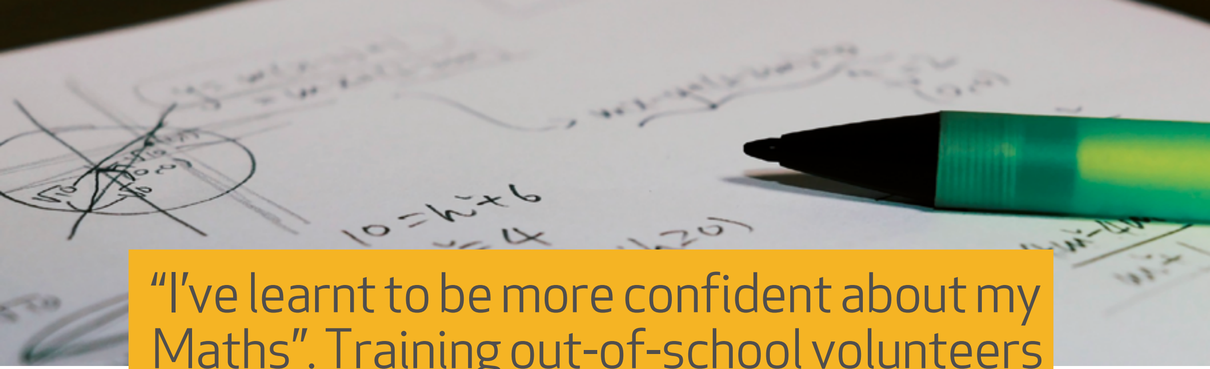

"I've learnt to be more confident about my Maths". Training out-of-school volunteers to raise students' self-efficacy in STEM

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KEY FINDINGS

- **Out of school activities allow engaging and playful educational methodologies while working with math contents in an innovative way. However, if the learnt content is not explicitly disclosed these activities have low impact in the self-efficacy in STEM at school**
- **Training methods based on real examples of similar educators, such as professional noticing, allow volunteers with different backgrounds to develop their teaching competences and Math self-efficacy.**
- **Initiatives addressed to raise out-of-school educators' and students' self-efficacy show positive but timid impacts. Non-surprisingly more actions in this line are needed to effectively change such deeply rooted believes.**

AN ENTRENCHED LOW SELF-EFFICACY IN MATHS OF SECONDARY STUDENTS FROM DEPRIVED SOCIAL BACKGROUNDS

The Universitat Autònoma de Barcelona (UAB) is a young public university situated in the outskirts of Barcelona, in a quite socio-economically deprived area. The context of this study is one of the social programmes of the UAB, the programme Unix (FAS), which involves university volunteers and 13-15 year old students from public schools in its surrounding. Students participating at the UniX program come from 4 different secondary schools. These students face diverse hardships at their homes, usually not having the necessary resources, environment and support to develop adequate study habits. These adversities result in low academic performance in class which is both cause and effect of a low sense of academic self-efficacy that schooling is not able to revert. As these students do not have the financial resources to participate in out-of-school support activities that help them to break this trend, low academic performance and low sense of self-efficacy are perpetuated and aggravate along time, even endangering these students' likelihood of finishing their compulsory studies.

SOLIDARITY AUTONOMOUS FOUNDATION AND THE UNIX PROGRAM

- *UniX is a program of the Solidarity Autonomous Foundation (FAS) of the Autonomous University of Barcelona (UAB). This program is aimed at promoting Math and transversal competencies of 13-15-year-old secondary students of a deprived area in the nearby of the university.*
- *The UniX program takes place after school hours and is carried out by more than 10 volunteer students from different university degrees of the UAB. A total of 4 secondary schools and 60 secondary students participated in the UniX program during the 2017-2018 academic year.*

Students of the UAB volunteer at the UniX to carry out Maths activities with the aim of providing opportunities to these students facing learning and familiar hardships. These volunteers have diverse backgrounds, some of them coming from STEM degrees (Science, Technology, Engineering, and Maths), and some of them coming from Social Sciences' degrees (Primary Education, Sociology, Psychology…). In addition, they also have different experience with out-of-school activities with teenagers. Personal past experiences of these volunteers as secondary school students are usually what motivates their participation in the UniX program, as expressed this student of Chemistry in an initial interview:

> When I was a teenager, I was not like the other girls in my class. I did not like the topics they liked nor the jokes they did, and this make me felt disengaged from school. My own experience as student may help me to understand how UniX students feel. I want to say them that they also have things to say and to do.

These initial feelings predispose UniX volunteers to empathize with the 13-15 years-old students they will support, and to act as a positive role models.

In the academic course 2016-2017 an evaluation of the impact of the UniX program was undertaken, revealing that, although secondary school students benefit from the participation in the program improving their performance in school, their self-efficacy beliefs in Maths remained unchanged. In a long-term perspective, an unchanged low self-efficacy in Maths usually results in detachment from STEM activities (Bandura, 1993). Thus, in order to ensure the future STEM literacy of these students and allow STEM aspirations in spite of the low scientific capital of their families (Archer & Dewitt, 2015), the UniX program should be revised. Within the framework of the STEAM4U project a new model of UniX workshop and subsequent training was carried out to increase the impact of the UniX program on students' self-efficacy beliefs in Maths.

INCREASING CONFIDENCE IN MATH’S ABILITY: THE TRAINING OF UNIX VOLUNTEERS

Development of a new model of the UniX workshops

The new model of UniX workshop was aimed at raising students’ self-efficacy in Maths by providing an engaging educational context, a low entry-level (an easy barrier of access to the activity) and an adequate sequence of learning steps so that leaps of difficulty become affordable for students and equilibrated throughout all the activities.

The workshop was centred on the polyhedron identification, 2D-3D relationships, transformation within the plane and placement and location in space, as shown in (Figure 17). The model of workshop was designed to be carried out in 6 sessions (Figure 18).

Sessions S1 and S2 of the workshop were devoted to play in teams a Math game named Tridio©, as described by Ribosa & Durán (2017) (Figure 18).

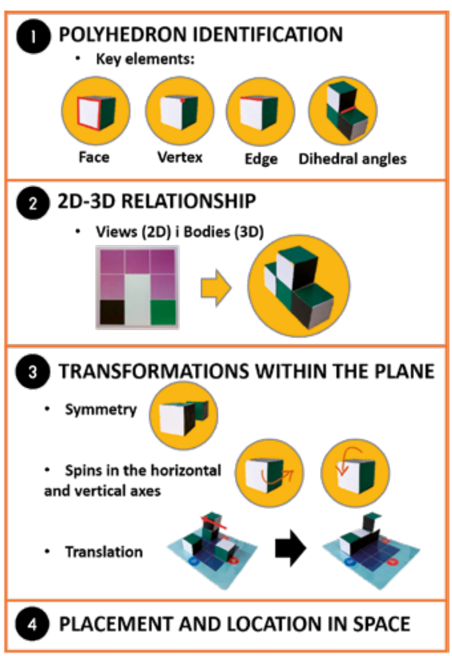


Figure 17. Representation of the Math content covered in the model of UniX

Figure 18. Summary of the development of the model of UniX workshop

S3 of the workshop was aimed at applying the knowledge built in the previous sessions to the deployment of diverse cubes in the plane and identifying mathematical patterns with construction pieces[2]. The S4 of the workshop was aimed at discussing different perspectives of a same figure, from different situations[3]. After the S1, S2 and S3 students were given complementary Maths challenges that they have to resolve at their homes[4]. These challenges were related to the content of the previous sessions. During the following session, de resolution of the challenge was discussed, with a special emphasis on the different strategies to achieve it. Finally, in sessions S5 and S6 of the workshop, students were asked to prepare a challenge for their colleagues, similarly to the challenges carried out previously. A 7th extra session was planned in which all students would present their work in a public event at the local theatre.

2 Complementary material can be accessed here: http://steam4u.eu/wp-content/uploads/2018/06/Microsoft-Word-ENGSessió-3Document.pdf
3 Complementary material can be accessed here: http://steam4u.eu/wp-content/uploads/2018/06/S4-From-2D-to-3D.pdf
4 https://www.dropbox.com/s/go2wcmiw3uigq0i/Challenge%20your%20Brain_V5.pdf?dl=0

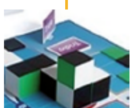
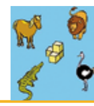
SESSION	S1	S2	S3	S4	S5	S6	FINAL SESSION
Activity	Present the workshop & play Tridio game 	Play Tridoi game & finish the game challenges	Promote students' thinking about Math content 	Contextual application 	Preparation of communica-tions 	Preparation of communica-tions	Public presentation at the theatre 
In-between sessions' challenges		Challenge 1	Challenge 2	Challenge 3			

Figure 19. A group of students playing Tridio® game and discussing about Math during the UniX workshop (1st session).

