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Can interactive online training make high school students more entrepreneurial? Experimental evidence from Rwanda*

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February 3, 2022

Abstract

We study the short-run effects of a gamified online entrepreneurship training offered to high school students in Rwanda during the COVID-19 pandemic. Using a randomized controlled trial, we estimate sizeable effects of the 6-week training on entrepreneurial activity. One month after the training, participants in schools offered the training were much more likely to own a business than participants in control schools. The training induced students to participate more actively in their school's business club, to undertake more business-oriented actions, to improve their business practices, and to interact more with other youth and family members about their business ideas. We hypothesize that the training might have motivated treated students to sustain their business activities during the COVID-19 crisis.

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1 Introduction

The COVID-19 pandemic has been a major economic shock to small businesses throughout the world. Several recent studies provide evidence of temporary closures, employee layoffs, and losses in sales and profits (Bartik et al. 2020; Crane et al. 2020; Fairlie 2020 in the US, Gourinchas et al. 2020 in Europe, and Apedo-Amah et al. 2020; Muzi et al. 2021 across continents). Young informal firms, female-owned businesses, and those in Sub-Saharan Africa were particularly affected (Aga and Maemir, 2021; Liu et al., 2021; Muzi et al., 2021). Interventions that can help businesses survive in this context are particularly relevant.

At the same time, the pandemic strongly limited typical tools that have been employed to train microentrepreneurs and, more generally, how education could be imparted. New methods linked to online education have been promoted as potential replacements for on-site classes, but there is not much evidence on the effectiveness of such new technologies (for meta-analyses, see Bernard et al., 2004; Means et al., 2010; Nguyen, 2015). One of the key concerns is the low and limited engagement of online learners. However, a gamified approach could generate the engagement necessary to improve outcomes.

In this paper, we study the short-run effects of a gamified online entrepreneurship training offered to high school students in Rwanda during the COVID-19 pandemic. The main goals of the training were to develop an entrepreneurial mindset, encourage students to aspire to be entrepreneurs, and to create or consolidate their own businesses. The training had a gamified approach and consisted of approximately 40 "bite-sized" business-related challenges, spaced over six weeks. We conducted a cluster randomized control trial (RCT) with 159 schools, with randomization at the secondary school level. Our results are based on an online endline survey conducted one month after the end of the training.

We find significant effects of the program on the probability that participants were running their own business right after the training, when COVID-related restrictions in Rwanda were still in place. The program also encouraged participation in income-generating school business clubs, the gateway to entrepreneurship in many high schools of Rwanda. These effects did not

happen at the expense of other economic activities: total earnings and hours worked significantly increased for participants compared to the control group.

We study possible mechanisms for these effects and find evidence that the program fostered entrepreneurial actions, adoption of improved business practices, interaction with other youths and family members to discuss business ideas, and greater preference for entrepreneurship courses at school. We do not find evidence that the training generated a more entrepreneurial mindset, nor that it improved curricular business knowledge, as we do not observe improvements in soft skills related to entrepreneurial success nor on questions on business topics covered in the course.

We make several contributions to the literature on entrepreneurship. First, we contribute to the small but growing evidence suggesting that adolescents in developing countries can acquire entrepreneurial skills. Several experiments have found increased self-employment in response to programs targeting youth (e.g., Bandiera et al., 2010; Bertrand et al., 2021; Blattman and Dercon, 2018; Blattman et al., 2014, 2020, 2019). However, most of these programs did not specifically train participants in entrepreneurial skills, but instead provided start-up grants or bundled entrepreneurship training with credit or other services. We find significant (short-run) effects on self-employment of a program that is brief and online. The gamified approach of the training we studied could have played a key role in keeping participants engaged and motivated.

Rigorous evidence specific to youth entrepreneurship training is less abundant. An experiment training entrepreneurship teachers in Rwandan secondary schools—the same context as our study—strengthened curricular implementation, but with modest increases in youth business participation and no effect on income (Blimpo and Pugatch, 2021). Similarly, entrepreneurship training for university students in Tunisia had modest short-run effects on self-employment, which faded in a four-year follow-up (Alaref et al., 2020; Premand et al., 2016). However, an intensive three-week program combining soft and hard skills and modeled in part after master's of business administration (MBA) curricula from the United States led to increases in business creation, survival, and earnings among recent secondary school graduates in Uganda (Chioda et al., 2021). In light of our results, this evidence suggests that youth entrepreneurship training

might be more effective in short, intensive programs with innovative curricula, rather than being embedded in traditional academic settings.

Second, we contribute to the overall literature on entrepreneurship training. McKenzie and Woodruff (2013) summarized the early literature on the subject, finding few studies with statistically significant effects on business outcomes, mainly due to a lack of statistical power. Simpler interventions such as rule-of-thumb training have been argued to be more efficient in some contexts (Drexler et al., 2014). Complementary interventions such as mentoring (Brooks et al., 2018) or role models (Lafortune et al., 2018) may be needed to increase the potential of these programs. To our knowledge, gamifying the training has not been explored before.

McKenzie (2021) recently conducted a review and meta-analysis, finding that the typical training program does increase profits and sales by an average of 5 to 10 percent. These programs would pass a cost-benefit analysis if their costs were not too high. Therefore, a key question in the literature is how to reduce costs to serve many firms in a financially sustainable way. One potential solution is to offer online training, but the literature on its effectiveness is new and limited (Liguori and Winkler, 2020). Jin and Sun (2020) find improved business outcomes in response to online training for sellers on a Chinese internet marketplace, while Cusolito et al. (2021) find that differences between Balkan firms trained either online or (largely) in-person fade after two years. Eesley and Wu (2020) compares different ways of imparting a MOOC for start-ups but does not compare it to a control group. The results from our study suggest that a gamified online version of business training can significantly foster entrepreneurship among secondary school students, at least in the short run. In a related study, Moberg (2021) conducts an experiment with 580 Danish youth to estimate the effects of an online-based entrepreneurship program, which was not gamified but based on role models. He also finds strong effects on entrepreneurial intentions in the short-run.

Third, we contribute to the formal evaluation of gamification as a tool to improve learning outcomes. Gamification has been experimentally tested as an intervention in several domains, including to improve sales performance, to elicit contributions to public goods such as Wikipedia, and to promote weight loss, with mixed results (Gallus, 2017; Kurtzman et al., 2018; Mollick

and Rothbard, 2014). In the education literature, gamification has been studied little relative to other learning technologies (Escueta et al., 2020). Meta-analyses show small but positive effects on learning (Sailer and Homner, 2020; Yildirim and Sen, 2021). Randomized experiments of gamified curricula in Chile and India found improved math skills (Araya et al., 2019; Dillon et al., 2017). Experiments with university statistics students also showed positive results (Legaki et al., 2021, 2020). However, another RCT in the United States of a math software that had some gaming component did not show positive impacts (Rutherford et al., 2014). We believe our study is the first randomized evaluation of a gamified entrepreneurship training.[1]

Finally, our study also relates to the literature on the transmission of soft skills through training. A large literature has linked personality traits and entrepreneurship (de Mel et al., 2010; Hamilton et al., 2019; Lazear, 2005; Levine and Rubinstein, 2017), but drawing a causal link has been more challenging. Campos et al. (2017) shows large positive impacts of personal initiative training for entrepreneurship in Togo. Ubfal et al. (2022) and Alibhai et al. (2019) find more nuanced evidence on similar programs. The former detects positive effects only in the short-run in Jamaica, arguing for the need of complementary interventions; while the latter finds mixed effects of two programs in Ethiopia, claiming that the more effective of the two programs had much higher quality trainers. Finally, Chioda et al. (2021) shows large effects from two training programs with different combinations of soft-skill and hard-skill training in Uganda. We do not find that the online gamified challenge we study improved soft skills, although it was one of the goals of the training, but we do find increased motivation and entrepreneurial actions.

The rest of the paper is organized as follows. The next section presents the research design. Section 3 presents the methodology. Issues of balance, take-up, and attrition are reviewed in Section 4. We present the results in Section 5, and conclude in the last section.

