Evaluation of Makers in Residence Mexico: Creating the Conditions for Learning and Invention*

Paulo Blikstein[¤], Gabriela Calderón[❇] and Nancy Otero[+]

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Abstract

The rapid advances in technology have changed the objectives of some educational systems, for instance in the United States, where developing abilities in science, technology, engineering and mathematics (STEM) are seen as necessary for an increasing number of jobs and specializations and should not only be a vocational skill for specific workers. In this way, an increasing number of new pedagogical approaches draw on prototyping or building with cutting edge fabrication technologies. However, little is known about the causal effects on students' performance especially regarding technological skills with these new tools. In this paper we evaluate an 80-hour digital fabrication workshop entitled "Makers in Residence Mexico" (MRM) that was applied in public high-schools in Mexico. Our findings suggest that students increased their confidence in technological skills as measured through the Exploration and Fabrication Technologies (EFT) index, as well as the time allocated to study after school and time allocated for invention of physical objects. Results suggest that this program contributed to students' ability to learn and their confidence in having technology-related skills. In addition, there is a significant increase in both the proportion of students who would choose a STEM career as a first choice.

Keywords: Economic Development, Innovation, Randomized control trial, STEM, Learning technologies

JEL Classification: I25, O31, C52

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[¤]Stanford University, Center for Educational Research, 530 Galvez Mall, Stanford, CA. Email address: paulob@stanford.edu.

[❇]Fablabmex Makers in Residence and Non-resident Fellow at Poverty and Governance, Stanford University. Email address: gabcal@alumni.stanford.edu.

[+] Fablabmex Makers in Residence and Stanford University, Center for Educational Research, 530 Galvez Mall, Stanford, CA. Email address:notero@alumni.stanford.edu.

1 Introduction

A developing enthusiasm for the development of innovative technological skills matched with the progressively affordable and accessible tools associated with this movement have resulted in the wide popularity of the “Maker Movement” (Gauntlett, 2011). The Maker Movement is associated with do-it-yourself (DIY) practices that include a variety of fabrication techniques, from woodworking to sewing to auto repair, especially focusing on tools that utilize computing including 3D printers, laser cutters, microcontrollers, robotics, and many others. This movement has also introduced new pedagogical approaches and social practices where students learn while prototyping or building with these innovative technologies (Martinez & Stager, 2013). For instance, students can take abstract ideas and make them physical through these new technologies, allowing new types of scientific and engineering investigations (Blikstein, 2014). The popularity of this approach to learning has led to a groundswell of FabLabs, Makerspaces, and similar innovation labs in K-12 schools, libraries, and museums both in the United States and abroad (Blikstein, 2013; Brahms & Werner, 2013; Petrich, Wilkinson, & Bevan, 2013). In particular, implementing digital fabrication and learning by ‘making’ in learning environments aims at broadening the development of science, technology, engineering, and mathematics (i.e., STEM) abilities for all students and not only to specific workers. Yet while despite this movement’s popularity, little is known about its causal effects on students’ performance.

Thus far, many of the reports on making rely on anecdotal evidence (Honey & Kanter, 2013), although a number of descriptive studies on individual spaces or workshops are emerging that move beyond the personal narratives or common sense arguments (Litts, 2014). Research on electronic textiles, which use conductive thread and sewable microcontrollers to create light-up clothes or other soft projects, has demonstrated improved knowledge of circuitry, programming practices, and engineering thinking (e.g., Eisenberg, Eisenberg, & Haung, 2013; Kafai & Burke, 2014; Peppler & Glosson, 2013). Further, these studies consistently show an increased sense of identity related to computer science and science or STEM more generally (Fields & King, 2014; Kafai, Fields & Searle, 2014). One study using a quasi-experimental design with eight middle school classes with the same teacher found significant gains in science interest amongst students in the e-textiles (versus traditional electricity) curriculum (Tofel-Grehl, Fields & Gu, under review). Outside of e-textiles, several studies have documented an improvement in the types of thinking involved in making, from tinkering to scientific inquiry skills such as observing, developing hypotheses, and evaluating solutions (Petrich, Wilkinson, & Bevan, 2013; Sullivan, 2009). Litts (2014) identified three primary design stances that students take in making projects —aesthetic, functional, and pragmatic—as well as a number of disciplinary approaches that students utilize, drawing on engineering, arts, and science. Notably each design stance drew on all of the disciplinary approaches, demonstrating that students may come with different approaches and still show rigor and STEM learning in their design processes. While these studies as a whole demonstrate the potential for positive development of interest in STEM as well as learning by making, research is needed that shows a causal relation between participation in maker settings and positive effects of learning and interest in STEM careers.

In this paper, we analyze the causal effects of Makers in Residence Mexico, an after-school program where students used fabrication technologies and prototyping to solve relevant problems. We evaluated students’ performance and confidence in technological abilities using a Randomized Controlled Trial that took place over 4 iterations in two sites in Mexico between 2013 and 2015. A general evaluation for measuring changes in behavior was performed by estimating the Intention-to-treat effects and Treated-on-the-treated effects on different relevant outcomes such as: time allocated to study after school, grades for classes related to science, career choices, dropout rates, and an index that measures skills on performance and confidence related to exploration and fabrication technology (Blikstein, Kabayadondo, Martin & Fields, in press).

In order to measure the effect of digital fabrication tools on learning we use the Exploration and Fabrication Technologies index, developed by Blikstein et al (2015). This validated instrument captures changes in i) exposure, ii) confidence and iii) performance towards maker technology and practices. The main components of this index are i) general computing confidence; ii) technologies for information and communication confidence (ICT confidence); iii) confidence on exploration and fabrication technologies (EFT confidence); and iv) performance on exploration and fabrication technologies (EFT performance). Each component measures expertise in different technologies that are not equivalent and provides a measure of the different phases of mastering technology focusing on three different landmarks: exposure to technology, confidence or self-efficacy in their technology abilities to use it to gain other learning, and ability to perform objective task that demonstrate their technology literacy. Presumably the MRM workshop should have an impact on EFT confidence and production but not necessarily on the use of general computing tools or information and communication technologies.

1.1 Summary of Results

In summary, our results indicate that students who were invited to MRM increase the time allocated to study after school approximately by 210 minutes per week. Their EFT confidence index increased by 65% of a standard deviation and their EFT performance index increased by 28% of a standard deviation. As expected, it did not have any statistical significant effect on general computing or ICT confidence. There is also some indication that students who were invited to MRM change their confidence about having high knowledge about fixing something by looking at someone or using a web page. In addition, the proportion of students who wanted to study an engineering major in college increased by 10 percentage points.

