8

What the PISA 2015 results on collaborative problem solving imply for policy

Most people will have to work together with others throughout their life, in both professional and personal capacities. Addressing this need, PISA has developed an assessment that measures students' ability to solve problems collaboratively. Based on this assessment, this chapter presents some policy recommendations that might lead to improved skills in and attitudes towards collaboration.

For over 15 years, PISA has assessed 15-year-old students' literacy in science, reading and mathematics. Proficiency in these subjects is vital for tomorrow's adults. They will need to draw logical conclusions from a wide range of evidence, as scientists do; they will have to understand a variety of written material and express themselves in a clear and coherent way; and they will need to be able to find and interpret patterns and relationships in data.

But more is needed. A variety of "21st-century skills" have been identified as being crucial for the youth of today to succeed in tomorrow's world, a world that is more interconnected, digital and unpredictable than it has ever been. Although there is no commonly accepted consensus as to what these "21st-century skills" are, the list generally includes the capacity to solve problems; to think creatively and critically; and to interact productively with others.

Most people will have to work together with others frequently throughout their life, whether as members of the same team, working for supervisors, supervising others, or in their personal relationships with family and friends. The willingness and ability to understand others' points of view, to negotiate between different and perhaps conflicting objectives, and to maintain and monitor team cohesion and morale will facilitate the productivity and effectiveness of collaborative efforts and also lead to stronger interpersonal relationships.

To address this, PISA developed an assessment to measure students' ability to solve problems collaboratively, building on the assessment of individual problem-solving abilities in 2012. As an internationally-comparable assessment, PISA allows education systems to benchmark themselves and see how their students fare as collaborative team players in an increasingly interconnected world. Data from PISA can also be used to identify common attributes among students with the strongest collaboration skills, and to target at-risk populations who might need to improve their collaboration skills. This chapter presents some of the policy implications that can be gleaned from results of the PISA 2015 collaborative problem-solving assessment.

COLLABORATIVE PROBLEM SOLVING IS NOT SCIENCE, READING OR MATHEMATICS

At first glance, the results from the collaborative problem-solving assessment look broadly similar to results from the PISA assessments in the three core subjects of science, reading and mathematics. The same education systems – Canada, Estonia, Finland, Hong Kong (China), Japan, Korea, Macao (China), New Zealand and Singapore – perform at or near the top in all four assessments.

However, the results show that the PISA collaborative problem-solving assessment is clearly distinct from the assessments of the three core subjects. A student's performance in science, reading and mathematics explains less than two thirds of his or her performance in collaborative problem solving, meaning that there is still more than one third of a student's performance in collaborative problem solving that is unique to this domain. The relationship between collaborative problem-solving skills and science, reading and mathematics performance is also much weaker than the relationship between science, reading and mathematics performance themselves. In particular, in countries such as Costa Rica, Iceland, Luxembourg and the United States, students can solve problems in a collaborative fashion better than would be expected given their performance in the three core PISA subjects.

Students in many all-around top-performing countries and economies, such as Australia, Japan, Korea, New Zealand and Singapore, are even better at collaborating than expected. However, other education systems, including Beijing-Shanghai-Jiangsu-Guangdong (China) (hereafter "B-S-J-G [China]"), Croatia, Lithuania and the Russian Federation (hereafter "Russia"), perform below what would be expected given their performance in science, reading and mathematics.

PISA 2015 also asked students about their attitudes towards collaboration, particularly their thoughts about their relationships with others and about working in teams. More positive attitudes towards collaboration are found to be positively associated with students' collaboration-specific skills.

Collaborative problem solving is also distinct from individual problem solving. The correlation between education systems' performance in the 2012 individual problem-solving and 2015 collaborative problem-solving assessments is weak, as only 23% of variation in countries' and economies' performance in the 2015 collaborative problem-solving assessment is accounted for by variations in their 2012 individual problem-solving scores. Furthermore, no correlation is observed between performance in individual and collaborative problem solving after accounting for performance in science, reading and mathematics. While the 2015 collaborative problem-solving assessment was developed by building upon the framework of the 2012 individual problem-solving assessment, the skills related to individual problem solving in the more recent assessment were intentionally kept at a low or medium level, thereby further isolating skills related purely to collaboration.

BUILD INSTRUCTIONAL PRACTICE FOR COLLABORATIVE PROBLEM SOLVING

While each school has its share of stronger and weaker students, PISA assessments in science, reading and mathematics have consistently shown that education systems also have stronger and weaker schools. Similar results are observed for the collaborative problem-solving assessment. However, there is less inter-school variation in collaborative problem solving. Between-school differences account for less than 25% of total performance differences in collaborative problem solving, while they account for 30% of total performance differences in science.

Between-school differences in collaborative problem solving are further reduced – by 86% – when cognitive skills, as measured by science, reading and mathematics performance, are accounted for. Only 9% of the differences between students' "purely" collaborative problem-solving skills are observed between schools, while the remainder is observed between students who attend the same school. Whether this means that schools are more equitable in developing students' collaborative skills, or whether collaborative skills are mainly developed outside schools, cannot be discerned from PISA data.