[1]We distinguish gamification from entrepreneurial "edutainment," such as reality television competitions among start-ups, which have shown promise to improve perceptions of entrepreneurship (Barsoum et al., 2021; Bjorvatn et al., 2020). Our work also relates to RCTs evaluating programs to reduce COVID-related learning loss (Angrist et al., 2020; Carlana and La Ferrara, 2021; Crawfurd et al., 2021), although in our case schools remained open.

2 Research design

2.1 Program

The Wavumbuzi[2] Entrepreneurship Challenge is a six-week, online entrepreneurship training program for adolescent youth. Wavumbuzi was designed by Allan and Gill Gray Philanthropy, a charity based in South Africa, to promote youth entrepreneurship. The program has previously run in South Africa and Kenya. We evaluate the launch of Wavumbuzi in Rwanda.

In Rwanda, Wavumbuzi serves as an extracurricular supplement to the study of entrepreneurship in secondary schools. Entrepreneurship has been a required subject in Rwandan secondary schools since 2009, making the country the "site of one of the most extensive efforts to promote youth entrepreneurship in the world" (Honeyman, 2016, p. xii). A major reform in 2016 reoriented the entrepreneurship curriculum towards practical business skills and encouraged students to form revenue-generating business clubs based at their schools. Wavumbuzi therefore occurred in a context of high familiarity with entrepreneurship among its participants.

The goals of Wavumbuzi are to promote entrepreneurial mindset, intentions, and actions. Wavumbuzi consists of approximately 40 modules called "challenges," spaced over the six weeks of the program. Challenges focus on elements of business development, such as conducting market research, designing a minimum viable product, and marketing, as well as socio-emotional skills such as grit and goal-setting. The program relies heavily on gamification to promote participant engagement. Participants progress through a virtual game world with each challenge. They earn virtual badges and points, based on quality ratings by other participants, when they submit challenges. An internal rater reputation system encourages good faith in ratings of peers. Participants can view live leaderboards by school, and leaders earn weekly prizes, such as consumer electronics, clothing, or school supplies. Figures A1-A2 show examples of a challenge and the leaderboard, respectively, as seen by participants.

The program ran for six weeks in January-February 2021. Secondary school students (grades 7-12) were eligible to register. A major marketing campaign was conducted in the month prior to

[2] *Wavumbuzi* is the Swahili word for entrepreneur. We hereafter refer to the program simply as Wavumbuzi.

program launch, with advertisements in national media and program "ambassadors" deployed throughout the country. Secondary school entrepreneurship teachers were encouraged to recruit their students to register. The program launch coincided with a spike in COVID-19 cases in Rwanda, triggering a 15-day lockdown and school closures in Kigali. The program thus occurred during a time particularly favorable for student attention to online activities, and of heightened economic insecurity.

2.2 Evaluation design

We conduct a cluster randomized control trial (RCT) with randomization at the school level. The sampling frame includes Rwandan secondary schools selected by the project as a collaboration between Wavumbuzi and the Rwandan Education Board (REB). All eligible students in these schools were encouraged to register online to Wavumbuzi. The evaluation sample includes schools in the sampling frame that had at least one student registered to the platform at the moment of the launch of the program in January 2021.

Using the evaluation sample, we randomly assigned 108 schools to treatment and 51 schools to control. The proportions allocated to treatment and control were determined to balance considerations regarding statistical power, logistical capabilities of the team and the desire of Wavuzumbi to maximize the number of participants in the Rwandan launch of the program. The randomization was stratified by district and number of registered students in the school (1 student, 2-10 students or more than 10 students).[3]

As students registered, they were allowed to complete the initial activities, which included four short challenges. This implied that the program ran for one week before the randomization took place. After the first week, only students in treated schools were granted full access. We allowed this initial participation among students eventually assigned to the control group for several strategic reasons. First, we expected initial program access to encourage completion of the baseline survey, higher participation in the program among those selected, and later completion

[3] "Misfit" schools not initially assigned due to uneven strata sizes were assigned independently across all strata, using the `wstrata` option of the `randtreat` command in Stata (Carril, 2017).

of the endline survey. Second, Wavumbuzi implementers wanted to provide some access to all registered students to encourage control group participation in later iterations of the program.

Students registering for the program were encouraged to complete an online baseline survey, which closed after random assignment. The online endline survey opened in the final week of the program and closed one month after the program ended. We provided incentives of about USD 3 in mobile airtime for each completed survey. In addition to these surveys, we also have administrative data on program participation. Figure A3 summarizes the program and data collection timelines.

3 Methodology

Our analysis follows a pre-analysis plan registered at the AEA RCT Registry. We label analysis outside this plan as exploratory. Our main specification is the ordinary least squares (OLS) regression:

$$y_{isg} = \alpha + \beta T_{sg} + \delta y_{0isg} + \gamma_g + \varepsilon_{isg} \tag{1}$$

where i, s, and g are indexes for student, school, and strata (by district and registration size), respectively; y is the outcome; T is an indicator for being offered the training; y_0 is the baseline outcome (when available); γ is a stratum fixed effect; and ε is the error term. For covariates (e.g., baseline outcomes), we replaced missing values with zero and include a dummy for missing values in the regression. The coefficient of interest is β, which measures the intent to treat (ITT) effect, or the effect of the offer of the program. We cluster standard errors to account for correlated outcomes among students within clusters. Instead of clustering at the school level, we cluster at the strata level, as recommended by de Chaisemartin and Ramirez-Cuellar (2020) when the number of units (schools) within strata is small.[4]

[4] de Chaisemartin and Ramirez-Cuellar (2020) show that in cases of strata with small number of units, there is a negative correlation between the outcomes of units within the same strata but in different assignment groups. They recommend clustering at the strata level as a more conservative strategy than clustering at the school level. All our results are robust to clustering at the school level.

In addition to the specification in equation (1), the pre-analysis plan describes the outcomes, baseline characteristics to check for balance, and tests for differential attrition.

4 Balance, attrition and take-up

We test for balance across treatment and control groups in two different data sets: 1) the registration data, which was a short form completed by all participants, and 2) the baseline survey, which was not required for participation in the program and completed by a selected sample of participants.

In Table 1, we present the characteristics of our sample using the registration data. We see that 42 percent of students are female, 43 percent have a mobile phone, and 88 percent provide an email address. The average age is around 18 years old. The majority reports that their mother-tongue is Kinyarwanda and a smaller fraction, English. A majority of participants are in their second-to-last year of high school (Senior 5) and more than 75 percent are within 3 years of graduating. The average number of learners in the platform from a given school is 76, but with a large variance. The average school in our sample has more than 400 students.

The third column of Table 1 indicates that overall, our randomization produced a relatively balanced set of participants. Most coefficients do not show statistically significant differences across treatment and control. However, we do have some coefficients with large differences: the treatment group is more likely to report English as their mother tongue compared to Kinyarwanda and schools in the treatment group are smaller, and with some differences in the composition of students by grade. This leads the joint F-test for no differences between treatment and control groups across all outcomes to be rejected.

