Non-Cognitive Skills Training and Educational Outcomes: New Evidence from French Middle Schools

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Abstract

Attempts to improve the French educational system and, in particular, to tackle existing inequality issues conditioning academic success on family background above all else have yet to secure lasting solutions. One increasingly popular answer to such issues is to focus on students' socio-behavioral skills rather than only academic performances, known for their failure to accurately predict adult life outcomes. Thanks to comprehensive panel data from France, as well as new analyses of International OECD surveys (PISA 2012, PISA 2015 and TALIS 2013), we attempt to draw some conclusions about the potential impact of non-cognitive skills on school outcomes, in general and for differentiated populations, and the extent to which it may be possible to influence these social and behavioral characteristics through pedagogical practices.

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1 Introduction

Tackling social and territorial inequalities and fighting against school dropouts has been established at least since 2012 as one of the main priorities of the French government in its educational strategy[1]. But despite significant public investments in education (10.5% of GDB devoted to childhood compared to an OECD average of 9%, and total domestic education expenditure accounting for 6.7% of GDP in 2016*), the variations in school results measured through international assessments such as PISA are both larger than in the rest of the OECD and increasing in France[2].

Moreover, many interventions put in place to improve school performances in priority education zones, especially for teenagers, have had little to no impact on academic results. This is the case for the ZEP mechanism (Benabou et al. 2004 and 2009), but also the more recent *Aim for Success* network ("Réseau Ambition Réussite", RAR) (Caille et al. 2016) and wide-scale Programs for Educational Success ("Programmes de Réussite Educative", PRE) (Bressoux et al. 2016).

One possible explanation for these issues is the poor performance of the French educational system in developing non-cognitive skills for its students. Substantial evidence of a relationship between certain socio-behavioral skills and favorable school, economic and social outcomes (see e.g. Heckman et al. 2014 for a review) suggests that the overwhelming focus on cognitive outcomes in French middle schools to the exclusion of "softer" skills could be responsible for the failings of the French school system to realize its goals. And indeed, cross-country comparisons of several socio-behavioral indicators seem to indicate that France performs more poorly than similar OECD countries on factors such as anxiety, motivation, feeling of control of their own life, etc.

[1] http://www.education.gouv.fr/pid285/bulletin_officiel.html?cid_bo=113978
[2] http://www.oecd.org/fr/france/vers-un-systeme-d-education-plus-inclusif-en-france.pdf

Thinking about whether educational policies can effectively target both cognitive and non-cognitive aspects thus seems to be particularly relevant in this context. We attempt to add to the existing evidence base on both the relationship between non-cognitive and cognitive skills, the extent to which it is verified in the French context and the differentiated effects it might have on different subpopulations. We also look at international survey data from the OECD (PISA and TALIS surveys) on non-cognitive skills and pedagogical practices, to check whether we find evidence of a link between teaching methods employed in different countries and the prevalence of socio-behavioral skills on students in these countries.

2 Literature Review

2.1 Theories of Human Capital

Although the idea that workers' ability plays a role in production has been discussed at least since Adam Smith (1776), little thought was given to the question of skills development in mainstream economic theory before the late 1950s with Mincer (1958), Schultz (1961) and Becker (1962)'s seminal works on the question of returns to schooling (Goldin 2016). Theories of human capital have come a long way since then, and have become a central element in branches including Labor, Growth and Development Economics. Acemoglu & Autor (2011) thus claim that "[o]ne of the most important ideas in labor economics is to think of the set of marketable skills of workers as a form of capital in which workers make a variety of investments." Examples include Mankiw, Romer & Weil (1992)'s attempt to bridge the residual gap by adding human capital growth to the canonical Solow model, or Katz & Murphy (1992)'s appeal to the increasing educational wage differentials ("skill premium") due to evolutions in the demand and supply for skilled labor to explain the widening of the wage distribution in the United States.

Nevertheless, the definition of human capital as "any stock of knowledge or characteristics the worker has (either innate or acquired) that contributes to his or her 'productivity'" (Acemoglu & Autor 2011) remains very broad, and its specific applications depend on what is understood by that term. The most common proxy, years of schooling, forgoes other sources of human capital differences such as innate ability, school quality or non-schooling investments, for instance. Furthermore, it limits human capital to a unidimensional variable, whereas works such as Gardener's 1983 book *Frames of Mind: The Theory of Multiple Intelligences* emphasize the co-existence of very different types of skills for individuals. In particular, the traditional focus on academic results seems far from sufficient given that, according to Heckman & Kautz. (2012), although test scores and IQ are highly correlated with schooling success, they fare far less well in predicting variations in later-life outcomes. One explanation proposed for this failure to account for variations in life outcomes is that such tests do not capture certain non-cognitive skills (personality

traits, goals, motivations or preferences) which could represent more accurate determinants of future success (Heckman et al. 2014).

If we can broadly speaking define cognitive skills as the ability to "perform higher processes of reasoning, remembering, understanding and problem solving" (Bernstein & al. 2007), non-cognitive skills are more challenging to pinpoint. A variety of terms are used by researchers from different fields to refer to them (soft skills, personality traits, socio-emotional skills, behavioral skills...) and they comprise very diverse characteristics from one to the other. We will follow García (2014)'s definition of "'patterns of thought, feelings and behavior' (Borghans et al. 2008) of individuals that may continue to develop throughout their lives (Bloom 1964), and that play some role in the education process". Despite this wide variety of possible interpretations and taxonomies, the "Big Five" classification stemming from several decades of research since the 1970s seems to be the most consensual classification of traits (Almlund et al. 2011): Openness to Experience, Conscientiousness, Extraversion, Agreeableness and Neuroticism (or OCEAN). Amongst these, Conscientiousness (i.e. "grit", organization and responsibility) is the strongest predictor of outcomes including academic results, employment and wage, as well as health or criminality (Heckman & Kautz 2012).

2.2 Cognitive and Non-Cognitive Skills

Though certain types of non-cognitive skills seem strongly related to variables of later-life income such as future earnings (e.g. Heckman & Rubinstein 2001, Lindquist & Vestman 2011) and job satisfaction (Cobb Clark 2014) even when controlling for the impact of cognitive skills, the literature suggests that they might also play a role due to their effect on cognitive skills. This makes sense, as Borghans et al. (2006) show through the example of IQ test scores, which are determined not only by a student's intelligence but also by her ability to focus and self-motivate. Students with stronger non-cognitive skills thus demonstrate higher academic achievement throughout the schooling process (Gabrieli et al. 2015). Duckworth et al. (2012) find that skills such as self-regulation and self-control are correlated to improved behavior in the classroom, which in turn

predicts higher academic results, whilst Farrington et al. (2012) suggest that the non-cognitive skills most strongly associated with academic performance are academic behaviors (e.g. going to class and participating), academic perseverance (e.g. grit and self-discipline), academic mindsets (e.g. feeling a sense of belonging within an academic community and believing that ability and competence can grow with effort), learning strategies (e.g. meta-cognitive strategies and goal-setting) and social skills (e.g. interpersonal skills and cooperation). Although the processes of socio-emotional development and cognitive development are intertwined, Heckman et al. (2014) nonetheless note a causal effect of increasing social and behavioral skills on academic results. A randomized experiments led by Cohen et al. (2009) for instance puts forward the causal impact of self-affirmation on academic outcomes for 7th grade students on Afro-American students -especially those performing poorly- by reducing the negative stereotype associated to Black minorities. Algan et al. (2014) also provide evidence by estimating the impact on lifetime outcomes of a randomized non-cognitive skills training program at school entry for disruptive kindergarten boys from low socioeconomic environments, and suggest that strategies to foster the development of social skills are likely to be important both for academic achievements and adult outcomes.

2.3 Pedagogical Practices

Another important question is whether such social and behavioral skills can be taught, and whether different teaching practices can have an effect on those issues. In other words, can non-cognitive skills and values be transmitted through school rather than only through mechanisms of family transmission, put forward by authors such as Bisin & Verdier (2001) or Tabellini (2008)? To answer this question, Durlak et al. (2011) conduct an extensive meta-analysis of over 200 interventions aimed at increasing the social and emotional learning of children from kindergarten through high school (ages 5–18). Their results show that social and behavioral skills of participants improved for treatment groups in experimental studies. What more, treated groups benefited in other ways from such interventions, namely with improved academic results. In 2013, Algan et al. also present empirical evidence on the connection between teaching and social

capital and show that teaching practices have an "independent and sizeable" effect on student beliefs. They address concerns about omitted variable bias and reverse causality by comparing aggregate cross-country data with within-countries between-schools estimates and finally looking at teaching practices and student beliefs across classrooms within a school. Heckman et al. (2014) also suggests that non-cognitive skills are more malleable and can be acted upon later than cognitive skills - according to them, it is not necessary for interventions targeting non-cognitive skills to focus on early childhood, so that pedagogical practices in teenage years can also have an effect on lifetime outcomes. Gutman and Schoon (2013) argue that some non-cognitive skills are more tractable than others. They nonetheless suggest that, within school, "effective teaching, the school environment, and social and emotional learning programmes (SEP) can play an important role in developing key non-cognitive skills". Lleras (2008) believes that the role of schools is also to prepare young adults to behaviors which will enable them both to succeed in their studies and to obtain better employment opportunities in the future.

3 Data

In order to address these questions, we make use of data from different sources. As a first step, we use data from a longitudinal study led by the Evaluation, Forecasting and Performance Department (DEPP) of the French Ministry for National Education to highlight the existence of a relationship between non-cognitive variables - in this case students' reported feeling of "self-efficacy" across three dimensions (social, academic and concerning their ability to "self-regulate") - and cognitive outcomes in France. We verify that PISA data from 2012 and 2015 confirms these findings at the cross-country level, at the individual level with country fixed effects, and for France more specifically. Finally, we combine data from the PISA surveys with additional variables from the 2013 Teaching and Learning International Survey (TALIS) to estimate the relationship between pedagogical practices in different countries and a variety of non-cognitive indices.

3.1 French Panel Data: DEPP 2007

This study is the seventh of a series initiated in 1973, wherein a panel of students is monitored during several years in order to gather data about their academic trajectories. Given the length of the study, the collection and analysis of data is shared between several bodies - the DEPP only follows students until 2013, after which their transition into adult life and further studies is monitored by the National Institute for Statistics and Economic Studies (INSEE) and by the Department for Statistical Studies of the Ministry for Higher Education and Research (SIES) for those students pursuing further studies after the Baccalauréat. This 2007 edition is composed of students entering "Sixième" (French equivalent of US 6th Grade) for the first time, either in standard schools or in streams for specially adapted general and vocational education ("Sixième SEGPA"), and covers both public and private middle schools ("collège"). In addition to traditional academic and contextual data gathered through questionnaires, this study is relevant to our analysis because it includes assessments specifically designed for the 2007 Panel for cognitive as well as socio-behavioral skills, which were administered to students every four years.

3.1.1 Sample characteristics

The 2007 Panel includes a much more representative sample than previous versions: thanks to the generalization of the numerical student database *Scolarité* in France, around 34,500 students were randomly drawn from the entire population of 760,000 first-time Sixième students (i.e. a sampling fraction of $\frac{1}{22}$), including at least one student from 98% of French middle schools open in 2007. However, given an average of five panel students per school, it was unfortunately not feasible to include school fixed effects to our analysis. Another limit of the panel is its unequal probability sampling design. Indeed, it includes students enrolled in schools from the French priority education network "Aim for Success" ("Réseau Ambition Réussite", RAR). In order to allow for sufficient statistical power in their analysis, 3,500 students from RAR schools were surveyed, which over-represents their true proportion in the population. To address this issue, we follow the DEPP's advice and include frequency weights in our treatment of the data.

3.1.2 Selection of variables

Our main objective with this data is to obtain a better idea of the relationship between socio-behavioral competences of French students and their academic results. Whilst the choice of variables measuring non-cognitive skills was relatively straightforward, deciding on which measure of cognitive outcomes to select was less obvious. After a brief description of our choice for variables of interest, we will detail the variables used as controls. Indeed, the family surveys included in the study (2008 and 2011, with a 93% and 91% response rate respectively) enable us to make use of detailed contextual information as control variables in our analysis. These comprise data about the students' education before middle school, their family and socio-economic environment, changes which might have come about in the family during the child's school years, and finally parents' perception of the school as well as their involvement in their child's education.

Cognitive and Non-Cognitive Variables

The 2007 Panel implements tailor-made evaluations of students' cognitive and socio-behavioral

skills on three occasions; in 2008, 2011 and 2012 (with participation rates of 89%, 83% and 80% respectively). The first two concern the entire cohort of students - second term of Sixième for every student in 2008 and, depending on their academic trajectory, in the second term of their fourth year of secondary studies in 2011. The 2012 survey targets only students in Troisième (9th grade US) at that time, i.e. those who repeated one year between 2008 and 2011. The tests are designed to assess the skills of students who are not necessarily in the same year and, importantly, to deliver comparable results across time which implies equivalent assessments in the three sessions.