There are several possible mechanisms that could explain the reason students increase the time allocated to studying. One possibility is that the new teaching technology allows them to change the student's methodology for learning. They "learn how to learn" using other methods: trial and error using new tools, looking things up in the internet, looking at how other people do it, questioning themselves about how to solve a specific problem, and recognizing the importance to follow a logic sequence in their attempt to solve a problem. Another mechanism that could be taking place is that the workshop also potentially changes their preferences about learning, because they realize that knowledge is in fact useful, the specific technology skills they learned are closely related to the items they use in their everyday life. A third possible mechanism is that the MRM workshop also increased their technology skills which affect directly their productive skills. These new set of skills allows them to use other knowledge to learn in school for future inventions, affecting future productive skills. In other words, with new technological skills the benefits of learning increase.

The importance of this program relies not only on changing the teaching technology but also on the potential long-run effects it could have on labor productive skills, which are one of the most important factors that affect growth. [1] Therefore, exploring the potential outcomes of these new

[1] Gollin (2002) showed that labor share accounts for more than 50% of national income for most countries (the share ranges between 65 to 80%).

methodologies for teaching is of utmost importance especially applied to low and middle income countries like Mexico. In addition, "there is a general perception that Mexico's insertion in supply chains has been mostly in assembly operations and that efforts should be made to incorporate additional domestic value in the international production networks in which the country participates" (Blyde, 2014). In fact, Blyde (2014) shows that Mexico's domestic value added in the production within the international value chain has been declining during the last six years. Countries like Mexico, where labor skills are not particularly focused on designing new products or leading a sophisticated process as part of the international supply chain are condemned to generate low value added and to remain in disadvantage compared to other more developed countries. Thus, programs like MRM are potential interventions to change these patterns. Even though research has been done in how access to technology (computers) contributes to improve grades among minority students, suggesting that the achievement gap can be partly explained by low levels of access to technology (Fairlie, 2012) little is known of how programs that give access to fabrication digital technology can benefit minority groups. This research can help understanding the effects of such access.

The rest of the paper is organized as follows. Fablab@school, the program in which this workshop is based, will be described in the second section, together with an explanation of the workshops that were implemented in Mexico City and Guadalajara. In the third section, the mechanisms which we think are the main drivers of change in education will be analyzed. The data and the empirical analysis will be presented in the fifth and in the sixth section the estimated effects of the variables of interest will be presented. Finally we conclude.

2 Background

The rapid advance in technology has forced us to change our view that learning or developing abilities on science, technology, engineering and mathematics (STEM) should be a vocational skill for specific workers. The National Research Council in several reports has established that skills to use and develop technology should not be focused solely on a "skill-based" approach but rather on a "fluency" approach (Blikstein, 2013). They argue that "an increasing number of jobs at all levels not just for professional scientists- require knowledge of STEM" (The National Research Council, 2011). Their objective is that knowledge and skills related to STEM should not be specifically focused on certain people with specific majors but on every single student. Robotics, data analysis, advanced science and engineering design should not be limited to specialized professionals. The educational policy in the US seeks that the average student engages in more sophisticated activities. The National Research Council set as an educational objective preparing "students to be lifelong learners".

Around the 2000s, researchers and schools started considering digital fabrication in education. Fablab@school[2] is a project that started at Stanford University where it tries to engage children with projects that solve real problems, with the intention of creating an authentic context for learning. Students feel motivated to learn when they need to solve real problems, therefore good projects create the need to learn more and develop the ability to learn. This program has extended to several countries, like Brazil, Spain and Thailand. However, it hasn't been evaluated before using randomization.

[2] Fablab@school webpage, can be found at: https://tltl.stanford.edu/project/fablabschool.

2.1 Description of the technology learning workshop: Makers in Residence

Makers in Residence Mexico (henceforth MRM) is an 80-hour workshop based on the Makers in Residence program developed by the Transformative Learning Technologies Lab at Stanford University. At MRM 20 to 25 participants (high-school students) learned, explored and used digital fabrication technology for a month at the fabrication laboratories of the university that hosted the program, with support of undergraduate students of STEM majors. During the workshops participants learned how to use different fabrication technologies such as vector graphic programs, laser cutters, 3D printers, microcontrollers such as GoGoBoards and Arduinos, and other fabrication tools. Students were also introduced to computational thinking and programming in order to program microcontrollers, create mobile apps, and design games and visualizations. At the end of the program, students participated in invention teams, developing projects with design thinking in order to solve a problem in their community.

In 2013, the NGO FAB! started implementing (MRM). Each workshop, was implemented with the collaboration of a private university and a public high-school that were sufficiently close in distance. MRM is a month-long after school program, participants go to school and after that they go to the host University everyday for four weeks. We search for private universities that have laser cutters and 3d printers, major in engineer and industrial design and be willing to collaborate with us during an entire month in a four hours daily basis. Public high-school students are invited to participate in the program with the only condition that the selection of participants will be randomly assigned. In this way, 50 students, stratifying by gender were randomly selected and received an invitation to participate in the program. From those, approximately more than half accepted the invitation. For various reasons, the take-up was half such as some students needed to work after school, were worry about not having time to finish their homework, among other reasons to decline the invitation.

Every workshop lasted 80 hours and we trained approximately 12 college students to help facilitate the program for every workshop, college students' role was to guide learning to the high school participants (from now on we called them facilitators). For every 3-4 participants, there should be at least one facilitator studying STEM careers, technology design or education. Facilitators participate in a two days (10 hours) training program and are assisted during the whole experience by facilitators that have participated in at least three previous workshops and the person that customized the program. Making both participants and facilitators focus on the development of a project, naturally develops a socialization process within two different socio-economic groups that otherwise would not like interact in Mexico City.

During the first two weeks, facilitators were organized in three groups. Every group prepared a topic for week one and a different topic for week two. Each topics included technology exploration, an organized mini-project activity using that technology and sometimes integrating technologies from previous days and some formalization of key concepts. The first two weeks were organized such that technology exposure was provided through the construction of one-day individualized projects guided by the facilitators during the first three days of the week (three projects per participant per week for week one and two) and during during the last two days of week one and week two, participants would integrate the learnt technology into a larger team project that followed a given challenge.

In the last two weeks of the workshop, the participants are asked to create teams and design a solution that will solve a problem that their society, their family or they face in their everyday life. We also guide students during their design process by applying design thinking. In this way, FAB! seeks to introduce a new way of learning, by generating technology and creating tangible ideas through the use of high tech. At the end of the program participants present their projects in an event organized in the hosting university and media, teachers, university professors, school administrators and families are invited.

