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Effectiveness and Spillovers of Online Sex Education: Evidence from a Randomized Evaluation in Colombian Public Schools

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ABSTRACT

Sexual health problems cause negative externalities from contagious diseases and public expenditure burdens from teenage pregnancies. In a randomized evaluation, we find that an online sexual-health education course in Colombia leads to significant impacts on knowledge and attitudes and, for those already sexually active, fewer STIs. To go beyond self-reported measures, we provide condom vouchers six months after the course, and find a 9 percentage point increase in redemption. We find no evidence of spillovers to untreated classrooms, but we do observe a social reinforcement effect: the impact intensifies when a larger fraction of a student's friends is also treated.

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1- Introduction

As young adults marry at older ages they are more likely to have sex before marriage, increasing exposure to unwanted pregnancy risk and sexually transmitted infections (STIs). In the United States, more than 30% of teenage girls become pregnant at least once by the age of 20, and more than 80% of those pregnancies are unintended (Finer and Henshaw, 2006). Because teenage pregnancy is one of the strongest correlates of dropping out of school (Ambrus and Field, 2008), this has long term impacts beyond timing of fertility. STI risk is especially high for young adults: one third of sexually active young people in the US become infected with an STI by age 24, with consequences ranging from discomfort to infertility, cancer, and AIDS (Kirby, 2007).

In developing countries, adolescents face the same complex choices around sexual activity, with the added constraints of lower availability of information about safe sexual practices and restricted access to reproductive health services. In Colombia, only 55% of sexually active females aged 15-17 used a condom in their first sexual encounter (DHS, 2010). This level of risk taking is reflected in a fertility rate among adolescents in Colombia of 74 births per thousand, compared to 41 per thousand in the US, 14 in Canada, 6 in Japan and 5 in the Netherlands (U.N. 2004). By age 19, 20% of female adolescents in Colombia have been pregnant while 16% are already mothers.[2] As Fortson (2009) has argued, sexual risk-taking in developing countries has graver consequences because governments lack the resources and health system organization to treat diseases such as HIV.

Acknowledging the public health importance of this issue, substantial amounts of research have focused on understanding how school-based sexual health education can improve sexual knowledge, attitudes and behavior. Recent comprehensive reviews of this literature include Kirby (2007, 2008), and Chin et al. (2012), both of whom find evidence that a plurality of these programs are effective at improving knowledge, attitudes and behaviors such as self-reported condom use.

Until now, the literature has mostly focused on evaluation of human-led interventions (by adults or peers). In recent years however the rise of information and communication technology (ICT) programs has started to change school-based sexual health education.[3] ICT instruction risks that teenagers learn less from computer-based instruction than via teacher interaction (*c.f.* Angrist and Lavy, 2002; Krueger and Rouse, 2004; Barrera et al 2009). However, recent evidence suggests that the opposite may hold true for

[2] All figures in the international comparison are for ages 15-19.
[3] Early work using new technology focused on videos (Downs et al 2004) and found encouraging results.

sexual health programs. Kiene and Barta (2006) evaluated a computer-based program for college students in the U.S. using a randomized control trial, and found that condom use had increased significantly one month after the intervention. Roberto et al (2007) studied a six-session online program among a population of rural adolescents in the U.S., and found a reduction in the number of sexual partners and a delay in the initiation of sex five months after the intervention. Noar et al (2009) review recent computer-based interventions focused on HIV prevention, and find similar efficacy as with human-delivered interventions.

Internet-based sexual health education has become an increasingly attractive option for three main reasons. First, online programs may prove easier to scale up than human-led programs, especially in countries that have already invested in internet-equipped computer labs in schools. Second, computer-based courses can be used by students in settings where teachers, health workers or peers refuse or are unable to provide in-person instruction. Third, human-led group settings may not be the ideal learning environment for topics such as sexual health. The sensitive nature of this issue can create discomfort and lead students to avoid engaging with the material or participating at all. From this perspective, the anonymity and privacy which are possible with computer-based learning (Barak and Fisher, 2003) may actually be better suited to teaching adolescents about sexual health. For example, Paperny (1997) concludes that a computer sexual-risk assessment program was perceived as nonjudgmental by adolescent users, whilst an in-person risk assessment was perceived more negatively.