A volunteer first piloted the implementation of the workshop, which was carried out at the beginning of October 2017. Results, videos and data from this pilot workshop with students was used as a model for the training of volunteers. The final implementation in 4 schools was carried out by the volunteers from December 2017 to January 2018.

Training of UniX volunteers

The training of volunteers took place from September 2017 to January 2018. Initial data gathered from the volunteers revealed 2 different needs: volunteers from STEM degrees (STEM volunteers) were used to do Math in their university preparation and did not hesitate about their Math abilities. However, they felt insecure about their educational competences to manage groups, especially in the presence of disruptive situations or students, and in how to teach math to youngsters. On the other hand, volunteers from social science degrees (SS volunteers) were confident about their competences in managing groups, but expressed strong reluctances about their own Maths skills. This situation led us to set 2 different aims for the volunteer training: to raise volunteers' self-efficacy in Maths (especially for SS volunteers) and to raise volunteers' self-efficacy in Math teaching (especially for STEM volunteers).

The design of the training was based in the proposal of Sherin, Jacobs, & Philipp (2011) around the concept of *teachers' professional noticing,* which draws from the experience of the educators' themselves while, experiencing and observing an activity (in our case, the new UniX workshop of Figure 2) to build the desired teacher knowledge cooperatively. Thus, it combines focus groups' sessions of reflection and discussion with experience and implementation the activities. As it is also shown in Table 4, the volunteers' training consisted on 3 focus-group sessions organised around 2 implementations of the new UniX workshop, the pilot and the definitive implementations.

Training session	S1: presentation and familiarisation with the STEAM4U workshop		S2: Analysis of episodes of the pilot implementation		S3: Analysis of own practices
Implementation of STEAM4U workshop		Implementation of the pilot STEAM4U workshop (1 volunteer)		Implementation of the STEAM4U workshop (other volunteers)	

Table 4. Structure of the training of the volunteers and the implementation of the new model of the UniX workshop.

The **first session** of the training (**S1**), was devoted to present the new model of UniX workshop to the volunteers. Volunteers were asked to play and participate in different Math activates to familiarise with the dynamics of the workshop as students themselves. Then, it was discussed what Math content was involved in each activity, which strategies each volunteer had used to solve challenges and which had been the most successful ones (Figure 20).

Figure 20. A group of students playing Tridio® game and discussing about Math during the UniX workshop (1st session)

After this first session, a volunteer accepted to implement the model of UniX workshop with their students (**pilot implementation**). A team of researchers observed and recorded this implementation, selecting some relevant episodes in which self-efficacy beliefs of students were manifested and/or opportunities for the construction of Math knowledge were identified.

In the **second session** of the training (**S2**), relevant episodes of this pilot implementation were analysed with the rest of volunteers in terms of the Math knowledge construction and the self-efficacy beliefs made explicit by students. Volunteers had to discuss those aspects by answering questions such as “what is the most relevant thing of the episode for you? How can you interpret what students say?”. Special emphasis was placed on discussing the teaching strategies used to promote deep construction of the Math knowledge and to authentically raise self-efficacy. Volunteers also had to co-design alternative, more sophisticated strategies to better achieve these same aims.

Figure 21. Representation of the second session. Volunteers watched and discussed some relevant episodes of the pilot implementation.

After S2, all volunteers implemented the model of UniX workshop with their students. Since the implementation was simultaneously carried out in 4 secondary schools, all the implementations could not be observed and recorded by the research team. In order to gather appropriate data for the subsequent session, volunteers were asked to identify and describe the relevant episodes that happened during their implementation.

After this second implementation, a **third training session** (**S3**) was carried out. Similarly to the second session, relevant episodes brought by the volunteers were analysed and discussed with the rest of the volunteers. The design and complementary materials of the training can be accessed through the following link: https://goo.gl/H3r4DW

ASSESSING THE IMPACT OF THE VOLUNTEER TRAINING AND THE NEW UNIX WORKSHOP ON PARTICIPANTS' SELF-EFFICACY

All volunteers and participant students were surveyed before and after their participation in the training and implementation of the new UniX workshop, respectively. Both questionnaires used were aimed at revealing volunteers and students' self-efficacy in Maths among other related variables, and were based on previous questionnaires from the literature gathered in the STEAM4U toolkit[5]. In addition, a selection of volunteers and participant students were also interviewed using a semi-structured protocol before and after their participation.

Gathered data from the surveys was analysed quantitavely using statistical analysis. Data from the interviews was analysed qualitatively, using a bottom-up approach for the emergence of categories that compare, collapse, describe and interpret participants' views.

"I DO NOT WANT MY STUDENTS TO GIVE UP". RESULTS OF THE IMPACT OF STEAM4U TRAINING ON UNIX VOLUNTEERS

Data gathered from the questionnaires, interviews and observations provided information on the impact of the STEAM4U initiative on the participating volunteers. 8 university students that volunteer in the UniX programme received the STEAM4U training and participated in the implementation of the new UniX wor-

5 http://steam4u.eu/homepage/the-steam4u-toolkit/

kshop. 4 volunteers (3 boys and 1 girl) came from STEM degrees and 4 volunteers (4 girls) came from Social Science degrees. However, 2 volunteers (girls from Social Science degrees) gave up the program in the middle of the implementation of the workshop, making a total number of 6 volunteers participating in all the initiative (4 volunteers from STEM degrees and 2 from Social Science degrees).

At the end of the training and the implementation of the workshop, most of the volunteers acknowledged having developed their strategies to help students to learn Maths. The *professional noticing* training methodology was much appreciated by volunteers because it was based on real examples of the implementation of the workshop, and promoted meaningful discussions about Math teaching strategies and strategies to raise self-efficacy. Volunteers considered that this model of training provided concrete ideas about what they could do in class afterwards (which problems could they face? How could they overcome them? How to make the most of their intervention in terms of raising self-efficacy in Maths and promoting Math competences?).

However, volunteers also complained about the detailed design of the workshop, which left them little space for doing other things with the students. Volunteers reported that when students felt anxious because they had lots of homework or upcoming exams, they preferred volunteers' help with these school tasks than to *play* with the Maths games. Though volunteers tried to answer these occasional needs, the timing of the sessions of the new UniX workshop was tight, leaving little extra time for them to adapt to students' urgent needs.

> Students sometimes were anxious about having lots of Math homework or for the Math exam they were having the following day. In these situations, they did not want to play the game or participate in the workshop, but to study or to do homework with us. They felt that the game was not useful for what they were doing at school. Maybe, when we plan the UniX workshop (for the next implementation), we could have into account these periods in which students will be more stressed to help them better or try to connect what we are doing at UniX with what students are doing in their classes.

Hence, more flexibility in the implementation of the workshop was introduced in the revised design of the model of workshop.

Apart from these general evaluations, results of the impact of the training and the implementation on volunteers' self-efficacy revealed strong differences among volunteers based on their backgrounds: experience of those volunteers coming from STEM degrees (STEM volunteers) were significantly different than those volunteers coming from Social Science's degrees (SS volunteers). Such differences in the impact on volunteers' self-efficacy are explained below.

Raising self-efficacy in Maths

Initial interviews and questionnaires revealed that SS volunteers held low levels of self-efficacy in Maths, similarly to the students participating in the UniX program. In this sense, data gathered displayed a significant improvement in self-efficacy in Maths of those SS volunteers. However, this improvement was mostly specific to the Math content covered in the UniX model of workshop (e.g. 2D-3D relationship). When asked in general, these same SS volunteers still expressed reluctances about their competences in the area:

> The training was very useful to shift my own fears and to change the "I am no good for this" (...). Now I feel much more confident implementing a UniX workshop, but still I do not feel able to design my own Math workshops, because I do not have the proper Math knowledge to do it.

Conversely, STEM volunteers held high initial self-efficacy believes, and results of the survey and interviews proved no impact on this construct. In other words, at the end of the training and of the implementation of the model of workshop, all volunteers showed a great level of self-efficacy about the specific Math abilities involved in the proposal of workshop, but when asked in general, only STEM volunteers maintained a high level of self-efficacy in their abilities in the Math area.