As explained above, only a selected sample of students completed the baseline survey. Baseline completion rates were different in treatment and control groups, as shown in Table 2. Only 28 percent of the control group answered the baseline survey, while 48 percent of the treatment group did. The difference is large and statistically significant. The correlation between treatment and participation in the baseline limits the usefulness of the baseline survey. We do not have any

Table 1. Baseline characteristics (from registration data) and balance

	Mean (Control)	S.D. (Control)	Treatment All students	Treatment Endline
Female	0.42	0.49	0.03	-0.08
			(0.11)	(0.10)
Mobile	0.43	0.50	0.22	0.25
			(0.22)	(0.24)
Email	0.88	0.32	-0.22	-0.21
			(0.17)	(0.18)
Age	17.93	2.23	0.07	-0.19
			(1.61)	(1.56)
English	0.24	0.43	0.30**	0.35*
			(0.12)	(0.18)
Kinyarwanda	0.76	0.43	-0.30**	-0.35**
			(0.11)	(0.17)
Senior 1	0.05	0.22	-0.02	-0.07***
			(0.04)	(0.01)
Senior 2	0.05	0.22	-0.01	-0.03
			(0.04)	(0.02)
Senior 3	0.14	0.34	0.02	0.07
			(0.07)	(0.09)
Senior 4	0.19	0.39	0.02	0.07**
			(0.06)	(0.03)
Senior 5	0.37	0.48	-0.01	-0.02
			(0.04)	(0.01)
Senior 6	0.17	0.38	-0.01	-0.03
			(0.10)	(0.13)
Num. Learners (Senior 6, School)	76.10	45.28	-7.09	-6.47
			(13.66)	(10.41)
Num. Students (School)	434.43	191.32	-67.92***	-73.00***
			(20.53)	(25.10)
Observations	1885	1885	1885	1102
Joint F-test statistic			2.20**	7.22***

The first and second columns report the mean and standard error of observations in the control group, respectively. The third and fourth columns report the coefficient of a regression where the outcome is the baseline characteristic and the explanatory variable is a dummy for being assigned to treatment, including strata fixed effects and standard errors clustered at the strata level. The third column includes the full sample, the fourth, only individuals who answered the endline. Senior 1-6 refer to grades 7-12, respectively. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

explanation for this correlation, as the baseline was answered before treatment assignment was revealed to participants. Appendix Table A1 presents a balance table using registration data for participants who completed the baseline survey. Most characteristics are balanced, but we do see important differences in gender. The last three rows of Table A1 uses baseline data on our main outcomes and shows that they are balanced across treatment arms in the subsample of students with baseline data.

Reassuringly, we also find that response rates to the endline survey were balanced between the two groups. Although attrition rates were very large (on the order of 50 percent), these response rates are typical of online surveys without interaction with participants.[5]

Table 2. Attrition by survey

	Mean (control group)	S.D. (control group)	Treatment
Baseline Survey	0.72	0.45	-0.20*
			(0.11)
Endline Survey	0.52	0.50	-0.01
			(0.16)

Attrition takes value 1 for students who did not complete the baseline (endline) survey. The first two columns report the average and standard deviation of the attrition dummy for the control group. The third column reports the coefficient of a regression where attrition is regressed on a dummy for being assigned to treatment and strata fixed effects, with standard errors are clustered at the strata level. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Finally, Table 3 provides evidence that attrition at endline was not differential by characteristics of the sample depending on treatment assignment. Attrition was less likely among those who had reported a mobile number, who were older, who spoke Kinyarwanda instead of English, and who were in higher grades. Reassuringly, however, we find only one characteristic where the attriters differ statistically between the treatment and the control group, and the difference is only significant at the 10 percent level. The joint test of significance does not reject the null of no differential attrition.

[5] A phone survey conducted a few months after our endline survey tracking the Rwandan secondary school entrepreneurship alumni from Blimpo and Pugatch (2021) had a similar attrition rate, suggesting widespread challenges contacting this population during the pandemic.

Table 3. Characteristics of those who did not answer the endline survey, by treatment assignment

	Treatment	Attrition	Treatment x attrition	Obs.
Female	-0.02	-0.10	0.16*	1,632
	(0.11)	(0.08)	(0.09)	
Mobile	0.24	-0.11***	-0.06	1,885
	(0.21)	(0.04)	(0.06)	
Email	-0.19	-0.05	-0.07	1,885
	(0.17)	(0.03)	(0.04)	
Age	-0.13	-1.19**	0.54	1,088
	(1.43)	(0.49)	(0.41)	
English	0.34**	0.09**	-0.14	1,635
	(0.14)	(0.04)	(0.09)	
Kinyarwanda	-0.34**	-0.09**	0.13	1,635
	(0.13)	(0.04)	(0.08)	
Senior 1	-0.03	0.02	0.04	1,638
	(0.02)	(0.01)	(0.05)	
Senior 2	-0.02	0.03	0.03	1,638
	(0.02)	(0.04)	(0.04)	
Senior 3	0.03	0.02	-0.03	1,638
	(0.07)	(0.04)	(0.06)	
Senior 4	0.03	0.07	-0.02	1,638
	(0.05)	(0.07)	(0.08)	
Senior 5	-0.01	-0.05*	0.02	1,638
	(0.03)	(0.03)	(0.05)	
Senior 6	-0.01	-0.16***	-0.02	1,885
	(0.10)	(0.04)	(0.07)	
Num. Learners (Senior 6, School)	-8.31	4.91	4.08	1,702
	(11.49)	(3.23)	(8.04)	
Num. Students (School)	-68.41***	14.35*	2.47	1,702
	(20.90)	(8.13)	(22.11)	
F-test of joint significance			1.16	

Attrition takes value 1 for students that do not have endline data. The first three columns report the coefficients in a regression of the student report characteristic on strata fixed effects and dummies for being assigned to treatment, for not answering the endline and for the interaction of both dummies, respectively. The last column includes the sample size. Senior 1-6 refer to grades 7-12, respectively. The F-test is conducted by estimating all equations in a SURE framework and testing the equality of all interaction coefficients to 0. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Because we face large imbalances in some variables, even when using the registration data, we depart from the pre-analysis plan and control for all available pre-determined variables in our main regressions. We report the pre-analysis plan specifications for all outcomes in the appendix, which show that most of the results are robust to including the additional controls. This suggests that the imbalance we face is not correlated with the impact of the treatment.

Table 4 shows evidence on program take-up. The treatment group was 46 percentage points more likely to complete at least one challenge than the control group. Treated participants completed on average 60 percent of the challenges, while the control group completed only 3 percent of the challenges. Overall, the treatment assignment induced significant participation in the program. While not reported here, we also find that participants were significantly more likely to conduct reviews of their peers' submission (28 versus 4 for the control group), suggesting that the objective of the challenge to make participants interact with one another was fulfilled.

Table 4. Impact of random assignment on program participation

	Completed at least one challenge (1)	Proportions of challenges completed (2)
Treatment	0.546***	0.650***
	(0.102)	(0.115)
Mean control	0.329	0.026
N. obs.	1102	1102
Baseline variable	No	No
Add. controls	Yes	Yes

Regressions include strata fixed effects and control for all registration variables. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** p<0.01, ** p<0.05, * p< 0.1

5 Results

5.1 Business and economic outcomes

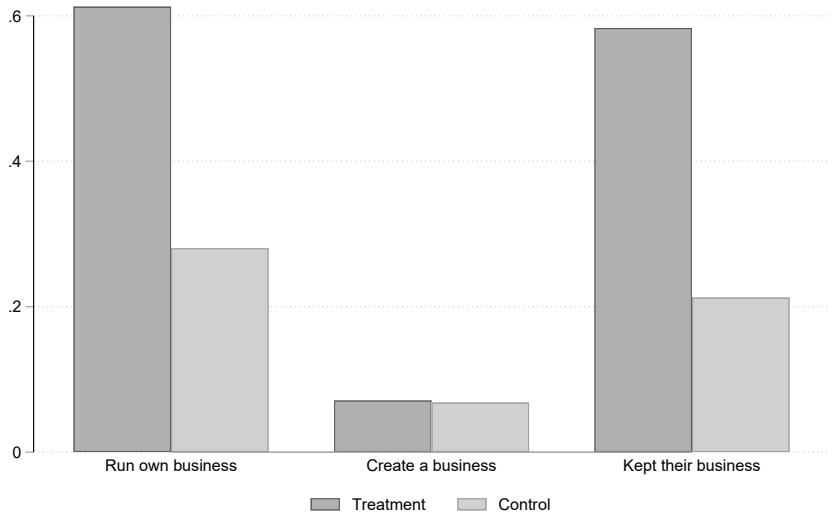
We now turn to the effect of treatment assignment on business outcomes, the ultimate goal of the program. First, we study how being assigned to treatment impacted business ownership. As shown in the first column of Table 5, around 28 percent of the control group reported running their own business in the endline survey. The program increases this share by 40 percentage points, a very large and statistically significant effect.

To explore whether this effect is due to the program leading to business creation or to business survival, we use a question included in the endline survey about business ownership in December 2020. We find that the program effect on business ownership is not due to an increase in business creation but rather a higher probability of participants keeping their business alive (Figure 1). Around 5 percent of treated and control participants created a business between December 2020 and April 2021. However, while only 20 percent of the control group kept their business alive from December 2020 to April 2021, this share was more than 30 percentage points higher in the treatment group. Given that our intervention took place during the COVID-19 pandemic, we see these results as consistent with higher constraints for creating new firms, and large closure rates. The challenge might have encouraged students to sustain their business in a period of crisis.[6]

The next two columns of Table 5 show that those assigned to participate in the challenge experienced significantly larger sales and profits when measured unconditionally.[7] Sales and profits in the 7 days before the endline survey increased by 2.5 USD and 1.4 USD, respectively. These are small absolute numbers, but very large increases over the means in the control group (1.1 and 0.5 USD, respectively). Conditional on having a business, we observe a negative and not statistically significant effect for sales and a positive and only marginally statistically significant effect for profits (with a large standard error). This indicates that most of the increase in business

[6] As shown in Appendix Table A2, results are very similar if we use the specification from our pre-analysis plan.
[7] The shares of missing values due to no reporting in sales are profits are not correlated with treatment.

Figure 1. Impact of assignment on business ownership



Notes: The value reported as *Treatment* is the sum of the treatment effect and the control mean of the respective outcome measured in April 2021. The regression controls for strata fixed effects and reported business ownership in December 2020. Standard errors are clustered at the strata level. *Control* displays the control mean. Both treatment effects on the probability of owning a business and on the probability of keeping one's business are statistically significant at the 1 percent level.

outcomes was driven by the extensive margin: many more businesses were alive in the treatment group than in the control group.[8] Interpreting these conditional results is complex, however, given that selection is endogenous to treatment.

Given that only a small share of high school students run their own business (i.e., 28 percent of the control group as shown in Table 5), we look at the effect of Wavuzumbi on alternative outcomes related to entrepreneurial activity. First, we focus on participation in school business clubs. Although business clubs are extracurricular activities, they are encouraged in the Rwandan secondary school entrepreneurship curriculum. They can be considered the entrance door to entrepreneurship.

Table 6 shows that while 63 percent of control students participated in a business club, the training increased this share by 48 percentage points.[9] Column 2 indicates that the increase in

[8]Results are very similar when using the pre-analysis plan specification, except for the coefficient in the last column, as shown in Appendix Table A2.

[9]Because of the strata fixed effects and the additional controls, the mean of the treatment group does not correspond to the sum of the treatment effect and the mean of the control group. This explains why in some outcomes, the sum is negative or higher than 1 for binary outcomes.

Table 5. Impact of assignment to challenge on business ownership, weekly sales and profits

				Conditional on having business	
	Runs own business (1)	Business sales (RWF) (2)	Business profits (RWF) (3)	Business sales (RWF) (4)	Business profits (RWF) (5)
Treatment	0.387***	2482.369***	1413.080***	-746.152	1543.130*
	(0.055)	(627.186)	(158.450)	(2014.143)	(835.625)
Mean control	0.280	1119.883	534.490	5394.366	2367.026
N. obs.	1102	1024	1013	319	319
Baseline variable	Yes	No	No	No	No
Add. controls	Yes	Yes	Yes	Yes	Yes

Regressions include strata fixed effects and control for all registration variables. We control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** p<0.01, ** p<0.05, * p< 0.1

business club participation was driven by business clubs that generate some revenue. The effect is mostly concentrated in agricultural business clubs (Column 4), with no statistically significant treatment effect on non-agricultural business clubs (Column 3).[10]

Table 6. Impact on business club behavior

	Business club participation (1)	Business club revenue generation (2)	Non agricultural business club (3)	Agricultural business club (4)
Treatment	0.477***	0.634***	0.189	0.253*
	(0.108)	(0.098)	(0.185)	(0.146)
Mean control	0.629	0.581	0.428	0.280
N. obs.	1102	1102	1102	1102
Baseline variable	No	No	No	No
Add. controls	Yes	Yes	Yes	Yes

Regressions include strata fixed effects and control for all registration variables. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** p<0.01, ** p<0.05, * p< 0.1

[10]These results are robust to using the analysis plan specification, only the coefficient in Column 4 loses statistically significance as shown in Appendix Table A3.

We next explore whether this increase in entrepreneurship crowded out other economic activities. The first two columns of Table 7 show that the probability that a youth had a paid job or worked within a family firm doubled because of the program. The increases were 27 and 35 percentage points, respectively. This indicates that participants increased their overall labor force participation. When we use as outcome a dummy for any economic activity (running a firm, working for a paid job or working in a family firm), we find an effect of more than 45 percentage points.

Overall, we see no evidence that the intervention led youth to substitute other economic activities to run their own business. On the contrary, the intervention encouraged participation in other economic activities.[11] This is notable given that our intervention took place during the COVID-19 pandemic and that overall economic opportunities appear to have been limited.

The higher degree of labor force participation resulted, as shown in the Columns 3 and 4 of Table 7, in very large relative increases in total earnings (including wage or business earnings) and hours worked. The effects are of 1.6 USD, and nearly six weekly working hours, respectively. While the effect in earnings seems small in absolute terms, it more than doubles the value of earnings in the control group. Conditional on working, we find a negative impact on earnings, which is not statistically significant, and a marginally significant increase in hours worked. However, as we remarked above, we should take conditional effects with caution since the employed sample is selected, and these last two effects do not have a causal interpretation.[12] Again, these results seem to be driven by changes in the extensive margin, with treatment generating higher participation in economic activities.

This increased involvement in economic activities could have been detrimental to students' academic outcomes. While we do not have information on school grades, we asked about time spent in school activities. When using the specification from our analysis plan, we observe that participants are more likely to report devoting more hours than in the previous year to their studies (both on entrepreneurship and other classes). However, these results are not robust to

[11] The fact that micro-entrepreneurship training can lead to higher labor force participation has been documented by Martínez A. et al. (2018) for adults.

[12] Appendix Table A4 shows that these results are robust to using our analysis plan specification instead of that adding registration data controls.

Table 7. Impact on overall economic activity, hours and earnings in previous week

					Conditional on employment	
	Paid job outside family (1)	Work in family firm (2)	Weekly earnings (RWF) (3)	Weekly hours worked (4)	Weekly earnings (RWF) (5)	Weekly hours worked (6)
Treatment	0.270***	0.347***	1579.325***	5.667***	-759.140	3.114*
	(0.086)	(0.065)	(456.153)	(0.508)	(985.123)	(1.623)
Mean control	0.212	0.314	1361.576	1.539	5610.349	6.048
N. obs.	1102	1102	1033	986	334	345
Baseline variable	Yes	Yes	No	No	No	No
Add. controls	Yes	Yes	Yes	Yes	Yes	Yes

Regressions include strata fixed effects and control for all registration variables. We control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** p<0.01, ** p<0.05, * p< 0.1

adding controls.[13] Overall, we do not find strong evidence that the program crowded out school activities.

5.2 Heterogeneity

Given that the literature in entrepreneurship training and that of school interventions has found significant differences in outcomes by gender, we explore whether the impact of the challenge on girls was different from that on boys. The first two columns of Table 8 show that, overall, we see similar treatment effects for girls and boys. We only see one outcome where the difference in treatment effects is statistically significant. We observe a larger effect for girls on having a paid job outside of their family. The size of the coefficient is enough to almost close the gender gap in labor force participation among the treated.[14] This suggests that the program impacted girls and boys similarly although it may have fostered more independence of girls in terms of economic activity.

We next turn to heterogeneity by school type.[15] We study the differential program effects

[13] Results presented in Appendix Table A5.

[14] These differences are not driven by differential take-up of the program, which is not statistically different for girls and boys.

[15] The heterogeneity analysis by school type and parents' education was not specified in the pre-analysis plan. We

Table 8. Differential impact of assignment by student characteristics

	By gender		By school type		By guardian's education	
	T	T*female	T	T*public	T	T*≥ secondary
	(1)	(2)	(3)	(4)	(5)	(6)
Run own business	0.146**	0.105	-0.000	0.313***	0.164**	0.078
	(0.055)	(0.069)	(0.065)	(0.058)	(0.065)	(0.149)
Weekly sales (RWF)	2301.840***	377.950	2006.827*	1038.178	2057.730***	1040.632
	(511.177)	(711.560)	(1011.659)	(1009.510)	(568.638)	(664.829)
Weekly profits (RWF)	1282.263***	292.953	1715.319***	-281.409	1299.893***	275.235
	(132.926)	(315.156)	(208.352)	(226.510)	(111.203)	(384.159)
Part. in business club	0.493***	-0.035	0.179***	0.650***	0.512***	-0.083
	(0.085)	(0.081)	(0.056)	(0.040)	(0.098)	(0.083)
Rev. generating bus. club	0.677***	-0.098	0.347***	0.581***	0.651***	-0.050
	(0.080)	(0.059)	(0.095)	(0.081)	(0.090)	(0.076)
Paid job outside family	0.214**	0.131***	0.174*	0.259***	0.249***	0.032
	(0.080)	(0.040)	(0.100)	(0.069)	(0.058)	(0.089)
Works in family business	0.356***	-0.025	0.053	0.489***	0.287***	0.146**
	(0.059)	(0.071)	(0.086)	(0.112)	(0.060)	(0.065)
Weekly earnings (RWF)	1596.793***	-35.768	454.263	1941.066***	1425.439***	296.397
	(317.723)	(725.316)	(333.611)	(633.359)	(455.573)	(917.031)
Weekly hours	5.592***	0.178	4.211***	2.989**	4.897***	1.759*
	(0.541)	(0.584)	(1.048)	(1.385)	(0.782)	(1.022)

Regressions include strata fixed effects and control for all registration variables. We control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. In columns (1) and (2), we interact treatment with a female dummy. In columns (3) and (4), we interact treatment with a dummy equal to one if the school is public. In columns (5) and (6), we interact treatment with a dummy equal to one if the guardian of the student has at least secondary schooling. The number of observations is 1,102 for most outcomes in the first and last set of regressions, while it is 1,045 for the middle columns, except for weekly sales (1024, 964), weekly profits (1,013 and 957), weekly earnings (1033, 977) and weekly hours (986, 931). Significance level: *** p<0.01, ** p<0.05, * p< 0.1

for students attending public schools with respect to those attending private or government-aid schools, both of which charge fees. Public schools include about a third of all registered students; they typically enroll students from households of lower socioeconomic status. Among public school students in our sample, 46 percent have no parent or guardian with a secondary education, compared to 26 percent in non-public schools. In addition, control students from public schools are less likely to participate in a business club and to have Internet access, which could have limited their benefits from the program.[16]

add it as exploratory analysis based on our ex-post discussions with the Wavuzumbi team. We selected these two variables because they can be considered proxies for the socio-economic status of the students and of the type of school environment without the program and were collected during registration or endline and thus available for the full sample.

[16]We do not have the school type for around 60 students, which reduces the sample size.

Columns (3) and (4) of Table 8 show large differences in the way the program affected public school participants. With the exception of the effect on sales and profits, all other interaction terms are positive and statistically significant. We see that the effect on running their own business is driven by public school students. We find that both business creation and survival increased in response to treatment for public school students, while only business survival increased for private school students. We also see much stronger treatment effects for public school students on participation in a business club, in particular one that earns revenue, on having a job outside one's family, and on working in a family business. This translates in significantly larger effects on weekly earnings and weekly hours worked. As in the case of gender, we do not find that take-up was different for public school students, suggesting that their program effects are not driven by participating more in the program. This could indicate that the program benefited particularly students who were in a school environment where motivating entrepreneurship was limited by the school budget. However, since enrollment in public schools is correlated with socio-economic status in Rwanda, these results could also simply imply that poorer students benefited more from the intervention.

To test this, we conduct exploratory heterogeneity analysis based on the educational attainment of the student's guardian.[17] We compare students whose guardian has completed at least secondary education (65 percent of the sample) with the other students. The last two columns of Table 8 show weak evidence of treatment effect heterogeneity in this dimension. Effects are statistically larger for participants with more educated guardians on the probability of working in a family business and on weekly hours worked. However, we do not find statistically significant differences in the other outcomes. Overall, this warns us against interpreting the results on school type as simply measuring heterogeneity in effects by socio-economic status. The combination of both sets of results seems to suggest that the program distinctly affected participants in public schools but not necessarily those from the lowest socio-economic background as measured by parental education. This could be thus a reflection that the program was particularly effective where previous entrepreneurship education was most lacking.

[17] This variable was not collected at registration, and we thus use the value reported at endline by students.

5.3 Mechanisms

Having shown significant impact of the intervention on business and economic outcomes, in this section we explore the possible mechanisms. The program's theory of change posited that it would generate more entrepreneurial activity through three main channels: increasing the attractiveness of entrepreneurship, enhancing entrepreneurial abilities, and encouraging entrepreneurial actions with the final goal of running a business.

5.3.1 Entrepreneurial preferences

We first study whether the program was successful at changing students' preferences regarding entrepreneurship. In the top panel of Table 9, we show the impact of being assigned to the treatment on the favorite subject at school. We note a high preference for entrepreneurship classes, with 64 percent of the control group reporting that their favorite subject at school was entrepreneurship. We see a very large program effect (of 30 percentage points) on this variable. Our results suggest that participants switched from preferring history and science to entrepreneurship and math.[18]

The bottom panel of Table 9 looks at the effect on future career choices. Most students in the sample saw entrepreneurship as their future career (87 percent in the control group), and almost 90 percent anticipated it being their primary or secondary activity in five years. We find positive but not statistically significant treatment effects on these measures. Perhaps this is not surprising given that the high baseline levels implied that there there was not much margin to change these outcomes.[19]

[18] As shown in Appendix Table A6, we observe a similar shift away from history when using our analysis plan specification but the increase in entrepreneurship and math is not statistically significant.

[19] In our pre-analysis plan specification, we find similar results except that there is a marginally significant effect on entrepreneurship as secondary activity. See Appendix Table A6.

Table 9. Impact of assignment on entrepreneurial preferences

	Treatment (1)	Mean control (2)	N.obs (3)
	Favorite topic at school		
Entrepreneurship	0.305***	0.640	1102
	(0.089)		
History	-0.101***	0.048	1102
	(0.031)		
Language	-0.022	0.048	1102
	(0.028)		
Math	0.065***	0.062	1102
	(0.024)		
Science	-0.181***	0.139	1102
	(0.055)		
Other	-0.066	0.062	1102
	(0.041)		
	Future aspirations		
Entrpreneurship as future career	0.069	0.867	1102
	(0.137)		
Entrepreneurship as primary activity in 5 years	0.051	0.898	1102
	(0.067)		
Entrepreneurship as secondary activity in 5 years	0.086	0.765	1102
	(0.091)		

Regressions include strata fixed effects and control for all registration variables. In the second panel, we control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** p<0.01, ** p<0.05, * p< 0.1

5.3.2 Entrepreneurial abilities

The program aimed to enhance entrepreneurial abilities, including cognitive skills, but focused mainly on socio-emotional skills to develop an entrepreneurial mindset.

We first look at whether the program increased knowledge of business concepts. Our endline survey included a question on opportunity costs and four questions related to topics covered in the challenge.[20] Table A7 shows a statistically significant impact on answering correctly the opportunity cost question. But this result is not robust to excluding controls.[21] We find no evidence that participants responded more accurately to topics covered in the challenge, perhaps due to

[20]Specifically, the questions related to the "gig economy," "making a dent in the universe," the "root cause analysis," and the "beachhead market."

[21]See Panel B of Table A7 for the results corresponding to our pre-analysis plan.

familiarity with these concepts, which are also included in the regular secondary school entrepreneurship curriculum. The treatment effect is negative and becomes statistically significant when using our pre-analysis plan specification, as can be seen in Panel B of Table A7. Overall, we do not find strong evidence for changes in business knowledge.

The challenge targeted socio-emotional skills aimed at developing a successful entrepreneurial mindset, such as intellectual imagination, resilience, personal initiative, spirit of significance, and drive (Frese and Gielnik, 2014). We used questionnaires validated in other studies to measure the following soft-skills: creativity, persistence, initiative, self-efficacy and locus of control (Bandura, 2006; Caliendo et al., 2016; Delavallade and Rouanet, 2020). We also included a measure of risk taking (Dohmen et al., 2011). We find no evidence of positive impact on any of these outcomes, as shown in Appendix Table A8. We actually find negative and significant coefficients for some of these outcomes. One hypothesis is that participants become more conscious of their short-comings due to the challenges.

Overall, we do not find evidence that the program was effective at changing cognitive or non-cognitive abilities.

5.3.3 Entrepreneurial actions

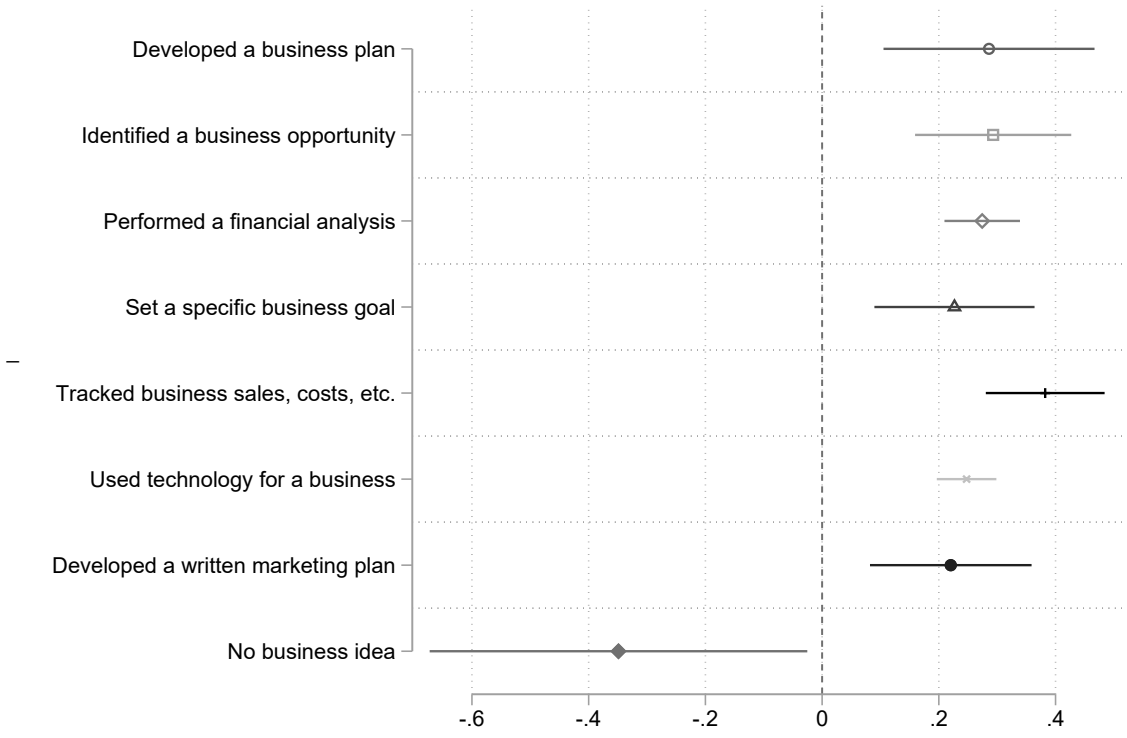
The third channel that could have led to business creation and survival is an effect on business actions and practices. We first explore whether the program led participants to take more actions oriented at creating a business and we then look at business practices.

Figure 2 presents program effects on four business actions: preparing a business plan, identifying a business opportunity, setting a business goal, and performing a financial analysis. These are usually thought as actions required to transform a business idea into starting a successful business, and many of them were covered by specific challenges in the training. We see significant effects of the program on all these actions.

Figure 2 next shows significant treatment effects on three recommended business practices: tracking business sales and costs, using technology and developing a market plan. These prac-

tices are positively correlated with business outcomes for businesses of different sizes around the world (McKenzie and Woodruff, 2017). If we construct a standardized index including these three business practices, we find a large treatment effect of 0.5 standard deviations, which is statistically significant at the 1 percent level.

Figure 2. Impact on business actions



Finally, another strategy to foster entrepreneurship is to develop business networks. The program encouraged learners to engage with each other, with their teachers, and with local entrepreneurs while they completed the challenge. Table 10 shows that the training increased the likelihood of talking about business ideas with classmates (16 percentage points increase over a control mean of 49 percent), friends (16 percentage points over a control mean of 41 percent) and family members (33 percentage points over a control mean of 58 percent). We see no effects on talking with teachers or other adults, which might indicate no changes in exposure to adult entrepreneurs. Given the restrictions due to the COVID-19 pandemic and social distancing measures, it is possible that treated students found it easier to interact more with people of their

age or family members than with adults and even with their own teachers. While not statistically significant, the negative coefficient on interaction with teachers indicates that trained students might have substituted discussions with teachers with classmates and family interactions.[22]

Table 10. Impact on business networks

	Classmates	Friends that are not classmates	Other adults	Parent/Adult family members	Teachers
	(1)	(2)	(3)	(4)	(5)
Treatment	0.164**	0.163***	0.134	0.329***	-0.193
	(0.062)	(0.058)	(0.129)	(0.079)	(0.159)
Mean control	0.490	0.408	0.445	0.581	0.731
N. obs.	1099	1099	1099	1099	1099
Baseline variable	Yes	Yes	Yes	Yes	Yes
Add. controls	Yes	Yes	Yes	Yes	Yes

Regressions include strata fixed effects and control for all registration variables. We control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** p<0.01, ** p<0.05, * p< 0.1

6 Conclusions

We study the effects of an online gamified entrepreneurship training offered to Rwandan students enrolled in secondary schools. We find substantial short-term impacts of the training on business ownership and economic outcomes. These results acquire even more importance if we consider that implementation of the intervention happened at a time when the COVID-19 pandemic was generating significant disruptions in business activity.

We present evidence that these impacts operated through an increase in business-oriented actions, adoption of business practices, and networking. We hypothesize that this short and intensive gamified training motivated treated students to sustain their business activities during the COVID-19 pandemic. It is possible that we would have observed more business creation instead of business survival in a more amicable economic environment.

The fact that the program we study was unable to improve soft skills linked to successful

[22]Very similar results are obtained when using the analysis plan specification, as shown in Appendix Table A9.

entrepreneurship, one of its main goals, is worth highlighting. Training programs that introduce components on soft skills might be more effective at increasing overall enthusiasm and interest in entrepreneurship than programs focusing only on hard skills, even if they do not actually manage to generate measurable changes in soft skills. This is a promising avenue for future research.

Our paper provides evidence that online training programs can be effective at motivating aspiring entrepreneurs in difficult times. Despite the potential dependence of our results on the challenging atmosphere faced by participants, this paper also brings valuable evidence indicating that online gamified training programs can be a promising way to scale-up business training programs among students. Future work should investigate whether our results apply to different samples (e.g., adult entrepreneurs), contexts, and more normal times.

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A Additional Figures and Tables

Figure A1. Wavumbuzi challenge example

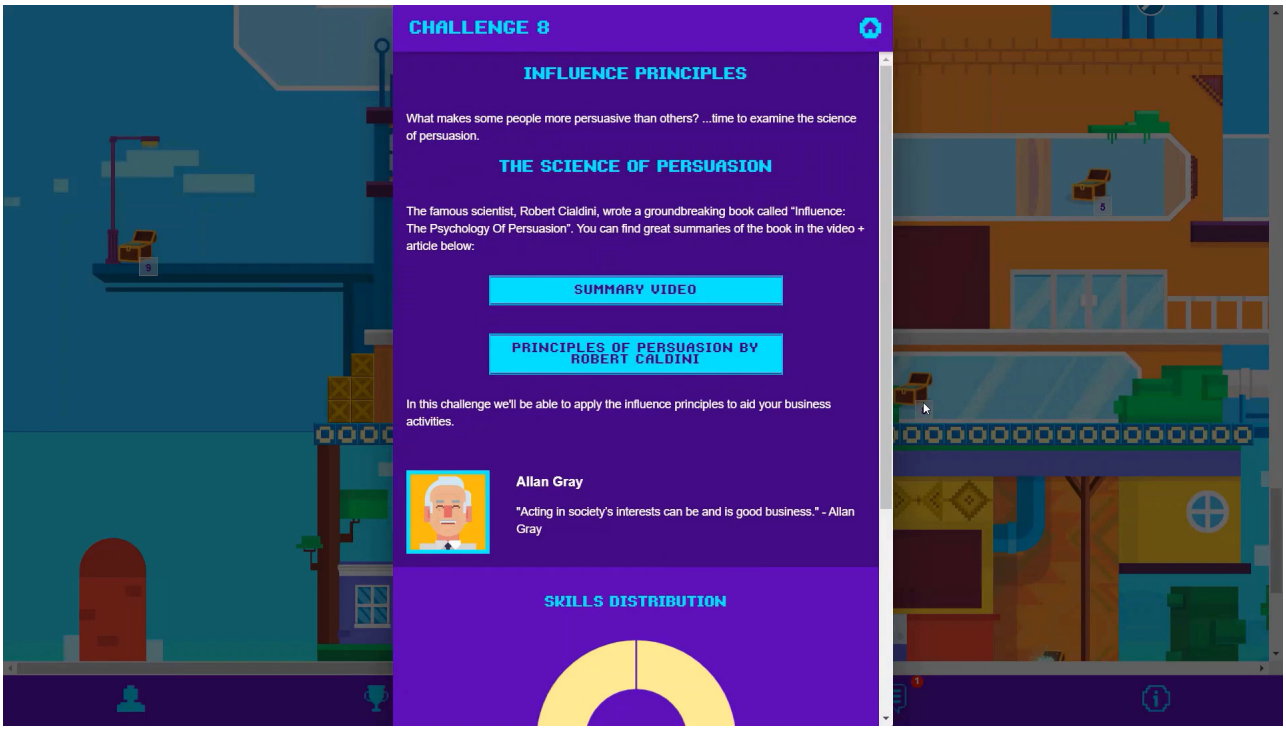

Figure A2. Wavumbuzi leaderboard

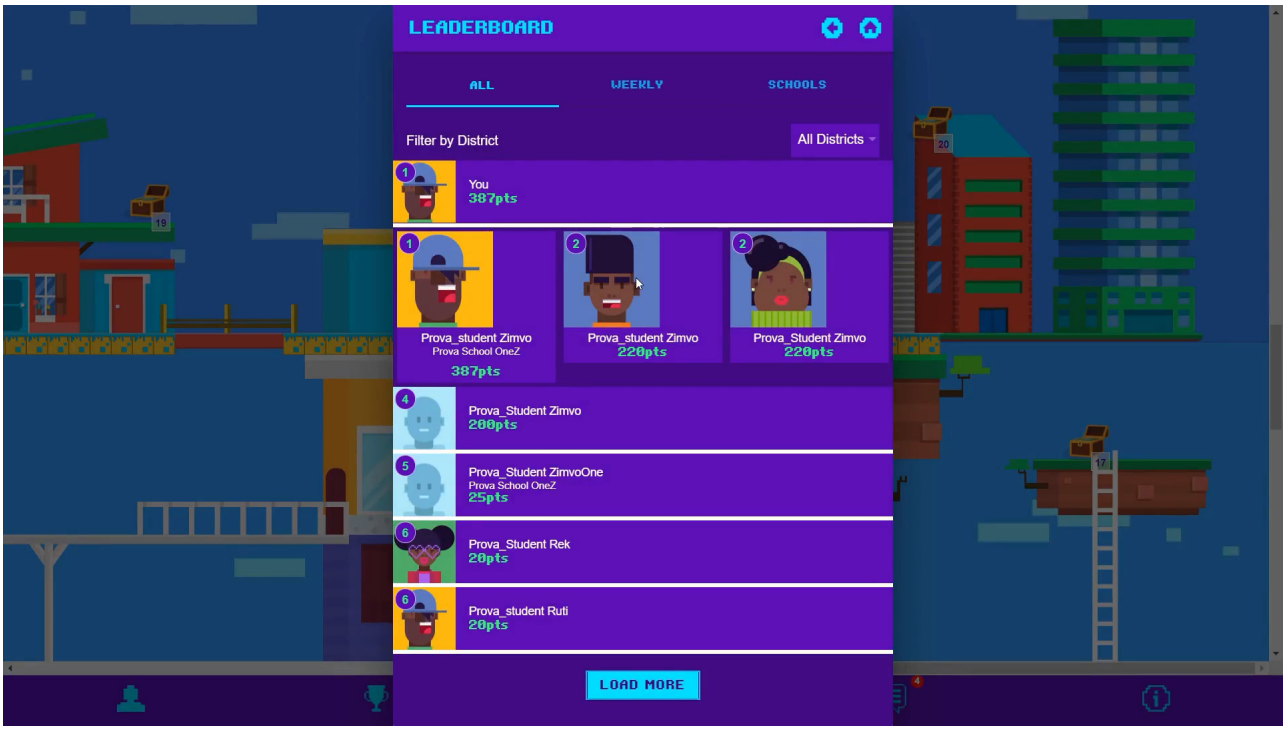

Figure A3. Wavumbuzi timeline

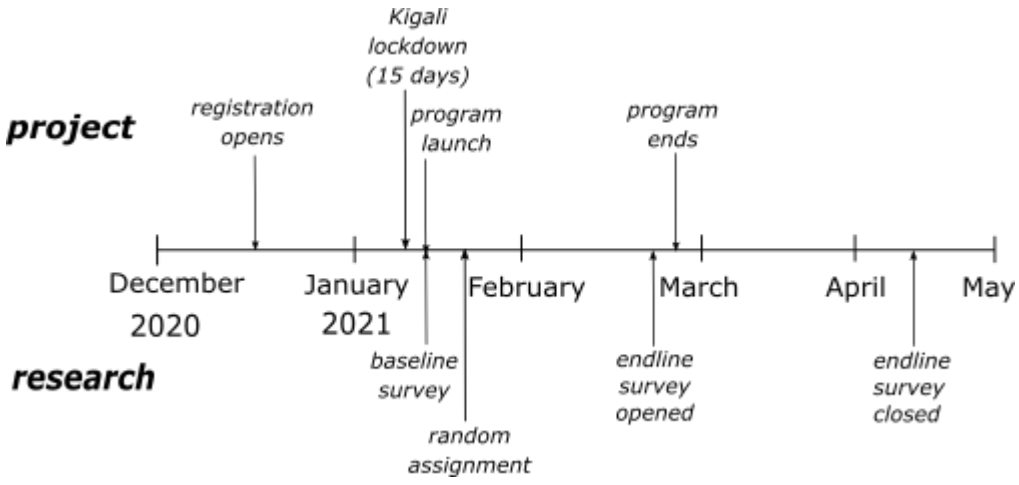

Table A1. Test of balance on those who answered the baseline survey

	Mean (control group)	Standard deviation (control group)	Treatment
Female	0.33	0.47	0.26***
			(0.09)
Mobile	0.63	0.49	-0.12
			(0.37)
Email	0.94	0.23	-0.09
			(0.24)
Age	18.26	2.28	0.15
			(1.80)
English	0.25	0.43	0.21
			(0.22)
Kinyarwanda	0.75	0.43	-0.22
			(0.21)
Senior 1	0.04	0.19	-0.08
			(0.05)
Senior 2	0.03	0.17	-0.00
			(0.03)
Senior 3	0.16	0.36	0.03
			(0.07)
Senior 4	0.23	0.42	0.07
			(0.09)
Senior 5	0.37	0.48	0.03
			(0.06)
Senior 6	0.17	0.37	-0.06
			(0.15)
Number of Learners (Senior 6) at School	67.54	49.84	-11.07
			(18.85)
Number of Students at School	364.84	226.42	-54.71
			(60.93)
F-test for student report characteristics:			1.16
Currently run own business	0.29	0.46	0.08
			(0.07)
Work in family business	0.33	0.47	0.12
			(0.14)
Work in paid job (outside family)	0.25	0.43	-0.02
			(0.06)

The first and second columns report the mean and standard error of observations in the control group, respectively. The third column reports the coefficient of a regression where the outcome is the baseline characteristic and the explanatory variable is a dummy for being assigned to treatment, including strata fixed effects and standard errors clustered at the strata level. The sample is restricted to those who answered the baseline. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A2. Replication of Table 5 using Pre-Analysis Plan specification

				Conditional on having business	
	Runs own business (1)	Business sales (RWF) (2)	Business profits (RWF) (3)	Business sales (RWF) (4)	Business profits (RWF) (5)
Treatment	0.365***	2271.774***	1129.689***	-1087.642	-387.666
	(0.016)	(539.690)	(249.131)	(2385.688)	(1141.104)
Mean control	0.280	1119.883	534.490	5394.366	2367.026
N. obs.	1102	1024	1013	319	319
Baseline variable	Yes	Yes	No	No	No
Add. controls	No	No	No	No	No

Regressions include strata fixed effects. We control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** p<0.01, ** p<0.05, * p< 0.1

Table A3. Replication of Table 6 using Pre-Analysis Plan specification

	Business club participation (1)	Business club revenue generation (2)	Non agricultural business club (3)	Agricultural business club (4)
Treatment	0.321***	0.449***	0.009	0.316
	(0.015)	(0.016)	(0.266)	(0.243)
Mean control	0.629	0.581	0.428	0.280
N. obs.	1102	1102	1102	1102
Baseline variable	Yes	No	No	No
Add. controls	No	No	No	No

Regression includes strata fixed effects. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A4. Replication of Table 7 using Pre-Analysis Plan specification

					Conditional on employment	
	Paid job outside family (1)	Work in family firm (2)	Weekly earnings (RWF) (3)	Weekly hours worked (4)	Weekly earnings (RWF) (5)	Weekly hours worked (6)
Treatment	0.269***	0.401***	1456.274**	5.689***	-2236.812	3.571***
	(0.078)	(0.064)	(600.213)	(0.507)	(1927.966)	(0.202)
Mean control	0.212	0.314	1361.576	1.539	5610.349	6.048
N. obs.	1102	1102	1033	986	345	334
Baseline variable	Yes	Yes	No	No	No	No
Add. controls	No	No	No	No	No	No

Regressions include strata fixed effects. We control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** p<0.01, ** p<0.05, * p< 0.1

Table A5. Impact of assignment on hours of study compared to April 2020

	Excluding entrepreneurship lessons			In entrepreneurship lessons		
	Same hours (1)	Less hours (2)	More hours (3)	Same hours (4)	Less hours (5)	More hours (6)
			Panel A: With registration controls			
Treatment	-0.007	-0.104	0.110**	-0.055	-0.094	0.149**
	(0.061)	(0.083)	(0.044)	(0.073)	(0.080)	(0.063)
Add. controls	Yes	Yes	Yes	Yes	Yes	Yes
			Panel B: Pre-analysis plan specification			
Treatment	-0.112***	0.121*	-0.009	-0.134	0.133*	0.001
	(0.016)	(0.070)	(0.057)	(0.096)	(0.067)	(0.030)
Add. controls	No	No	No	No	No	No
Mean control	0.218	0.306	0.476	0.244	0.289	0.467
N. obs.	1102	1102	1102	1102	1102	1102
Baseline variable	No	No	No	No	No	No

Regression includes strata fixed effects. Standard errors clustered at the strata level. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table A6. Replication of Table 9 using Pre-Analysis Plan specification

	Treatment (1)	Mean control (2)	N.obs (3)
	Favorite topic at school		
Entrepreneurship	0.158	0.640	1102
	(0.161)		
History	-0.020**	0.048	1102
	(0.009)		
Language	-0.022	0.048	1102
	(0.034)		
Math	0.027	0.062	1102
	(0.038)		
Science	-0.071	0.139	1102
	(0.038)		
Other -0.073*	0.062	1102	
	(0.062)		
	Future aspirations		
Entrpreneurship as future career	0.038	0.867	1102
	(0.107)		
Entrepreneurship as primary activity in 5 years	0.005	0.898	1102
	(0.025)		
Entrepreneurship as secondary activity in 5 years	0.054***	0.765	1102
	(0.019)		

Regressions include strata fixed effects. In the second panel, we control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** p<0.01, ** p<0.05, * p< 0.1

Table A7. Impact of assignment to challenge on business knowledge

	Knows how to compute opportunity cost	Prop. of challenge related questions answered right
	(1)	(2)
	Panel A: With registration controls	
Treatment	0.075**	-0.085
	(0.031)	(0.063)
Mean control	0.524	0.534
N. obs.	1102	1102
Baseline variable	Yes	No
Add. controls	Yes	Yes
	Panel B: Pre-analysis plan specification	
Treatment	-0.036	-0.122***
	(0.092)	(0.011)
Mean control	0.524	0.534
N. obs.	1102	1102
Baseline variable	Yes	No
Add. controls	No	No

Regressions include strata fixed effects and control for all registration variables in Panel A. We control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table A8. Impact of assignment on soft skills

	Creativity (1)	Initiative (2)	Persistence (3)	Self-efficacy (4)	Locus of control (5)	Risk-taking (6)
			Panel A: With registration controls			
Treatment	-0.678**	-0.607***	-0.657***	-0.500***	0.178***	0.066
	(0.271)	(0.111)	(0.128)	(0.175)	(0.053)	(0.361)
Add. controls	Yes	Yes	Yes	Yes	Yes	Yes
			Panel B: Pre-analysis plan specification			
Treatment	-0.625**	-0.414***	-0.405***	-0.296**	-0.001	-0.084
	(0.286)	(0.082)	(0.122)	(0.139)	(0.034)	(0.329)
Add. Controls	No	No	No	No	No	No
Mean control	0.002	-0.001	-0.000	0.002	-0.003	0.004
N. obs.	1101	1102	1101	1101	1101	1101
Baseline variable	Yes	Yes	Yes	Yes	Yes	Yes

Regressions include strata fixed effects and control for all registration variables in Panel A. We control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** p<0.01, ** p<0.05, * p< 0.1

Table A9. Replication of Table 10 using Pre-Analysis Plan specification

	Classmates (1)	Friends that are not classmates (2)	Other adults (3)	Parent/Adult family members (4)	Teachers (5)
Treatment	0.142*	0.170***	0.046	0.078***	-0.136
	(0.071)	(0.027)	(0.149)	(0.022)	(0.199)
Mean control	0.490	0.408	0.445	0.581	0.731
N. obs.	1099	1099	1099	1099	1099
Baseline variable	Yes	Yes	Yes	Yes	Yes
Add. controls	No	No	No	No	No

Regression includes strata fixed effects. We control for the baseline value of the outcome when available; we replace missing observations with 0 and add dummies for missing observations. Standard errors clustered at the strata level are reported in parentheses. Significance level: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$