We implement a randomized control trial to evaluate an online sexual health education course designed by the Colombian non-profit organization Profamilia (a member of Planned Parenthood International) and implemented among adolescents in Colombian public schools. The course involved the use of five separate modules covering the topics of sexual rights, pregnancy/family planning and the use of contraceptives, STIs/HIV and the use of condoms, objectives in life and the role of sexuality (empowerment), and prevention of sexual violence.[4] The course was implemented over the course of an academic semester and involved scheduled sessions in the school's computer lab with teacher supervision. In addition, students had access to the course from any computer using a password-protected account (for example at home or an internet café). Students were also assigned a remote tutor in the central Profamilia offices who would answer students' questions individually and confidentially. The sample comprised 138 ninth grade classrooms from 69 public schools in 21 Colombian cities. Pre-intervention characteristics were assessed using a baseline survey before students knew they would be taking a sexual education course. A first follow-up survey was conducted one week after course

[4] Silverman, Raj and Clements (2004) show that dating violence is a relevant pregnancy risk among adolescents.

completion to measure immediate changes in knowledge and attitudes, and a second follow-up survey six months after the course to measure medium-term impacts.

Beyond the developing-country context, there are three main innovations in this study. The first tries to address the problem of self-reported outcomes in the sexual-health literature by augmenting standard self-reported measures with administrative data on the redemption of vouchers for condoms at a local health clinic six months after the end of the course. This objective outcome addresses the criticism of self-reported data, and is arguably as close to actual use of condoms as we can credibly obtain. The emphasis on this particular outcome is attributable to the fact that condom use is the key policy target typically employed to prevent STIs and pregnancy among sexually active teenagers.

Second, by randomizing treatment across schools, and then across classrooms within schools, we created an experimental design that not only allows for an assessment of direct impacts for treated students, but also for the measurement of spillovers from treated to untreated classrooms in the same school.

Third, we present an analysis of the role of friendship networks in sexual health outcomes. We are able to assess the extent to which the sexual education course has a differential impact depending on the percentage of a student's friendship network who get treated – network level complementarities or what Manski (2011) calls reinforcing interactions. Knowledge of a student's friendship network also allows us to determine if the fact that a given student receives the course has an indirect impact on outcomes for a friend that did not take the course – network level spillovers.

In the baseline and follow up surveys we obtained measures on sexual health knowledge, attitudes and behavior. We create standardized indexes to determine the effectiveness of the course on sets of related outcomes. We find that Profamilia's course caused improvements in sexual knowledge and attitudes along most measured outcomes among intent-to-treat students. These students are better able to identify safe and risky sexual practices, STI symptoms, and violent/abusive sexual situations.

The overall sexual behavior index does not reveal significant differences in self-reported sexual practices, but we do find improvements in terms of reduced STI presence for those sexually active at baseline. Additionally, the condom voucher analysis shows that voucher redemption was 27% among treatment students compared to 18% among control students, providing non-self-reported evidence that the course led to an increase in condom demand.

Under the assumption that the only channel through which the training had an impact on sexual behavior is through knowledge and attitudes as taught in the course, we can take advantage of the random assignment to treatment to obtain an instrumental variable estimate of the effect of knowledge and attitudes on self-reported sexual behavior. We find that a one standard deviation (SD) increase in the index of knowledge and behavior leads to a one fifth SD improvement in the index of sexual behavior, a larger effect than that obtained from a standard OLS estimation. Naturally this exercise requires that the exclusion restriction hold. If, for example, the program also led to social interaction (e.g., class discussions) that led to behavior change, concurrent with the observed increase in knowledge and attitudes, the IV approach would be invalid. We do not have a direct test of the exclusion restriction, and thus include it but note the necessary assumptions for correct interpretation.

We tackle spillovers through two approaches, one in the design of the study, with non-treated classrooms in treatment schools as well as pure control schools, and a second in the data through collecting information on social networks within and across classrooms. For the first, we do not find clear evidence of spillovers from treated classroom to non-treated classroom in the same grade and school (which we refer to as a spillover classroom). For the second, we find strong evidence of reinforcement: the treatment effect is strongest when those treated are also friends with people who were treated. Someone who took the course but had no friends also taking the course had an estimated effect around half of the size as someone who took the course and whose full list of friends also took the course. In particular, when whole networks of friends take the course, we not only find much stronger effects of the course in terms of knowledge and attitude indicators, but we also observe significant improvements in sexual behavior indicators: reductions in the number of sexual relationships, frequency of sex and number of partners. For students in the spillover group, we find that having friends who did take the course results in a significant reduction on reported STIs, but not on other outcomes.

