior in a diversity of life domains, including in teaching and learning. Research has shown that student self-efficacy (SE) is central to students' and teachers' school-related outcomes and well-being (Bandura, 1997; Fackler & Malmberg, 2016; Multon et al., 1991; Richardson, Abraham, & Bond, 2012; Vieluf, Kunter, & van de Vijver, 2013). In line with socio-cognitive theory, SE is defined as the belief in one's capabilities to achieve a desired goal or outcome (Bandura, 1997). High levels of student SE have been linked with quality motivation, more adaptive learning goals, in depth learning, and ultimately better school performance and decreased dropout rates (Alivernini & Lucidi, 2011; Mills, Pajares, & Herron, 2007). Current SE-based theories and empirical investigations are built on the assumption that self-efficacy has determinants and processes that are generalizable between nations (Chiu & Klassen, 2010; Lee, 2009). However, theoretical research has questioned this assumption, especially with regards to the culturally-specific roles of the environment, such as the roles of teachers and cultural values, in shaping student SE (Oettingen, 1995; Oettingen & Zosuls, 2006), with few studies having empirically challenged this belief (Fackler & Malmberg, 2016). Investigating cross-cultural differences of the role of the environment in fostering student SE has the potential to generate context-specific knowledge on how SE operates, that would be culturally relevant.

The present study aims to provide a large-scale cross-cultural understanding of the links between teacher SE, teaching practices and student SE in light of cultural values held by 16 different nations. To achieve this aim, we used data from Assessment and Analytical Framework

Program for International Students Assessment 2015 (PISA 2015; OECD, 2016a) that include responses from more than 135,000 students and 23,000 teachers, across 16 nations. Judgments of SE stem from a variety of sources, particularly previous performance outcomes, social comparison with peers, verbal persuasion provided by credible judges, and the physiological state experienced when confronted by a task (Bandura, 1997). According to Wood and Bandura (1989), an ability is only as good as its execution. When a person possesses the requisite skills for a task, having a belief of high SE will promote improved utilization of existing cognitive resources. Teachers' effectiveness is an important factor driving differences in fostering student SE (Ashton & Webb, 1986; Schunk & Pajares, 2002). Self-perceived teachers' effectiveness also plays a critical role in the effectiveness of teachers' teaching practices (Holzberger, Philipp, & Kunter, 2013), and student outcomes (Richardson et al., 2012). This finding suggests focusing on teacher SE (i.e. teacher self-perceived effectiveness) as a means to understand student SE. Furthermore, research suggests to contextualize the links between teacher and student SE in light of the culturally-relevant values held in different nations (Oettingen, 1995).

1.1. The Importance of Student Self-Efficacy

Research into the functional role of student SE in academic outcomes has given rise to a vast number of studies (Lee, Lee, & Bong, 2014; Robbins et al., 2004; Schunk & Pajares, 2002). Students with a positive sense of SE put forth a high degree of effort and self-regulation in order to meet their objectives (Jackson, 2002), attribute failure to causes that are under their control rather than blame external factors (Hsieh & Schallert, 2008), and recover quickly from setbacks (Margolis & McCabe, 2006). Students with low SE may consider challenging tasks as threats to be avoided and have low aspirations, which may result in disappointing academic performances that in turn becomes part of a self-fulfilling negative feedback cycle. Bouffard and Couture

(2003) have shown that, irrespective of their assignment to a regular, accelerated or delayed school track, the SE of students was similarly related to their achievement goals. Furthermore, a longitudinal study has found that pupils who have more positive academic self-concepts (a construct related to academic SE, in the present case, linked with more or less positive self-evaluation of one's academic success, Bong & Skaalvik, 2003) in primary school showed higher persistence and achievement in college, regardless of their cognitive ability (Bonneville-Roussy, Bouffard, & Vezeau, 2017).

1.2. The Importance of Teacher Self-Efficacy

According to Tschannen-Moran and Hoy (2001), “A teacher's efficacy belief is a judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated” (p. 783). Thus, teacher SE is rooted in their perceived ability to affect students' learning. Klassen and Tze (2014) conducted a meta-analysis of teaching effectiveness and concluded that teacher SE was very strongly related to teaching skills.

Teacher SE has been associated with instructional quality and student support (Holzberger et al., 2013). Hoy and Spero (2005) have asserted that highly efficacious teachers tend to better meet the needs of their students, to persist longer when things do not go smoothly, and to be more resilient and able to rebound from setbacks. Conversely, teachers with low SE tend to rely more heavily on a controlling teaching style, are more critical of students and are reluctant to experiment with new tools or methods. Those assertions have been validated in several empirical studies (Holzberger et al., 2013; Martin & Marsh, 2006). With regard to students' outcomes, teacher SE has been linked with student achievement (Caprara, Barbaranelli,

Steca, & Malone, 2006; Skaalvik & Skaalvik, 2007), higher motivation (Mojavezi & Tamiz, 2012) and positive changes in students' self-perceptions of ability (Ross, 1998).

1.3. Teaching Practices as Mediators of the Links Between Teacher and Student Self-Efficacy

Research on the direct links between teacher and student self-efficacy is scarce (Anderson, Greene, & Loewen, 1988; Tschannen-Moran & Hoy, 2001), and it is believed that teaching SE is indirectly associated with student SE through a variety of teaching behaviors. The type and quality of teachers' instruction is likely an important mechanism through which teacher SE has an indirect effect on student outcomes (Guo, Connor, Yang, Roehrig, & Morrison, 2012). Teacher-led (TL) teaching practices is an approach to teaching where the teacher leads the activity and students focus on the teacher (Brown, 2003). This involves direct instruction, lectures, repetitive practice of basic skills, and constructive feedback. The teacher acts as the provider of information and the students as listeners. Emphasis is put on mastering content and basic skills primarily through lecture and repetition, and uses of rewards or praises to reinforce desirable behaviors and achievement.