The **non-cognitive**, or *conative* part of the evaluation aims to measure students' "self-efficacy" and to confront it to what the students declare in terms of motivation and / or anxiety relative to learning, school support as well as academic and extra-curricular interests. The questions used to construct these indicators derive from a questionnaire developed by Bandura (1990) - his theory on personal self-efficacy explains motivation and academic outcomes through students' belief in their own capacity to regulate their learning and succeed in school. In the same way, he holds that students' capacity to create and maintain social relations and resist peer pressure affects their tendency towards pro-social behaviors. The answers to these questions are indexed through three factorial scores in perceived efficacy on academic, social and "self-regulation" dimensions respectively, which are the main variables that we will use as proxies for non-cognitive skills:

- **Perceived Academic Efficacy** includes 19 items on different domains of academic activities: students' belief in their ability to succeed in various school subjects, the regulation of their own motivation and learning activities, and concerning their parents' and teachers' expectations.
- The index for **Perceived Social Efficacy** includes 13 items: 3 on hobbies and extra-curricular group activities, 5 on students' confidence in their ability to initiate and maintain relationships and regulate interpersonal conflict and 5 on how they feel about their own self-assertiveness.

- Finally, the factorial score for **Perceived Efficacy on Self-Regulation** includes 5 items on students' beliefs about their capacity to resist to peer pressure on high-risk behavior (alcohol, drugs, transgressive habits).

We decide not to include the **motivation** score also contained in the DEPP dataset. This non-cognitive variable follows Deci & Ryan (1993)'s self-determination theory, according to which different types of motivation correspond to degrees of autonomy. When a student chooses to practice an activity herself, because of the pleasure she derives from it, her feeling of autonomy is strong: this is referred to as *intrinsic motivation. Extrinsic motivation* means that she is regulated in her actions (to varying degrees) by the external context. Finally, if she cannot perceive a relation between her actions and their result, or does not find any meaning in her activity, she is in a situation of *amotivation.* However, Blanchard et al. (2013)'s study on the non-cognitive variables included in the DEPP dataset explain that there is no relation between these different forms of motivation - reflecting autonomy - and the cognitive and academic results. They suggest that, contrary to perceived efficacy, motivation is limited in time and thus does not reflect in annual school results.

The **cognitive** variables that we use are a global score giving the average over a series of tests assessing students' proficiency in language (vocabulary and comprehension) and mathematics (arithmetic and numbers, magnitudes and measurement, logical data organization, geometry). The same test was given to students in Sixième and Troisième, so that we can use the same measure of cognitive skills for both. As a check of the robustness of our analysis, we could replace the Sixième cognitive score by the French and Mathematics results of a national evaluation which takes place at the beginning of the Sixième year, and the Troisième cognitive score by the "Brevet des Collèges" (French Certificate of general education which takes place at the end of the Troisième year) average mark.

Context variables

The DEPP Panel, in particular the family survey, gives very detailed information about the stu-

dent's background. We include typical controls (gender, immigration, measure of economic, social and cultural index), partly based on choices made on the PISA dataset, in order to remain comparable, but we also take advantage of the breadth of the data to control for "age in Sixième", "private education", "Sensitive Urban Zone" and "rural" area.

Different questions enable to get an idea of socio-economic variations between students. Some variables directly concern the level of wealth of the family: pre-tax income, available as a numeric variable or by income brackets defined by the study with levels of income ranging from "less than €400 per month" (category 1) to "€10,000 per month or more" (category 14); whether the student is government-funded ("boursier"); the size of the family home and number of children under fourteen years old living at home; the presence of a computer and access to Internet; whether the student possesses their own room and computer; and how burdensome the family finds financial efforts related to the child's studies. Others attempt to form a more precise picture of the socio-cultural context of the family. On top of their socio-professional category, the family survey thus includes precise questions about both parents' occupation and qualifications (highest degree obtained; whether they are currently employed or have been in the past; the status, qualification and main functions of their current job) and their cultural habits, measured through items such as the number of books or the number of CDs, records and audio- and video-cassettes at home, and questions about different cultural events attended by the parents in the last month (concert, theater, cinema, sports event, museum).

To replicate the unique "social, economic and cultural index" that we included in our PISA analysis, we also focus on a single measure: the family head's socio-professional category. We create a categorical variable aggregating the detailed options proposed in the survey to correspond to the top-level INSEE categories: "agriculteurs exploitants" (farmers), "artisans, commerçants et chefs d'entreprise" (craftsmen, tradesmen and entrepreneurs), "cadres et professions intellectelles supérieures" (white collar jobs), "professions intermédiaires" (intermediary occupations), "employés" (service workers), "ouvriers" (blue collar jobs),"autres personnes sans activité professionnelle" (others without professional activity).

3.2 International Survey Data: PISA and TALIS

The Program for International Student Assessment (PISA) is a series of standardized tests carried out every three years since 2000 by the Organization for Economic Cooperation and Development (OECD). We focus on the 2012 and 2015 editions, since these are the first to include information about students' behaviors and disposition towards learning, such as perseverance or anxiety. The 2018 report, due to come out at the end of this year, should include even more comprehensive data on the evaluation of non-cognitive skills. Before PISA 2012, there was a notable lack of data on non-cognitive skills in international assessments including PISA. In 2011 for instance, Brunello & Schlotter regret that "[t]o date, there is no available dataset that allows researchers to compare personality traits and non cognitive skills across countries", which they find surprising given the wealth of international surveys collecting data on cognitive skills for both children and adults (Brunello & Schlotter, 2011). The two editions also represent different stages in the transition from primarily paper-based tests with optional computer-based modules in 2012 to a fully computer-delivered survey (apart from a few economies taking a reduced paper-based version of the assessment) in 2015. The new delivery mode enables to measure extended aspects of the domain constructs, such as interactive simulated scientific inquiries or chat-based collaborative problem-solving tasks.

PISA assesses the performance of 15-year old students from its 34 member countries and associated economies in mathematics, reading and science, as well as a variety of skills including (individual) creative problem solving (PISA 2012), collaborative problem solving (PISA 2015) and financial literacy (both). Each session focuses on one of the three main domains in turn (thus once every nine years) to be assessed more thoroughly - this was mathematics in 2012 and science in 2015. The kind of outcomes that PISA aims to monitor is students' *literacy* in different subjects, i.e. their ability to apply their knowledge to unfamiliar contexts, based as much as possible on situations likely to occur in day-to-day life. This enables to avoid issues linked to domain-specific knowledge likely to vary widely across countries and, instead, assess broader skills adapted to life in the 21^{st} century. In accordance with research on differences in performance on items

of different format (Routitsky and Turner 2003), the test items for both 2012 and 2015 include different response modes (multiple-choice items, numeric or text entries, image and drop-down menu selection, and drag-and-drop questions). In both cases, students took different overlapping combinations of test items such that total testing time for the four core domains reached two hours for each student.

In addition to those cognitive assessments, both versions of the PISA survey include detailed complementary questionnaires for students, their parents as well as the schools, which enable us to gather relevant information on variables other than cognitive skills, including indices of socio-behavioral characteristics and others relating to (students' perception of) their teachers' pedagogical practices. We complement this with aggregate data from the Teaching and Learning International Survey (TALIS), another OECD survey, focused on the inputs of teachers and school principals. They provide information about the professional development they have received, their teaching beliefs and practices, the review of teachers' work and the feedback and recognition they receive about their work, etc. The aim of the survey is to obtain an idea of the different educational practices in participating countries.

3.2.1 Sample Characteristics

PISA: between 15 years and 3 months and 16 years and 2 months - age chosen because close to the end of compulsory education in most countries. 540,000 students tested in 2015, representing a total of 29 million students from 72 countries and economies. Each country has to draw a sample of at least 5,000 students, and in countries where this number exceeds the total number of students in that cohort (e.g. Iceland or Malta) the entire population of students of this age is tested.

3.2.2 Selection of Variables

Non-Cognitive Variables

Thanks to student responses to the context questionnaires in both PISA 2012 and 2015, the OECD

were able to construct several indices concerning non-cognitive skills. The ones which we have chosen to look at are:

- **Perseverance** (PISA 2012), constructed from students' report that the following statements describe them "very much", "mostly", "somewhat", "not much" or "not at all": "When confronted with a problem, I give up easily", "I put off difficult problems", "I remain interested in the tasks that I start", "I continue working on tasks until everything is perfect" and "When confronted with a problem, I do more than what is expected of me".

- **Sense of Belonging to School** (PISA 2015), constructed using student responses over the extent they "strongly agreed", "agreed", "disagreed" or "strongly disagreed" to the following statements: "I feel like an outsider (or left out of things) at school", "I make friends easily at school", "I feel like I belong at school", "I feel awkward or out of place in my school", "Other students seem to like me", "I feel lonely at school", "I feel happy at school", "Things are ideal in my school" and "I am satisfied with my school".

- **Mathematics/Test Anxiety** (PISA 2012/2015). For both versions, the index was derived from students' responses on a four-point Likert scale ("strongly disagree", "disagree", "agree", and "strongly agree") to the following statements: "I often worry that it will be difficult for me in mathematics classes/taking a test", "I get very tense when I have to do mathematics homework/study for a test", "I get very nervous doing mathematics problems/when I don't know how to solve a task at school", "I feel helpless when doing a mathematics problem/Even if I am well prepared for a test I feel very anxious" and "I worry that I will get poor <grades> in mathematics/at school". The five items measuring mathematics anxiety (PISA 2012) had also been used in PISA 2003.

- **Mathematics Self-Concept** (PISA 2012), i.e. the students' level of agreement on their performance in mathematics. It was constructed using students' responses (same scale as above) to: "I am just not good at mathematics", "I get good marks in mathematics", "I learn

mathematics quickly", "I have always believed that mathematics is one of my best subjects" and "in my mathematics class, I understand even the most difficult work".

- **Value Cooperation** (PISA 2015), derived from students' responses (same scale) to: "I prefer working as part of a team to working alone", "I find that teams make better decisions than individuals", "I find that teamwork raises my own efficiency" and "I enjoy cooperating with peers".

- **Enjoy Cooperation** (PISA 2015), using students' answers, on the same scale, to "I am a good listener", "I enjoy seeing my classmates be successful", "I take into account what others are interested in", and "I enjoy considering different perspectives".

- **Motivation** (PISA 2015). Constructed using students' responses (on the same scale) to new questions developed for PISA 2015: "I want top grades in most or all of my courses", "I want to be able to select from among the best opportunities available when I graduate", "I want to be the best, whatever I do", "I see myself as an ambitious person" and "I want to be one of the best students in my class".

Pedagogical Practices

PISA does not provide much information about pedagogical practices, and the only data we have is derived only from students' perceptions, since there are no teacher questionnaires linked to PISA. The few student-declared variables in both 2012 and 2015 relating to measures of pedagogical practices that we use are:

- **Mathematics Teacher Support** (PISA 2012), constructed from students' answers on a four-point scale from "strongly agree" to "strongly disagree" to the following items: "My teacher lets us know we need to work hard", "My teacher provides extra help when needed", "My teacher helps students with their learning", "My teacher gives students the opportunity to express opinions".

- **Teacher Support in Mathematics/Science Classes** (PISA 2012/2015), derived from students' reports on how often ("never or almost never"; "some lessons"; "many lessons"; "every lesson or almost every lesson") the following happened in their mathematics/science lessons: "The teacher shows an interest in every student's learning", "The teacher gives extra help when students need it", "The teacher helps students with their learning", "The teacher continues teaching until the students understand" and "The teacher gives students an opportunity to express opinions".

- **Index of Adaptive Instruction** (PISA 2015), constructed from students' reports on how often (on the same scale) the following happened in their science lessons: "The teacher adapts the lesson to my class's needs and knowledge", "The teacher provides individual help when a student has difficulties understanding a topic or task", "The teacher changes the structure of the lesson on a topic that most students find difficult to understand".

- **Index of Perceived Feedback** (PISA 2015), constructed from students' reports on how often (on the same scale) the following happened in their science lessons: "The teacher tells me how I am performing in this course", "The teacher gives me feedback on my strengths in this <school science> subject", "The teacher tells me in which areas I can still improve", "The teacher tells me how I can improve my performance", "The teacher advises me on how to reach my learning goals".

- **Inquiry-Based Science Teaching and Learning Practices** (PISA 2015), derived from the students' responses on a four-point scale (same scale) to "When learning <school science> topics at school, how often do the following activities occur?": "Students are given opportunities to explain their ideas", "Students spend time in the laboratory doing practical experiments", "Students are required to argue about science question", "Students are asked to draw conclusions from an experiment they have conducted", "The teacher explains how a <school science> idea can be applied to a number of different phenomena", "Students are allowed to design their own experiments", "There is a class debate about investigations",

"The teacher clearly explains the relevance of <broad science> concepts to our lives".