In this paper we present the results of the evaluation of four workshops organized by FAB!: i) In September 2013, we partnered with Instituto Tecnológico de Monterrey (ITESM) Campus Santa Fé in Mexico City to implement the workshop Makers in Residence and the participants were randomly selected from the Colegio de Bachilleres 8, Cuajimalpa; ii) In September 2014, in Guadalajara we implemented the workshop at Instituto Tecnológico y de Estudios Superiores de Occidente (ITESO) where students from Preparatoria 5 at Universidad de Guadalajara participated, iii) In October 2014, in Mexico City a third workshop was implemented at ITESM Campus Santa Fé but this time participants were from Colegio Jesús Urquiaga and iv) In October 2015, in Guadalajara inside of the first FabLab@School inside Preparatoria 20 de Zapopan.

2.2 Makers in Residence Design

Makers in Residence Mexico (MRM) uses a project-based multidisciplinary approach that incorporates STEM + C (Computer Science) skills and principles using digital fabrication. Project-based learning has been found to greatly increase the learning gains of the traditional lecture method (Yadav, Subedi, Lundeberg, and Bunting, 2011). Involvement in project-based programs can lead to greater general scientific literacy and inspire pathways to higher learning and for science and technology careers (Sneider and Burke, 2011). In addition, multidisciplinary approaches, especially those that incorporate art and aesthetics have been shown to be more inclusive for girls and minorities (Root-Bernstein, 2011, Storksdieck, 2011). One of the main MRM's limitation is that it is an after school program, not an activity integrated inside the school curriculum available to everyone. After the program is over participants do not have a place where to continue fabricating their inventions, access to the technology or the facilitators, and no connection between their learning in the MRM and the rest of their learning life.

Interconnectedness of STEM fields leads to higher motivation to explore individual subjects in deeper ways (Thornburg, 2008). Projects where students are empowered to make choices about their learning through the several fields of knowledge of STEM can modify their emotional experience. Using technologies to internalize and express their ideas in complex and sophisticated ways can promote STEM and make help students to experience learning as an active process that promotes critical thinking and creativity (Dewey, 1933). MRM has been designed to promote equity through the experience of digital fabrication. Organized in ways that privilege the ongoing, generative process of thinking and making (Ingold, 2000) where tinkering is thought as a disposition towards design and making characterized by interaction and playful experimentation (Resnick and Rosenbaum, 2013).

MRM was designed with the goal of widening the definitions of learning, science, art, design and intelligence by developing imagination, creativity and play in a learning environment that promotes collaboration and links the program to a social endeavor. MRM integrate disciplines and experts, diverse tools, materials, methodologies and media with the goal of promoting reexamination of students conception of the same phenomenon (Petrich et al. 2013, Resnick and Rosenbaum, 2013). These principles have been considered to promote equity in teaching and learning (Vossoughi, et al. 2013).

MRM activities were designed to create a safe-space where students have an object to point to "an artifact that may be rickety or lopsided, but yet has resolved the problem that so puzzled the learner" (Petrich et al. 2013). This process of becoming stuck and then unstuck is an opportunity for teachers and facilitators to offer suggestions in terms of students' ideas and goals with the focus of expressing project complexity in students own terms. Blikstein (2013) suggests that these environments can provide "visceral design experiences and new levels of frustration and excitement, which students normally do not get to experience in school, helping students to conceive failure as a productive activity and support the exploratory mind of the students (Blikstein, 2013).

MRM has an essential community component that served to leverage the skills of each student towards a social goal. Fabrication team projects generate opportunities for students to learn to work together, share tools and ideas, provide peer assistance and embrace their intellectual diversity. Students claimed new roles as leaders and teachers as the project activities unfolded. Design thinking is a socially rich activity that participants use during the last two weeks of the workshop. By contributing to a larger collective project, individual artifacts designed by participants took on new meaning as part of a larger social creation, finding meaningful opportunities for participants to share their work can deepen engagement, encourage connections across artifacts and their makers, and create opening for children to stretch into new roles and practices. Goal development and design are also given direction by the broader social purpose of the activity.

A main problem with MRM's design is that it is a very intensive program that competes with another after school activities, and homework, if the MRM was spread out the school semester or if it was integrated as part of the school curriculum it will interfere less with students' performance in the school.

2.3 Relation Between Time Allocation to Study and Skill Formation

Economists since the seventies have been analyzing time allocation as an important input to produce tangible or intangible goods. The seminal work of Gary Becker "A Treatise on the Family" introduces the concept that time and goods are inputs into the production of commodities, which directly provide utility. In the paper "A Theory of the Allocation of Time", he emphasis the idea of the cost of time on the same direction as the cost of any good. There is a trade-off between allocating time to work and other non-work activities like leisure, learning skills or abilities, training, childrearing among others. "...many economists have stressed that the time of students is one of the inputs into the educational process, that this could be used to participate more fully in the labour market and therefore that one of the costs of education is the forgone earnings of students".

Every individual has to choose where to allocate optimally his or her time. Under the model of theory of choice developed by Becker (1965), individuals will allocate time such that they maximize utility, where time and market goods are combined via production functions to produce basic commodities. Households choose the best combination of these commodities so they can maximize the utility function.

One of the applications of this model is to explain the human capital accumulation of individuals. We could think that time can be allocated to work or to study, and if it is allocated to study then it will produce more abilities that could be used in the future to study more or to generate production goods. This means that time allocated to study is an investment that will have long-term effects on the life of an individual.

Time allocated to study has been the most important input in human capital theory framework. Under this framework a large literature has been developed, and has tried to explain why allocating time during young ages is an optimal decision for an individual. The reason is that there is a longer period over which they can receive returns on their investment (see Friedman and Kuznets, 1945; Becker 1962, 1964 and Mincer, 1958 and 1962).

Following this same framework, Cunha and Heckman (2007) developed a model of skill formation where they consider multiple stages of childhood. An important assumption of this model, based on literature in psychology, education and neuroscience is that inputs --of the production function of human capital- are complements in different stages. This means that abilities developed in younger ages will contribute to the development of more abilities in older ages. Cunha and Heckman (2007) define this as self-productivity such that "higher stock of skills in one period create higher stock of skills in the next period". Therefore if the stock of cognitive and non-cognitive skills raise the productivity of subsequent investment, then an increment in these type of abilities will lead that there are higher returns of learning in the subsequent periods. And one way to observe this larger investment is through a higher allocation of time in education.

