A brief analysis of the impact of Olympiads in Brazilian education

When I am asked how I ended up coming from a regular Brazilian high school to an elite university in the United States, my answer always has the word “Olympiads” in the middle of it. As a 13-year-old, I was awarded a full-ride scholarship at a top private high school in my town and, with that, I was introduced to Olympiads. Through these competitions, I learned high-level material in Science, Technology, Engineering and Mathematics (STEM) subjects, traveled abroad to represent Brazil at international tournaments and met like-minded people from all over Brazil and the world. These experiences not only defined what I wanted to major in, physics, but also made me a more disciplined student and opened up a world of possibilities for my education, including but not limited to getting my undergraduate degree at a top-ranked world-class university.

My personal experience, as well as the experiences of people with similar paths, is my main motivation for this work. I want to understand if and how Olympiads can have a positive impact in other students’ lives and play a role to improve the Brazilian educational system. In order to do this, I first make an analysis of previous literature on the topic, mainly about the two biggest Olympiads in Brazil. Then I discuss the data I got from an anonymous online survey about the perception of students who graduated from high school in Brazil since 2000 on how extracurricular activities impacted their lives and where they ended up after their secondary education. Finally, I explore how best practices of partaking in Olympiads can be expanded to improve Brazilian education in general.

What are Olympiads and how can they impact Brazilian education?

Olympiads are academic competitions that can take several different forms and be on many different subjects and topics. Currently, in Brazil, high school students can take part in Olympiads in mathematics, physics, chemistry, biology, astronomy, robotics, linguistics, geography, informatics, history and many other fields. They are usually in the form of exams and divided in different phases. The higher the phase of the exam, the more selective it is. The competitions culminate in the selection of the best-performing students, who are awarded medals, certificates and sometimes other prizes, such as a spot to represent Brazil at international competitions. Some Olympiads can also take other forms, such as research reports and debates among teams, like the International Young Physicists' Tournament (IYPT), or group work that is submitted online leading to a final on-site exam, such as the Virtual Tournament of Chemistry (TVQ) and the National Olympiad of Brazilian History (ONHB). Most Olympiads allow students to register to participate by themselves if they cannot find support from their schools.

In a world where studying hours everyday for college entrance exams, the so-called *vestibular*, is the norm, Olympiads and other extracurricular activities can inspire young people (Campagnolo, 2011). In Brazil, it is very uncommon for schools to offer extracurricular activities and for students to do anything apart from studying for admissions exams. Not surprisingly, teenagers get discouraged and bored with their studies very quickly. Olympiads help keeping students motivated at school, however discouraging studying for the *vestibular* is. These competitions can improve discipline when students are preparing for exams. Preparation is highly dependent on the type of school the students attend and on the kind of resources to which they have access. As I will show later, students who participate in Olympiads, sometimes

referred to as Olympic students, seem to agree that academic competitions helped them preparing for admissions exams, which are the only way of getting admitted to college in Brazil.

Entrance exams are usually very competitive, especially for free public universities, which are generally considered to be the best in the country and not rarely at the top of Latin American rankings (QS Top Universities, 2015). With a few exceptions, entrance exams for private universities tend to be less competitive. However, 24 out of the 25 high schools that ranked at the top of the National High School Exam (ENEM) – which also selects students to most public universities around the country – in 2014 were private institutions (G1, 2015). That being said, students from private high schools, who are generally more privileged, are usually the majority of young adults going to college at Brazilian public universities. Students from public high schools usually come from low social classes and are much less likely to attend such higher education institutions. Olympiads can level the ground between students in public and private high schools in educational terms when enough support is provided, as we will see later.

Moreover, by participating in competitions, students usually benefit from meeting other teenagers who are interested in the same subjects and share similar goals. Being in contact with like-minded people motivates Olympic students academically, makes them aware of opportunities they had never heard of, such as studying abroad or going to summer schools, and fosters friendships. Students from different places usually come in contact when finalists have to go to a certain place to debate or take a final exam. This contact is also particularly relevant at international Olympiads. For such competitions, teams of 4 to 6 students are selected through national tournaments, so they get to travel for free to different countries and are exposed to cultural experiences they would not have otherwise.