We also added TALIS data on an extra four indicators, derived from the percentage of lower secondary education teachers who report using the following teaching practices "frequently" or "in all or nearly all lessons" : "Students work in small groups to come up with a joint solution to a problem or task" ("Group Work" index), "Give different work to the students who have difficulties learning and/or to those who can advance faster" ("Adaptation of Instruction" index), "Students work on projects that require at least one week to complete" ("Project-Based Work index) and "Students use ICT for projects or class work" ("ICT use" index).

Cognitive Variables

To simplify the comparison, we use a single measure of cognitive performance available in both PISA 2012 and PISA 2015. Since many of the non-cognitive variables as well as pedagogical practices in PISA 2012 are related to mathematics, we will focus exclusively on the global score in mathematics. PISA does not provide a single value per student for the score, but a combination of 10 “plausible values” per field for each student. Indeed, in order to assess a wide range of skill domains and gain a better understanding of performance at the aggregate level, a vast number of items are developed for each assessment and, to reduce response time, each student answers only part of the full set of items. This means that variations in test scores could be attributed to differences in difficulty or measurement errors rather than proficiency. Instead, to estimate individual scores, the OECD uses Item Response Theory (IRT) for item calibration - regularities in the response pattern in a set of same-skill items are used to compare students and items on a common scale - and, fixing the item parameters at these values, fitting a latent regression model to the data with proficiency as missing variable. This enables them, following in Rubin (1987), to obtain regression weights Γ and a residual variance-covariance matrix Σ. Using these parameters, they derive a proficiency distribution given item responses and context variables, from which 10 plausible values are drawn at random. We then use the REPEST module for STATA, which is specifically designed for such analyses with multiply imputed variables, to compute an average

estimator across plausible values and add an imputation error to the variance estimator.

Context variables

We add classical controls for individual student characteristics (age, gender, immigration, and economic, social and cultural family index), for school characteristics (class size and public school), as well as country-fixed effects.

4 Empirical Strategy and Results

Through our analysis, we attempt to answer two main questions: whether the relationship between performances on non-cognitive items and cognitive results is confirmed for France, and whether we can observe a link between different pedagogical practices and non-cognitive skills. We first estimate the impact of present and past non-cognitive skills on current cognitive performance - and thus want to compare students with similar family backgrounds, from the same type of schools and areas, and with the same level of past performance.

4.1 DEPP

To include both 2011 and 2012 data - i.e. to include students who repeated a grade at some point between Sixième and Troisième and ended up in Troisième in 2011-2012 - we generate a new variable, equal to the 2012 value when it exists, and to the traditional 2011 value otherwise. We repeat the process for the total cognitive score; for our three self-efficacy factors for academic, social and self-regulation; for the "motivation" index; for the average obtained for the Brevet exam and for the mark out of twenty obtained for "vie scolaire" (i.e. attendance, punctuality and behavior) during the Troisième year. In order to control for the grade repetition, we then generate a dummy equal to one when the student's class in 2011-2012 is "Troisième" - i.e. if the variable "clas5" takes on a value corresponding to one of the possible Troisième classes.

We also generate dummy variables for "female" when the gender variable takes on that value;

"immigration" when the student's nationality is either "foreign" or "acquired the French nationality"; "private education" if the child attended an exclusively private school at some point up to 2011 (kindergarten, primary school, middle school or even high school for students who were early in 2011); for "ZUS" when the student attended a school located in a sensitive urban zone for any year between 2007 and 2012 (and "RAR" when the school belonged to the Aim for Success network), and finally for "rural" when the students' home or school did not belong to an urban unit between those years.

As a first test of our data, we start by regressing the cognitive score obtained through the Sixième assessment on our three non-cognitive variables. As predicted by the literature, the coefficients for both the academic and self-regulation self-efficacy indexes are positive and significant [see Table 1]. The adjusted R-squared goes from .206 when looking only at the self-regulation variable to .245 when adding the other the other two dimensions. The significant negative coefficient for the social dimension can be explained through a decomposition of the items determining the score - questions about hobbies and extra-curricular activities can for instance be interpreted as students focused more on life outside of school than on school work. We will thus concentrate only on the other two variables, which are better suited to what we are looking to estimate.

The last column of our table adds frequency weights associated to the 2008 specific evaluation and family questionnaire. Indeed, as we are only working with the subpopulation consisting of students who were both assessed in the specific evaluation of 2008 and whose family filled in the 2008 questionnaire, we follow the advice of the DEPP documentation and add the probability weights "pond_eva2008f" to the regression equation. This enables to correct for the over-representation of RAR students on one hand and "non-natural" attrition on the other. We use the weighted coefficients in further regressions.

We then add controls for the child's gender, age of first entry in Sixième (thus controlling for grades repeated or skipped in the past, as well as age of entry in the school system), immigration status and social position (through a categorical variable for the head of the household's socio-professional category). The coefficients remain strongly positive [see Table 2], and the R-squared

Table 1: Impact of 6e self-efficacy variables on 6e scores

	(1) Global Score 6e	(2) Global Score 6e	(3) Global Score 6e	(4) Global Score 6e
Self-Regulation SEP 6e	6.670***	5.578***	5.770***	5.690***
	(0.0782)	(0.0849)	(0.0878)	(0.0883)
Academic SEP 6e		2.988***	3.825***	3.920***
		(0.0839)	(0.0966)	(0.0993)
Social 6e			-1.860***	-1.932***
			(0.0957)	(0.102)
Constant	100.5***	101.2***	101.4***	101.7***
	(0.0779)	(0.0788)	(0.0798)	(0.0804)
Observations	27972	24927	23754	23754
Adjusted R^2	0.206	0.240	0.245	0.246

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

reaches 0.4. Finally, we attempt to control for the type of school attended by the student by adding a dummy for "private education" and for the characteristics of the area by adding a dummy for "sensitive urban zone" (ZUS) and another for rural zones. The coefficients barely shift, and we henceforth discard our rural variable for lack of significance. The "private" dummy also does not appear to add much information relative to our social position dummies, so that we end up only keeping our variable for sensitive urban zone.

In Table 3, we perform this analysis separately for students from the RAR network and for the rest. We notice that, controlling for student and area characteristics described above, the two self-efficacy variables explain a much larger proportion of the global cognitive score for students who do not belong to the RAR network than for those who do, with (significant) coefficients of 3.733 for the role of perceived self-regulation efficacy on our measure of cognitive outcome for students in schools belonging to the RAR network (versus 4.109 for others) and 1.929 for their perceived academic self-efficacy index (versus 2.232 for non-RAR students).

We then carry out the same regressions for Troisième students - perceived self-regulation and academic efficacy indexes from the 2011 and 2012 data on the global cognitive score for

Table 2: Impact of 6e self-efficacy variables on 6e scores (with controls)

	(1) Global score 6e	(2) Global score 6e	(3) Global score 6e
Self-Regulation SEP 6e	5.485***	4.137***	4.122***
	(0.0843)	(0.0771)	(0.0770)
Academic SEP 6e	3.063***	2.185***	2.225***
	(0.0860)	(0.0795)	(0.0794)
Female		-0.859***	-0.867***
		(0.142)	(0.142)
Age 6e		-9.431***	-9.330***
		(0.200)	(0.200)
Immigration		-2.226***	-1.952***
		(0.335)	(0.336)
Agriculteurs		0	0
		(.)	(.)
AC&CE		-0.436	-0.291
		(0.486)	(0.490)
CPIS		4.618***	4.728***
		(0.468)	(0.476)
PI		0.319	0.643
		(0.471)	(0.476)
Employés		-2.571***	-2.118***
		(0.478)	(0.485)
Ouvriers		-3.866***	-3.393***
		(0.458)	(0.464)
Other, no activity		-9.163***	-8.378***
		(0.852)	(0.862)
Private			1.156***
			(0.161)
ZUS			-2.046***
			(0.226)
Rural			0.0757
			(0.157)
Constant	101.6***	208.0***	206.4***
	(0.0792)	(2.260)	(2.260)
Observations	24927	24653	24653
Adjusted R^2	0.240	0.401	0.405

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Impact of 6e self-efficacy variables on 6e scores (with controls)

	Non-RAR	RAR
	Global score 6e	Global score 6e
Self-Regulation SEP 6e	4.109***	3.733***
	(0.0799)	(0.252)
Academic SEP 6e	2.232***	1.929***
	(0.0820)	(0.259)
Female	−0.897***	−0.556
	(0.146)	(0.524)
Age 6e	−9.361***	−7.760***
	(0.209)	(0.579)
Immigration	−1.842***	−0.862
	(0.366)	(0.677)
Agriculteurs	0	0
	(.)	(.)
AC&CE	−0.328	−3.190
	(0.492)	(2.842)
CPIS	4.634***	3.269
	(0.473)	(2.987)
PI	0.452	−1.183
	(0.476)	(2.812)
Employés	−2.138***	−4.914
	(0.485)	(2.727)
Ouvriers	−3.553***	−4.566
	(0.465)	(2.697)
Other, no activity	−8.360***	−8.523**
	(0.956)	(2.930)
ZUS	−1.602***	0.474
	(0.253)	(0.548)
Constant	207.4***	183.9***
	(2.348)	(7.206)
Observations	22724	1929
Adjusted R^2	0.394	0.378

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

those years. To this end, we reduce our sample size only to those students for whom we have data from both their specific evaluation for Troisième (in either 2011 if they were on time or 2012 if they repeated a class) and their 2008 family survey. We thus choose different weights than previously "pond_eva3e", which are designed for this precise subpopulation of students. The

last two columns of Table 4 once again enable a comparison of the scores with (4) and without (3) added weights. As in Table 1, we find positive and significant values for perceived efficacy indices for self-regulation and school success, and a negative value for the social index. The scores were reported differently than the global scores for Sixième students which explains the much lower value for the constant as well as the coefficients. However, we also obtain a much smaller R-squared than for 6e students (.118 for the three variables in the weighted regression), which could suggest that these non-cognitive skills explain less of the variation between scores for Troisième students than they did in Sixième.

Table 4: Impact of 3e self-efficacy variables on 3e scores

	(1) Global score 3e	(2) Global score 3e	(3) Global score 3e	(4) Global score 3e
Self-Regulation SEP 3e	0.664***	0.402***	0.405***	0.478***
	(0.0174)	(0.0186)	(0.0188)	(0.0288)
Academic SEP 3e		0.431***	0.489***	0.475***
		(0.0123)	(0.0129)	(0.0165)
Social SEP 3e			-0.211***	-0.205***
			(0.0133)	(0.0166)
Constant	0.150***	0.458***	0.510***	0.430***
	(0.0124)	(0.0145)	(0.0146)	(0.0203)
Observations	23390	22539	21993	21993
Adjusted R^2	0.058	0.103	0.111	0.118

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In Table 5, we add controls for gender, age of entry in Sixième and an additional variable constructed to indicate grade repetition between 2007 and 2011 (column 2), and then control for immigration, social position and belonging or not to a Sensitive Urban Zone. Both coefficients remain positive and significant (.316 for Self-Regulation and .262 for Academic self-efficacy). Including all controls we explain almost 40% of the variation in scores. Adding a measure of past cognitive score (global score for Sixième) makes the R-squared reach .765, and considerably reduces both self-efficacy coefficients: Self-Regulation decreases to .127 and Academic to .126. Neverthe-

less, both the sign and the significance remain: perceived self-efficacy seems to predict cognitive outcomes even controlling for past school results.

Table 5: Impact of 3e self-efficacy variables on 3e scores (with controls)

	(1) Global score 3e	(2) Global score 3e	(3) Global score 3e	(4) Global score 3e
Self-Regulation SEP 3e	0.475***	0.330***	0.316***	0.127***
	(0.0277)	(0.0196)	(0.0181)	(0.0114)
Academic SEP 3e	0.422***	0.287***	0.262***	0.126***
	(0.0153)	(0.0127)	(0.0118)	(0.00769)
Female		-0.191***	-0.167***	-0.0733***
		(0.0222)	(0.0211)	(0.0132)
Age 6e		-2.015***	-1.716***	-0.557***
		(0.0333)	(0.0324)	(0.0217)
Grade repeat since 6e		-0.750***	-0.611***	0.254***
		(0.0369)	(0.0341)	(0.0236)
Immigration			-0.418***	-0.0705*
			(0.0512)	(0.0327)
Agriculteurs			0	0
			(.)	(.)
AC&CE			-0.0641	-0.0681
			(0.0714)	(0.0404)
CPIS			0.581***	0.0890*
			(0.0684)	(0.0386)
PI			0.0334	-0.0486
			(0.0694)	(0.0389)
Employés			-0.357***	-0.176***
			(0.0719)	(0.0410)
Ouvriers			-0.558***	-0.229***
			(0.0682)	(0.0381)
Other, no activity			-1.370***	-0.437***
			(0.141)	(0.0818)
ZUS			-0.443***	-0.159***
			(0.0353)	(0.0216)
Score 6e				0.0989***
				(0.000694)
Constant	0.377***	22.97***	19.82***	-3.384***
	(0.0194)	(0.369)	(0.362)	(0.285)
Observations	22539	22539	22304	22304
Adjusted R^2	0.112	0.343	0.398	0.765

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We then again look at differentiated results for students from priority education schools and others. This time, the results have shifted: for older students, the perceived "self-regulation" capacity plays a bigger role in RAR schools than elsewhere (.223 coefficient for RAR versus .123 for students in non-RAR schools). It is still the case however that, with those controls, students' academic self-efficacy predicts their cognitive outcome better for students in non-RAR schools. In both cases, those controls explain over 75% of the variability in test scores, with an R-squared of .729 for students in schools belonging to the priority education network, versus .760 elsewhere.