Having an exogenous change in the complementary inputs can generate a larger investment in human capital, and these will have long-lasting effects. Therefore, if the MRM workshop is changing different inputs in the production function of human capital formation and it is generating more abilities to the participants, then we should expect a higher productivity in the production of their skills in the subsequent period and as a result it will be optimal for them to invest more time in studying. This is exactly what we will be observing in our results: both an increment in abilities and in the time allocated to study. We will argue that this might not be the only possibility since students might find it more motivating or change their preferences towards STEM knowledge or tech-savvy self-image, where they find it an amusing activity.

3 Data and Sample

3.1 Experimental Design and Data Collection

To determine whether the student learning increased as a result of the program we administered two surveys to all our sample, before and after the MRM workshop took place. Our data was collected from four different high-schools in Mexico -two were located in Mexico City and two in Guadalajara between 2013 and 2015. The survey included different information that will help us measure technology literacy -different measures of exposure, confidence with the usage of technology and particular skills to solve problems- socioeconomic characteristics, time allocation, college degree decisions and grades in science courses. The baseline survey was applied approximately one or two weeks before the invitation to the workshop, and the follow-up survey was made and at least two months after they took the course. All students from the last year of high-school took both surveys.

It is non-trivial to measure changes in technology literacy. Therefore, we use the index developed by Blikstein et al. (in press) to capture: i) exposure to technologies; ii) confidence or self-efficacy in their abilities to manipulate and work with technologies in the pursuit of other learning; and iii) demonstration of performance with technology. Blikstein's Exploration and Fabrication Technologies Index -EFT henceforth- aims at measuring evidence of learning in fabrication settings, where "learning is grounded in developing competence with digital fabrication tools". This measure aims at pinning down the ability of fabrication which measures activities oriented towards invention, fixing, construction and design, and the ability of exploration which are activities oriented towards expression, tinkering, learning and discovery.

The technology literacy literature emphasizes the role of performance over confidence. As students get better in managing technology they gain confidence since they feel more comfortable with production tools and materials for fabrication. However, improving EFT confidence does not guarantee that a student's EFT performance is increasing. Thus, it is important to have these two dimensions to evaluate the evolution and variation on technology literacy.

3.2 EFT Confidence Instrument

The EFT Confidence Instrument has three main components: i) General computing confidence; ii) Technologies for information and communication (ICT) Confidence; and iii) EFT Confidence. The instrument or questionnaire includes a section where the student answers in a scale between 1 and 6 how confident they feel with the following technology. The elements contained that measure general computing confidence include: computers, tablets, and smartphones. To measure ICT confidence we included: blogging, edition of digital videos, construction of robots, and programming. We asked students how familiar they felt with woodwork, welding, laser cutter, 3d printers and fixing appliances, furniture or toys.

3.3 EFT Performance Instrument

In order to measure EFT performance we asked the student to identify the components of an alarm car. In this way we added up all the correct answers they had for those questions. There were 10 components listed and the student has to indicate if the item was part of an alarm car or if it was not, and we added all the correct answers. Even if the students did not open specifically an alarm car device, they should understand better how a mechanism works and infer which components will be available in this item.

3.4 Other learning methods

We used additional instruments to measure EFT confidence focused towards new learning methods. In order to assess this, we added a question where the student was asked to fix a toaster. Using a scale from 1 to 6 we asked the individual how confident he or she will feel to fix a toaster under the following conditions: (a) following instructions from a manual; (b) if there was someone who he/she could ask for help on how to fix it; (c) if he/she had never used a toaster; (d) if he/she could refer to a book or a web page; (e) if he/she could observe someone else fixing it; (f) if he/she has never use it before.

Two new ways of learning were of particular interest to us. Students could feel confident on performing a task by referring to a book or a webpage or by observing if someone else did it. The MRM workshop emphasize the idea that facilitators do not always know the answer to some questions, therefore, they could look at the web or on a book. Also, facilitators did some initial examples in order to show how the technology works, and continuously ask each other for help in order to solve a problem. In this way, participants presumably will understand and realize that these were other efficient methods for learning.

We classified if a student was feeling with low-confidence to fix a toaster if they respond with 1 or 2 for each of the measures considered for learning, with medium-confidence if they respond with 3 or 4, and with high confidence if he/she respond with 5 or 6.

All indexes -general computing confidence, ICT confidence, EFT confidence and EFT performance- were normalized in order to make a better interpretation of the outcome. These indexes will be our main indicators of performance.

3.5 Additional Measures for Changes in Ability and Preferences

As we explained in section 2, according to the model of Heckman and Cunha (2007), time allocated to study will provide us with some valuable information about gaining additional abilities. If skills for learning increase then it will be optimal for an individual to invest more in studying because it is easier for him/her to accumulate more skills.

We will use different measures to corroborate that skills are changing. Changes in confidence and performance for using technology will be measured by EFT confidence and performance indexes. Other abilities that could have change are learning abilities --such as looking at someone else or looking for information at the web- that indeed will help them facilitate their learning and increase the time allocated to study.

Another indirect way to detect that learning skills are increasing is to measure changes in their reservation wage. We asked about the lowest amount of money that they will accept a job in case they receive a job offer. Increasing their reservation wage means that the tradeoff between studying and working increases, and shows that the value of studying increases more in relation to working.

Abilities related to cognitive skills can be measured also with test scores. Ideally we would like to measure changes in test scores using administrative data, however, this data is not available and we asked students for their grades in math and science.

Besides performance and confidence, students can also modify their learning behavior by the use of meta learning tools, increase their motivation to learn or their self-image as inventors or tech-savys, or because they feel more motivated with STEM related topics. Improving their self-image as inventor or increasing their interest in STEM related fields can be proxy by asking students which major was their first option in case they want to study college. If students feel more motivated towards learning STEM related topics or like the idea of being perceived as inventors after taking the MRM workshop then we will probably observe an increment on the proportion of those who want to study an engineering career.

We add other measures of time allocation in order to evaluate and analyze trade-offs between different activities. Activities such as fixing electrical devices in the household, constructing or repairing their house, reaching out to the community and trying to create or invent something were some of the activities we were interested in analyzing. Besides analyzing changes in behavior in studying, it is possible that MRM could have also modify the behavior in reaching out to the community, trying to create or invent something and fixing electrical devices. Many low income households allocate time to constructing or repairing their home as part of their household duties, or fixing items in their home, like electrical devices. It is a proxy for some type of home production. However, following Becker's idea of time allocation and human capital formation there is a trade-off between home production and skill formation. Therefore we could potentially observe a decrease home production and an increase in skill production if abilities increase after participating in the MRM workshop.