Previous literature on the topic: the cases of OBMEP, OBA and other

Olympiads exist in Brazil since 1967, but it was only recently that they started getting a lot of attention from teachers, students and the media. The two biggest are the Brazilian Mathematics Olympiad for Public Schools (OBMEP) and the Brazilian Olympiad of Astronomy and Astronautics (OBA). In fact, OBMEP is considered the biggest Olympiad in the world in number of participants; over 19 million students took the competition's first phase exam in 2009, since it is a governmental initiative. In the same year, OBA counted with over 800 thousand students from public and private middle and high schools. Due to the number of participants, it is fair to assume that both competitions not only had students taking the exams for the challenge they offered, but also many who did so because their schools made it compulsory somehow. For this reason, both OBA and OBMEP offer a pool of data that encompasses not only the best performing students, but also average ones who experienced practices related to Olympiads (preparation, exam taking or both). In addition, there exists in depth literature about both of these competitions, making data easily accessible for further investigation.

Previous research (Biondi, Vasconcellos and Menezes-Filho, 2012) shows that schools whose students took OBMEP exams had higher Prova Brasil scores. Prova Brasil is a standardized exam on reading (in Portuguese) and mathematics administered by the Ministry of Education and given to all urban public schools in the country every two years. Biondi et al. (2012) found that, in 2007, schools that took part in OBMEP performed better by a statistically significant amount in the Prova Brasil than schools with similar profile that did not participate in the competition. In order to reach this conclusion, they got the scores of all schools which took the Prova Brasil and divided them into two groups: a group of schools whose students took OBMEP exams and a treatment group of schools with similar profile that did not participate in

the Olympiad. They disregarded scores of schools that had very different teaching practices, sizes or environments. As it turns out, not only did students do better in the math section of Prova Brasil after taking part in OBMEP, but they also scored higher in reading. Taking part in the competition apparently increased the motivation students had to study not only math, but also all of the other subjects. Indeed, according to OBMEP's official report on its educational impact (Centro de Gestão e Estudos Estratégicos [CGEE], 2010), 60% of the participating teachers affirmed that their students were more motivated to learn after the competition. Likewise, students improve their capacity to reason about what they read when they face original problems that are presented to them in Olympiads. This motivation to study after the participation in competitions is also noticed by other scholars. For instance, Quadros et al. (2013), in their work about the Chemestry Olympiad of the State of Minas Gerais (OMQ), acknowledges that teachers noticed that students "started to study, to engage more [in classes] and to take an interest in the [presented] topics" (p. 156) after participating in OMQ.

Another very important finding by Biondi et al. (2012) was that the Prova Brasil's score improvement was not only effective for high achievers, but also for the lower-performing students, even though the impact is in fact higher in schools where students were awarded as OBMEP medalists. One of the hypotheses to justify such finding is that students experienced raised expectations and everyone benefited from the encouraging atmosphere at schools that supported participation in the Olympiad. The reasonable improvement of lower-performing students outcomes is an evidence of how Olympiads and related practices can have a positive impact for all children, even those who are not necessarily the aim of such competitions. The same researchers also noticed the trend that schools that participated in OBMEP multiple times, more specifically from 2005 to 2007, had even better outcomes in the Prova Brasil than the ones

which only did so once or twice. Finally, as Biondi et al. (2010) conclude in their paper, Olympiads turn out to be "a good investment in terms of public policy because the per-student costs are very low and the number of beneficiaries is very high" (p. 165).

Campagnolo (2011), in his study about OBA, claims that Olympiads can be of great encouragement for students because of external sources of motivation, such as prizes, the perspective of travelling and meeting new people, as well as opportunities to attend programs that a teenager would not be a part of otherwise. According to him, "some students are [also] motivated by the challenge [that Olympiads represent]" (p. 28). His findings corroborate the arguments of the reports and studies about OBMEP. Still according to Campagnolo (2011), institutions can "use a competition as a part of a teaching strategy focused on presenting new and interesting contents to students, as well as promoting their integration" by the means of "study groups and help sessions dedicated to the preparation [for the competition]" (p. 35). The core of his argument referred to data acquired on a questionnaire given to over 15 thousand teachers who had their students participating in OBA in 2008 and 2009. OBA's questionnaire found that 80% of the teachers agreed that their students showed more interest in their science classes after taking the Olympiad exam. Furthermore, 94% of the teachers said that the exam questions and their support texts contributed to the knowledge of the participating kids. This is very strong evidence that teachers can even use previous exams as support material in the classroom, taking the benefits of the Olympiad beyond the scope of the competition by itself.