These results complement recent literature on peer effects in sexual health. Dupas (2011) finds positive information spillovers across cohorts of secondary school students in Kenya from an HIV information campaign. Fletcher (2007) and Richards-Shubick (2011) provide evidence that peer group norms have a first order effect in explaining sexual health outcomes. Our results show that not only do peer-groups matter for explaining behavior in equilibrium, but also that the treatment effect of interventions is influenced by the social networks.

In terms of cost effectiveness of the course, we find that for every $1,000 spent[5] on the Profamilia course, one can provide services to 68 students, and avert between 1.2 (if effects disappear after 6 months) and 10.5 STIs (if effects decay at 25% annually). As adolescents age and become sexually active, the prevalence of STIs increases, and thus even with a 25% decay rate, the acceleration in propensity to contract an STI outpaces the decay, and generates large predicted benefits. Thus all-in, we estimate a cost per averted STI ranging from $824 (if effects disappear after 6 months) to $95 (under the 25% annual decay assumption). In contrast, the benefits of averting an STI are estimated in the literature to be between $634 and $785, suggesting that because of the low costs of implementation, the course has at a minimum a benefit to cost ratio of around 1 and under more reasonable assumptions about the decay of effects we estimate a benefit to cost ratio of 8.

The paper proceeds as follows. In Section 2 we describe Profamilia's online sexual health education course. Section 3 explains the experimental design and econometric strategy. Section 4 presents the results, and section 5 concludes.

2. The Profamilia Internet Sexual Health Education Course

Profamilia is an internationally recognized non-profit provider of family planning and reproductive health services in Colombia, with over 33 clinics and 1,800 employees. A member of the International Planned Parenthood Federation since 1967, Profamilia is Colombia's largest non-governmental organization focused on sexual health and reproductive health. Profamilia's education branch, *Profamilia Educa*, developed the internet-based sexual education course. Development of the online course was motivated by deterioration in some important adolescent sexual health indicators, such as teenage pregnancy rates (DHS, 2005) and legal changes which mandate the introduction of a sexual health curriculum in Colombia's public schools. Legislation establishing sexual education as obligatory in public schools was passed in 1994, and national public policy had been drafted by 2003 (Ministerio de la Protección Social, 2003). In practice, however, sexual education in public schools remains limited. For most adolescents, lectures on anatomy during biology class cover the extent of sexual education currently being implemented (DHS, 2010).

Rooted in Profamilia's 40 years of experience in providing Colombian youth with services and counseling for sexual and reproductive health,[6] the online course provides a comprehensive curriculum

[5] All figures in 2012 US dollars.
[6] See Miller (2010) for a study of long term effects of Profamilia family planning services in Colombia.

aimed at shaping adolescents' understanding and perceptions of sexuality, risks, reproductive health, sexual rights and dating violence. All modules have a human rights approach to pregnancy and teen sexuality. They focus on helping the student recognize herself as a person endowed with rights, such as the right to say no to sex, to access basic health services, to access family planning services, and to live without sexual violence.[7]

Profamilia's course takes full advantage of internet connectivity to provide an interactive experience and responsive, anonymous counseling. The modules can be accessed any time of day, and there is a remote tutor available to answer questions and support the learning process, with the aim of creating a safe social environment for adolescents to discuss sensitive topics.

Treatment consisted of five modules of Profamilia Educa's course. Students worked on the course for a total of 11 weeks. Each group of treated students was given three weeks to complete activities in the first module and become acquainted with the platform and two weeks to complete activities for each of the other four modules. Each school dedicated at least one session of 1.5 hours per week to allow the students to complete the course in the school's computer labs. The students were also encouraged to continue the activities at either home, a public library or an internet café.

Each group engaged in the course in the presence of a teacher who was tasked with helping the students resolve questions about use of and access to the platform, but not questions related to the content of the course. Every student was directly assisted and monitored by an online tutor, who was a trained Profamilia counselor who dedicated part of her/his day to following students during their completion of the course. The tutors have two main roles: answering students' questions about the course contents, and monitoring the students' performance.