4. Baseline and Experiment Design

In order to draw a causal inference of the program Makers in Residence Mexico (MRM) on learning and other outcome variables of interest, we implemented a Randomized Controlled Trial (RCT) where students who were invited to the program were randomly selected at the individual level. As any RCT we want to measure the counterfactual of the performance of those students who participated in the MRM workshop under the scenario in which they did not participate. This randomization process allows us to obtain estimates that measure the average impact of the program without getting into a selection bias problem, which means that we are avoiding measuring changes in learning due to unobservable characteristics of students who participated in the program; for example, the participants could be more inclined to learn new technologies because they are systematically more curious.

Our sample consists of 496 students who were surveyed in the baseline and in the follow-up. Among those 126 were invited to participate in the program (25%) and 94 went indeed to the workshop MRM. This means that approximately 75% accepted to participate in the program. When treatment is randomly assigned -in our case, inviting them to participate to the MRM workshop- the only difference between the treatment and the control groups is their exposure to the MRM workshop. This means that treatment and control should be equal in their observable and unobservable characteristics.

In Table 1 we can observe the mean difference of some characteristics between the control and the treatment group -who are those students that were invited to MRM. Our sample has approximately 40% of men, the age of students is around 17 years old, and about half of our sample lives in a household that earns less than $30,000 pesos per month (60%). Most students want to study college (approximately 90%) and from those approximately 21% want to choose as a major an engineer as a first option, 12% as a second option and 33% as a first or second option. In case they will work, they would accept a job for approximately $3,000 pesos, approximately 20% want to study engineering major as a first option, and 12% as a second option.

In terms of time allocation, it seems that students allocate approximately 500 minutes per week to study after school, 50 minutes per week to fix electrical devices, between 45 and 70 minutes per week repairing or constructing their home, between 42 and 51 minutes per week reaching out to their community and only 15 minutes per week for creating or inventing something.

Table 1 shows the average characteristics of the control and treatment group. The third column shows the mean difference, and p-values of the t-test are presented in the fourth column. On average, the control and treatment groups are similar in levels, this means that for most variables the difference is not statistically significant before the MRM workshop takes place.

Table 1: Balance Table

	Control	Treatment	Difference	p-value
Proportion of Men	0.365	0.429	-0.064	0.204
Age	17.51	17.547	-0.037	0.706
Proportion of households with income less than $30,000	0.581	0.619	-0.038	0.455
Reservation wage	3044.103	3296.875	-252.772	0.483
Proportion that want an engineer major as a first or second option	0.338	0.333	0.005	0.927
Proportion that want an engineer major as a first option	0.219	0.175	0.044	0.29
Proportion that want an engineer major as a second option	0.122	0.159	-0.037	0.287
New methods learning -Low Confidence	-0.016	0.047	-0.063	0.541
New methods learning- Medium Confidence	-0.049	0.143	-0.192	0.063
New methodss learning- High Confidence	0.041	-0.121	0.162	0.117
General computing confidence normalized	-0.006	0.016	-0.022	0.835
ICT confidence normalized	0.043	-0.122	0.164	0.12
EFT confidence normalized	-0.028	0.081	-0.109	0.304
EFT performance normalized	-0.03	0.088	-0.118	0.253
Total time allocated to study	517.751	471.032	46.72	0.273
Total time allocated to fix electrical devices	42.732	58.54	-15.807	0.257
Total time allocated to build or repair house	45.53	72.127	-26.597	0.151
Total time allocated to create an invention	15.689	18.016	-2.327	0.853
Total time allocated to reaching out to the community	51.493	42.476	9.017	0.511
Self-reported math test scores	88.896	88.661	0.236	0.823
Self-reported science test scores	87.542	87.688	-0.146	0.868
Observations	370	126		

Note: This table presents the average characteristics of the control and treatment group, the mean difference and the p-value of this difference. We used different measures based on Blikstein (2015) to assess changes in i) General computing confidence; ii) Technologies for information and communication (ICT) Confidence; and iii) Exploration and Fabrication Technologies confidence and performance Index (EFT confidence and EFT performance) which aims at measuring evidence of learning in fabrication settings, where "learning is grounded in developing competence with digital fabrication tools". We also used an index to measure new tools for learning that included usage of web or books and looking to someone in order to perform a task with high, medium or low confidence. Time allocation is measured in minutes allocated to different activities per week.

Since the invitation to MRM was randomly allocated, we can isolate the effect of the causal impact of Makers in Residence in different outcomes of interest. First, the average effect of all who were invited -Intention to Treat Effect (ITT)- even if some students did not participate is estimated with a difference-in-difference strategy. The regression form is specified in the following equation:

$$y_{it} = \alpha + \beta Invited_i + \theta Af\ tert + \gamma(Invited_i * Aftert) + \epsilon_{it} \qquad (1)$$

where yit is the outcome of interest for individual i at time t, Invitedi is an indicator variable whenever a student was randomly assigned to receive an invitation to participate, Af tert is an indicator variable that takes the value of one in the post-intervention period. Pre-intervention characteristics could be included in order to increase precision in the estimates. In this way, the ITT is identified by γ when equation (1) is estimated. Dummies at the school level were included in all regressions in order to compare students within the same school.

The Treatment-on-the-treated effect (TOT) is estimated using an 2SLS or IV regression where the second stage can be written as follows:

$y_{it} = \pi + \sigma MRM_i + \rho After_t + \tau (MRM_i * After_t) + \psi_{it}$ (2)

where MRMi is an indicator variable if student i participated in the workshop Makers in Residence Mexico, and this variable will be instrumented by the variable Invitedi since as in any RCT the random allocation is the invitation and not the participation. The parameter τ will identify the TOT of the program when equation (2) is estimated.

In some occasions the IV estimate is capturing the effect of unobserved characteristics of the compliers. However, we do not believe that there is a biased in the estimate through a local average treatment effect; i.e. that some of the effect is coming from those participants who know that their ability in technology is higher and that is why they chose to participate. The reasoning for these is that students from public high-schools definitively have a really low exposure to the exploration or the fabrication of technology therefore presumably they do not know exactly their own ability on this.

5 Results

There are four main outcomes in our analysis: i) changes in school behavior; ii) changes in methodologies for learning; iii) confidence related to the use of technology; and iv) specific abilities related to the use of technology. With this set of specific outcomes we can possibly tell which mechanisms are taking place on participants of the MRM workshop.