In comparison, inquiry-based (IB) teaching practices are built on constructivist learning theories that emphasize the active role of the subjects when exploring and discovering their world and the importance of their interaction with the environment and society (Piaget, 1974; Vygotsky, 1962). Teaching through inquiry (Capps & Crawford, 2013; Gormally, Brickman, Hallar, & Armstrong, 2009) involves engaging students in the research process with teachers coaching students in a supportive environment that keeps students in their zone of proximal development. In addition, according to socio-cognitive theory, students build their self-efficacy from mainly four sources: repeated experiences of mastery in tasks, vicarious experience (seeing

others succeed), verbal persuasion from a person in a position of authority, and physiological states (Bandura, 1986). Teachers using IB practices directly or indirectly influence at least three of these sources, by allowing students to work through, and master, problems at their own pace, by allowing students to see other students master a task and by providing non-contingent positive feedback.

Using mostly student ratings, links have been found between Teacher SE and teaching practices. Teacher SE has been related to the use of a broader variety of teaching practices, especially those related to inquiry-based and student-centered practices (Holzberger et al., 2013; Holzberger, Philipp, & Kunter, 2014). Regarding the links between teaching practices and student SE, Fencel and Scheel (2005) have found that IB lab activities and conceptual problems contributed to creating a positive climate in the classroom. Collaborative learning and the use of electronic applications were positively linked with increased SE in students. In studies where IB was utilized as the primary instructional method, students' attitude and confidence towards science increased (Lord & Orkwiszewski, 2006).

Recent meta-analyses of more than 100 studies have revealed that inquiry-based practices adequately supported by teacher guidance lead to more positive learning outcomes than traditional unidirectional teacher-led teaching practices (Furtak, Seidel, Iverson, & Briggs, 2012; Lazonder & Harmsen, 2016). In sum, most research reports that IB teaching is linked with student SE to a greater extent than TL teaching. Although past research has advocated for the indirect effect of teacher SE on student outcomes, through the use of IB teaching practices (Guo, et al. 2010; 2012), we found no empirical study that have examined this issue specifically.

1.4. Moderating Effects of Cultural Values on Student Self-Efficacy

Klassen, Usher and Bong (2009) have suggested that beliefs about the self, such as SE, may act differently in cultural contexts where they are influenced by expectations and values of the cultural in-group (see also Chiu & Klassen, 2010; Lomos, Hofman, & Bosker, 2011). In a seminal work, Hofstede (1986) offered a theoretical framework that explains the moderating role of cultural values in learning and teaching that includes four main dimensions of values, two of them being relevant to the development of academic SE: individualism orientation (the extent to which nations value collective versus individual success), and uncertainty avoidance (the degree of acceptance of uncertainty in decision-making). While the aforementioned researchers have speculated on the links between teaching styles, student SE and the moderating role of country-level cultural values, empirical studies that have tested those links cross-culturally are limited. The links between individualism versus collectivism cultural orientations and teaching and learning processes have been widely studied (Bandura, 2002; Klassen, 2004; McIntyre, Mainhard, & Klassen, 2017). Research has shown that collectivistic and individualistic countries differ in their SE through the importance given to individual accomplishments as compared with collective ones (Oettingen & Zosuls, 2006), and in the significance given to the evaluations of one's own accomplishments (a modest individual self-evaluation is preferred in collectivistic nations, and self-enhancement is favored in individualistic nations; Salili, Chiu, & Lai, 2001; Triandis 1995).

Bandura (2002) has indicated that, in both individualistic and collectivistic nations, teacher support is a strong determinant of student SE. However, the moderating role of teachers' attitudes and behavior on student SE in more or less individualistic or collectivistic nations are currently unknown. Uncertainty avoidance is defined as the cultural need to be in familiar, structured and predictable situations (Oettingen, 1995). As such, individuals in nations with a

high level of uncertainty avoidance can be easily worried by unclear or unpredictable rules, outcomes or situations. In nations who score high on uncertainty avoidance, individuals may expect a clear (and usually single) outcome, considered as the truth. Although not yet empirically examined, in nations with a strong need for certainty (high in uncertainty avoidance), students may take their source of SE from TL practices, that are more clearly hierarchical in their relationship structure, and reward outcomes (e.g. having the correct answer; Ahn, Usher, Butz, & Bong, 2016; Oettingen, 1995).

1.5. The Present Study

The study has three specific objectives: (1) To test a path linking teacher and student SE; (2) To examine TL and IB teaching practices as potential mediators of the links between teachers and student SE; and (3) To evaluate the moderating effects of cultural values on the links between teacher SE and teaching practices on student SE, based on Hofstede's (1986) and Oettingen's (1995) cultural values of individualism/collectivism and uncertainty avoidance. To account for inter-individual variability between nations, we examined those links within a multilevel framework. The conceptual models underlying our study are shown in Figure 1. Based on the aforementioned literature, we aimed to test the following hypotheses.

Hypotheses related to Objective 1:

1. The links between IB and student SE will be stronger than between TL and student SE.
2. Teacher SE will positively predict IB and TL teaching practices.
3. Because wordings of teaching practices match exactly between the teacher and student questions, we expect to find high levels of congruence (associations) between teacher-reported and student-perceived IB and TL teaching practices.

Hypothesis related to Objective 2

4. The links between teacher SE and student SE will be fully mediated by IB and TL teaching practices.

Hypotheses related to Objective 3

5. Cultural values (individualism/collectivism and uncertainty avoidance) will moderate the link between teacher SE and student SE.
6. Cultural values will moderate the links between teaching practices and student SE.