Finally, the longitudinal nature of the study enables us to regress students' scores in 3e on their 6e self-efficacy indicators, in order to see whether the relationship between non-cognitive and cognitive outcomes is verified several years apart. And indeed, we get similar results to previously in Table 7, with positive significant coefficients for Sixième Self-Regulation and Academic perceived efficacy (with a coefficient almost twice as important for the Self-Regulation effect than for the Academic index), and negative for Social. Together, the three Sixième non-cognitive measures explain over 20% of the cognitive measure for Troisième.

Although this remains true when adding our controls (Table 8), including the measure of cognitive score in Sixième greatly reduces the explanatory power of the self-efficacy variables: the coefficient for Self-Regulation decreases from .480 to .0779, and the coefficient for Academic self-efficacy goes from .219 to .0339. This supports the idea of a feedback loop between non-cognitive and cognitive outcomes, and suggests that part of the link observed between socio-behavioral skills (at least for the feeling of self-efficacy) and academic results might stem from reverse causality or omitted variable bias.

When differentiating between RAR and non-RAR students (Table 9), we again observe a much higher coefficient for Self-Regulation for students from the high priority education network than for the rest (.112 versus .077). However, when controlling by the Sixième cognitive score, the perceived academic efficacy coefficient is no longer significant for students in RAR (it is for others).

Table 6: Impact of 3e self-efficacy variables on 3e scores (with controls)

	Non-RAR	RAR
	Global score 3e	Global score 3e
Self-Regulation SEP 3e	0.123***	0.223***
	(0.0118)	(0.0365)
Academic SEP 3e	0.127***	0.116***
	(0.00797)	(0.0249)
Female	−0.0710***	−0.136*
	(0.0135)	(0.0559)
Age 6e	−0.577***	−0.227**
	(0.0223)	(0.0727)
Grade repeat since 6e	0.248***	0.383***
	(0.0242)	(0.0856)
Immigration	−0.0723*	−0.0385
	(0.0357)	(0.0682)
Agriculteurs	0	0
	(.)	(.)
AC&CE	−0.0713	0.120
	(0.0409)	(0.178)
CPIS	0.0823*	0.526*
	(0.0390)	(0.206)
PI	−0.0511	0.0559
	(0.0394)	(0.165)
Employés	−0.175***	0.00884
	(0.0417)	(0.149)
Ouvriers	−0.229***	−0.0159
	(0.0386)	(0.145)
Other, no activity	−0.458***	−0.104
	(0.0944)	(0.175)
ZUS	−0.141***	−0.112
	(0.0245)	(0.0611)
Score 6e	0.0987***	0.0987***
	(0.000717)	(0.00258)
Constant	−3.118***	−7.481***
	(0.293)	(0.948)
Observations	20671	1633
Adjusted R^2	0.760	0.729

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Impact of 6e self-efficacy variables on 3e scores

	(1) Global score 3e	(2) Global score 3e	(3) Global score 3e	(4) Global score 3e
Self-Regulation SEP 6e	0.801***	0.680***	0.711***	0.723***
	(0.0116)	(0.0127)	(0.0131)	(0.0148)
Academic SEP 6e		0.337***	0.474***	0.506***
		(0.0127)	(0.0146)	(0.0176)
Social SEP 6e			-0.287***	-0.290***
			(0.0142)	(0.0167)
Constant	0.267***	0.323***	0.333***	0.287***
	(0.0113)	(0.0116)	(0.0117)	(0.0131)
Observations	22535	20245	19345	19345
Adjusted R^2	0.174	0.195	0.206	0.218

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2 PISA

As explained above, PISA analysis is traditionally realized at the cross-country level, since scores and indexes are computed at the aggregate rather than individual level. Nevertheless, to get beyond aggregate correlations, we use plausible values and the REPEST module to estimate the link between non-cognitive indicators and cognitive performances at the individual level. To control for omitted variables, we include several student and school characteristics, as well as country-fixed effects. For both PISA 2012 and PISA 2015, we merge the student and school questionnaire databases by school ID, since are variables for "class size" and "public school" come from the school questionnaires. We create dummy variables for "public school" if the "school type" variable is equal to 3 ("public school"), for female and for immigration status.

For both PISA 2012 and PISA 2015, we first realize a first regression of the mathematics score (pv@math, the average of plausible values for individual students obtained through REPEST) on our socio-behavioral variables, adding our controls and a country-fixed effect (Table 10. In each case, the "Anxiety" coefficient is strongly negative. The coefficients for "Perseverance", "Mathematics Self-Concept", "Enjoy Cooperation" and "Motivation" on the other hand are positive and significant. However, we do not get much out of the "Belonging" variable, given that its coeffi-

Table 8: Impact of 6e self-efficacy variables on 3e scores (with controls)

	(1) Global score 3e	(2) Global score 3e	(3) Global score 3e	(4) Global score 3e
Self-Regulation SEP 6e	0.694***	0.532***	0.480***	0.0779***
	(0.0143)	(0.0129)	(0.0125)	(0.00834)
Academic SEP 6e	0.372***	0.228***	0.219***	0.0339***
	(0.0152)	(0.0129)	(0.0125)	(0.00814)
Female		-0.180***	-0.164***	-0.0384**
		(0.0222)	(0.0214)	(0.0137)
Age 6e		-1.779***	-1.539***	-0.506***
		(0.0342)	(0.0335)	(0.0221)
Grade Repeat since 6e		-0.609***	-0.497***	0.266***
		(0.0371)	(0.0358)	(0.0253)
Immigration			-0.286***	-0.0487
			(0.0523)	(0.0330)
Agriculteurs			0	0
			(.)	(.)
AC&CE			-0.121	-0.0675
			(0.0698)	(0.0417)
CPIS			0.520***	0.0840*
			(0.0668)	(0.0397)
PI			0.00308	-0.0424
			(0.0677)	(0.0403)
Employés			-0.368***	-0.152***
			(0.0702)	(0.0424)
Ouvriers			-0.544***	-0.207***
			(0.0666)	(0.0395)
Other, no activity			-1.156***	-0.330***
			(0.150)	(0.0891)
ZUS			-0.401***	-0.180***
			(0.0362)	(0.0222)
Score 6e				0.104***
				(0.000674)
Constant	0.271***	20.24***	17.79***	-4.594***
	(0.0129)	(0.379)	(0.374)	(0.282)
Observations	20245	20245	20053	20053
Adjusted R^2	0.209	0.381	0.427	0.773

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

cient is negative for PISA 2012 and positive for 2015. Finally, we surprisingly obtain a negative coefficient for "Value Cooperation". These variable explain 48% and 37% (respectively PISA 2012 and 2015) of the mathematics score.

We replicate the same analysis at the French level (Table 11), and obtain both similar results and almost identical R-squared. In this case, however, "Belonging" gives significant positive coefficients for both 2012 and 2015. The role of anxiety seems less important in France, whereas we get higher coefficients for the mathematics self-concept. Class size seems much more influential in France than elsewhere, with coefficients exceeding 5 for both PISA 2012 and PISA 2015 - it is an order of magnitude lower for all countries. The family social position index and going to a public school are also a stronger predictor of success on the cognitive math score for France than for the rest of the countries, whereas immigration is more strongly correlated with failure. This is consistent with OECD reports that academic success depends more on predetermined family conditions in France than the OECD average.

Finally, we look at how the student-reported pedagogical practices in both editions of PISA influence these different non-cognitive indicators (Tables 12 and 13). In general, these results are less compelling than previously, with average R-squared around .15. As might be expected, teacher support has a significant negative effect on anxiety in PISA 2012 and 2015, but our other indicators, including the variable for "mathematics teacher support", are not significant. Nevertheless, we obtain significantly positive results for the role of all indicators on "Belonging" in both versions of the survey, on "Perseverance", "Mathematics Self-Concept", "Cooperation" (both "Value" and "Enjoy") and "Motivation". Both "Mathematics Self-Concept" and "Motivation" have an R-squared of .20 - teacher support seems to play a relatively important role in the construction of a positive math self-concept. Adaptation of instruction seems to play a role on how much students enjoy cooperation.

These results are similar in France (Tables 14 and 15), with a stronger effect of teacher support on perseverance and mathematics self-concept but less significant results on anxiety. In general, the effect of different pedagogical practices (as measured by PISA student-reported indicators) on

those socio-behavioral skills seems to be even less pronounced in France than in the rest of the world.

Table 9: Impact of 6e self-efficacy variables on 3e scores (with controls)

	Non-RAR	RAR
	Global score 3e	Global score 3e
Self-Regulation SEP 6e	0.0770***	0.112***
	(0.00861)	(0.0308)
Academic SEP 6e	0.0336***	0.0474
	(0.00834)	(0.0338)
Female	−0.0364**	−0.0705
	(0.0139)	(0.0684)
Age 6e	−0.525***	−0.237**
	(0.0226)	(0.0820)
Grade Repeat since 6e	0.260***	0.408***
	(0.0258)	(0.106)
Immigration	−0.0546	−0.0137
	(0.0356)	(0.0883)
Agriculteurs	0	0
	(.)	(.)
AC&C	−0.0717	0.252
	(0.0421)	(0.219)
CPIS	0.0765	0.591*
	(0.0401)	(0.235)
PI	−0.0457	0.168
	(0.0407)	(0.206)
Employés	−0.152***	0.153
	(0.0431)	(0.194)
Ouvriers	−0.210***	0.153
	(0.0400)	(0.192)
Other, no activity	−0.336**	−0.0316
	(0.103)	(0.221)
ZUS	−0.170***	−0.150*
	(0.0245)	(0.0712)
Score 6e	0.104***	0.103***
	(0.000690)	(0.00324)
Constant	−4.360***	−7.930***
	(0.288)	(1.065)
Observations	18680	1373
Adjusted R^2	0.769	0.726

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Impact of socio-behavioral variables on students' performance in mathematics (all)

	Math Score	p-value	Math Score	p-value
	PISA 2012		PISA 2015	
Anxiety	-18,55	0,0000	-10,3	0,0000
	(0,67)		(0,52)	
Belonging	-3,68	0,0000	2,62	0,0000
	(0,5)		(0,41)	
Perseverance	5,15	0,0000		
	(0,55)			
Math self-concept	15,47	0,0000		
	(0,6)			
Cooperation (value)			-11,35	0,0000
			(0,49)	
Cooperation (enjoy)			10,61	0,0000
			(0,45)	
Motivation			11,72	0,0000
			(0,58)	
Age	13,95	0,0000	10,6	0,0000
	(1,69)		(1,33)	
Female	-4,39	0,0001	-9,11	0,0000
	(1,08)		(0,83)	
Immigration	-13,28	0,0004	-15,35	0,0000
	(3,76)		(2,62)	
Economic, social and	25,8	0,0000	24,81	0,0000
cultural index of the family	(0,62)		(0,54)	
Class size	0,51	0,0000	0,68	0,0000
	(0,11)		(0,12)	
Public school	-9,24	0,0000	-8,2	0,0001
	(2,21)		(2,15)	
Intercept	201,14	0,0000	318,31	0,0000
	(26,51)		(21,04)	
Country fixed effects	Yes		Yes	
R-squared	0,48		0,37	
No. observations	144738		346712	

Table 11: Impact of socio-behavioral variables on students' performance in mathematics (France)

	Math Score	p-value	Math Score	p-value
	PISA 2012		PISA 2015	
Anxiety	-13,05	0,0000	-8,25	0,0000
	2,23		1,48	
Belonging	2,14	0,2837	5,62	0,0009
	1,99		1,69	
Perseverance	4,37	0,0602		
	2,33			
Math self-concept	22,33	0,0000		
	2,54			
Cooperation (value)			-9,96	0,0000
			1,31	
Cooperation (enjoy)			11,57	0,0000
			1,49	
Motivation			7,68	0,0000
			1,7	
Age	-0,1	0,9906	12,75	0,0063
	8,44		4,67	
Female	-3,92	0,3911	-13,83	0,0000
	4,57		3,12	
Immigration	-21,34	0,0493	-32,39	0,0000
	10,86		7,67	
Economic, social and	33,69	0,0000	32,37	0,0000
cultural index of the family	3,8		2,99	
Class size	7,62	0,0000	5,79	0,0000
	0,91		0,59	
Public school	-16,48	0,0356	-11,37	0,0611
	7,84		6,07	
Intercept	307,04	0,0193	151,84	0,0383
	131,23		73,3	
R-squared	0,49		0,37	
No. observations	1384		5066	