These results confirmed that self-efficacy beliefs are strongly linked and narrowed to a particular task and at a particular level (Bandura, 2006). For instance, a volunteer can believe that he or she will be very capable of solving a particular Math challenge involved in the UniX workshop, but feel not able to solve another algebra problem. Self-efficacy in the Math area, though, is the result of a compilation of self-schemas that are created from earlier experiences and that would need abundant experiences of success to change it, as reported by Bong & Skaalvik (2003). Raising self-efficacy in the STEM area is a long-distance race. In this sense, volunteers' self-efficacy in Maths did not increase to a great extend along the training experience. Our viewpoint is that many more workshops like this one would be needed to have an impact in such a deep-rooted concept as self-efficacy in an area.

During the interviews, some elements of the training and the new workshop design were highlighted by the volunteers as boosters of self-efficacy. In particular, the first session of the training, devoted to carry out the UniX workshop as a student, was especially valued for those volunteers with lower levels of self-efficacy in Maths. SS volunteers valued that the proposed activities had a low entry level, that is, that the activities were accessible to everyone whatever their math competence. Another element valued by volunteers was the trainer conducting the training, who was described as charismatic. They explicitly mentioned the key messages she gave them and how they helped to break their initial reluctances, engaging them in the activity and helping them to persist despite the difficulties. These two elements have been also reported in the work of Zimmerman & Campillo (2003) as successful strategies to promote self-efficacy, and reassured us about the positive impact of the training on volunteers' beliefs.

Apart from these two strategies, volunteers highly appreciated the teaching materials of the new workshop, aimed at helping them to implement this same workshop in their UniX session afterwards. Specifically, volunteers valued the detailed instructions and recommendations for all activities, as well as the samples of possible both right and wrong answers for all the activities and challenges.

> The Tridio® game went very well. The challenges motivated the students and engaged them in the sessions. And for me, having the solutions to the challenges, made me feel much more confident when doing the activity.

As it can be extracted from the interviews, these materials helped the volunteers to gain confidence during the preparation of the workshop. During the implementation they also acted as aids and backups if they felt they were losing track of the activity.

In addition, the volunteer in charge of the pilot implementation of the workshop valued very much the presence of an expert in the field while she was implementing it. This expert was a researcher carrying out observations and was only aimed at collecting data. However, at some points when the volunteer felt insecure with the Math content, she came out to help the volunteer, giving rise to some informal episodes of co-teaching. Unfortunately, we did not have the resources to provide an expert to the rest of volunteers while they were implementing the new workshops for the first time, but we believe that this non-planned and occasional co-teaching holds promising prospects of raising educators' self-efficacy on the content, similarly to its already reported benefits in the professional development field by Pancsofar & Petroff (2013)and other authors.

Raising self-efficacy in Math teaching

Impact on self-efficacy in Math teaching on both STEM and SS volunteers was also different. Volunteers coming from STEM degrees initially felt fairly confident about their Math knowledge and, although they acknowledged little or no experience in Maths teaching, they were also confident in their abilities to teach Maths. Thus, were mostly interested in developing their skills to managing groups with possible disruptive students:

> I am studying a degree in Chemistry, so my Math knowledge is good. However, I felt uneasy with the group managing, especially when thinking what I could do with the more disruptive students.

As the training progressed, those volunteers started to realise from the examples and the questions posed by the trainer that teaching Maths was something more than having a good Math knowledge and/or skills to manage groups, but to know how to ask good questions in class and at the right moment to stimulate students' Math reasoning, identify which cognitive difficulties students were facing, another elements included in what Shulman (1986) defined by Pedagogical Content Knowledge (PCK).

Although it was positive that the training made the volunteers aware of the competences needed to teach Maths, data gathered proved that more training would have been needed to develop a good teaching level of pedagogical content knowledge on the volunteers. At the evaluation of the last training, STEM volunteers acknowledged facing difficulties in the UniX workshops to identify when and how to pose good questions to students either to promote their Maths competencies or to raise their self-efficacy in Maths. STEM volunteers also recognized that was much easier for them to reproduce traditional teaching practices (lectures, etc.) than carrying out a lesson based on social construction of mathematical ideas, despite that learning through dialogue engaged their students much more. Hence, data gathered at the end reflected this raise of the awareness of STEM volunteers of Math teaching competences, but almost no impact on their self-efficacy in Maths teaching. A bigger impact for those volunteers should be expected of longer training programs.