2. Method

2.1. Participants

PISA 2015 (OECD, 2016a) conducted by the Organization for Economic Co-operation and Development (OECD), examined the key knowledge and skills of 15- year-old students in OECD and partner countries focusing on science, with reading, mathematics and collaborative problem solving as smaller areas of assessment using nationally representative samples. In total, more than 500,000 15-year-old students were assessed in 72 countries (OECD, 2016a). For more information about the PISA framework refer to OECD (2016a). For the purpose of this study, only participants whose nations opted in to the additional teacher and school assessments, and for which cultural values assessments were available, were included in the analysis (N = 16 nations). Therefore, a sample of 132,279 students and 22,557 teachers attending 4,423 schools was derived ($M = 29$ students and $M = 5$ teachers per school). It should be noted that teachers were clustered at the school level and that no specific information about teachers' own students was given, although teachers were selected only if they had students participating in PISA assessment. Therefore, the lower unit of analysis to examine students and teachers together was their school. To examine the objectives stated above, measures from teachers were averaged within schools and then used for analysis.

Of the students who provided socio-demographic information, 50.90% of them were females, of on average 15.81 (SD = .29) years of age. The majority of students were in the expected grade (10th year of formal education, 61.00%), whereas 4.1% of them were two years or more below school year average, and less than 1% of students were two years or above their expected school year. The vast majority of students were born in the country of testing (92.7%), 7.50% were second-generation immigrants and 7.3% considered themselves first-generation immigrants. Of those who mentioned, the teachers assessed were aged on average 43.12 years old (SD = 10.51), with an average of 16.38 (SD = 10.10) total years of experience in teaching, and 54.70% of them were females.

2.2. Procedure

During PISA assessment, students were examined on a number of computer-based tests, lasting a total of two hours for each pupil. Test items included both multiple-choice questions and open-ended items. Students also completed a background questionnaire concerning themselves, their home, family, school and the learning environment. Some of the countries (those 16 nations included in the current analysis) also asked teachers to complete a related questionnaire about their attitudes towards their students, teaching and school.

2.3. Measures

Full details of the construction and validation of the surveys, as well as all the questionnaire items, are given in the document “PISA 2015 Assessment and Analytical Framework” (OECD, 2016a). It should be noted that the focus of PISA 2015 was on sciences and therefore, the questions were targeted towards the science subjects. In order to be able to compare teacher and student assessments on teaching practices, we took from the database only the teaching practices items that were parallel between teachers and students (e.g. “The teacher

explains scientific ideas.” for students, and “I explain scientific ideas” for teachers). In addition, the design of PISA allowed us to pair students and teachers at the school-level. Therefore, teacher measures were aggregated within their schools. Although this method may not distinguish the potential sources of variance at the teacher-level (Lee, Dedrick, & Smith, 1991), because all of the questions were either targeted at the teacher themselves (for self-efficacy) or at their own classrooms for teaching practices) it is still a good indicator of general teaching practices and the relations between those practices and student perceptions at the student, school and country levels.

2.3.1. Teacher measures. The teacher questionnaire included items that were partially incorporated from the OECD Teaching and Learning International Study (OECD, 2009). Because this questionnaire aimed at examining the similarities and differences between groups of teachers, who were assumed to work within a comparable school-based curriculum, the level of analysis of data gathered from teachers is the school.

2.3.1.1. Teacher science-related SE. Using a framework put forward by Klieme, Pauli, & Reusser (2009), the teacher SE measure was designed to examine SE beliefs regarding the science content and teaching in the classroom. It contains eight items within the generic sentence: “To what extent can (or could) you do the following?” (answers on four points ranging from *Not at all* to *To a large extent*) teachers were asked to answer science-specific questions such as “Explain the links between biology, physics and chemistry”, reliability $\alpha = .90$.

2.3.1.2. Teacher IB and TL teaching practices in sciences. The teacher questionnaire incorporated a number of items concerning teacher-led versus inquiry-based teaching practices in science. Only the questions that were worded similarly between teachers and students were kept. The teachers were asked to rate in a 4-point Likert Scale, ranging from *Never* or *Almost Never* to

Every Lesson or Almost Every Lesson: “How often do these things happen in your school science lessons?”. Only the questions that had parallel wordings or meanings between students and teachers were kept. An example is, for **IB practices** (e.g. “Students are given opportunities to explain their ideas.”), $\alpha = .80$, and for **TL practices**, “I explain scientific ideas.”, $\alpha = .72$.

2.3.2. Student measures.

2.3.2.1. Students’ science-related SE. Students’ science SE was measured on an eight-item scale (see OECD, 2016a). This scale was closely related to the work of Bandura (1997) and aimed at measuring real world rather than curriculum-based science tasks (e.g. “How easy it would be for you to perform the following tasks on your own?”), followed by eight specific types of science activities (e.g: “Describe the role of antibiotics in the treatment of disease”). Items were measured on a four-point Likert scale ranging from: *I couldn’t do this* to *I could do this easily*, reliability $\alpha = .89$.

2.3.2.2. Student perceived IB and TL teaching practices in sciences. Only the questions that had parallel wordings or meanings between students and teachers were kept. Students were asked to rate items on a 4-point Likert Scale with the overarching question : “How often do these things happen in your lessons for this school science course?”, ranging from *Never* or *Almost Never* to *Every Lesson* or *Almost Every Lesson*. An example for **IB practices** is *When learning school science topics at school, how often do the following activities occur?* “Students are given opportunities to explain their ideas.”, $\alpha = .73$; and for **TL practices**, “ The teacher demonstrates an idea.”, $\alpha = .82$.