Campagnolo (2011) also claims that it is not uncommon for students to develop an interest for the subjects covered in Olympiads. Such outcomes are more common for high achievers who end up going to later stages of student competitions. These students usually have access to preparatory programs and advanced summer schools as part of their prizes. These

programs make students learn advanced material and "live [and interact] with students with similar abilities" (p. 30), helping them to "improve their self-esteem" (p. 31) and promoting collaboration. Some of these students are also selected to participate in international Olympiads, where they interact with teenagers from different regions of the globe and for which they prepare by learning topics they "would never learn in a regular high school" (p. 41). In the end, Campagnolo (2011) also has very similar conclusions to the studies about OBMEP: "with a relatively small cost, around R$ 1 per student for the case of most Olympiads, [such competitions] can spread the interest in science in a practically unlimited operating range" (p. 61). He closes his conclusion saying the Olympiads should not be "the end of an educational project," but rather a way of "motivating students" (p. 62).

Result of survey about Olympiads and testimonies

In order to better understand the long-term effects of Olympiads, I designed a survey, which had 460 respondents, using the Yale Qualtrics Survey system. It could be answered by anyone who graduated from any type of high school in Brazil since 2000 or who is in high school at the moment. Responses came from all Brazilian regions. The questionnaire began with questions to further understand respondents' demographics: what type of high school they went to and their class year. Then it advanced to concrete questions about their participation in Olympiads and what they ended up doing after secondary education. Finally, the questionnaire ended by asking about other extracurricular activities and the perception of students about competitions: if they later decided to follow careers related to their extracurriculars, noticed that Olympiads helped them in the *vestibular* or had any further comments about the topic. In total, 137 people decided to elaborate more on the topic and the data acquired from the survey would

require a much longer paper to be analyzed. However, we can draw a few conclusions that are worth mentioning and that you can find in the following paragraphs.

Given that the survey was distributed on social media, different social circles among which it was shared restrict the data. Therefore, the demographics of the respondents do not represent an accurate picture of Brazilian education. Most of the respondents came from traditional private high schools (figure 1) and the ones who went to public schools are outliers. We can infer the latter from checking that 75% of traditional public high school students went to college after graduation, 69% of which went to public Brazilian universities, usually considered the best in the country. Also 100% of the respondents who are still in traditional public high schools said they intend to go to some university. However, by acknowledging that most surveyed people from public high schools are an exception to the rule, it is possible to draw some conclusions about the importance Olympiads in the trajectory of less privileged teenagers. Additionally, by analyzing the data, we can still get very important conclusions about the long-term effects of Olympiads by comparing responses of people who did and did not participate of them. Lastly, most of the respondents graduated recently from or are still in high school (figure 1). Hence, the data reflects how Olympiads can impact the Brazilian education system as it is now.