The intention-to-treat (ITT) and the treatment-on-the-treated (TOT) effects over the main outcome variables can be appreciated in Table 2. Column 1 presents the estimated average effects for all of the students who were invited (ITT) represented by the parameter γ in equation 1. Column 2 presents the standard deviation of the estimated parameter and column 3 presents the number of observations. The TOT estimated effect can be appreciated in column 4 -- corresponding to the parameter τ in equation 2- its standard deviation in column 5 and the number of observations in column 6. Each row of column 2 presents the results of the main outcomes of interest.

5.1 Time allocated to study

First, we will focus on the effects on behavior related to school. As we can see in the section of Time Allocation of Table 2, the time allocated to study after school per week increased among those students who were invited to the program by approximately 120 minutes or 2 hours. And the TOT estimates indicate that those who participated increased by 175 minutes which corresponds to almost three hours per week. The results indicate that these students change their behavior by investing more in skill formation. There are several potential explanations for this. According to Cunha and Heckman's (2007) model students might have gained abilities that lead them to invest more in human capital. Additional explanations are that they can deal they can deal with frustration better while learning and therefore they are able to progress in their understanding for longer hours. And a third possible explanation is that their preferences change. It is possible that students who participated in the program start liking topics related to STEM more than they did before.

Table 2: Intent-to-Treat and Treatment-on-the-Treated Effects of the Makers in Residence Program

Outcome variables:	After*Invited	Standard Deviation	Observations	After*Participants	Standard Deviation	Observations
Grades	(1)	(2)	(3)	(4)	(5)	(6)
ln(Math Grades)	0.01	(0.017)	803	0.015	(0.024)	803
ln(Science Grades)	-0.014	(0.015)	795	-0.02	(0.021)	795
Time Allocation						
Time Studying	119.144*	(72.125)	986	171.756*	(103.085)	986
Time Fixing Elect Dev	-10.317	(27.799)	989	-14.743	(39.712)	989
Time Building	-36.569*	(21.918)	987	-52.401*	(31.346)	987
Time Invention	31.907**	(14.408)	989	45.812**	(20.504)	989
Time Community	-0.831	(19.241)	988	-1.257	(27.515)	988
Indexes						
Computer Index	-0.054	(0.15)	881	-0.073	(0.202)	881
ICT Index	0.173	(0.153)	873	0.234	(0.207)	873
EFT Conf Index	0.506***	(0.151)	877	0.685***	(0.2)	877
EFT Perf Index	0.081	(0.142)	989	0.112	(0.194)	989
Learn Index Low	-0.116	(0.146)	989	-0.159	(0.199)	989
Learn Index Med	-0.141	(0.145)	989	-0.192	(0.198)	989
Learn Index High	0.288**	(0.146)	989	0.394**	(0.2)	989
Preferences						
Engineer First Option	0.121**	(0.059)	989	0.176**	(0.085)	989
Engineer Second Option	-0.027	(0.049)	989	-0.04	(0.071)	989
First or Second Option	0.099	(0.069)	989	0.144	(0.099)	989
Reservation Wage	45.806	(693.107)	617	29.084	(942.437)	617

Note: This table presents the Intent-to-Treat (ITT) effects and the Treatment-on-the-treated (TOT) effects of the Makers in Residence program in Mexico for several outcomes of interest. Column 1 presents the estimated average effects for all of the students who were invited (ITT) represented by the parameter γ in equation 1. Column 2 presents the standard deviation of the estimated ITT parameter and column 3 presents the number of observations in the regression. The TOT estimated effect can be appreciated in column 4 --corresponding to the parameter τ in equation 2- its standard deviation in column 5 and the number of observations in column 6. For the TOT estimation we use as an instrument a random invitation at the individual level to participate in the MRM workshop. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

5.2 Confidence and performance in technology usage

We will explore the first possibility that could explain the increment in time allocation to study which is that they gain abilities. In Table 2, in the section of indexes we can appreciate different measures of abilities. There are two important changes in abilities that we can appreciate: i) the EFT confidence index and ii) the ability to learn and perform a task with high confidence using new methods. The ITT effects on the EFT normalized confidence index suggest that this measure increased by 0.6 standard deviations, while the TOT estimates suggests that the participants increased by 0.812 standard deviations. As we can recall this index represents if a student feels highly confident by using "learning technologies" such as robotics, programming, laser cutters, 3D printers, among others. The estimated effects on the participants on their confidence on each one of the individual components of the General Computing Confidence Index, Technologies for Information and Communication Index and Exploration and Fabrication Technologies Confidence Index are shown in the Appendix Table AI. The main changes are observed in feeling high confidence in constructing programmable robots like lego, programming, welding, fixing appliances, and using laser cutters and 3D printers. It seems that the MRM workshop has great success in making students feel confident about using 3D printers and laser cutters. The proportion of students who feel highly confident on programming increased by 13.6 percentage points and it increased in 20 percentage points there confidence to construct programmable robots, like lego mindstorms. Those who felt highly proficient on the use of laser cutters increased by 41 percentage points and in using 3D printers increased by 34.8 percentage points.

Among the three different measures of technology confidence measures -general computing, ICT and EFT- the EFT confidence was the only component that indeed increased. These results suggest that students are not changing confidence over the usage of general computing or ICT. Instead the ITT and TOT estimate effects suggest that only the EFT confidence index is changing. We were not expecting that the general computer index and the ICT confidence index change after the MRM program because the program was not particularly focused in teaching students how to get familiarized with computers or with communication technologies.

EFT performance was measured as the number of correct answers they got when they were asked the components of an alarm key. They had 10 items and they should say if those items were components of the alarm. The idea of the index is that by using "learning technologies" and other tools they will be able to identify more clearly how a technological item works and which components are there. This measure intends to pin down a concrete knowledge about how a mechanism works. If students have an idea of how a mechanism works, then they should imagine their components. The ITT estimated effect of the MRM program over the EFT normalized performance index is an increase of 0.14 standard deviations and the TOT is approximately 0.20 standard deviations. However, the estimated parameters are not statistical significant at a 10 percent level. One possibility is that there might be a high variation in this type of measure. As expected, EFT performance increase less than half compared to the EFT confidence, as expected (Blikstein, 2015).

Test scores are other measures of performance that we use. However we did not have administrative test scores because they are confidential. Instead we use self-reported test scores in math and science. Specifically we ask for the average scores during the current semester. The ITT and TOT effects are presented in Table 2 in the Grades section. We did not have evidence that grades on math or sciences are changing after the MRM.