2.3.3. Cultural values (nation-level)

Nation-level cultural values ratings were taken from the publicly available cultural dimensions dataset (Hofstede, 2001; Hofstede, Hofstede, & Minkov, 2010). Hofstede’s cultural

value ratings have proven to be reliable proxies of participants' ratings in educational research (Chiu & Klassen, 2010; Fackler & Malmberg, 2016; Vieluf et al., 2013). Based on surveys of residents of 76 nations, this dataset examines cultural values on the dimensions found in Hofstede (2001). The cultural value scores, on a 0–100 scale, originated from the pooled results of eight international studies conducted with samples of students, employees and other individuals who were actively involved in the cultural formation of the nations. In addition to providing values from multiple informants, Hofstede's data have the benefit of measuring values on a continuum instead of forming categories of nations based on arbitrary information (e.g. all Asian countries treated as collectivist). These ratings are relevant to learning and instruction in that cultural values patterns are mirrored in schools and other cultural contexts (Hofstede, 1986; Manikutty, Anuradha, & Hansen, 2007; Reeve et al., 2014). The country-specific ratings are available in Appendix 1 of the Online Supplementary Material.

2.3.4. Analytical Strategy

We used a multilevel structural equation modeling framework (MSEM). To answer the first and second objectives, we evaluated the relationships between teacher and student SE beliefs using MSEM with latent variables, and examined the indirect effects between teacher and student SE with mediated MSEM. To address the third objective, we examined between-nations variations on the relationships between teacher as well as teacher- and student-rated TL and IB teaching practices on student SE, using three-level multilevel modeling (MLM) regressions with random intercepts and slopes (intercept and slope-as-outcomes model). Throughout the study, missing data were handled using full information maximum likelihood (FIML). The models were estimated using robust maximum likelihood (MLR), to account for data non-normality, and the

use of hierarchical and complex data (Muthén, Muthén, & Asparouhov, 2017). All predictor variables were grand mean centered.

Goodness-of-fit of our mediation models was evaluated according to the recommendations of Marsh et al., (2004; 2009, see also in the context of multilevel modelling Finch & Bolin, 2016; Heck & Thomas, 2015). That is, a model was deemed to have acceptable fit with a comparative fit index (CFI) equal to or higher than .90 (and an excellent fit equal to or greater than .95) and a root mean square error of approximation (RMSEA) and standardized root mean square residuals (SRMR) equal to or less than .08 (or less than .05 for an excellent fit; Kline, 2016). Multilevel-specific indices (intra-class correlation coefficients, ICC, and design effect, DEff) were also examined (Maas & Hox, 2005). ICC measures the proportion of within-level variance explained at the cluster level. DEff adjusts the ICC according to cluster sizes. Convention stipulates that when ICCs are higher than .10 and DEffs are higher than 2.00, the multilevel aspect of the data needs to be taken into account. The analyses were performed using the statistical software Mplus Version 8.0 (Muthén & Muthén, 1998-2017).

3. Results

3.1. Preliminary analyses

ICC for each of the items composing the student-based variables ranged between .04 and .23, with DEffs ranging between 2.12 and 7.44. Therefore, a significant proportion of the variance can be explained at the teacher-within-school level. ICCs for teacher measures ranged from .51 to .54, with DEffs ranging from 8.62 to 9.11.

3.2. Correlations

Correlation analyses between the latent variables at the within and the between level are presented in Table 1. Table 1 shows that, at the within-level, small to moderate relationships

were found between the student-rated variables. Moderate to strong links were found between all the variables at the between-level.

3.3. MSEM Linking Teacher and Student Self-Efficacy, Through Teaching Practices

3.3.1. Latent Variable MSEM. To answer our first objective on the paths linking teacher and student SE, a latent variable MSEM was designed. In this first model, at the between-level (teacher-within-school, Level 2, L2), we hypothesized that teacher SE would predict their self-reported IB and TL teaching practices. Teaching practices would in turn predict student perceptions of the teaching practices. Perceived teaching practices would finally predict student SE. We also estimated a direct link between teacher and student SE at L2. We predicted that each of the SE and teaching practices latent constructs would be indicated by their respective observed items described in the Measures section. At the within-level (student, Level 1, L1), we predicted that students' perceived IB and TL teaching practices would positively be associated with their own SE beliefs. Regarding the latent student- and teacher- rated SE, IB and TL items, we expected to find similar factor structures (one factor per construct) at the within and the between levels.

The hypothesized model was an adequate fit to the data, $\chi^2_{(551)} = 27,135, p < .001$, RMSEA = .02, CFI = .95, TLI = .95, SRMR Within = .03, SRMR Between = .10.

Unstandardized and standardized results of the mediation model linking teachers SE, teachers' teaching practices, students' perceptions of teaching practices and students SE are presented in Figure 2. Factor loadings of each of the observed variables on their respective factors are presented in Appendix 2 (Online Supplementary Material) and the list of items used in the present study is in Appendix 3.

At L2, the direct link between teacher and student SE was not significant. As can be seen in Figure 2, teacher SE was strongly related to teachers' IB ($\beta = .71$) and TL ($\beta = .73$). As expected, both IB and TL teaching styles were associated with students' perceptions of those styles; the relation was much stronger for IB ($\beta = .81$), with a large effect (as compared with $\beta = .35$ for TL). In addition, teacher IB was moderately positively related to students' perception of TL ($\beta = .26$). However, teacher TL was negatively (but weakly) linked with students' perceptions of IB ($\beta = -.16$). Finally, both student-perceived teaching styles were moderately related to student SE, with a stronger link between perceived IB ($\beta = .29$) as compared with TL ($\beta = .17$). At L1, weaker, but significantly positive relationships were found between perceived teacher IB and TL, and student SE ($\beta = .16$ and $\beta = .09$, respectively). The factor loadings reported in Appendix 1 (supplementary material) reveal that the structure of each factor was as expected both at L1 and L2. The model explained 4% of the variance in student SE at the student level, and 18% at the teacher level.

To further test the validity of variable ordering, and to rule out the assumption of reciprocal determinism of teacher and student SE (Williams & Williams, 2010), we tested an alternative model whereby teacher IB and TL teaching practices predicted student IB and TL, that predicted student SE, that in turn predicted teacher SE. This model provided poor fit to the data, RMSEA = .08, CFI = .86, TLI = .61, SRMR Within = .00, SRMR Between = .25.