At the end of every module, the tutor provided the teacher responsible for the group with a grade based on the results of a test. Then, each school participating in the course included these grades as a component of the grade of one subject, typically computer education. Each student had to complete module evaluations individually, which was the basis for his/her individual performance report. Participation in the course was mandatory for students.

[7] Examples from the course modules can be accessed at www.profamiliaeduca.com/profamilia/index.php

3. Experimental Design and Estimation Strategy

Sexual education courses must ideally be targeted at children of the appropriate age to benefit from them – neither too young nor too old. Very young children may not yet be interested in sexuality issues, which points towards the benefits of targeting an older age range. On the other hand, sexual education should in principle be provided before sexual initiation to convey its full benefits. In Colombia, 13.5% of adolescents have sex before age 15, and 60% have their sexual debut before age 18.[8] For this reason, Profamilia's course targets 14-15 year olds.

The sample frame consists of 9th grade students in Colombian urban public secondary schools. Given our interest in cross-classroom spillovers, we required enrolled schools to have at least two 9th grade classrooms. Schools were also required to have at least one computer room with internet access.[9] All participating administrators of the schools had to consent for their school to participate in the field experiment before knowing the result of the randomization. Schools agreed to facilitate data collection and coordination, to make the computer lab available for the prescribed time every week (if selected to implement the course), and to not substantially modify their sexual and reproductive health education for 9th graders during the study. A short questionnaire for the school principals at baseline revealed that sexual education in our sample was either non-existent, a topic covered in biology class, or consisted of a visit or two per year by a health professional. Schools in the control group received a sports equipment package as compensation at the end of the study.

The sample consists of 69 public secondary schools recruited in 21 cities with Profamilia clinic presence.[10] From each school, two classrooms of 9th graders were selected to participate in the study. If the school had more than two classrooms of 9th graders, a pair was randomly selected to partake in the study.

Six months after the end of the study, we offered students a voucher for 6 condoms with a market value of about $5 dollars at the local Profamilia clinic. The offer was made via an email for all students and additionally via an SMS message for those who provided us with a cell phone number (86% of the sample). To assess whether voucher redemption was hindered by transportation costs to the local clinic,

[8] In the U.S. 15% of adolescents have sex before age 15 (Flanigan et al 2006).
[9] We selected schools with a functioning computer lab connected to the internet with at least one computer for every three students. On average schools had 37-38 computers with a ratio of around one participating student per computer.
[10] The sample excludes rural public schools. In urban settings, it is common for schools in Colombia to have two shifts per day (morning and afternoon). A student is offered a place at a certain shift before the beginning of the school year and once a school is selected, he/she cannot take classes in other shifts or switch shifts. Given the lack of interaction among children of different shifts, we treat different shifts in our sample as different schools. We use both shifts for 13 schools in our sample.

we randomly offered 50% of students reimbursement for the cost of a bus trip (about $1.5 dollars) payable at the clinic when they redeemed the voucher. We then recorded which students went to redeem their voucher at the local Profamilia clinic.

Randomization procedure

Because the sexual education course was part of the curriculum of a computer education or other course, treatment was at the classroom level. Hence our randomization unit is the classroom (also referred to as group). There are three types of classrooms: treatment, spillover and control. The randomization is done in two stages. First, schools are assigned to either treatment or control. Then, within treatment schools, classrooms are assigned to either the treatment or the spillover condition. A spillover classroom does not receive the treatment, but is in the same school as one which does.

Table 1 shows the partition of schools and groups in the study. We study 138 groups spread over 69 schools. Groups have an average of 33 students, giving a total sample size of 4,599 students. 46 groups were assigned to control (across 23 schools), 46 groups were assigned to treatment, and 46 groups were assigned to the spillover condition.

Randomization of treatment was performed before the baseline survey. We obtained some basic information about participating school characteristics (Table 2 Panel A data) and after randomly assigning groups to different conditions, verified that assignment to treatment was not correlated with any of the available variables.[11]

Implementation

The sexual education course was implemented from August through November 2009 in schools with school year beginning in January,[12] and November 2009 through March 2010 in regions with school year beginning in September. As expected for a middle-income country, it was not difficult to recruit schools with computer labs. However, it proved more difficult to recruit schools with workable internet connections. In three of the 46 groups assigned to treatment, lack of internet access prevented implementation of the online course.[13] In some treatment groups, students were unable to complete all

[11] This followed a re-randomization procedure as detailed in Bruhn and McKenzie (2009).
[12] The school year in some regions of Colombia begins in January (Calendario A), whereas in other regions it begins in September (Calendario B).
[13] For the statistical analysis, these classrooms are still in the intent-to-treat group.

five modules due to unforeseen events such as teacher strikes. Grades on the tests at the end of each module were on average 4 out of 10, with a large mass at zero (48%). Excluding those students with a score of zero, the average was 8 out of 10, suggesting an acceptable degree of understanding for those actually taking the course and the tests, and underlining student compliance as an important challenge for internet-based education.