To put it on perspective related to other programs, the ITT effects on two 40-min of computer-assisted learning math sessions per week during two months increased students standardized math scores by 0.15 standard deviations (Lai et al, 2015). This program consisted on playing computer and played animation-based math games that helped students review the material seen in class. Another example is the evaluation of the deworming program developed in Kenya by Miguel and Kremer (2004). Their results indicate that a 10 percentage point increase in attendance is associated with a 0.217 standard deviation higher scores, and the estimated effect of deworming on test scores is approximately 0.11 standard deviations. In the MRM evaluation, we do not have evidence that there is an improvement on test scores, however, there is evidence that a confidence index and a performance index increase. The estimated coefficients suggest that the effects are considerably larger than those with computer-assisted learning or a deworming program.

5.3 Learning abilities

The MRM workshop introduced a completely new way of teaching or facilitating knowledge to participants. Some of the learning is based on self-directed activities, therefore looking at tutorials, learning by looking to someone or looking into the web. In order to measure changes in ways of learning we include in the survey a question regarding how confident they felt on having high, medium or low knowledge of fixing a toaster by i) looking at instructions, ii) doing it without help; iii) never using it before; iv) looking at a webpage; v) looking at someone; vi) figuring it out with sufficient time; and vii) taught by someone. However, the two specific ways of learning we were interested at was: using the web or a book or looking at someone doing it. Therefore, we created a normalized index with these two components. The ITT effects on these variables --Learn Index Low, Learn Index Med, and Learn Index High- can be seen in Table 2 in the Indexes section. We can observe two interesting facts. First, there is suggestive evidence that the propensity to perceive themselves with low or medium confidence to fix a toaster after looking how to do it using a website or a book or looking at someone diminishes. And the propensity to feel highly confident using these tools to perform this task increases. For those who participated in the program this index grows by 0.4 standard deviations.

As obvious as it might be, students who have access to a computer do not necessarily know the advantages of using the web for looking for answers. During the workshop facilitators were there to support, guide, question and respond to technical questions about the technology, but they didn't provide the solution. However, sometimes when the facilitator didn't know the answer, they looked together with the participant at the web a possible answer to the student's question. Two things might be happening when a student takes the MRM workshop: 1) they now know that they can use the web to find specific answers to their questions, or 2) they knew how to use this tool before but now they realize that they can understand it and it is indeed helpful. The same might be happening when they observe a facilitator provide an example. They probably realize that there is a considerable amount of knowledge when they observe others perform a task.

Table A2 presented in the Appendix presents the individual components of different tools used for learning. As we can see there is an important increment in their confidence of fixing a toaster by using a webpage or a book. The probability that they feel highly confident using this tool increases by 18.5 percentage points. There is only suggestive evidence that looking at someone or being taught by someone could help them fix a toaster.

5.4 Reservation wage

An additional component to asses that abilities are improving is that the minimum wage they will accept in order to work --reservation wage- also increases. The estimates indicate that their reservation wage increases between 9 to 11 percentage points. However, the ITT and TOT effects over the reservation wage are not significant at the 10 percent level. It is possible that this measure is noisier than others and that we need more observations in order to increase the statistical power.

5.5 Preference over STEM majors and motivation

The results indicate that students i) are studying more and ii) are increasing skills related to technology. These outcomes are consistent the Cunha and Heckman (2007) model where an exogenous shock of skills will lead to an increment on time allocation to study or to the creation of more human capital in the future. As we explain before, this is not the only possible explanation. An alternative mechanism that could be driving an increment on time allocated to study is that students increase their motivation and enthusiasm to study topics related to technology or science. One way to measure their positive experience with technology is looking at the time allocated to invent or create something. As we can see in Table 2 in the section of Time Allocation, the ITT estimates suggest that there is an increment of 30 minutes per week in time allocated to invent. And for those who participated in the program we observe that they added 45 minutes to this type of activity. It is interesting to observe also that there is almost the same amount of time reduced in activities such as building or constructing a part of their house.

Additional evidence that their preferences for fields related to technology or science is changing is their choice for their major when they enter to college. We observe a 12 percentage points in the proportion of students who want to study an engineer major as a first option on average for all those who were invited. For the students who indeed participated in the program we observe an increment of 17 percentage points. This result can also have other interpretations. Indeed, students might be realizing that they are able to develop technology skills and that it could be convenient for them to start investing in these types of activities. This could be happening even in the scenario under which students are not gaining any type of ability.

5.6 Robustness check

There is a possibility that students are not changing any type of behavior due to MRM workshop but they are only responding to the general enthusiasm of the program. However, we do not see this type of response on all the expected outcomes. For example, the MRM workshop in the last two weeks asked the students to develop a project that help their community. If they were only responding to the survey because of some type of enthusiasm then we should observe also an effect on time allocated to community services or fixing electrical devices in their house. The results in Table 2 in the section of Time Allocation do not reflect this.

The coefficient for both estimate of fixing electrical devices or time allocated to community services is not significantly different from 0 and the magnitude of the estimate is small. Therefore, we think that indeed time allocated to studying changed and that results are not driven only for a general enthusiasm for the program.

5.7. Discussion

Given the different variables that are part of this intervention --project-based learning, technology exposure, mentorship, design thinking prototype, etc.- is hard to understand which element or elements are working to produce the resulted effect. Still, no evaluation like this has been done before and the results can help to point directions where the Makers Movement can be supportive for learning, developing STEM-related skills, motivating and creating formal education.

Several questions arise from this research, here are some key ones: Are the participants actually studying more or their self-perception about them changed? We have no evidence besides their self-report for this result, and their self-report grades have not shown a significant increment that can confirm the effects on skills. The last one can be due the fact that the post-survey was two months after MRM and during MRM participants had less time in the evening to spend in school related activities because they were at MRM every evening for a month, so after the MRM participants had to catch up with school activities.

Further research needs to be done to understand the change in time allocation to study and what effects this has in participants' life and in formal learning. Even if the change is just in the self-perception of the participants it may underline an increment on the value they assign to studying, presumably because the program changed their incentives and motivation for studying after school, due to their increment in their capacity to learn or to changes in their abilities. An additional question in the same lines is the human capital invested in the future for those who participated in the project. If indeed the mechanisms that are driving a real increment in time allocated to study are because they are gaining more abilities then we should also expect to observe a higher human capital accumulation in the future, as Cunha and Heckman's (2007) model predicts.