3.3.2. Mediation MSEM. Mediation analyses were examined as part of the model presented in section 3.3.1. As can be seen in Table 1, the direct association of teacher SE and student SE was significant ($r = .24$, $p < .001$). To investigate the indirect associations between teacher SE and student SE (Hypothesis 4), two mediation links were analyzed at L2, one for each

type of teaching practices using the Delta method of estimation of mediation analyses and 99% confidence intervals (CI) (Muthén et al., 2017): (1) Teacher SE → Teacher-rated IB → Student-rated IB → Student SE; and (2) Teacher SE → Teacher-rated TL → Student-rated TL → Student SE.

We found indirect effects between the predictors and outcomes in both mediation analyses that fully mediated the link between teacher and student SE. For the first mediation, the standardized indirect effects between teacher and student SE via IB teaching practices was significant, 0.17 (99% CI = 0.10; 0.24), $z = 6.54$, $p < .001$, and the standardized mediated paths via TL practices was also significant but weaker, 0.04 (99% CI = 0.01; 0.07), $z = 3.75$, $p < .001$. In sum, the link between student and teacher SE was fully mediated by teaching practices, more strongly through IB.

3.3.3. Cross-Cultural Variations Moderating the Links Between Teacher SE, Teaching Practices as Predictors of Student SE

To address the third objective, a series of three-level MLM was performed. The first model examined the direct relations of teacher SE, and teaching practices in predicting student SE at the nation-level (Level 3, L3; see the right-hand panel of Figure 1). The following random effects were examined: (1) Random intercept of student SE; and the random slopes between Student SE (as the dependent variable) and: (2) Teacher SE; (3) Teacher IB; (4) Teacher TL; (5) Student-perceived IB; and (6) Student-perceived TL. Descriptive statistics are shown separately for each nation in Table 2.

As indicated in the right-hand side of Table 3, at L3, we found significant between-nation variance of the random intercept (student SE). A closer look at the first column of Table 2 indicated that Dominican Republic was the country with the highest mean-level student SE, and

that Columbia was ranked the lowest (see also OECD, 2016b). The left-hand side of Table 3 also shows that random slopes of student SE on their perceived IB and TL were on average significant, with perceived IB having a stronger (but moderate, $0.288, p < .001$) effect on student SE than perceived TL ($0.089, p < .001$). We also found evidence of between-level variations of the links between the two students-rated teaching practices (student-perceived IB and TL) and student SE, as shown by significant variances on the right-hand side of Table 3. Although the magnitude of the effects of variances is difficult to interpret, IB practices appear to have a greater effect ($0.004, p = .021$) than TL practices ($0.001, p = .056$). They can be interpreted as standardized increases in perceived IB and TL teaching practices for increases of one standard deviation in student SE. None of the random slopes or the variances for the teacher-rated measures predicting student SE reached significance.

To examine Hypotheses 5 and 6 specifically, two further random effects models were modeled, one for each of the cultural values, using only the significant effects found in the previous analysis. Individualism (Model 1) and uncertainty avoidance (Model 2) were regressed on student self-efficacy random intercept random slopes of student SE on student-perceived IB and TL. Nation-level cultural values data are available in Appendix 2 (online supplementary material). The results are shown in the bottom section of Table 3. In Model 1, the direct link between Individualism and student SE was not significant, nor was the random interaction effect of Individualism on the links between IB practices and student SE. We found a significant positive interaction between Individualism and the random slope of TL practices and student SE, $.001, p = .008$. As can be found in Figure 3, as Individualism increased in separate nations, the strength of the regression slope between TL practices and student SE modestly increased of .001 per unit from .048 (Taiwan) to .138 (Australia). Regarding the links between uncertainty

avoidance and the random intercept and slopes (Model 2), the direct effect of uncertainty avoidance on student SE, and in moderating the random slope of TB practices and student SE were not significant. The interaction between uncertainty avoidance and the random slope of IB practices and student SE was negative and significant, -0.002 , $p < .001$. Figure 4 illustrates the results. As uncertainty avoidance increased in nations, the strength of the association between IB practices and student SE decreased of $-.002$ per unit, from $.296$ (Hong Kong) to $.145$ (Peru). In all, the effects of uncertainty avoidance were slightly stronger than those of individualism.

4. Discussion

This research offers the first systematic cross-cultural examination of the contextual roles of teachers SE and teaching practices on student SE, taking into account the cultural values of each nation. In line with socio-cognitive theory (Bandura, 1997), our results provide strong evidence for the role of teachers' SE beliefs, attitudes and behaviors in shaping student SE. We found significant cross-cultural variations in the manifestations and teaching sources of student SE, through the country-level cultural values of individualism and uncertainty avoidance. This result can partly be explained by cultural differences in how nations experience learning and instruction.

4.1. On the Links Between Teacher SE, Teaching Practices, and Student SE

Our first, second and third hypotheses were supported: The links between IB practices and SE were slightly stronger than between TL and SE, both for teachers and students, and teacher-reported teaching behaviors were highly related to students' perceptions of these behaviors, especially for IB practices. In terms of the magnitude of the effects, the effects were slightly stronger at the teacher-level, indicating that teachers' teaching practices might be more important for student self-efficacy than students' individual perceptions of these practices. In

addition, teachers' teaching practices fully mediated the links between teacher SE and student SE, thus supporting our fourth hypothesis. An alternative model examining a potential feedback loop between student SE and teacher behavior yielded poor model fit, providing further validity for the path linking teacher SE and teaching practices to student SE.