Table 12: Impact of teacher practices on non-cognitive skills, controlling by cognitive skills (1)

	Anxiety	p-value	Anxiety	p-value	Belonging	p-value	Belonging	p-value
	PISA 2012		PISA 2015		PISA 2012		PISA 2015	
Teacher support	-0,10	0,0000	-0,03	0,0000	0,11	0,0000	0,08	0,0000
	(0,01)		(0,01)		(0,01)		(0,01)	
Teacher support (Math)	0,01	0,2162			0,23	0,0000		
	(0,01)				(0,00)			
Adaptation of instruction			0,01	0,3717			0,03	0,0000
			(0,01)				(0,01)	
Perceived feedback			0,00	0,9015			0,04	0,0000
			(0,01)				(0,01)	
Inquiry-based approach			-0,02	0,0001			0,02	0,0018
			(0,01)				(0,01)	
Age	0,03	0,0044	-0,01	0,4217	-0,01	0,5035	-0,01	0,5375
	(0,01)		(0,02)		(0,01)		(0,01)	
Female	0,15	0,0000	0,37	0,0000	0,02	0,0151	-0,02	0,0421
	(0,01)		(0,01)		(0,01)		(0,01)	
Immigration	-0,10	0,0001	0,04	0,2721	-0,05	0,1624	-0,12	0,0000
	(0,03)		(0,03)		(0,03)		(0,02)	
Economic, social and	0,03	0,0000	-0,01	0,1729	0,07	0,0000	0,06	0,0000
cultural index of the family	(0,00)		(0,01)		(0,00)		(0,00)	
Class size	0,00	0,0042	0,00	0,0000	0,00	0,0160	0,00	0,8802
	(0,00)		(0,00)		(0,00)		(0,00)	
Public school	-0,02	0,1523	-0,03	0,0669	0,00	0,8133	-0,03	0,0442
	(0,01)		(0,01)		(0,01)		(0,01)	
Math score	0,00	0,0000	0,00	0,0000	0,00	0,0000	0,00	0,0000
	(0,00)		(0,00)		(0,00)		(0,00)	
Intercept	1,08	0,0000	0,83	0,0017	-0,22	0,2594	-0,33	0,1550
	(0,19)		(0,26)		(0,20)		(0,23)	
Country fixed effects	Yes		Yes		Yes		Yes	
R-squared	0,18		0,11		0,13		0,06	
No. observations	291940		296759		291836		291823	

Table 13: Impact of teacher practices on non-cognitive skills, controlling by cognitive skills (2)

	Perseverance	p-value	Self-concept	p-value	Cooperation (value)	p-value	Cooperation (enjoy)	p-value	Motivation	p-value
	PISA 2012		PISA 2012		PISA 2015		PISA 2015		PISA 2015	
Teacher support	0,09	0,0000	0,13	0,0000	0,07	0,0000	0,09	0,0000	0,04	0,0000
	0,01		0,01		0,00		0,01		0,01	
Teacher support (Math)	0,12	0,0000	0,07	0,0000						
	0,01		0,01							
Adaptation of instruction					0,04	0,0000	0,08	0,0000	0,04	0,0000
					0,01		0,01		0,01	
Perceived feedback					0,07	0,0000	0,06	0,0000	0,05	0,0000
					0,01		0,01		0,01	
Inquiry-based approach					0,02	0,0016	0,04	0,0000	0,03	0,0000
					0,01		0,01		0,01	
Age	0,00	0,9983	-0,05	0,0000	-0,03	0,0126	0,04	0,0036	0,01	0,4518
	0,02		0,01		0,01		0,02		0,01	
Female	-0,02	0,0809	-0,20	0,0000	-0,11	0,0000	0,17	0,0000	0,07	0,0000
	0,01		0,01		0,01		0,01		0,01	
Immigration	0,10	0,0244	0,20	0,0000	0,00	0,8882	0,04	0,0799	0,13	0,0000
	0,04		0,03		0,03		0,02		0,03	
Economic, social and	0,04	0,0000	-0,02	0,0000	0,00	0,6299	0,07	0,0000	0,08	0,0000
cultural index of the family	0,01		0,00		0,01		0,00		0,00	
Class size	0,00	0,1473	0,00	0,0072	0,00	0,0411	0,00	0,0287	0,00	0,1008
	0,00		0,00		0,00		0,00		0,00	
Public school	0,05	0,0358	0,05	0,0003	0,01	0,5409	0,01	0,4382	0,02	0,1661
	0,02		0,01		0,01		0,01		0,01	
Math score	0,00	0,0000	0,00	0,0000	0,00	0,0000	0,00	0,0000	0,00	0,0000
	0,00		0,00		0,00		0,00		0,00	
Intercept	-0,64	0,0247	-0,14	0,4496	0,92	0,0000	-1,39	0,0000	-0,67	0,0024
	0,29		0,19		0,22		0,24		0,22	
Country fixed effects	Yes		Yes		Yes		Yes		Yes	
R-squared	0,14		0,20		0,06		0,08		0,20	
No. observations	144786		291919		296687		296692		296607	

In TALIS 2013, participating countries and economies had the option of applying TALIS questionnaires to a PISA 2012 subsample with the purpose of linking data on schools, teachers and students. This option is called the “TALIS-PISA Link” database. However, this was not used in France, so that we have no way of linking TALIS to PISA data on an individual level. Instead, we use aggregated PISA and TALIS data to look first at the prevalence of certain teaching habits in France compared to similar OECD countries, and then at correlations attempting to distinguish a link between the level of "preparedness" that teachers feel on both the contents of their class and the pedagogical tools they have at their disposition in different countries (obtained through TALIS) and country-level estimates for PISA non-cognitive skills (see Appendix for graphs). Our "Northern countries" average is based on results from Denmark, Finland, Norway and Sweden and "Southern countries" on Italy, Greece (only in PISA since we do not have TALIS data for Greece) and Spain. We observe that France performs worse than average on most items related to pedagogical practices, with the notable exception of "Inquiry-Based Science Teaching and Learning Practices". We also see that the teachers’ perception of how well-prepared they are on pedagogical practices (lower in France than in other countries) is correlated to the the average performance in the country on socio-behavioral variables.

Table 14: Impact of teacher practices on non-cognitive skills, controlling by cognitive skills (France 1)

	Anxiety	p-value	Anxiety	p-value	Belonging	p-value	Belonging	p-value
	PISA 2012		PISA 2015		PISA 2012		PISA 2015	
Teacher support	-0,09	0,0001	-0,05	0,0066	0,05	0,0482	0,03	0,0140
	0,02		0,02		0,03		0,01	
Teacher support (Math)	0,06	0,0065			0,16	0,0000		
	0,02				0,02			
Adaptation of instruction			0,03	0,0781			0,03	0,0593
			0,02				0,01	
Perceived feedback			0,03	0,0629			0,02	0,1916
			0,02				0,01	
Inquiry-based approach			0,00	0,9360			0,03	0,0597
			0,02				0,02	
Age	-0,03	0,4730	0,08	0,1463	0,10	0,1034	0,03	0,5283
	0,05		0,05		0,06		0,04	
Female	0,34	0,0000	0,45	0,0000	0,10	0,0017	0,00	0,8795
	0,03		0,03		0,03		0,02	
Immigration	0,11	0,2622	0,00	0,9712	0,10	0,3209	0,01	0,9098
	0,10		0,07		0,10		0,06	
Economic, social and	0,06	0,0456	-0,02	0,5112	0,13	0,0000	0,07	0,0001
cultural index of the family	0,03		0,03		0,03		0,02	
Class size	0,02	0,0000	0,02	0,0007	0,01	0,0685	0,00	0,1329
	0,01		0,00		0,01		0,00	
Public school	-0,10	0,0222	-0,08	0,0694	0,01	0,8765	0,00	0,8769
	0,05		0,04		0,04		0,03	
Math score	0,00	0,0000	0,00	0,0000	0,00	0,0000	0,00	0,0000
	0,00		0,00		0,00		0,00	
Intercept	1,87	0,0150	-1,14	0,1773	-2,55	0,0144	-1,02	0,1396
	0,77		0,84		1,04		0,69	
R-squared	0,17		0,08		0,08		0,03	
No. observations	2766		4527		2762		4521	

Table 15: Impact of teacher practices on non-cognitive skills, controlling by cognitive skills (France 2)

	Perseverance	p-value	Self-concept	p-value	Cooperation (value)	p-value	Cooperation (enjoy)	p-value	Motivation	p-value
	PISA 2012		PISA 2012		PISA 2015		PISA 2015		PISA 2015	
Teacher support	0,15	0,0001	0,19	0,0000	0,03	0,1092	0,05	0,0101	0,04	0,0579
	0,04		0,02		0,02		0,02		0,02	
Teacher support (Math)	0,09	0,0161	0,03	0,2755						
	0,04		0,03							
Adaptation of instruction					0,02	0,2179	0,09	0,0000	0,07	0,0000
					0,02		0,02		0,02	
Perceived feedback					0,05	0,0273	0,03	0,0757	0,01	0,5176
					0,02		0,02		0,02	
Inquiry-based approach					0,02	0,3533	0,05	0,0246	0,03	0,2418
					0,03		0,02		0,02	
Age	-0,09	0,3551	-0,05	0,4119	0,00	0,9411	0,05	0,2733	0,02	0,7167
	0,10		0,06		0,06		0,04		0,04	
Female	-0,18	0,0002	-0,35	0,0000	-0,09	0,0062	0,18	0,0000	-0,01	0,7433
	0,05		0,04		0,03		0,03		0,03	
Immigration	0,38	0,0045	0,28	0,0018	-0,08	0,3618	0,10	0,1404	0,40	0,0000
	0,13		0,09		0,08		0,07		0,07	
Economic, social and	0,03	0,4896	0,00	0,9332	-0,04	0,0797	0,11	0,0000	0,11	0,0000
cultural index of the family	0,04		0,03		0,02		0,03		0,03	
Class size	-0,02	0,0014	-0,02	0,0004	0,00	0,4779	0,00	0,7700	0,00	0,5679
	0,01		0,01		0,00		0,00		0,00	
Public school	-0,03	0,5810	0,07	0,1235	-0,03	0,4518	-0,02	0,6509	-0,08	0,1266
	0,06		0,05		0,04		0,04		0,05	
Math score	0,00	0,0000	0,01	0,0000	0,00	0,0000	0,00	0,0000	0,00	0,0000
	0,00		0,00		0,00		0,00		0,00	
Intercept	-0,28	0,8571	-1,18	0,2555	1,06	0,2608	-1,66	0,0225	-1,02	0,1541
	1,54		1,04		0,94		0,73		0,72	
R-squared	0,15		0,26		0,03		0,07		0,06	
No. observations	1381		2765		4519		4508		4522	

5 Conclusion

These results are encouraging, and allow us to support the existing literature on non-cognitive skills, both on the existence of a relationship with cognitive performances - although with varying effects on differentiated populations - and on the possibility that teaching practices (at least more teacher training on these questions and pedagogical issues, rather than primarily on subject contents as is the case in France) could be influential in developing certain types of socio-behavioral skills for students. Although the circularity of these relations makes it hard to make a convincing causal claim, given issues of endogeneity and omitted variables, the comprehensive panel data collected through the Ministry of National Education suggests some effects of these skills throughout time. The increasing focus on measuring these non-cognitive skills alongside traditional indicators of academic success, in future versions of PISA and TALIS as well as in national data, will enable to draw more solid conclusions on what works and in what contexts on the question of non-cognitive skills.