Education systems can foster collaboration skills and attitudes in existing subjects or courses, or through new programmes, as Singapore did with its *Project Work* programme. The OECD is collecting information on how collaboration and co-operation are incorporated into school curricula through its *Education 2030* project.

MANY SCHOOL SUBJECTS PROVIDE OPPORTUNITIES TO CULTIVATE SKILLS IN AND ATTITUDES TOWARDS COLLABORATION

Collaboration skills can be taught and practiced in cognitive subjects, such as science, reading and mathematics: students can work and present in groups and can help each other learn the subject. However, much of the effort to master the material taught is typically made individually by the student. In contrast, collaboration is vital to many activities in physical education class, most obviously team sports, which require individuals to work together in groups to achieve a common goal.

However, there is variation across countries in what is emphasised in physical education class. Some countries, including Finland and Japan, emphasise collaboration instead of competition in physical education class (European Commission/EACEA/Eurydice, 2013; Nakai and Metzler, 2005). Other countries, such as Germany, Hungary, Latvia and the United Kingdom, place greater emphasis on competition and attaining one's personal best (European Commission/EACEA/Eurydice, 2013). For example, in Germany, the *Bundesjugendspiele* or Federal Youth Games are an annual individual sports competition in athletics, gymnastics, and swimming that is obligatory for all students between Years 1 and 10 (BMFSF-J, 2017).

Unfortunately, cross-sectional data from PISA cannot indicate which approach is more effective at developing collaboration skills.

What the data do show, though, is that students who attend physical education class once or twice per week score highest in collaborative problem solving. After accounting for performance in the three core PISA subjects, students who attend between zero and three days of physical education class per week score similarly, and score above students who attend four or more days per week.

ENCOURAGE STUDENTS TO MINGLE WITH OTHERS FROM DIFFERENT BACKGROUNDS

Previous PISA volumes have consistently documented that socio-economically advantaged students perform better in science, reading and mathematics than disadvantaged students. This is also true for performance in collaborative problem solving.

However, this relationship with socio-economic status is not consistently observed across education systems when looking solely at the collaborative aspect of students' collaborative problem-solving scores (i.e. once performance in science, reading and mathematics is accounted for). If anything, students of lower socio-economic status often do better than students of higher socio-economic status relative to their performance in the three core PISA subjects – although this relationship is highly variable across education systems.

In other words, students who are materially disadvantaged seem less disadvantaged when it comes to being able to work productively with others. Disadvantaged students are more likely to value teamwork, perhaps because they value more the extra boost that teamwork can bring to their own performance. Likewise, there are no large differences between the collaborative skills of immigrant and non-immigrant students.

One of the demographic factors related to the collaborative aspect of performance in this assessment is the concentration of immigrant students in a student's school. Non-immigrant students tend to perform better in the collaboration-specific aspects of the assessment when they attend schools with a larger proportion of immigrant students. This result cannot be generalised to socio-economic diversity within schools, however. Education systems should investigate whether, in their own context, diversity and students' contact with those who are different from them and who may hold different points of view can aid in developing collaboration skills.

BOYS NEED HELP IN DEVELOPING STRONGER COLLABORATION SKILLS, BUT DON'T FORGET GIRLS

Girls outperform boys in collaborative problem solving in every education system, both before and after accounting for performance in science, reading and mathematics. The relative size of the gender gap in collaborative problem-solving performance is even larger than it is in reading, where girls also outperform boys in every education system. This gender gap contrasts with that in the PISA 2012 individual problem-solving assessment, where boys outperform girls.

Hence, boys need particular support in enhancing their ability to solve problems collaboratively. This might come through developing boys' attitudes towards collaboration. Girls are found to hold more positive attitudes towards relationships, meaning that they tend to be interested in others' opinions and want others to succeed. Boys, on the other hand, are found to hold more positive attitudes towards teamwork: they see the instrumental benefits of teamwork and how collaboration can help them work more effectively and efficiently.

As positive attitudes towards collaboration – whether towards relationships or towards teamwork – are positively correlated with the collaboration-related component of performance in this assessment, education systems should look into fostering boys' appreciation of others, and their interpersonal friendships and relationships. In order to work effectively in a team and solve problems or achieve something in a collaborative fashion, boys must be able to listen to others and take their viewpoints into account. Only in this manner can teams make full use of the range of perspectives and experiences that team members offer.

However, although girls outperform boys, on average, there is a large overlap in their score distribution, with many girls also attaining only low levels of proficiency in collaborative problem solving. Schools should support both boys and girls who have trouble in forming healthy, positive and mutually supportive relationships with others.