In our study, teacher SE was indirectly linked to student SE, more strongly through the use and perception of IB practices than TL practices, therefore supporting our fourth hypothesis. According to Gormally, Brickman, Hallar, and Armstrong (2009), students who are taught through inquiry-based techniques seldom experience failures, as they are, to some extent, allowed to work through projects at their own pace and to set their own levels of challenge. This is not the case with traditional TL practices. Since first-hand experience of success is one of the core components of SE development (Bandura, 1997), IB practices may foster SE by enabling students to experience successes at a greater rate. We found moderate to high correlations between the two teaching styles, from the points of view of both teachers and pupils. As such, these two styles are not necessarily opposed but can be seen on a continuum of pedagogical practices rather than teacher-centered or learner-centered. The most effective teacher may be the one able to move from one style to another when necessary.

Another interesting result is the high levels of congruence between teacher and student ratings of the same teaching practices, that highlight the fact that students and teachers see teaching practices similarly, and that student ratings of teaching practices are reliable proxies for teacher views of those practices. It is worth noting that student beliefs alone explained a lower amount of variance in the model (at the student level) than when used in conjunction with teacher-reported teaching practices and SE (at the teacher level). Therefore, our results suggest

that an efficient way of increasing student SE would be to increase their teacher SE and their use of varied pedagogical practices.

4.2. The Role of Cultural Values in Academic Self-Efficacy

The results of our cross-cultural analysis showed systematic moderating effects of the two cultural values (individualism/collectivism and uncertainty avoidance) on the links between student-perceived TL and IB teaching practices, and student SE, therefore supporting Hypothesis 6. Individualism had a moderating effect on the relationship between TL teaching practices and student SE: Countries with high individualism scores also displayed stronger links between perceived TL practices and student SE. In individualistic countries, individual students SE may benefit from more direct outcome-related feedback from teachers TL practices, as this feedback is related to individual performances (Oettingen, 1995). In collectivistic countries, student SE may be less influenced by individual feedback and more by collective goal settings, and the role of TL practices may be minimized in collectivistic nations.

The present study also revealed that students in nations who scored high in uncertainty avoidance (preference for certainty) derived their sense of SE less from IB teaching practices than in countries where uncertainty was tolerated. IB practices involve self-exploration and discoveries from students, with fewer prescribed processes and fixed answers (Furtak, et al., 2012). Students in countries high in uncertainty avoidance may find IB practices more stressful and may thrive when processes and outcomes are definitive. On the contrary, in nations where higher levels of uncertainty are accepted, IB practices may allow students to develop their self-beliefs by allowing them to make their own conclusion and to see ambiguity as a challenge rather than a threat (Oettingen & Zosuls, 2006). In all, uncertainty avoidance seems to have a greater effect than individualism on the links between teaching practices and student self-efficacy. This

finding requires further investigation but suggests that studying cultural values other than the widely examined individualism/collectivism values may shed further light on how self-efficacy may develop differently within and between nations.

We did not find significant effects of cultural values in moderating the links between teacher and student SE, therefore Hypothesis 5 was rejected. Since the mediation analyses showed that teaching practices fully mediated the path of teacher and student SE, it is likely that teaching practices, being more proximal and “visible” to students, influence student SE to a greater extent. Although we found high levels of congruence between teacher- and student-perceived teaching practices, the direct links between teacher teaching practices and student SE were non-significant. Those two findings combined are important as they reveal that how students perceive their teachers’ style is in some sense their reality, which may be similar from what teachers report but be more significant.

4.3. Limitations

The current study has some limitations, and these highlight areas for future research. First, we mostly relied on pre-existing correlational questionnaire data to assess the measures used in this study, and therefore no causality can be inferred from the results presented. The use of secondary data variables to measure SE and teaching practices may only provide partial information, and targeted measures may show even stronger effects. In particular, the operationalization of teacher and student SE may have shaped the results in a way that may have promoted greater associations between IB practices and SE, as compared with TL practices and SE. Also, the multilevel nature of the data and our analyses allowed us to have an in depth-look at cultural variations, but since teacher measures were clustered at the school-level, we could not look at the direct associations between individual teachers and their students. This methodology

did not allow us to separate the sources of variance in teachers' teaching practices. It did, however, explain student, school and country-level variance. In addition, aggregated variables may inflate the correlations between variables measured at the same level. In our case, the correlations between teacher-reported measures of self-efficacy and teaching practices were high. However, teaching practices were also very highly related to student-rated measures, even if different individuals reported those measures at a different level. Therefore, the high correlations between teacher-reported measures may have been the product of responses from multiple informants on constructs that are conceptually similar. Clearly, future research should replicate the results using teachers as the primary level of analysis.

The measures of SE and teaching practices were all taken from the sciences subjects, which may limit generalization of the findings to other fields or subjects. In addition, the role of cultural values was examined through only two values as highlighted by Hofstede's (1986) cultural values theoretical framework, and future studies are needed to replicate and confirm the findings with a broader set of values based on theory.

5. Implications and Conclusion

The present study highlighted the importance of cultural values in understanding the links between teacher and student SE, and teaching practices. Therefore, this research has theoretical and practical implications internationally. Theoretically, this study shows that research on self-efficacy needs to be culturally relevant.. International studies are not always possible, but the role of cultural values can be studied even within nations. As such, in countries that are less ethnically homogenous, for instance in many of the North American countries, a greater theoretical understanding of the nature of self-efficacy between cultural groups is needed.

Practically, this research has implications for teacher training, and educational policy makers at the school level and internationally. In terms of teacher training, interventions that focus on teachers' self-efficacy and their awareness of a balance between teacher-led and inquiry-based practices to increase student academic self-efficacy, and teacher training that also use a balanced approach to teaching, has the potential to have the most beneficial outcomes on students (Fackler & Malmberg, 2016). In addition, this research highlighted the need to increase teachers' understanding of the roles of cultural values in learning and teaching. This awareness of cultural values would be best implemented by school or governmental policies that are culturally friendly, for instance by gaining and promoting a basic understanding of how teaching practices may affect students differently according to their cultural background. This could be particularly useful in countries with higher rates of first and second-generation immigrants. These policies could be executed by having national and international policies that acknowledge the breadth of cultural values in learning and instruction, the role of teachers as agents of these values, and their importance in student outcomes.