Panel B in Table 2 shows summary statistics by treatment condition. The average age is 15 years (mid-adolescence), and 43% of the sample is male. Approximately 34% of students in the sample are sexually active, and 31% have a computer at home.

Baseline Balance

Panel B in Table 2 shows that there are no statistically significant differences across treatment, spillover and control groups except for proportion male, in which the control group has 8-9 percentage points more males than the treatment or spillover groups. Although the sample is unbalanced across this dimension, an F-test from a regression of treatment assignment on a full set of baseline characteristics does not reject that all baseline coefficients are jointly equal to zero.

Econometric Specification

Randomization allows for identification of reduced form intent-to-treat effects. Let Y_{ijt} denote an outcome of interest at follow up (t =1, 2) for individual i in classroom j. Treatment and spillover classroom assignment dummies are given by T_j and S_j respectively. Treatment classrooms were selected for internet sexual health training whereas spillover classrooms were not selected for the training but are in a school that has a treated classroom. We also include the baseline dependent variable as control for precision. We estimate the following regression model via ordinary least squares:

$$Y_{ijt} = \alpha_1 + \beta_1 T_j + \beta_2 S_j + \beta_3 Y_{ij0} + \varepsilon_{ijt}, \quad (1)$$

where the error term ε_{ijt} is assumed to be uncorrelated across classrooms but not within them, hence we cluster standard errors at the classroom level.[14] Because T_j and S_j were randomly assigned, the estimated

[14] Standard errors clustered at the school level are virtually identical to those clustered at the classroom level due to low intracluster correlation.

coefficients are unbiased estimators of the intent-to-treat effects of the course, which we argue are the policy coefficients of interest.

We have multiple measures of sexual health knowledge, attitudes and behavior in the survey. However, testing multiple outcomes using (1) for each measure independently increases the probability of rejecting a true null hypothesis for at least one outcome above the significance level used for each test (Duflo, Glennester and Kremer, 2007). Hence, we follow Kling, Liebman and Katz (2007) and define a summary measure Y^* as the unweighted average of all standardized outcomes in a family. That is, we obtain:

$$Y^* = \frac{\sum_k Y_k^*}{k} \text{, where } Y_k^* = \frac{Y_k - \mu_k}{\sigma_k}.$$

For standardization we use the estimated mean and variance for the control group at baseline. Thus, the mean and standard deviation of β in (1) allows us to test whether treatment had an overall positive effect on the corresponding family of outcomes. Furthermore, the estimate is easily interpreted as the effect of the course in terms of standard deviations of the outcome variable at baseline.

We also report heterogeneous effects by sexual activity status at baseline and gender, using the following fully saturated specification:

$$\begin{aligned} Y_{ijt} = \alpha_2 + \beta_4 A_{ij} + \beta_5 M_{ij} + \beta_6 T_j + \beta_7 S_j + \\ +\beta_8 (A_{ij} \times T_j) + \beta_9 (A_{ij} \times S_j) + \beta_{10} (M_{ij} \times T_j) + \beta_{11} (M_{ij} \times S_j) + \beta_{12} (A_{ij} \times M_{ij}) + \\ +\beta_{13} (A_{ij} \times M_{ij} \times T_j) + \beta_{14} (A_{ij} \times M_{ij} \times S_j) + \beta_{15} Y_{ij0} + \varepsilon'_{ijt}, \end{aligned} \quad (2)$$

where A_{ij} is a binary variable that equals one if the student was sexually active at baseline, and M_{ij} is equal to one if the student is male. This allows us to differentiate between effects of the course by gender and for students who were reached pre/post coital initiation.

4. Results

We present the first set of results in Tables 3-5, using aggregate standardized indexes on knowledge (table 3), attitudes (table 4) and behavior (table 5).[15] Table 5 also reports the results on the condom voucher experiment. All tables consist of two panels. The first one includes estimates from equation (1), while the second one reports heterogeneous impacts by gender and sexual activity status at baseline from equation

[15] The tables also include the definition of the individual variables used in the construction of each index. For space reasons, we do not report results on every individual outcome but they are available upon request.

(2). For each indicator, we include the results at both follow ups, the first taken one week after the end of the intervention, and the second one taken six months later. We focus more on the results of the second follow up; however, the comparisons of effects between the short and medium run give us an indication of the durability of the effects.

Knowledge

Table 3 presents the impacts on five standardized indexes which measure knowledge of the identification of STI symptoms and causes, the recognition of sexual violence, prevention of STIs, prevention of undesired pregnancies, and proper condom use. Column 6 is an index of all the variables used in the table.[16] The aggregate knowledge index suggests a 0.37 SD increase in overall knowledge one week after the intervention and a 0.38 SD increase in overall knowledge six months after the intervention. On an index by index comparison, the lowest impact is found on the identification of situations of sexual violence, as we find that treated beneficiaries are 0.12 standard deviations (SD) more likely to correctly identify a situation of sexual violence. The largest impact is found on the knowledge about STI prevention, where treated teens are 0.51 SD more likely to correctly identify proper condom use as the safest method to avoid acquiring an STI six months after the end of the intervention. The impact on the identification of sexual violence was larger when the questions were asked one week after the end of the training, suggesting that knowledge vanishes gradually with time. This knowledge decay pattern, however, is not found in all indexes. Indeed, the opposite pattern appears in the case of pregnancy prevention knowledge. The second row in Panel A shows that we do not find clear evidence for cross-classroom spillover effects on average on knowledge about sexual and reproductive health.

Table 3 Panel B presents evidence that knowledge effects are not heterogeneous across gender and baseline virginity. We cannot reject that the effects are the same for those sexually active at baseline compared to those sexually inactive.

Attitudes

Table 4 presents the results on three attitude subindexes: attitudes towards the use of condoms, conservatism with respect to age of initiation of sexual activities, and attitudes toward denouncing and seeking help in case of sexual abuse. Column 4 presents an overall index of attitudes, containing all

[16] To reduce the loss of observations due to item non-response, the overall index in Column 6 uses the average of the available indicators for the individual. This correction for missing values is not done for the subindexes (Columns 1-5) so that the reader can assess the extent of item non-response. We follow this rule in Tables 3, 4, 5, 8, 9, and 10.

variables used in the table. We find significant effects of 0.24 SD in terms of attitudes one week after the intervention and 0.17 SD six months later, which suggests some decay in attitude impacts over time.

Significant effects were found for each subindex six months after the intervention. The training was effective in generating a more positive attitude towards condom use, a more conservative attitude towards sexual activity, and increased awareness regarding sexually abusive situations among participating teenagers. Indeed, trained teens scored 0.13 SD higher in the sexually conservative attitudes subindex composed of the following variables: a) indicates that individuals their age should not have multiple sexual partners in the same month, b) thinks it is too early for individuals of their age to engage in sexual activities, and c) feels confident he/she will be able to wait to have sex until emotionally prepared to do so. Treated teens are also 0.12 SD more likely to agree with the need to denounce cases of sexual abuse to the authorities and the need to seek medical attention in such situations. The training was also successful in generating more positive attitudes towards the use of condoms, both immediately after the course (0.17 SD) and at the second follow up (0.11 SD). For attitude indicators, we again find no consistent evidence of spillovers across classrooms.

These results on knowledge and attitudes are important because these two factors have been shown to be the strongest protective factors in preventing STIs, HIV and pregnancy among teens (Kirby, 2005). Furthermore, recent research has documented the important role that social norms play in responsible sexual behavior (Munshi and Myaux, 2005; Ashraf, Field and Lee, 2009). By changing knowledge and beliefs for youth at the school level, sexual education can play a fundamental role in achieving desirable aggregate changes in sexual attitudes, knowledge and ultimately behavior. We return to this point after presenting reduced form evidence of program impact on behavioral outcomes.

Sexual Behavior

In columns 1 to 8 of Table 5, we show self-reported sexual behavior outcomes. Following previous literature and due to the small number of indicators, we report both individual outcomes and in Column 8 an overall index of behavior. The estimation reveals that the course did not change the average number of partners, frequency of sex or rate of abstinence over the six months following the course. An often made argument against sexual education in early adolescence is that that it will result in increased sexual activity. Our results reject this, which is consistent with other studies (Chin et al. 2012).