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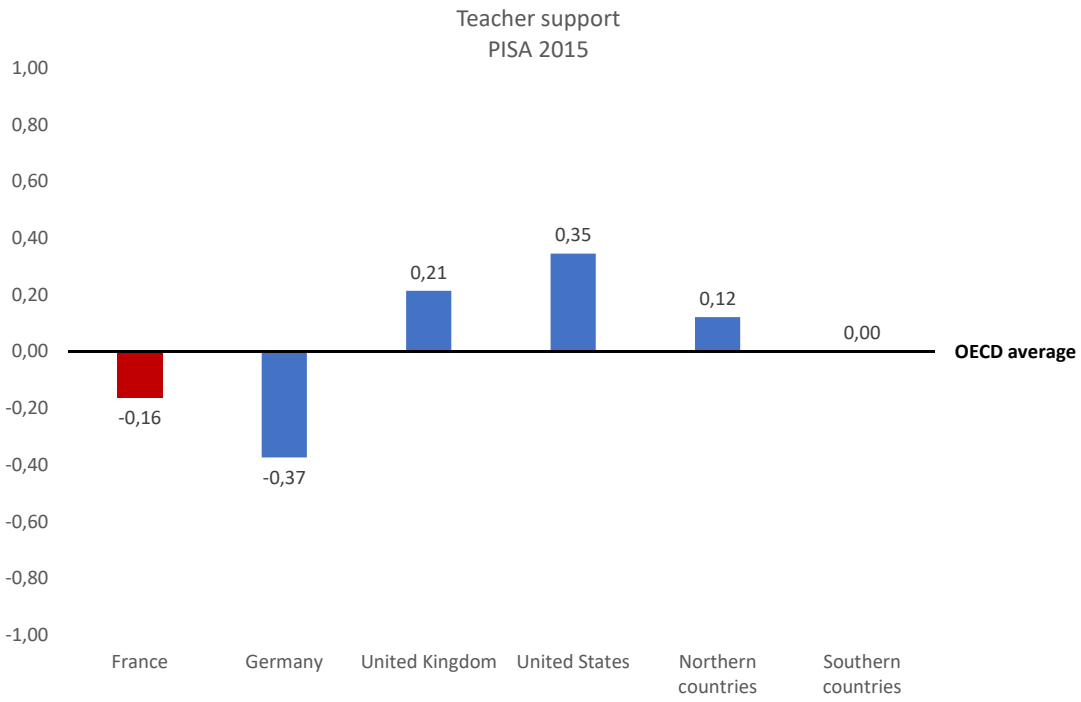
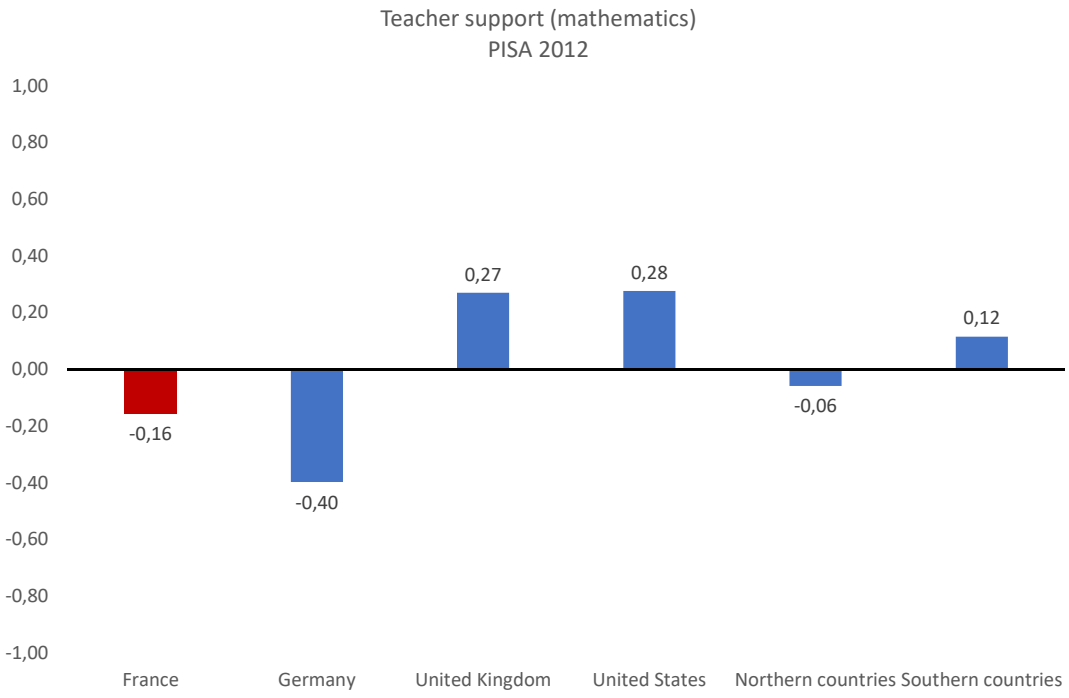
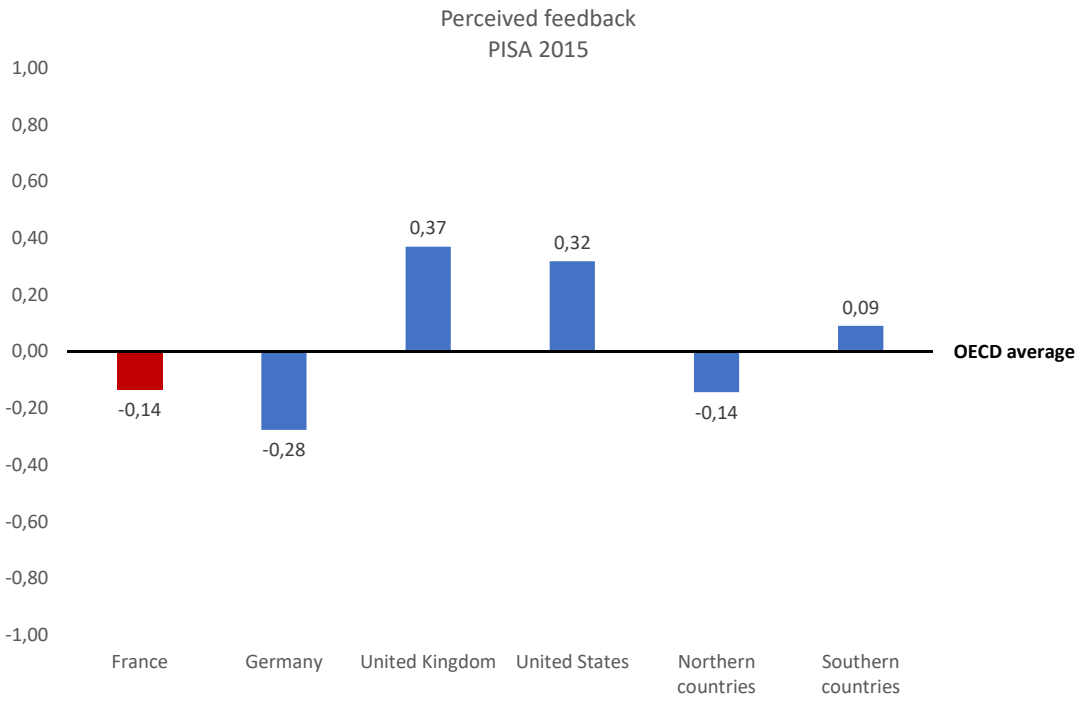
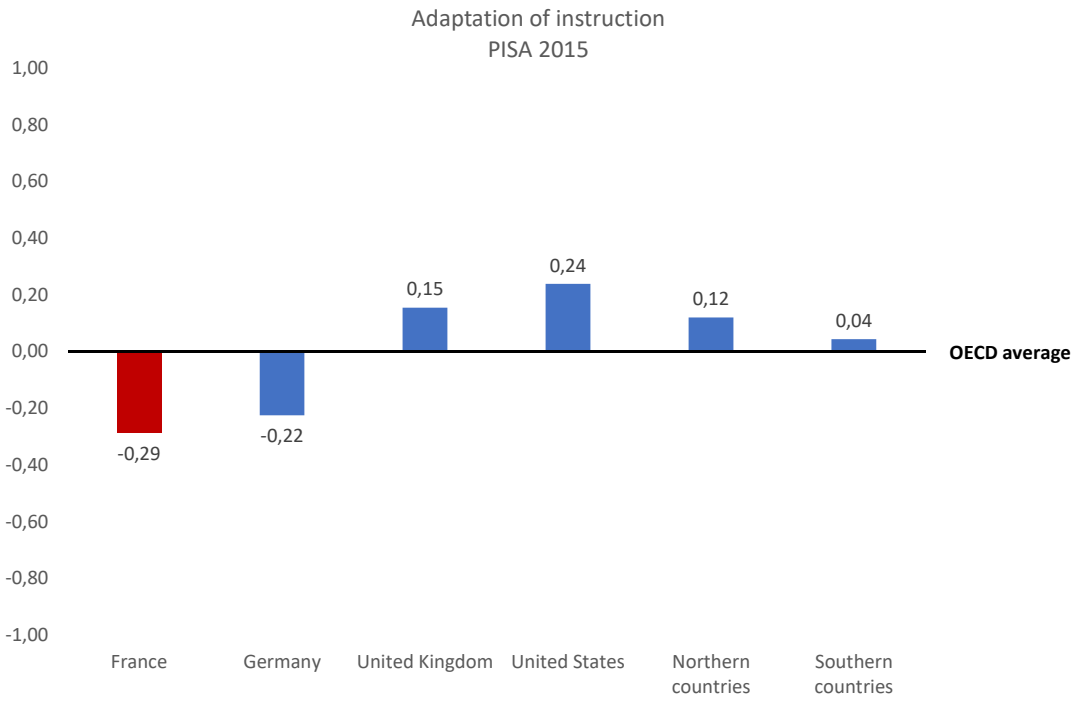
Appendix

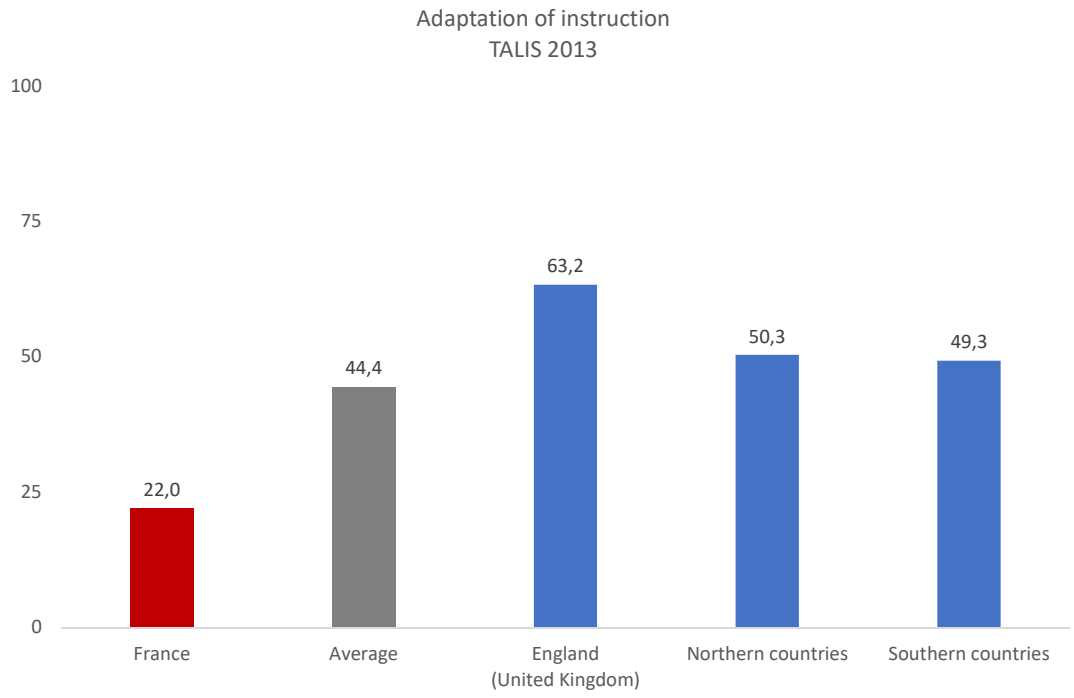

Teacher support
PISA 2012
1,00
0,80
0,60
0,40
0,20
0,00
-0,20
-0,40
-0,60
-0,80
-1,00
-0,23
-0,31
0,34
0,18
0,14
-0,08
OECD average
France
Germany
United Kingdom
United States
Northern countries
Southern countries

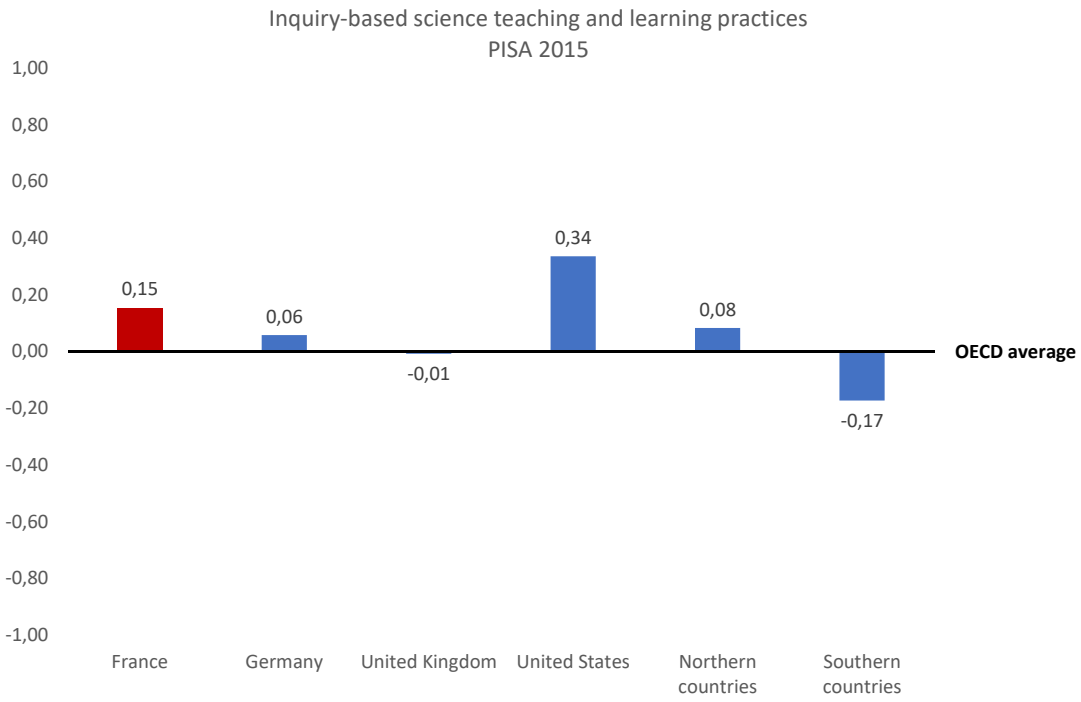

Teacher support
PISA 2015
1,00
0,80
0,60
0,40
0,20
0,00
-0,20
-0,40
-0,60
-0,80
-1,00
-0,16
-0,37
0,21
0,35
0,12
0,00
OECD average
France
Germany
United Kingdom
United States
Northern countries
Southern countries