Impact on self-efficacy in Math teaching of SS volunteers was slightly different. As described before, these volunteers had low sense of Math self-efficacy and expressed serious doubts about their abilities to teach Maths, as this volunteer expressed:

> I have not ever been a good Math student, so I am not sure if I will be able to do it well (the implementation of the workshop).

However, these volunteers felt confident about their general pedagogical skills (knowing of broad principles and strategies of classroom management and organisation, knowing of different educational contexts, educational purposes, etc.).

During the training, we observed that their increase of self-efficacy in Math teaching was fast as soon as these volunteers felt confident about the Maths topics involved in the workshop. In other words, knowledge of the content acted as a limiting factor for these volunteers. Thus, and conversely to their STEM colleagues, volunteers coming from social science degrees took much more advantage of the reflections centred in the Maths contents involved in the UniX model of workshop, rather than of the discussions about the teaching skills throughout the training.

It is important to note that the raise of self-efficacy in Maths teaching of those SS volunteers was narrowed to the particular Math content, similarly to their self-efficacy in Maths reported previously. Thus, when asked at the end of the STEAM4U challenge if they would feel capable of doing and designing new UniX workshops, they still expressed strong doubts about their competences. In the interviews, these hesitations showed to be motivated by their low sense of self-efficacy in the Math area. These findings reinforce the role of Maths' knowledge and Maths' self-efficacy as limiting factors in the professional development of these profile of volunteers, and has been extensively reported in the literature since the work of Shulman (1986).

In practice, we observed that in those sessions where volunteers from different backgrounds participated during the implementation of the UniX new workshop, volunteers relied on each other's expertise (either Math knowledge or general pedagogical knowledge), creating a positive synergy between them. For us, these collaborations constitute another of the extra values of the UniX volunteering program, which should be exploited in the future.

RESULTS OF THE IMPACT OF STEAM4U TRAINING ON 12-13-YEAR-OLD STUDENTS

A total of 60 students from 4 different secondary schools (30 females, 28 males and 2 No-Answer) participated in the pre-workshop questionnaires, and a total of 45 students from those same schools (21 females, 16 males and 8 NA), answered the post-workshop questionnaire. Questionnaires allowed us to track a number of 38 students (21 females, 16 males and 1 NA) having answered both pre and post-workshop questionnaires. All these students were between 12 and 13 years old and came from socially deprived backgrounds[6].

Different tendencies have been observed among boys and girls along the implementation of the new UniX workshop in terms of self-efficacy and, in particular, related to the use of Maths in school contexts or in everyday activities.

Impact on students’ self-efficacy in Math in school contexts

The perception of Unix volunteers on the impact of the implementation ascribes an improvement of students’ self-efficacy in Maths for all participating students, as a volunteer expressed in the interview:

> The main benefit of the UniX workshops for the students is that they raise their self-confidence in Maths. At the beginning they come saying that they do not know anything about Maths and, as you walk with them, they realize that they are able to do it.

However, data gathered from boys and girls before and after doing the workshop showed differences among them (Figure 22). According to data, at the beginning, boys seemed to feel much more confident than girls about their abilities: less than 20% of boys felt little capable on maths while more than 45% of girls felt the same. These behaviour, in which girls assess their Maths abilities lower than do boys, have been extensively reported in the literature (Bøe & Henriksen, 2013; Hill, Catherine, Corbett, & St. Rose, Andresse, 2010). These differences are commonly explained as girls holding themselves to a higher standard than do boys, believing that they have to be exceptional to succeed (Hill, Catherine et al., 2010).

6 The average level of studies of their parents, considered a strong predictor of the socio-economic level of students, was *secondary studies finished*. The average of the parents’ level of studies from Catalonia population (data from PISA 2015) is *Bachelors’ degree*, 2 categories above of the UniX sample.

On the other hand, the effect of the implementation also shows strong gender differences. By the end of the intervention, self-efficacy beliefs regarding maths showed to be in the upper scale of confidence. That is, both boys and girls felt very or somewhat capable, and there were no students feeling little or no capable. Due to the differences in self-efficacy at the beginning between boys and girls, girls' final self-efficacy experienced a greater improvement along the intervention, compared to boys.