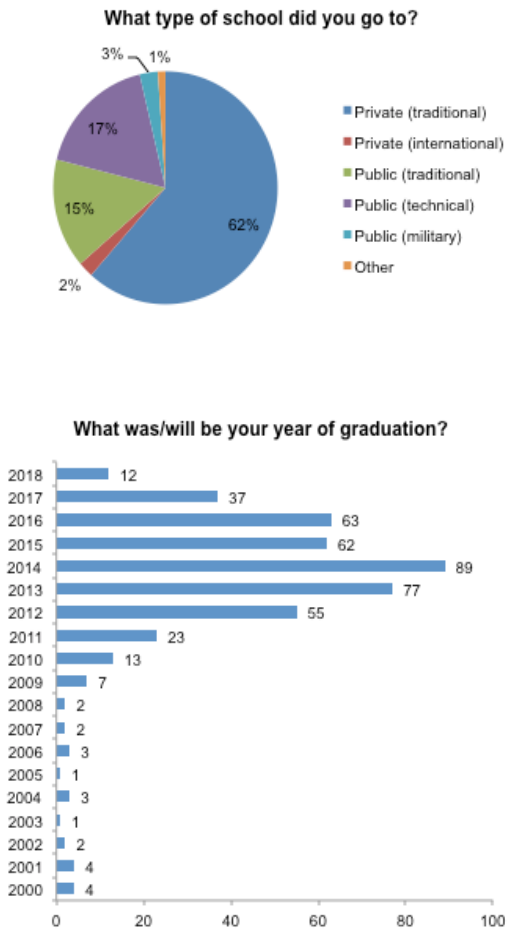

Figure 1 – Respondents' demographics

This paper does not by any means aim to endorse Brazilian college admissions. Nonetheless, doing well in entrance exams is crucial for the future career paths of teenagers, given that the *vestibular* is the only college admissions process in Brazil. From the 460 respondents, 320 confirmed that they had participated in some Olympiad before. From these 320 people, 184 had already graduated, and 90% (165 people) of these 184 went to college. Out of these 165, 75% went to Brazilian public universities and 12% went to study abroad; only 13% went to private institutions in Brazil (figure 2). Moreover, about half of those who went to Brazilian private universities answered that they had gone to Fundação Getúlio Vargas and Insper, arguably two of the highest-ranked Brazilian private universities, especially in business and economics (Folha de São Paulo, 2015). In contrast, among the 140 students who said they had never done an Olympiad exam, 88 had already graduated and gone to college. 61% of these 88 students ended up in Brazilian private universities (figure 2); 6 out of the 7 who went abroad among non-Olympic students had at least done some other type of extracurricular activity.

The data on where students ended up after high school shows that teenagers who engage in Olympiads, or at least in some extracurricular activity, tend to perform better in Brazilian entrance exams or admissions processes for foreign universities. It is fair to assume that most of the non-Olympic students who answered the questionnaire come from middle and upper social classes, because 83% of the survey respondents who went to public high schools, supposedly the least privileged students, did Olympiads. This rules out the possibility that students who did not do Olympiads attended poor high schools. Hence, being unprivileged is not the reason why they ended up in lower-ranked universities. In fact, 79% of non-Olympic students who answered the questionnaire went to a private high school.

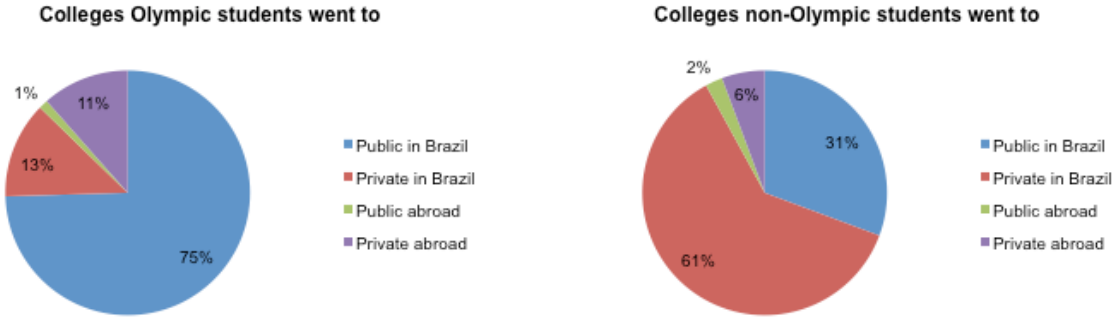

Figure 2 - Where high school students ended up when the participated or not in Olympiads.

One could argue that the students who take part in Olympiads are already overachievers and, thus, more likely to go to a better college. Then, Olympiads would not have that much of a role in preparing these students to go to higher education institutions. Nonetheless, 70% of students who did Olympiads and the *vestibular* (293 people in total)[1] said that the competitions helped them with entrance exams. This percentage is even higher (83%) among people who also confirmed that their schools offered good preparation targeting student competitions (88 people). From these answers, we can infer that Olympiads indeed played some role in their performance in admissions exams, even if they were already bound to go to good colleges. The down side of it is that, although preparation for Olympiads seems to be effective for students to perform well in the *vestibular*, it is also unequal.

According to the survey, 72% of the Olympic students coming from private high schools of any type had some sort of preparation for these competitions, even if they ranked it as ineffective. On the other hand, 56% of Olympic students from public high schools said that they had no support at all from their schools in their preparation for Olympiads (figure 3). It is not in the scope of this paper to suggest how Olympiads can be expanded to public high schools. Nevertheless, facing these numbers, it is clear that expanding these competitions to public schools is one step towards making education and college access more equal for Brazilian students. As one public school student elaborated in the survey, among several other similar

[1] Students can take the *vestibular* before graduating from high school for practice.

comments, he or she "was sure that Olympiads could be of more advantage if there were preparation and incentive, besides them being great practice for the *vestibular* and a big opportunity to obtain recognition to get into a university abroad." Olympiads' organizers could also provide a framework that could easily be followed by instructors to teach relevant content, which would break the tendency of only private high school kids having access to appropriate training. This framework could include interactive activities that would engage not only overachievers, but also students who are not as motivated.