The present research contributes to the ongoing discussions about the determinants and outcomes of academic SE. In all, our results confirm that students source a good part of their SE from their teacher, indirectly through their teaching styles, and that those links are influenced by context-specific cultural values. The findings have important implications for the understanding of teaching and learning internationally.

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Table 1. Within and between level bivariate correlations between the latent variables

	1	2	3	4	5	6
1. Students SE	—	.400	.343	.240	.309	.182
2. Student Inquiry-based TP	.188	—	.553	.459	.723	.264
3. Student Teacher-led TP	.137	.297	—	.448	.449	.492
4. Teachers SE	—	—	—	—	.714	.734
5. Teacher Inquiry-based TP	—	—	—	—	—	.524
6. Teacher Teacher-led TP	—	—	—	—	—	—

Notes. The lower diagonal represents correlations at the within level and the upper diagonal represents the between level. N Within (L1) = 132,279 students; N Between (L2) = 22,557 teachers clustered in 4,423 Schools. Variables 4-6 exist at L2 only; therefore correlation coefficients are not computed at L1. SE = self-efficacy; TP = teaching practices. All coefficients are significant at $p < .001$.

Table 2. Nation-specific sample characteristics

Country	Student Assessed				Teacher Assessed			
	N	Self-Efficacy	Inquiry-based TP	Teacher-based TP	N	Self-Efficacy	Inquiry-based TP	Teacher-based TP
Australia	13947	-0.057	0.015	0.056	3314	0.404	0.433	0.417
Brazil	18371	0.017	-0.019	-0.023	2306	-0.142	-0.610	-0.182
Chile	6610	-0.047	0.000	0.005	759	0.294	-0.113	-0.131
Taiwan	7578	0.060	-0.044	0.094	1444	-1.047	-0.805	-0.735
Colombia	10646	-0.079	-0.031	-0.012	1143	0.814	0.743	0.955
Czech Republic	6831	0.009	-0.008	-0.131	1950	-0.350	-0.625	-0.728
DR	3875	0.089	0.053	-0.011	382	1.278	1.620	1.369
Germany	6337	-0.040	-0.005	-0.092	1750	-0.013	0.038	-0.563
Hong Kong	5319	-0.033	0.035	0.053	955	-1.887	-0.876	-1.171
Italy	10878	-0.002	-0.038	-0.046	2094	-0.345	-0.443	-0.373
Korea	5058	0.019	-0.094	-0.096	842	-1.070	-1.420	-1.158
Macao	4476	-0.012	-0.006	0.008	366	-0.994	-0.778	-0.875
Peru	6732	0.074	0.101	-0.051	848	0.235	0.763	-0.043
Spain	6700	-0.071	-0.067	0.017	1225	0.207	-0.049	0.562
UAE	13288	0.062	0.051	0.044	2185	0.830	0.949	0.984
USA	5633	0.020	0.053	0.057	994	0.480	0.684	0.616

Note. The descriptive statistics are derived from factor scores. DR = Dominican Republic; UAE = United Arab Emirates; USA = United States of America; N= 132,279 students; 22,557 teachers. TP = teaching practices. S.E. mean < .0001 for all of the variables.

Table 3. Cross-cultural means and variations of teacher SE and teaching practices predicting student SE.

Variable predicting student SE	Effect	SE	99% C.I.		P-Value (effect)	Variance ^a	SE (variance)	99% C.I. (variance)		P-Value (variance)
			Low	High				Low	High	
Direct effects model										
L3 Intercept (Student SE)	-	-	-	-	-	0.001	0	0	0.001	.015
L3 SM Inquiry-based TP (S1)	0.288	0.016	0.247	0.329	<.001	0.004	0.002	0	0.008	.021
L3 SM Teacher-led TP (S2)	0.089	0.009	0.066	0.113	<.001	0.001	0.001	0	0.003	.056
L3 TM Inquiry-based TP	-0.008	0.016	-0.051	0.034	0.606	0	0.008	-0.02	0.02	1.000
L3 TM Teacher-led TP	0.007	0.013	-0.026	0.04	0.583	0	0.002	-0.006	0.006	.935
L3 Teacher SE	0.025	0.019	-0.023	0.074	0.177	0	0.011	-0.028	0.028	1.000
L2 SM Inquiry-based TP	-	-	-	-	-	.017	0.003	0.01	0.024	<.001
L2 SM Teacher-led TP	-	-	-	-	-	.007	0.001	0.003	0.01	<.001
L2 Error variance	-	-	-	-	-	0	0	-0.001	0.001	.978
L1 Error variance	-	-	-	-	-	.195	0.009	0.171	0.22	<.001
Interaction Model 1 L3 Individualism										
Random Student SE	0.000	0.000	-0.002	0.001	.27	0.002 ^a	0.000	0.001	0.003	<.001
Random Slope Inquiry-based TP (S1)	0.000	0.000	-0.001	0.001	.49	0.002 ^a	0.001	0.000	0.004	.03
Random Slope Teacher-led TP (S2)	0.001	0.000	0.000	0.001	.008	0.001 ^a	0.001	-0.001	0.003	.11
Interaction Model 2 L3 Uncertainty Avoidance										
Random Student SE	0.000	0.001	-0.001	0.002	.70	0.002 ^a	0.001	0.001	0.004	<.001
Random Slope Inquiry-based TP (S1)	-0.002	0.000	-0.003	-0.001	<.001	0.001 ^a	0.000	0.000	0.001	<.001
Random Slope Teacher-led TP (S2)	0.000	0.001	-0.002	0.001	.65	0.001 ^a	0.001	-0.001	0.003	.088

Notes. ^a. All coefficients in the variance sections of the Interaction Models are error variances.