Despite this positive effect of the intervention in diminishing low levels of self-efficacy, the % of boys that rated their capacity really high (very capable) does diminish along the intervention. This fact, again, could be explained by the tendency of boys to overestimate their capacities before they actually experience the implementation. At the end of the activities, they would have more evidences to realistically rate their own performance. It is important to note that levels of self-efficacy in Maths at school appear to be similar between boys and girls at the end of the implementation.

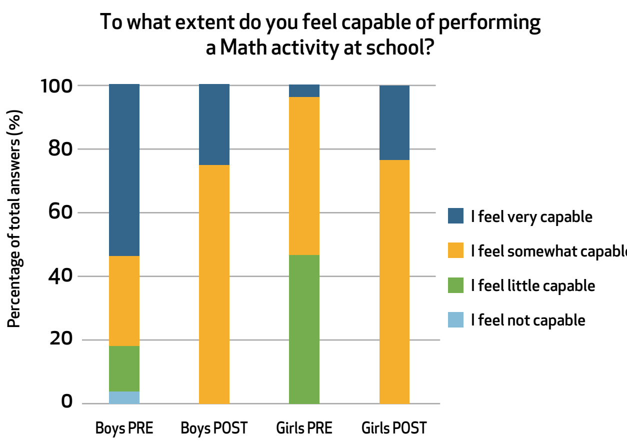


Figure 22. Differences between boys and girls self-efficacy at school.

Interestingly, when interviewing students about the workshop, we found that many students did not have the feeling they had learned Math content during the workshop:

> 3D and 2D are not Math content, but I have learnt many things I did not know.
> After participating in the UniX workshop I do not feel more able to do Maths in class, because the problems we do there are different.

These perceptions made us rethink the impact of the workshop on students' change of self-efficacy in Maths reported in Figure 22 to consider other possible factors that may have an effect on it, such as the work at school, volunteers' helping with the homework, increase matureness of students, etc. But especially, these perceptions pointed out an important consideration: when designing innovative Math activities that are very different from traditional school ones, Math topics can be hidden by the dynamics of the activity. Thus, volunteers need to make these contents explicit and connect them with the school curriculum in order to make students more aware of their math learning.

In addition, and based on the experience, we also believe that students would benefit more from carrying out workshops directly related with the Math topics students are working in school at the time, so that these connections are easier to be made. In this way, students would realize that Math can be learnt and done in a different way, breaking the negative association caused by their school experience, and helping them reduce their assessment anxiety.

CONCLUSIONS

The design, implementation and evaluation of the training of volunteers and UniX workshop provided some evidences of the potential of out-of-school activities to raise self-efficacy in Maths. The training, based on the *Teacher noticing* methodology (Sherin et al., 2011), was highly appreciated by the volunteers. In particular, the use of real examples of episodes of the implementation of the workshop allowed the volunteers to engage in meaningful discussions about teaching strategies to promote Math competences and raise self-efficacy in their context.

At the end of the training and implementation, volunteers coming from Social Science degrees experienced a raise in their self-efficacy beliefs about Maths. These volunteers acknowledged the low entry level of the UniX workshop, the key messages of the trainer and the quality of the teaching materials, as strategies helping them to raise their confidence. However, this increase of self-efficacy was narrowed to the particular Math content involved, so views of the SS volunteers about their own capacities in the Math area did not change. These evidences confirm that self-efficacy believes are deeply rooted in past personal experiences, and suggest that many different actions need to be undertaken to effectively change them.

Volunteers coming from STEM degrees (Science, Technology, Engineering & Maths), whose initial self-efficacy beliefs in Maths and Math teaching were high, become more aware of the concrete competences needed to teach Maths, despite no impact in their self-efficacy of Math teaching was observed. Conversely, although SS volunteers felt insecure about teaching Maths, once they felt confident about the Maths contents the development of their self-efficacy for teaching Maths was fast. All these evidences prove us that the volunteer training was appropriate and served to help both STEM and SS volunteers, and that combination of both sorts of volunteers in the same school would be highly beneficial.

The enduring character of self-efficacy believes was also observed in the impact of the implementation on students. Results show a modest rise of self-efficacy in Maths, which is particularly relevant for girls'. Again, these results suggest courses of action for the future. On the one hand, the need to undertake many similar actions to truly improve students' own self-efficacy believes. On the other, the need to address weak points of the implementation, such as the need to make explicit the Math curricular content involved in the workshop, and the need to directly connect the UniX workshops with what students are doing in their lessons at school.