HOW CAN STUDENTS DEVELOP STRONG RELATIONSHIPS? ON LINE, AT HOME, BUT NOT THROUGH VIDEO GAMES

One way in which children develop relationships is on line, through Internet chat rooms or social media. In the past, students would meet friends face-to-face during the lunch break or after school, or would call them and talk on the phone from home. Today, students use Facebook, WeChat, WhatsApp, Twitter, Instagram, Tumblr, and other applications to get in immediate touch with their friends. If their friends are not on line, they can leave messages that their friends can read whenever they log on again.

This might seem like a superficial method of developing relationships, one that goes against the received wisdom that it is the time spent together that forges friendships. However, in an increasingly virtual world, perhaps today's children are inadvertently training themselves to become better collaborative problem solvers simply by going on line.

Another way through which students can develop stronger relationships without leaving their own home is to develop better relationships with those at home. Many students do chores or take care of a family member. These tasks might allow them to develop a greater sense of responsibility towards others, as their family members count on them to contribute to the household. Spending time with the family members that one is caring for also gives students an opportunity to develop relationships with others – much like the concept of "opportunity to learn" in the core PISA subjects.

It is difficult to see how students develop stronger relationships when playing video games. While video games use the same virtual method of interaction as the Internet, chat rooms and social networks, students who play video games often do so under assumed names and characters, not as their true personalities. These relationships might therefore be less consequential; students have less of an incentive to maintain these relationships. If one of these relationships breaks down, there are always other avatars in this online world with whom to interact.

Of course, the type of video game that students play might be particularly important. First-person shooter games (such as *Counter-Strike*) have a goal, or perhaps a problem that players must solve, but do not give players the time to develop deeper relationships with each other. Social simulation games (such as *The Sims* series) often do not have a goal, but focus on the relationships between players' avatars.

In any case, the evidence from PISA show that students who play video games perform worse in the collaborative elements of the assessment than students who do not, something that is seen in almost every participating education system. In contrast, students who use the Internet, chat or social networks outside of school are better (or at least just as good) collaborators than students who do not. This is observed repeatedly across education systems, except in the United States. Finally, while students who use the Internet, chat or social networks, play video games, or work in the household or take care of family members all value teamwork more than students who do not, students who use these online forms of communication or who help out at home are also more likely to value relationships, while students who play video games are less likely to value relationships.

Participation in these activities is typically beyond the reach of the school curriculum. Each of these activities also comes with consequences not necessarily related to collaboration. For example, the proliferation of online networks means that students can continue to be bullied while at home, while in the past, bullying mostly ended once students left school grounds. Policy makers should consider the benefits and drawbacks of each of these activities (using the Internet, chat rooms and social networks; working in the household and taking care of family members; playing video games) and what they mean for children's collaboration skills and their ability to use these skills to solve problems.

PROMOTE POSITIVE RELATIONSHIPS AT SCHOOL

Previous OECD reports indicate that a socially connected school, in which all stakeholders know and respect each other, can be beneficial to the academic performance and well-being of students (OECD, 2017; OECD, 2016). Similarly, this report shows that fostering positive relationships at school can benefit students' collaborative problem-solving skills and their attitudes towards collaboration, especially when these relationships involve students directly. Students who establish more positive relationships with peers, teachers and parents tend to score higher in collaborative problem solving, and so do other students in the school. Even after accounting for their academic performance in reading, mathematics and science, students still perform higher in collaborative problem solving when more of their peers agreed that other students seem to like them, disagreed that they feel lonely at school, and reported that they never, or almost never, had been threatened or attacked by other students or insulted by teachers.

The good news is that most students, teachers and principals report a positive learning environment in their schools. However, too many students report that they feel isolated at school, are bullied repeatedly or are treated unfairly by teachers. While ensuring that all students are happy, safe and socially integrated at school is easier said than done, schools can start by identifying students who are socially isolated, organising activities to foster constructive relationships and school attachment, providing teacher training on classroom management, and adopting a whole-school approach to prevent and address school bullying (Borba, 2016). For their part, parents should provide academic and emotional support to their children, and talk regularly with them.

References

BMFSF-J (2017), *Bundesjugendspiele: Handbuch (Wettkampf, Wettbewerb, Mehrkampf)*, Bundesministerium für Familie, Senioren, Frauen und Jugend, Berlin, www.bundesjugendspiele.de/downloads/handbuch/handbuch_komplett_15_07_2017.pdf.

Borba, M. (2016), *The 6Rs of Bullying Prevention: Best Proven Practices to Combat Cruelty and Build Respect*, Free Spirit Publishing, Minneapolis, MN.

European Commission/EACEA/Eurydice (2013), *Physical Education and Sport at School in Europe*, Publications Office of the European Union, Luxembourg.

Nakai, T. and **M.W. Metzler** (2005), "Standards and practice for K-12 physical education in Japan", *Journal of Physical Education, Recreation & Dance*, Vol. 76/7, pp.17-22, http://dx.doi.org/10.1080/07303084.2005.10609307.

OECD (2017), *PISA 2015 Results (Volume III): Students' Well-Being*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264273856-en.

OECD (2016), *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264267510-en.