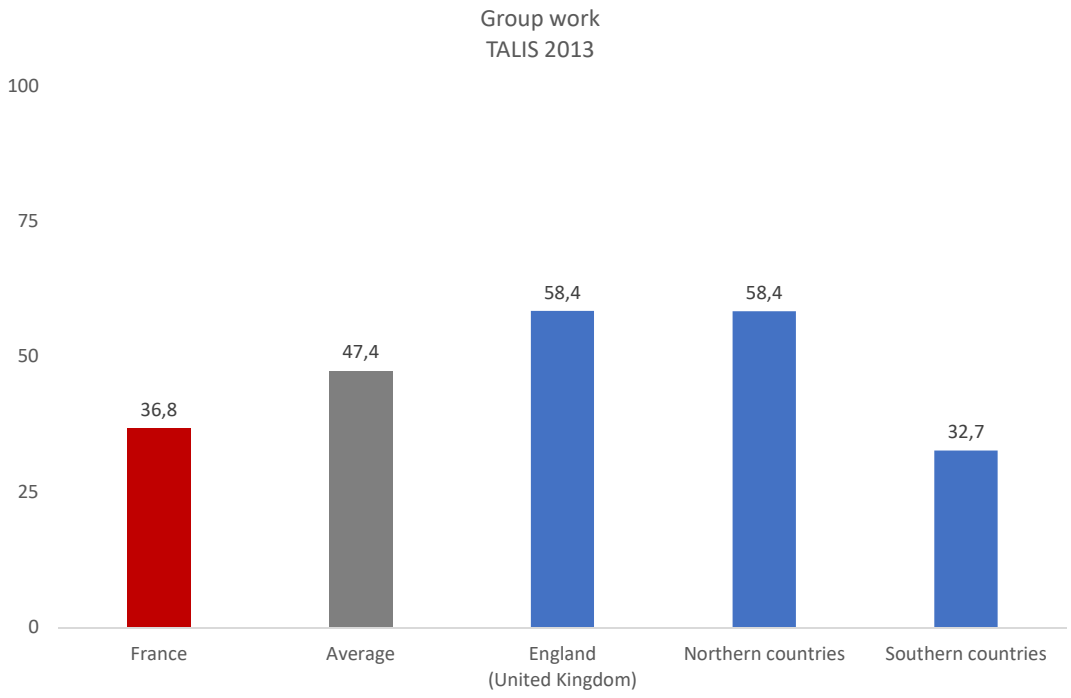

Teacher support (mathematics)
PISA 2012
1,00
0,80
0,60
0,40
0,20
0,00
-0,20
-0,40
-0,60
-0,80
-1,00
-0,16
-0,40
0,27
0,28
-0,06
0,12
France
Germany
United Kingdom
United States
Northern countries
Southern countries

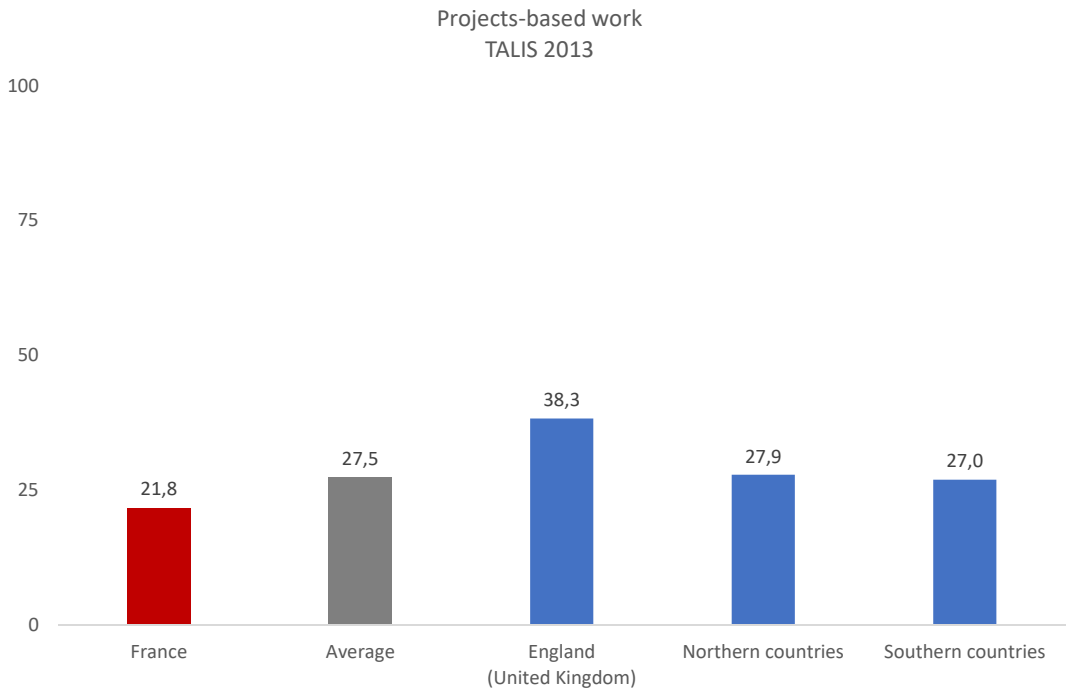

Perceived feedback
PISA 2015
1,00
0,80
0,60
0,40
0,20
0,00
-0,20
-0,40
-0,60
-0,80
-1,00
-0,14
-0,28
0,37
0,32
-0,14
0,09
OECD average
France
Germany
United Kingdom
United States
Northern countries
Southern countries

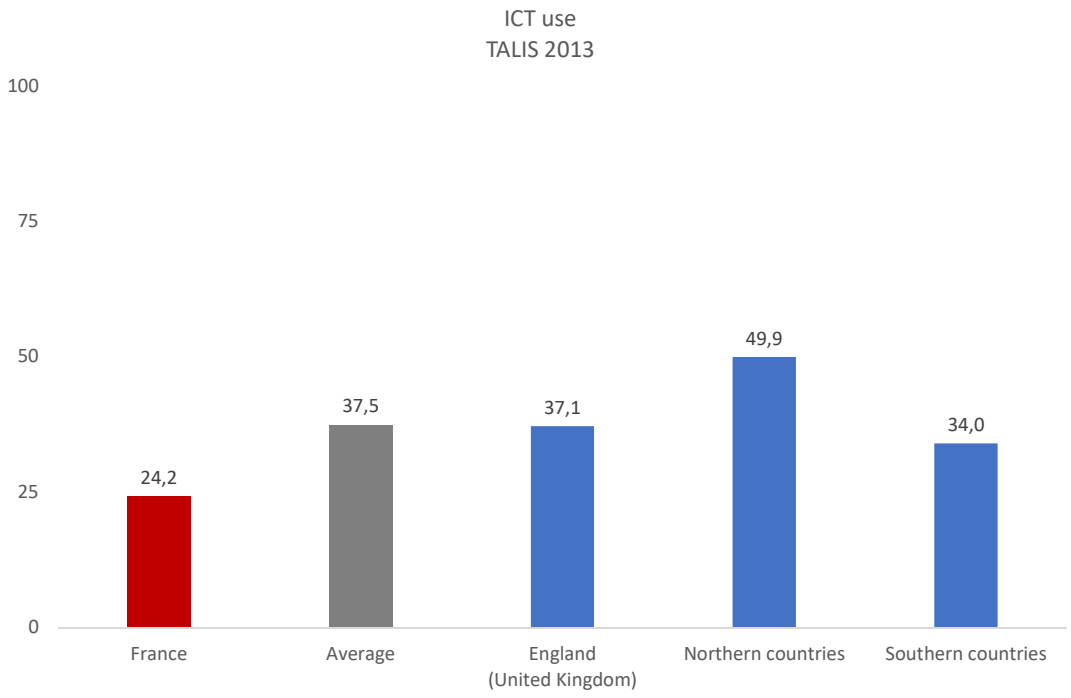

Adaptation of instruction
PISA 2015
1,00
0,80
0,60
0,40
0,20
0,00
-0,20
-0,40
-0,60
-0,80
-1,00
-0,29
-0,22
0,15
0,24
0,12
0,04
OECD average
France
Germany
United Kingdom
United States
Northern countries
Southern countries

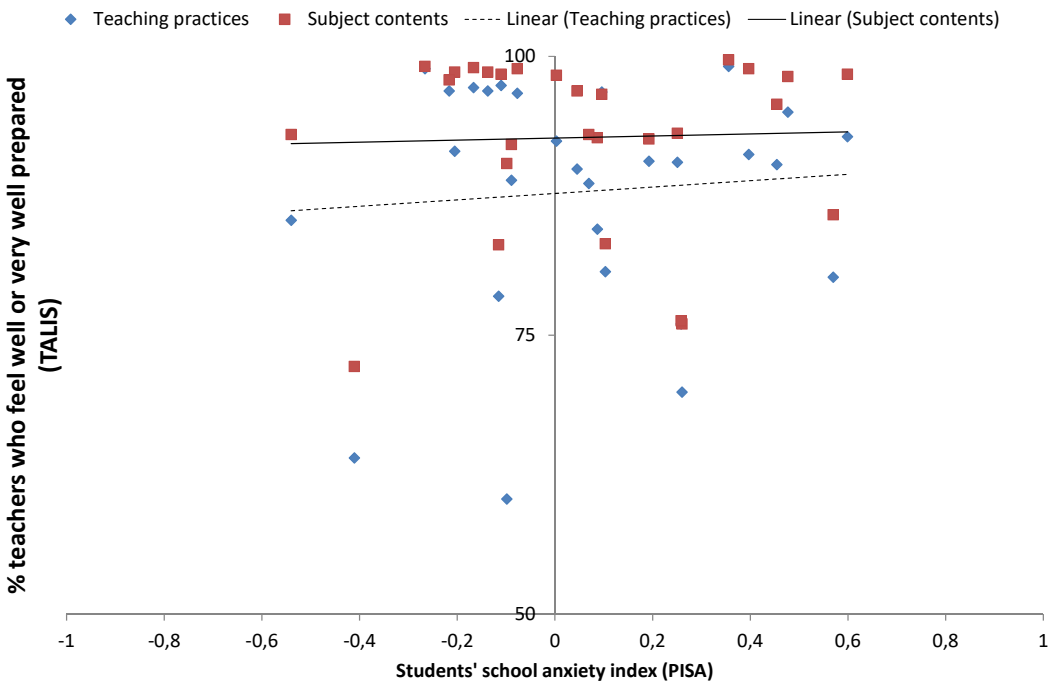

Adaptation of instruction
TALIS 2013
100
75
50
25
0
22,0
44,4
63,2
50,3
49,3
France
Average
England (United Kingdom)
Northern countries
Southern countries

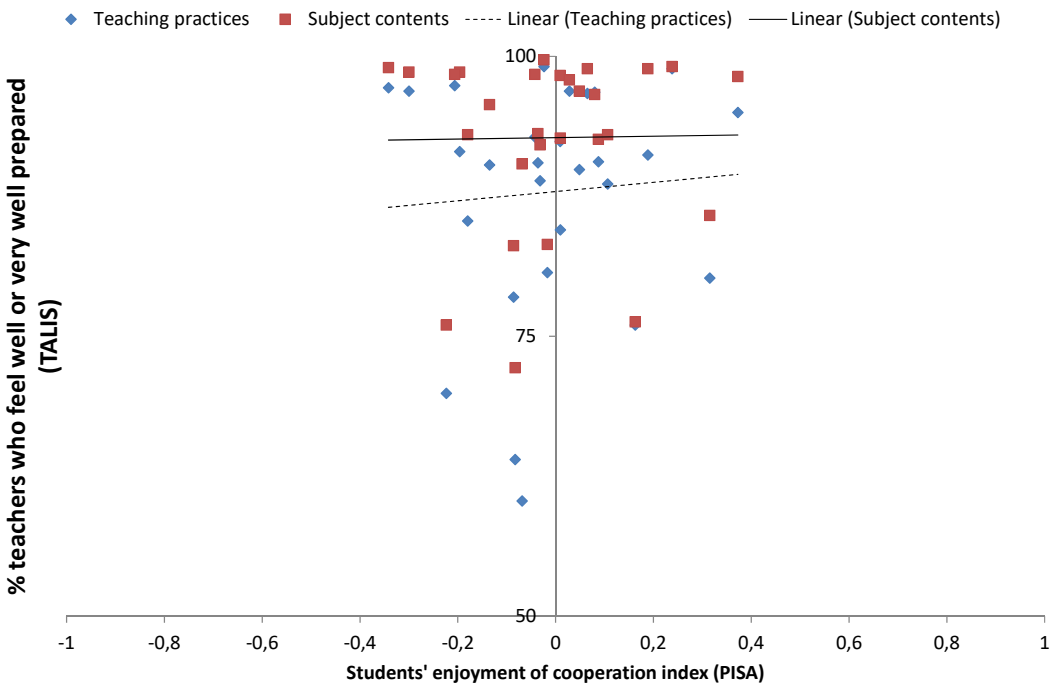

Inquiry-based science teaching and learning practices
PISA 2015
1,00
0,80
0,60
0,40
0,20
0,00
-0,20
-0,40
-0,60
-0,80
-1,00
0,15
0,06
-0,01
0,34
0,08
-0,17
OECD average
France
Germany
United Kingdom
United States
Northern countries
Southern countries