Nevertheless, Olympiads' goals are not only training students to pass exams. As seen in the survey, the competitions were able to influence career decisions, further motivate students to study and open up their social circles. From the pool of surveyed individuals who took part in Olympiads and had already graduated from high school, 60% said that competitions played a positive role in their choice of career path. This percentage increases to 78% among students who were awarded medals and to 100% of the respondents who went to international Olympiads (figure 4). Only 4 respondents out of 136 said that Olympiads discouraged them to pursue STEM fields. Among respondents who did other extracurricular activities (159 in total), the majority also decided to pursue related career paths. 53% said their extracurriculars positively influenced their decisions, 43% were unaffected and only 4% said that they were discouraged and followed completely unrelated tracks. The results of the questionnaire confirmed the trends identified by

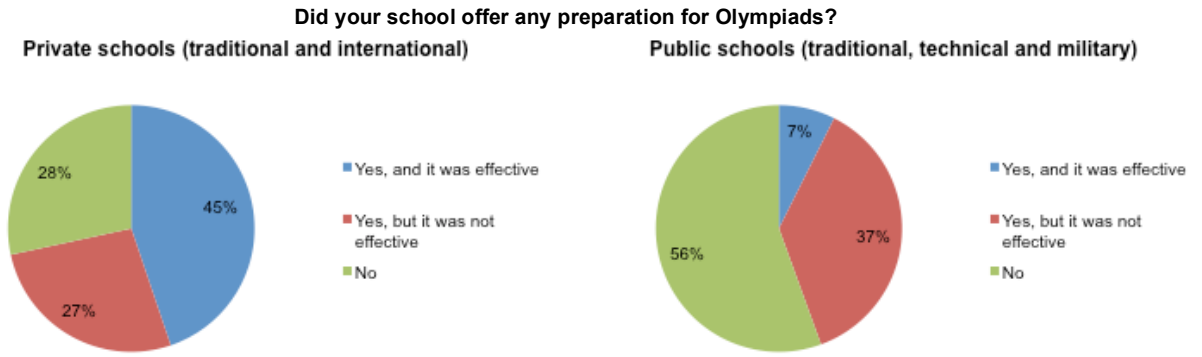

Figure 3 - Type of support for Olympiads offered by different schools.

Campagnolo (2011): students are usually motivated to pursue STEM fields after Olympiads, and the further they go into the competitions, the more encouraged they are to pursue similar fields.

In the last section of the survey, several respondents commented on the positive impact Olympiads had in their personal lives. For example a student in the class of 2016 at a technical public high school said he or she could "affirm that, without [Olympiads], [he/she] wouldn't be who [he/she is] today, because OBMEP mainly made [him/her] decide on the field [he/she] wants to study after leaving high school." This student further says that he/she "experienced a personal growth, given that, through the contact with people from several regions of the country, [he/she] got in touch with many cultures and thoughts very different from [his/hers]."

According to Daniel Fernando Pinto,[2] a member of the IYPT 2006 Brazilian team, the tournament "made [him] develop characteristics of leadership and a proactivity attitude, besides helping [him] with [his] public speaking skills, something that [he] could only start developing when he started participating in the tournament" (B8 Projetos, 2010, p. 22). His testimony puts on the spotlight how Olympiads can help students developing real world skills and becoming leaders. Moreover, Diogo Bercito, also a member of two IYPT Brazilian delegations (2004 and 2005), stated that, now as journalist, the tournament helped him to "research about everything, exactly as in journalism" (B8 Projetos, 2010, p. 23). His testimony reaffirms that Olympiads gave him skills that were helpful later in his life, even when he followed a path that was apparently alienated from physics. We have evidence, therefore, that Olympiads can be used in a normal high school setting to develop sets of skills that are helpful in

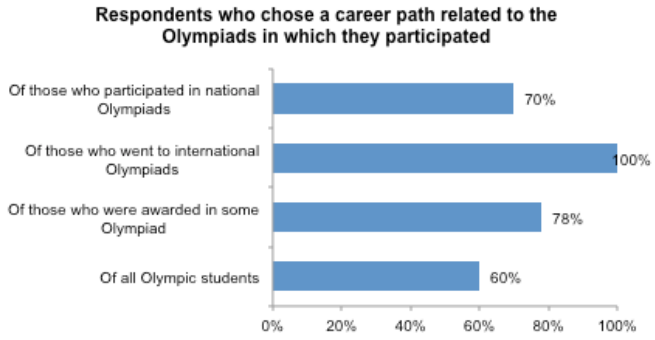

Figure 4 - Influence of Olympiads in career decisions

[2] Testimonies of many former IYPT participants can also be found on iyptbr.wordpress.com.

different aspects of life, motivating students in their studies. Teachers can promote Olympiads in their schools to make students think critically, applying their knowledge to research problems, which are the core of the IYPT for example, and learning how to communicate their ideas when speaking in public.