As we discussed throughout the paper there are other possible explanations about changes in learning behavior besides the acquisition of skills, for example, students might have change their identity. Are participants less interested in allocating time to building houses and more interested in inventing objects because their identity changed? The participants of MRM are members of underserved populations, we know some of them or their parents work as builders or electricians. It is interesting to see a decrease in their time allocation for that activity and simultaneously we observe an increment in the time allocated to invention in almost the same magnitude. This can be explain by a change in their self-efficacy as inventors, in the value they provide to invent, or in the cost reduction for inventing given the acquired skills. Additional investigations can be done to explain this results and how MRM and workshops that support participants to create their own prototypes foster innovation and invention. Indeed EFT confidence increased even more than performance which provides evidence that students increased their empowerment and self-confidence on using these components on their everyday life.

A final question is: Why the EFT performance index did not increase significantly as the EFT confidence index did? Even though the technology performance index increase it was not significant which might change when we add the next experiment. An explanation can be that one month of exposure to different technology is not enough to increase the EFT performance and that formalization of concepts during the workshop is needed to create that change.

An interesting result is the increase in the proportion of high school students that choose engineer as their first career choice. A possible explanation is that participants' self-efficacy regarding what they perceived as engineering increased, making it seem accessible for them to succeed in that domain. Another influence can be that some of the facilitators were studying engineering and participants were able to ask questions about the facilitators' experience and establish a relationship with someone with that major. Montmarquette et al. (2002), distinguished three important components for student's career choice: i) the perceived probability of success or perceived ability and effort needed to complete with success the concentration chosen, ii) the (expected) earnings after graduation, and iii) the earnings alternative if the student fails to complete a college program. The program MRM might have influence one or more of these parts.

Besides these open questions we have been able to show evidence that technologies used for developing learning abilities does work especially for generating confidence and changing expectations. There have been several studies related to the effects of computers in learning but not with this new experience of learning by doing and by trial-and-error. Under our knowledge this is the first study that has evaluated the digital fabrication environment over learning abilities and empowerment.

7 Conclusions

There is a general lack of enthusiasm for studying and engaging students into learning. On the other hand, policymakers in the U.S. are concerned that the workforce has too few individuals trained and working in STEM fields and numerous possible solutions have been proposed to remedy this deficit, including improving STEM K-12 education and programs to retain more students in STEM subjects, majors and ultimately professions (Wiswall, et al., 2014). The results of this paper suggest that learning by trying to solve real life problems and prototyping can engage the student more into learning. In particular, we showed that MRM can increase the time allocated to study after school by almost two hours per week on the intent-to-treat group, and the time allocated to invention by half an hour. These results suggests that the program changed their incentives and motivation for studying after school. As we discussed before, there could be several explanations for these changes. First, their ability to learn increased —by increasing their ability to learn by themselves- so it is less costly to learn. Second, their preferences changed towards learning since now this activity can be indeed fun.

In countries like Mexico where there is lack of innovation and an important flaw on the ability of how to apply a scientific knowledge in an every day life problem (OECD, 2012) this type of program could potentially become very promising.

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6. Appendix

Table A1: IV regressions for the Individual components of the General computing confidence, Technologies for information and communication and Exploration and Fabrication Technologies confidence Index

	(1) Computer	(2) Smartphone	(3) Tablet	(4) Blogging	(5) Video	(6) Lego	(7) Woodwork	(8) Programming	(9) Welding	(10) Applicance	(11) Drill	(12) Laser Cutter	(13) 3D Printer
treated	0.04	0.066	-0.005	-0.036	-0.008	-0.007	0.065	-0.036	0.024	-0.008	0.016	0.008	-0.007
	(0.064)	(0.068)	(0.062)	(0.087)	(0.047)	(0.036)	(0.089)	(0.087)	(0.042)	(0.046)	(0.047)	(0.029)	(0.031)
Invited*After	-0.013	-0.047	-0.075	0.098*	0.034	0.199***	0.003	0.136***	0.160***	0.134**	0.097	0.418***	0.348***
	(0.091)	(0.097)	(0.089)	(0.053)	(0.067)	(0.052)	(0.056)	(0.052)	(0.06)	(0.066)	(0.067)	(0.042)	(0.045)
after	0.065*	-0.038	0.011	0.018	0.051**	0.042**	0.041**	0.015	0.032	0.051**	0.021	0.019	0.014
	(0.034)	(0.036)	(0.033)	(0.02)	(0.025)	(0.019)	(0.02)	(0.019)	(0.022)	(0.024)	(0.025)	(0.015)	(0.016)
Constant	0.245***	0.406***	0.281***	0.039*	0.084***	0.042*	0.083***	0.061***	0.080***	0.087***	0.177***	0.047***	0.047**
	(0.038)	(0.041)	(0.037)	(0.022)	(0.028)	(0.022)	(0.023)	(0.022)	(0.025)	(0.028)	(0.028)	(0.018)	(0.019)
Observations	989	989	989	989	989	989	989	989	989	989	989	989	989
R-squared	0.025	0.025	0.008	0.016	0.019	0.069	0.015	0.024	0.047	0.028	0.028	0.282	0.176

Note: The table presents the IV estimated effects of the MRM workshop on the individual components of the indexes of general computing confidence, technologies for information and communication and exploration and fabrication technologies. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Table A2: Highly confident on fixing a toaster using different tools or methods

	(1) Following instructions	(2) Without receiving any type of help from a person	(3) If he/she has never used a toaster before	(4) If he/she had a book or a webpage as a reference	(5) If he/she could see someone fixing it	(6) If he/she had enough time	(7) If someone had told him/her before how to fix it
MRM	0.003	0.035	0.002	-0.108	-0.043	0.004	-0.052
	(0.068)	(0.051)	(0.039)	(0.07)	(0.068)	(0.067)	(0.065)
MRM*After	0.042	0.033	0.01	0.185*	0.152	0.028	0.14
	(0.097)	(0.072)	(0.055)	(0.099)	(0.096)	(0.095)	(0.093)
After	-0.038	0.038	0.051**	0.004	0.026	0.062*	-0.109***
	(0.036)	(0.027)	(0.02)	(0.037)	(0.036)	(0.035)	(0.034)
Constant	0.610***	0.106***	0.054**	0.410***	0.325***	0.301***	0.733***
	(0.041)	(0.03)	(0.023)	(0.042)	(0.041)	(0.04)	(0.039)
Observations	989	989	989	989	989	989	989
R-squared	0.011	0.012	0.012	0.012	0.006	0.01	0.015

Note: The table presents the IV estimated effects of the MRM program over different methods or tools that they can use in order to feel with high confidence that they can fix a toaster. Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Pictures of the program: