

The impact of career development activities on PISA mathematics tests

An analysis of data from the Organisation for Economic Co-operation and Development (OECD)

By Elnaz T. Kashefpakdel and Matteo Schleicher

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For more information about this report, contact: Jordan.Rehill@educationandemployers.org
Education and Employers Taskforce, 22-24 Red Lion Court, Fleet Street, London EC4A3EB.

Summary

This paper tests the hypothesis that greater teenage engagement in career development activities organised by schools and including elements of direct exposure to the contemporary working world, will be associated with higher student scores in the PISA mathematics assessment. The hypothesis originated from a 2014 interview with the OECD's Director of Education and Skills, Andreas Schleicher, and makes use of a unique OECD dataset to test it. Within the 2012 Programme for International Student Assessment (PISA), a series of questions explore teenage participation in career development activities such as job fairs and career advice at school.

In the analysis, four activities are isolated: participation in internships, job shadowing, job fairs, and speaking with a careers advisor in school. Only a minority of countries taking part in PISA 2012 opted into these questions and of these, six have been selected for analysis (Australia, Belgium, Canada, Denmark, Finland and Ireland). Analysis considered the scores of students aged 15-16 in the 2012 PISA mathematics assessment. Drawing on existing OECD analytical practice, a series of control variables were applied to the analysis enabling account to be taken of the typical social and demographic factors which can determine student engagement and success in education.

The analysis found in some cases a strong, statistically significant relationship between participation in career development activities and higher scores in the PISA mathematics test. The most consistent positive effects are found in relationship to speaking with a careers advisor in school. Relationships are particularly strong in Ireland and Finland.

Introduction

I do think we need to be honest with young people about how challenging the youth employment market has become. We need to be honest with them about how education to work transitions are now commonly complex and prolonged. Governments and educators need to recognise the consequence of these changes and take action to make transitions easier. As well as thinking anew about the curriculum and the preparations for modern working life that schooling provides, greater attention needs to be focused on improving signalling of the different pathways available to young people. This is why exposure to the workplace is so important within education. It not only provides excellent opportunities for experiential learning across the curriculum, but also underpins effective careers education and the decision-making of young people. Work experience and other forms of employer engagement demonstrate to young people the links between what they do in the classroom and how those skills ultimately will be used in the labour market. For young people, and for their teachers, that is a great motivator.

Andreas Schleicher cited in (Mann and Huddleston 2015, 28).

The OECD has long argued that employer engagement has an important role to play within careers provision (OECD 2010). However, in his interview Schleicher argued that not only might positive impacts from employer-enriched provision be expected in the economic outcomes of young people as they transition into the labour market, but also be seen in the classroom: in increased student motivation following exposure to the realities of the working world.

Over recent years, the evidence base surrounding the impact of careers-focused provision has improved considerably, offering validation to the OECD's confidence that school-mediated work-related engagements can be robustly associated with better employment outcomes. In July 2016, the UK government-funded Education Endowment Foundation published *Careers Education: international literature review* by Hughes et al. The latter publication considered literature from across the OECD countries published since 1996 which used randomised controlled trials, or quasi-experimental approaches, such as analyses of longitudinal databases, to review the impacts of "careers-focused school- or college-mediated provision designed to improve students' education, employment and/or social outcomes."¹

Identifying mainly U.K. and U.S. material, the review found that 67% of 27 studies considered, provided evidence of largely positive economic outcomes for young people, with the remainder of papers offering no distinct patterns in terms of outcomes. The identified economic outcomes were often considerable in size. The review also identified that 60% of 67 studies which considered the impact of careers-focused interventions on the academic attainment of young people found evidence of largely positive outcomes (Hughes et al 2016, 4-5) with the great majority of outstanding studies again showing no distinct patterns in terms of results. The review, however, found that while clear results were often identified by researchers, comparatively modest attention had been given to trying

¹ Including such activities as mentoring and careers provision with employee volunteers, job shadowing and work experience placements, enterprise learning and Information, Advice and Guidance.

to understand what was driving results. Where undertaken, in broad terms, researchers agreed with the current perspective

The literature reviewed here has relatively little to say about why interventions related to careers-focused education have, on average, positive impacts on the attainment of young people. It does, however, broadly support the hypothesis that careers education helps young people to better understand the relationship between educational goals and occupational outcomes, increasing pupil motivation and application (Hughes et al 2016, 4).

Investigating this further, a study published by Education & Employers research team in December 2016 using the OECD PISA data found that there is a strong, statistically significant relationship between participation in career development activities and more positive attitudes towards schooling.²The findings of this report and the shortage of existing literature providing evidence of the impact of career development activities on student attainment drives the analysis presented in this publication.

This paper aims to put together evidence to test the extent to which statistically significant relationships can be drawn between participation in selected career development activities and higher scores in the PISA mathematics tests in the participating countries. In doing so, the analysis makes use of a unique dataset collated and made publically available for analysis by the OECD. The data collected in the Programme for International Student Assessment (PISA) study represents one of the world's most valuable resources for understanding how the academic abilities of young people (in terms of reading, mathematics and problem-solving skills) vary between and within countries, and how variations in results can be linked to the different backgrounds and experiences of the students. Undertaken every three years, over 500,000 students from 65 countries and regions took part in the 2012 PISA surveys.³ Collecting a rich set of data about the family and social backgrounds of the 15-16 year old survey participants and their schools, PISA allows analysts to control for the characteristics which commonly drive academic performance, to isolate and analyse the impacts of distinctive interventions.

The 2012 PISA survey asked a number of questions about participation across a series of career development activities, including some commonly organised by schools and some involving engagement with local employers (e.g. attendance in job shadowing, job fairs, internships). Only a minority of participating countries, however, opted in to this series of questions. In the paper that follows, statistical analysis is initially presented exploring relationships between activity participation and evidence of student academic attainment.

The study builds on the work of the OECD itself which in 2015 set out variation in participation levels in activities by gender, and of Sweet et al. (2014) and Brisson et al. (2017) which explored relationships between participation in career development activities and self-assessed competencies. More precisely, Brisson et al.'s work (2017) sheds lights on the importance of young people understanding the value and utility of mathematics in daily life and in their future careers. Providing information about the utility of mathematical learning for career opportunities has been found to improve secondary school students' maths grades, they argue. The study found that students' self-efficacy and achievement in mathematics were higher in the group of students who realised the importance and

²<http://www.educationandemployers.org/research/the-impact-of-career-development-activities-on-student-attitudes-towards-school-utility-an-analysis-of-data-from-the-organisation-for-economic-co-operation-and-developments-programme-for-int/>.

³ For full details of PISA visit <https://www.oecd.org/pisa/aboutpisa/>.

utility of what they are learning in the classroom, compared to the control group. This is something that it is believed careers-learning activities could improve to a certain extent; connecting the dots between what people learn in classrooms and its future use.

In the literature review mentioned earlier, only one study evidenced a relationship between work-related learning and examination results. Using a longitudinal design, Linnehan (2001) examined the experiences of 202 African American high school students who engaged in extended periods of work experience, and found that students whose experience lasted more than six months achieved higher examination results (i.e. higher grade point averages) than control group peers.

Education and Employers research team, therefore, hopes to further research in this area, and to prompt a series of analyses to identify any possible connections between participation in career development activities and academic attainment.

Data

The OECD's PISA is a unique study in scale that develops tests for young people which are not directly linked to the school curriculum.⁴ The tests, rather, are designed to assess the extent to which students, as they reach the end of their period of compulsory education, are able to apply their knowledge to real-life situations in preparation for full entry to society as adults. Every three years, dozens of countries and regions from around the world work with the OECD to randomly select students aged 15-16 to take part in the tests which measure capability in reading, mathematics, science, problem-solving and financial literacy. In 2012, some 510,000 young people across 80 nations and regions took part in the tests.

The PISA tests take a young person about two hours to complete and involve students responding to open ended and multiple choice questions. In total, nearly 400 questions are asked and include explorations of the social background and family life of students. Participating schools also return data on the broader school system and learning environment, and some parents are also asked to complete parental questionnaires. The OECD makes considerable data about the PISA study publically available: student questionnaires, results, school and parental data.⁵ Data is provided in Excel and SPSS formats allowing for easy analysis by statisticians which focused on a series of specific data.

Careers development activities

The Educational Career Questionnaire in PISA 2012 asked student respondents: *Have you done any of the following to find out about future study or types of work?* Respondents were able to answer either 'yes' or 'no, never' to four questions which explored the extent to which young people had come into direct contact with workplaces or careers professionals through the agency of their school.⁶

I did an internship⁷

I attended job shadowing or work-site visits

I visited a job fair

I spoke to a career advisor at my school

⁴ For more information about PISA, visit <https://www.oecd.org/pisa/>.

⁵ See: <https://www.oecd.org/pisa/pisaproducts/pisa2012database-downloadabledata.htm>.

⁶ The survey also asked young people about whether they had spoken to a career advisor out of school, completed careers-focused questionnaires, researched the internet about careers and higher level educational programmes or visited an institution offering provision to young people at a higher level. Additionally, the OECD PISA study asks students for their perspectives about a series of competency based questions about skills related to careers provision – whether respondents *feel* they know how to search for employment, write a CV or prepare for an interview and find information on continuing education programme. Some analysis against these interesting self-assessments has been undertaken by Sweet et al (2014).

⁷ No definition of 'internship' were offered to respondents.

Participating countries

Only a minority of countries and regions undertaking PISA in 2012 chose to include these questions about careers development activities. Twenty-two countries arranged for young people to be asked three or more of the four questions about career development activities. Of these, results from six countries were considered in the current report: Australia, Belgium, Canada, Denmark, Finland and Ireland. The countries selected are those the charity has special interest in due to prior global collaborations. Further study could look at a bigger sample and investigate similar questions in other participating countries.

Measuring student attainment in mathematics

PISA measures the students' "capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena."⁸ The various items of the mathematical assessment are structured accordingly.

Test items in PISA 2012 are organised in four content categories (change and relationships, space and shape, quantity, and uncertainty and data), where items in each content category have a range of difficulty and mathematical demand.

Items in each category are composed of assessment units comprising verbal stimulus material and information such as tables, charts, graphs or diagrams.

This analysis used the paper-based instruments of the 2012 mathematics tests, which contain a total of 270 minutes of mathematics material.

Control variables

As is routine within statistical analysis of such a database within the social sciences, it is important for researchers to understand and control for key background characteristics which might distort findings. These control variables are used within analysis to determine whether any detected impacts related to career development activities as interventions, are, in reality, a mask for some deeper variation in the experience of student participants. The control variables used in this analysis drew on those applied in the OECD's own analyses of the performance of students in the mathematics assessment:

1. Gender.⁹
2. Socio-economic status.¹⁰ *Measured by the PISA Index of Economic, Social and Cultural Status – an index including parental occupation, parental education and home possessions.*
3. School type. *The school type control variable includes details of school location, drop-out rates, class size, staff/student ratios and private/public status.*

⁸OECD, 2013, p.25.

⁹OECD, 2014, pp. 4, 99, 101.

¹⁰OECD, 2014, p. 94.

4. Immigrant background.¹¹*The control variable includes immigrant status (native/first generation/second generation) and language spoken at home.*
5. Motivational factors.¹²*Control variable includes truancy factors (missing whole school days and classes within a school day).*
6. Cognitive potential. *The variable includes responses to questions on whether respondents have been required to repeat a year of study.*

Student participation in career development activities

In the table which follows, descriptive statistics are presented illustrating the variation in student participation across the four leading career development activities managed through schools and engaging local employers by country or region.

Table 1. Students reporting participation in four career development activities by country

	Internship	Job shadowing or work-site visit	Taken part in a Job Fair	Spoken to a Careers Adviser at my school
Australia	49%	30%	52%	66%
Belgium	11%	20%	15%	30%
Canada	9%	34%	40%	40%
Denmark	69%	52%	25%	94%
Finland	62%	43%	38%	84%
Ireland	7%	39%	11%	52%

Analysis

In the analysis which follows, statistical tools are used to assess whether participation in each of the four career development activities under consideration can be associated with higher student attainment in the PISA mathematics assessment, after taking account of the control variables. Through linear regression it is possible to measure whether participation in career development activities can be associated with higher scores in the mathematics tests. The analysis compares young people with peers in their own countries. Results are expressed as coefficients, which represent a number of points obtained in the mathematics tests. By way of example, Australian students who visited a job fair improved their mathematics score in the 2012 PISA test by 4.4 points. Only relationships with statistical significance of 1% or better are included. This means that there can be a 99% or better confidence that the relationships observed are not coincidental and neither mask for a variation in social background detected by use of the control variables. When it comes to judging the strength of the relationship, the lower the level of statistical significance, the better.

¹¹OECD, 2014, p. 94, 110.

¹²OECD, 2014, p. 111.

Technical Annex

Full results of the analysis undertaken in the production of this paper are given in a separate paper also available at www.educationandemployers.org/research-main:

The impact of career development activities on PISA mathematics tests: an analysis of data from the Organisation for Economic Co-operation and Development (OECD). Technical Annex.

Results¹³

Table 2. Analysis: relationship between participation in internship and student attainment

COUNTRY	COEFFICIENT
Finland	2.045*

** Statistically significant at 1%*

Table 2 shows the result of the linear regression analysis for the ‘internship’ career development activity. In Finland, young people who spoke to a career advisor in school improved their mathematics score in the PISA tests by 2.1 points compared to their peers, and the relationship is statistically significant at 1 percent meaning that there is a 99% or better chance that the relationship is not coincidental.

Table 3. Analysis: relationship between participation to job shadowing and student attainment

COUNTRY	COEFFICIENT
Finland	2.379*
Ireland	4.048*

** Statistically significant at 1%*

Similar patterns are found for Finland and Ireland when analysing the participation in job shadowing activities. Statistically significant relationships are found: Finnish and Irish students who had a job shadowing experience improved their mathematics score by 2.4 points and 4.1 points respectively.

Table 4. Analysis: relationship between participation to job fairs and student attainment

COUNTRY	COEFFICIENT
Australia	4.408*
Finland	5.004*

** Statistically significant at 1%*

Table 4 illustrates strong relationships in some cases between taking part in a job fair and higher scores in the PISA mathematics assessment. In Australia, students who took part in a job fair improved their

¹³Note that results are given by activity, with only the statistically significant results and positive relationships between participation in career development activities and higher PISA scores being reported.

mathematics score by 4.4 points, compared to their peers. Similarly, in Finland, teenagers who took part in job fairs improved their score by more than 5 points compared to their peers.

Table 5. Analysis: relationship between participation in career advice in school and student attainment

COUNTRY	COEFFICIENT
Belgium	3.035*
Denmark	12.188*
Finland	17.544*
Ireland	8.686*

** Statistically significant at 1%*

In Table 5, statistically significant positive relationships are found between participation in career advice in school activities and higher mathematics scores. In four of the six countries analysed, career advice at school had a strong positive impact on student attainment in the PISA mathematics test scores. The highest improvements in the PISA mathematics scores are found in Denmark (12.2 points), Finland (17.6 points), and in Ireland (8.7 points). E.g. Finnish teenagers who received career advice at school improved their mathematics score by 17.544 compared to their peers – which is a substantial amount in the PISA scale.¹⁴

Table 6. Summary of statistically significant positive relationships between career development activities and higher scores in the mathematics tests, by activity and country

	Australia	Belgium	Canada	Denmark	Finland	Ireland
Internship					x	
Job shadowing					x	x
Job fair	x				x	
Career advisor		x		x	x	x

¹⁴See the 'Discussion' section below.

Discussion

This paper has tested the hypothesis that greater teenage engagement in career development activities organised by schools and including elements of direct exposure to the contemporary working world will be associated with higher PISA mathematics scores. In this analysis, four activities have been isolated (participation in internships, job shadowing, job fairs, and speaking to a careers advisor in school). Only a minority of countries taking part in PISA 2012 opted into these questions and of these, six have been selected for analysis (Australia, Belgium, Canada, Denmark, Finland and Ireland). Drawing on existing OECD analytical practice, a series of control variables were applied to the analysis enabling account to be taken of the typical social and demographic factors which can determine student engagement and success in education. Important within these variables was school type. In a number of countries, young people are channelled at age 14 or younger into either vocationally or academically focused educational institutions. Controlling for attendance at such institutions is particularly important as they can be indicators for very different school environments and curricula, and very different types of students, particularly by attainment level. Put simply, in running the analysis, there is confidence that it is not the type of school or college attended which drives the level of career development activities undertaken. That said, the analysis took no account of streaming within schools and, of course, other unknown variables related to the delivery of the activities which, if added to the analysis, might influence results.

The analysis finds levels of association between participation in the career development activities and higher PISA mathematics score. Of the four activities, it is speaking with a careers advisor in school which is most consistently associated with more positive responses, followed by participation in a job fair, taking part in job shadowing and internships. Of the six countries, it is teenagers in Finland and Ireland who demonstrate the greatest levels of responsiveness to participation in career activities.

The increase in PISA mathematics score points is substantial looking at the scale of results across all OECD countries – points increase from 2 to 17 – which indicates, all other factors being constant, that there is potential improvement associated with higher volumes of careers-learning activities.

Note that the PISA scale for the mathematics assessment ranges from 368 points (Peru) to 613 points (Shanghai-China). The difference from the lowest achiever to highest achiever country/region is therefore 245 points. This means that a 17.6 points increase in the PISA mathematics score (in the case of Finland for career advice in school) represents 1/14 of the overall difference. This is a substantial difference considering that only one activity triggers such an improvement in the score. This perhaps suggests that career development activities and notably career advice at school can have a big impact on PISA results – also note that career advice in school had a positive impact in four of the six countries of our sample.

The main assumption here, to be investigated further through a series of new studies, is that career-related learning activities might be explicitly designed to channel students to make associations between their schooling and its utility within the adult workplace. We have seen in the previous analysis¹⁵ of PISA data that those young people with the exposure to the world beyond the classroom saw more value in their education; which could then potentially, as Brisson et al. (2017) show, results in better mathematics scores. Alternatively, simple exposure might challenge students to consider their educational experiences in a new light, connecting themselves between what happens in the

¹⁵<http://www.educationandemployers.org/research/the-impact-of-career-development-activities-on-student-attitudes-towards-school-utility-an-analysis-of-data-from-the-organisation-for-economic-co-operation-and-developments-programme-for-int/>

classroom and how it can relate to future workplaces which were previously harder to make. A possible implication of the relationships illustrated here between participation in school-mediated career development activities and improved PISA mathematics scores is that more motivated students will receive some boost to their attainment through greater engagement in learning.

This analysis cannot explain why such results have been found, further in-depth analysis of all the participating countries would help understanding the underlying relationships. Different countries' approaches (structural, quality, labour markets etc.) could play a major role in determining the relationship between the participation in career-learning activities and increase attainment.

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Education and Employers

Quantum House

22-24 Red Lion Court

Fleet Street

London EC4A 3EB

Telephone 0207 566 4880

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