KEY MESSAGES FOR EDUCATORS

- **As a trainer, train educators who will implement STEM workshops according to their needs: educators coming from Social Science degrees will benefit more from discussing about the content as students themselves; educators coming from STEM degrees will benefit more from discussing about strategies to teach a particular STEM content.**
- **As an educator, make evident the Math content/ competences involved in any innovative STEM activity, connecting it with the traditional curriculum. Otherwise, your students will mostly feel an increase of their personal abilities in general, but not a particular raise of their self-efficacy in Maths.**
- **Try to carry out diverse actions to raise your participants' self-efficacy in Maths, using a variety of strategies. Self-efficacy believes are deeply rooted and many different experiences are needed to change them.**

FUTURE STEPS

Non-formal educational contexts offer unique opportunities to develop Maths competences breaking the negative feelings that usually generate in school, in particular for students from deprived social backgrounds. From our experience, two considerations should be taken into account for future implementations. Firstly, in order to increase the impact of such initiatives in participants' self-efficacy in Maths, we need to better connect those experiences with what participants' do in their schools. By making evident the Math concepts involved in the activities and trying to carry out out-of-school workshops directly connected with what students are doing in their Math lessons, the impact on students' self-efficacy believes will increase more.

Secondly, the implementation of innovative activities pose some difficulties to new educators that cannot be ignored. As such, it is important to provide volunteers and other educators with a good training based on both subject matter and pedagogical content knowledge, balancing the weight of both according to volunteers previous expertise. Concrete and meaningful examples of the workshops, but also longer training efforts, should be considered to increase the impact of the training in both volunteers and students regarding the complexity of self-efficacy in maths.

TO KNOW MORE

Archer, L., & Dewitt, J. (2015). Science Aspirations and Gender Identity: Lessons from the ASPIRES Project. In E. K. Henriksen, J. Dillon, & J. Ryder (Eds.), Understanding Student Participation and Choice in Science and Technology Education (pp. 89–102). Springer Editorial. http://doi.org/10.1007/978-94-007-7793-4

Bandura, A. (1993). Perceived Self-Efficacy in Cognitive Development and Functioning. Educational Psychologist, 28(2), 117–148.

Bandura, A. (2006). Adolescent development from an agentic perspective. In Self-efficacy beliefs of adolescents (pp. 1–44).

Bøe, M. V., & Henriksen, E. K. (2013). Love It or Leave It: Norwegian Students' Motivations and Expectations for Postcompulsory Physics. Science Education, 97(4), 550–573. http://doi.org/10.1002/sce.21068

Bong, M., & Skaalvik, E. M. (2003). Academic Self-Concept and Self-Efficacy: How Different Are They Really? Educational Psychology Review, 15(1), 1–40. http://doi.org/10.1023/A:1021302408382

Hill, Catherine, P. ., Corbett, C., & St. Rose, Andresse, E. D. (2010). Why So Few? Women in Science, Technology, Engineering, and Mathematics. Aauw.

Pancsofar, N., & Petroff, J. G. (2013). Professional Development Experiences in Co-Teaching. Teacher Education and Special Education: The Journal of the Teacher Education Division of the Council for Exceptional Children, 36(2), 83–96. http://doi.org/10.1177/0888406412474996

Ribosa, J., & Durán, D. (2017). Cooperación, juego y matemáticas: análisis de la aplicación del Tridio Cooperativo con alumnado de primaria. PNA. Revista de Investigación En Didáctica de La Matemática, 11(3), 205–231.

Sherin, M. G., Jacobs, V. R., & Philipp, R. A. (Eds.). (2011). Mathematics teacher noticing: Seeing through teachers' eyes. New York: Routledge.

Shulman, L. S. (1986). Those who understand knowledge growth in teaching. Educational Researcher, 15(2), 4–14.

Zimmerman, B. J., & Campillo, M. (2003). Motivating Self-Regulated Problem Solvers. In J. E. Davidson & R. J. Sternberg (Eds.), The Psychology of Problem Solving (pp. 233–262). Cambridge, UK: Cambridge University Press. http://doi.org/10.1017/CBO9780511615771