How Olympiads-related practices can be expanded to improve Brazilian education

According to Darling-Hammond (2010), there is "higher achievement on intellectually challenging tasks for students who experienced what the researchers termed *authentic pedagogy*." She refers to schools that promoted constructive relations between what was taught in the classroom to the real world. This is also applicable to Olympiads. Previously, I discussed how preparation for competitions can improve students' knowledge and help with entrance exams. However, Olympiads can also generate helpful material and ideas.

ONHB, for instance, is a history Olympiad whose exams must be solved in groups of three students. To answer questions, students must investigate historical documents and have group discussions. In later stages, they must also develop historical investigations about their communities. Teachers can make classes more engaging using similar practices of historical investigation in their classrooms, especially given that the documents[3] used in the competition's questions are available online. Material of other competitions can also be easily accessed online and used in regular classes. Teachers can even use the structure of competitions that are done in groups to propose group activities and increase collaboration among students.

Some competitions promote interactive activities that can be implemented in the normal curriculum. OBA organizers, for example, promote a rocket competition. Other tournaments are interactive in their own nature, such as the IYPT. As one of the surveyed students said: "for

[3] Find the link for ONHB's questions and documents in the references.

OBA, for example, I needed to build a rocket based on baking soda and vinegar, employing knowledge of chemistry, physics and math […]. Open problems like IYPT's are also super cool. They stimulate critical thinking [and] research." Such experiments can serve as inspiration for instructors, require easily accessible material and can be performed anywhere. In short, there are plenty of ways in which Olympiads can serve as inspiration and resources for teachers that further help effective learning.

Conclusion

Olympiads are student competitions in several different subjects that can be in the form of exams, debates or research. There is enough evidence to support that they can positively impact the learning of high and low-performing students (Biondi et al., 2012). Considering that in Brazil the educational system solely focuses on the preparation for entrance exams and students easily get discouraged in their studies, Olympiads can add great value to education.

One of the main pro-Olympiads arguments is that students are generally more motivated after participating in such competitions. Both Biondi et al. (2012) and Campagnolo (2011) came to similar conclusions in this respect. While the latter confirmed that teachers perceived student motivation to increase after OBA, the former found that schools that did OBMEP had better scores in math and reading in the Prova Brasil than other schools with similar profile, meaning that students were motivated in all subjects, not only the ones directly related to the competition. Another important finding by Biondi et al. (2012) was that even lower achievers improved their scores after the Olympiad, which can be related to raised expectations for all students in schools where they took the competition exam.

From a survey conducted for this work, we see that students who participated in these competitions had a better shot at getting into more selective colleges, even though participation in extracurriculars is not taken into account for college admissions in Brazil. The demographics distribution of the survey's data shows that social class does not bias this result. Teenagers seemed to be more equipped to take the *vestibular* after Olympiads. Consequently, Olympiads can help closing the gap between poor and privileged students. However, the percentage of students positively impacted increased with the effectiveness of their training for contests, and, as the survey found, there is a huge gap between the preparation of Olympic students in public and private high schools. We also see what Campagnolo (2011) concluded; responses show that Olympiads increased students' likelihood to go into STEM, especially if they went to higher levels of the competitions. Respondents also confirmed that Olympiads had a big impact in their personal lives by putting them in contact with like-minded people.

There are a few ways that Olympiad-related practices can be expanded to improve Brazilian education. Olympiads' organizers can offer a framework of preparation for the competitions, allowing students from poorer high schools to have access to effective training, which, as seen, can also help with college entrance exams. Teachers can also use Olympiad material already available online to make the classroom experience more interactive.

This research should be later expanded to see how different types of extracurricular activities affect student performance. In addition, less limited data should be taken including more details about socioeconomic conditions of students taking part in such competitions. Nevertheless, after this brief analysis about the impact of Olympiads in Brazilian education, we can conclude that such competitions are a powerful and low-cost tool to improve educational outcomes.

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