The upper model represents the direct effects of teacher SE and teaching practices on student SE. The lower models represent the moderation effects of the cultural values on the slopes presented in the upper model. L1 = Student-level; L2 = School-level; L3 = Country-level; S1-S2 refer to the random slopes found in the direct effects model. SE = self-efficacy; SM = student-measured; TM = teacher-measured; TP= teaching practices.

Figure 1. Conceptual model of the links between teacher self-efficacy and student self-efficacy (Hypotheses 1-4) and the moderating effect of cultural values between nations (Hypotheses 5-6).

Figure 2. MSEM linking teacher self-efficacy to student self-efficacy. Unstandardized and standardized coefficients are shown (standardized coefficients under brackets). Teacher-rated variables are clustered at the school-level. N= 132,279 students; n = 22,557 teachers clustered within N = 4,423 schools. The full latent model results are presented in Appendix 1 (online supplementary material). $p < .0001$ for all of the variables.

Figure 3. Moderation effects of individualism on the random slope of TL practices predicting Student SE at the country level. Overall effects are presented in Table 3. The y-axis represents the strength of the associations between Student SE and student-perceived TL practices. Each dot represents one nation. Each score on the x axis (value) can be associated with its nation found in Supplementary Material (e.g. the dot found at the extreme left of the figure is associated with the lowest score in individualism (Taiwan)). The regression line indicates that, as nations score higher on the individualism scale, we see a greater association between TL practices and student SE.

Figure 4. Moderation effects of uncertainty avoidance on the random slope of IB practices predicting Student SE at the country level. Overall effects are presented in Table 3. The y-axis represents the strength of the associations between Student SE and student-perceived IB practices. Each dot represents one nation. Each score on the x axis (value) can be associated with its nation found in Supplementary Material (e.g. the dot found at the extreme left of the figure is associated with the lowest score in uncertainty avoidance (Hong Kong)). The regression line indicates that, as nations score higher on the uncertainty avoidance scale, we see a weaker association between IB practices and student SE.

Online Supplementary Material to:

‘The role of cultural values in teacher and student self-efficacy:
Evidence from 16 nations’

Appendix 1. Cultural values ratings

	Individualism	Uncertainty Avoidance
Australia	90	51
Brazil	38	76
Chile	23	86
Chinese Taipei	13	80
Colombia	17	69
Czech Republic	58	74
Dominican Republic	30	45
Germany	67	65
Hong Kong	25	29
Italy	76	75
Korea	18	85
Macao	20	30
Peru	16	87
Spain	51	86
United Arab Emirates	27	80
United States	91	46

Note. Data are available open-access to researchers on Hofstede’s website geerthofstede.com/research-and-vsm/dimension-data-matrix/, and data from all countries except Dominican Republic were taken from this website. Data from Dominican Republic were taken from hofstede-insights.com/product/culture-compass/

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Appendix 3. List of items taken from PISA 2015

Student self-efficacy

How easy do you think it would be for you to perform the following tasks on your own?

ST129Q01TA	Recognise the science question that underlies a newspaper report on a health issue.
ST129Q02TA	Explain why earthquakes occur more frequently in some areas than in others.
ST129Q03TA	Describe the role of antibiotics in the treatment of disease.
ST129Q04TA	Identify the science question associated with the disposal of garbage.
ST129Q05TA	Predict how changes to an environment will affect the survival of certain species.
ST129Q06TA	Interpret the scientific information provided on the labelling of food items.
ST129Q07TA	Discuss how new evidence can lead you to change your understanding about the possibility of life on Mars.
ST129Q08TA	Identify the better of two explanations for the formation of acid rain.

Student-reported inquiry practices

When learning <school science> topics at school, how often do the following activities occur?

ST098Q01TA	Students are given opportunities to explain their ideas.
ST098Q02TA	Students spend time in the laboratory doing practical experiments.
ST098Q05TA	Students are asked to draw conclusions from an experiment they have conducted.
ST098Q07TA	Students are allowed to design their own experiments.

Student-reported teacher-led practices

How often do these things happen in your lessons for this <school science> course?

ST103Q01NA	The teacher explains scientific ideas.
ST103Q03NA	A whole class discussion takes place with the teacher.
ST103Q08NA	The teacher discusses our questions.
ST103Q11NA	The teacher demonstrates an idea.

Teacher-reported self-efficacy

To what extent can (or could) you do the following?

TC033Q04NA	Design experiments and hands-on activities for <inquiry-based learning>
TC033Q05NA	Assign tailored tasks to the weakest as well as to the best students
TC033Q06NA	Use a variety of assessment strategies
TC033Q08NA	Facilitate a discussion among students on how to interpret experimental findings

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TC034Q01NA	Explain a complex scientific concept to a fellow teacher
TC034Q02NA	State and defend an informed position on ethical problems relating to <broad science>
TC034Q04NA	Read state-of-the art papers in my scientific discipline
TC034Q06NA	Explain the links between biology, physics and chemistry

Teacher-reported inquiry practices

How often do these things happen in your <school science> lessons?

TC037Q01NA	Students are asked to draw conclusions from an experiment they have conducted.
TC037Q02NA	Students are given opportunities to explain their ideas.
TC037Q09NA	Students do their own scientific study and related research.
TC037Q11NA	Students carry out practical work.

Teacher-reported teacher-led practices

How often do these things happen in your <school science> lessons?

TC037Q03NA	I explain scientific ideas.
TC037Q05NA	A whole class discussion takes place in which I participate.
TC037Q10NA	I discuss questions that students ask.
TC037Q13NA	I demonstrate an idea.

Reference

OECD (2016). *PISA 2015 Assessment and Analytical Framework*. OECD Publishing.

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