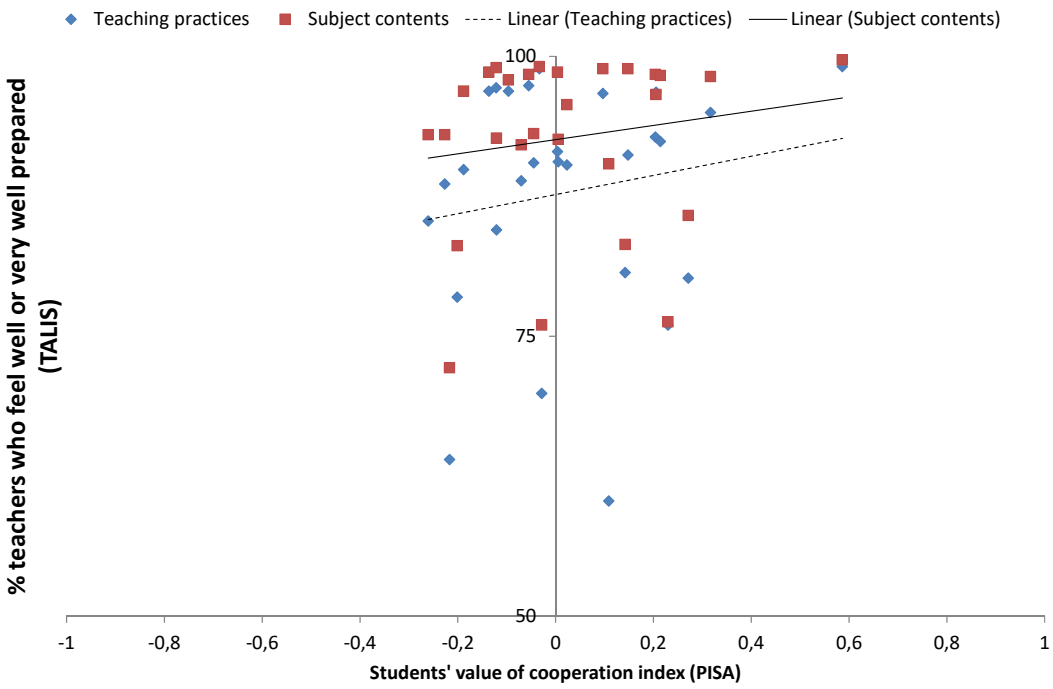

Group work
TALIS 2013
100
75
50
25
0
36,8
47,4
58,4
58,4
32,7
France
Average
England (United Kingdom)
Northern countries
Southern countries

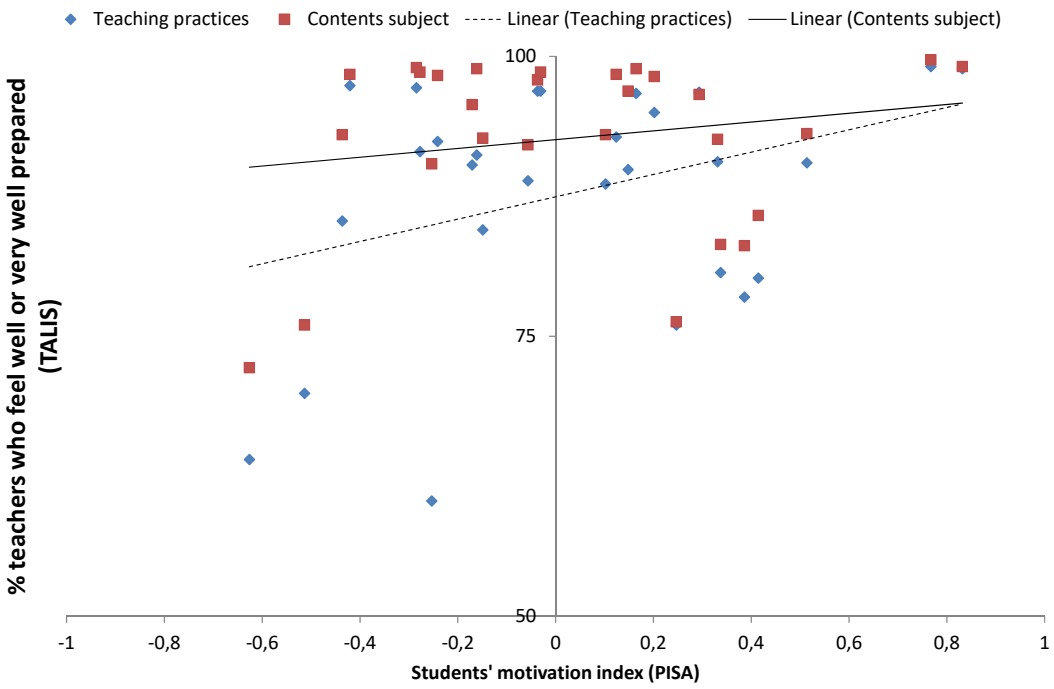

Projects-based work
TALIS 2013
100
75
50
25
0
21,8
27,5
38,3
27,9
27,0
France
Average
England (United Kingdom)
Northern countries
Southern countries

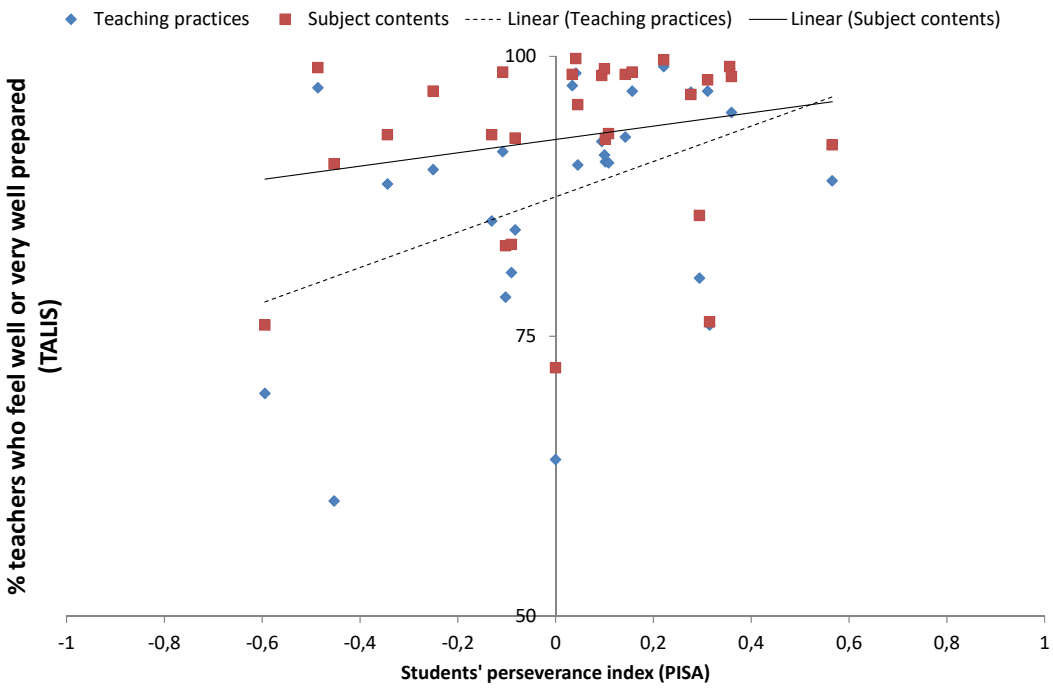

ICT use
TALIS 2013
100
75
50
25
0
24,2
37,5
37,1
49,9
34,0
France
Average
England (United Kingdom)
Northern countries
Southern countries

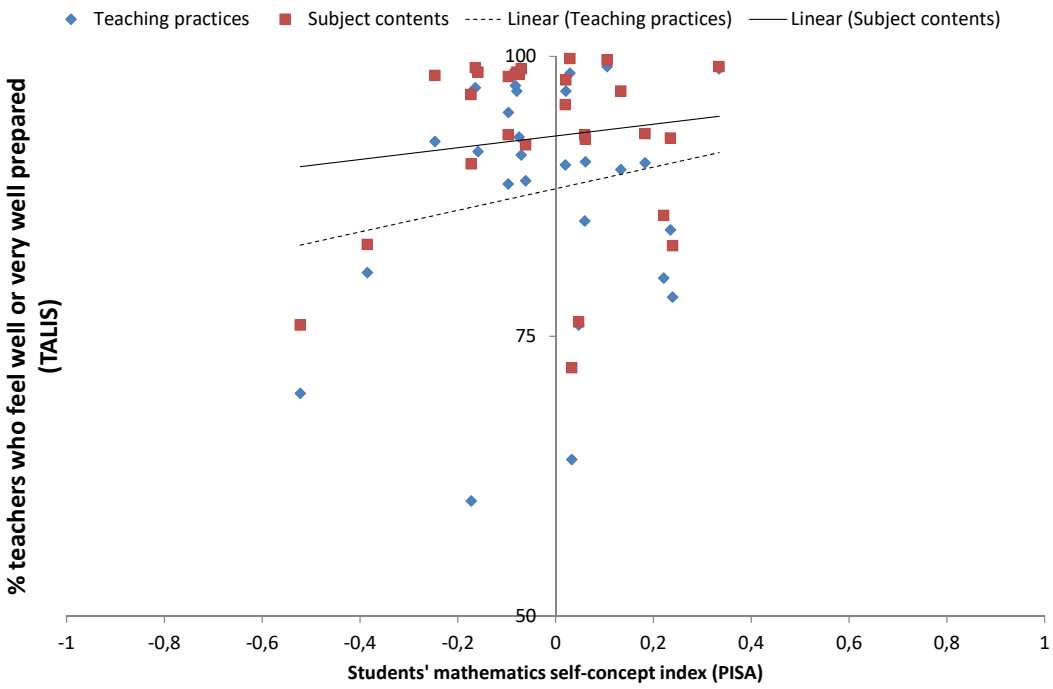

Teaching practices
Subject contents
Linear (Teaching practices)
Linear (Subject contents)
% teachers who feel well or very well prepared (TALIS)
100
75
50
-1
-0,8
-0,6
-0,4
-0,2
0
0,2
0,4
0,6
0,8
1
Students' school anxiety index (PISA)


Teaching practices
Subject contents
Linear (Teaching practices)
Linear (Subject contents)
% teachers who feel well or very well prepared (TALIS)
100
75
50
-1
-0,8
-0,6
-0,4
-0,2
0
0,2
0,4
0,6
0,8
1
Students' enjoyment of cooperation index (PISA)


Teaching practices
Subject contents
Linear (Teaching practices)
Linear (Subject contents)
% teachers who feel well or very well prepared (TALIS)
100
75
50
-1
-0,8
-0,6
-0,4
-0,2
0
0,2
0,4
0,6
0,8
1
Students' value of cooperation index (PISA)


Teaching practices
Contents subject
Linear (Teaching practices)
Linear (Contents subject)
% teachers who feel well or very well prepared (TALIS)
100
75
50
-1
-0,8
-0,6
-0,4
-0,2
0
0,2
0,4
0,6
0,8
1
Students' motivation index (PISA)


Teaching practices
Subject contents
Linear (Teaching practices)
Linear (Subject contents)
% teachers who feel well or very well prepared (TALIS)
100
75
50
-1
-0,8
-0,6
-0,4
-0,2
0
0,2
0,4
0,6
0,8
1
Students' perseverance index (PISA)


Teaching practices
Subject contents
Linear (Teaching practices)
Linear (Subject contents)
% teachers who feel well or very well prepared (TALIS)
100
75
50
-1
-0,8
-0,6
-0,4
-0,2
0
0,2
0,4
0,6
0,8
1
Students' mathematics self-concept index (PISA)