In terms of risky sex indicators, in panel B of the table, we find a reduction (0.05 percentage points) in the incidence of STIs among treated teens that were already sexually active at baseline (the result seems driven by females, although the difference between males and females is not statistically significant). Consistent with this finding, columns 6 and 7 in panel B show that treated females were significantly more likely to procure condoms and other contraceptives in the past six months.

Our summary of self-reported behavior (in which a negative sign reflects reduction in risky sex and an *increase* in contraceptive and condom procurement) is reported in column 8, which shows that we do not find a significant improvement in behavior for the classroom on average.

Condom Vouchers

The validity of self-reported sexual behavior among adolescents has long been a limitation in the literature (Brener et al 2003). We address the possible lack of reliability in self-reported outcomes by designing an objective safe-sex practice measure, measuring the percentage of students who redeem vouchers for condoms at nearby Profamilia clinics. Column 9 in Table 5 reports the results of the voucher experiment. The administrative data from voucher redemption shows statistically significant and important effects. Treated students were 40% more likely to redeem the vouchers than the control group (9 percentage points, SE of 4.2 percentage points). Condom availability is important for adolescent health given the sporadic nature of adolescent sexual activity (CDC, 2006). We find that the effect is especially strong among sexually active males at baseline. We interpret higher voucher redemption rates as improving safe-sex practices because it reflects increased demand for condoms.

The Effect of Knowledge and Attitudes on Behavior

The established literature has long argued that there exists a causal effect of knowledge on health behavior (*cf.* Kenkel 1991). In doing so, researchers have been aware that an OLS regression of behavior on knowledge does not provide consistent estimates due to the presence of unobserved factors which can influence both variables, such as parental education, or expectations about the future (Kearney and Levine, 2012). Reverse causation may also contribute to the lack of consistency in OLS estimates. For example, a risky sex event may trigger a search for information and hence an increase in knowledge.

Kenkel (1991) in particular posits a structural relationship between knowledge and behavior, where knowledge is an endogenous variable, and then uses an instrumental variables approach to estimate the

impact of knowledge on behavior. A requirement for the consistency of this strategy is that the sole mechanism through which behavior can be affected is knowledge. We use the randomly assigned sexual education course as an instrument for an index of knowledge and attitudes, and then estimate the effect of knowledge and attitudes together on sexual behavior. The exclusion restriction requires that the course only affects behavior through its effect on knowledge and attitudes. As long as this condition holds, we can estimate the effect of knowledge and attitudes on sexual behavior for those affected by the course (a local average treatment effect, or LATE). This exercise is valuable because it provides a credible estimate of the effect of sexual knowledge and attitudes on future sexual behavior. It can also help interpret studies which are limited to knowledge and attitudinal outcomes. However, caution is advised. For instance, perhaps the course also has an impact on behavior due to an authoritarian effect, or through an increased social interaction and shifting of social norms, which happens concurrently with the shifts in knowledge and attitudes captured in the index. This would be a violation of the exclusion restriction necessary to interpret the IV regressions as causal from the knowledge and attitudes index to behavior.

Table 6 presents OLS and IV estimates of behavior on an index of knowledge and attitudes.[17] The first two columns are presented without controls, while columns 3 and 4 control for gender and sexually active at baseline. The F-statistics reported in the table rule out weak instruments. The OLS estimate is small in both columns (-0.028 and -0.038, respectively), while the IV estimates are much larger.[18] While the IV estimate in Column 2 is imprecisely estimated, Column 4 suggests a large effect of knowledge and attitudes on behavior. For every SD increase in the knowledge and attitudes index the IV estimate predicts a 0.22 SD improvement in the behavior index. This magnitude is broadly consistent with the reduced form estimates, which showed a relatively large effect of the course in terms of knowledge and attitudes (0.38 SD for knowledge and 0.18 SD for attitudes), and a smaller effect in terms of behavior (close to a fifth of the size at 0.04 SD).

Beyond interpreting these results as evidence that the effects of knowledge on behavior are economically and statistically significant, the reader can also take away from these results that the individuals who improved their knowledge and attitude scores due the course were also those that presented improvements in terms of sexual behavior.

[17] The knowledge and attitudes index is composed of all the items in the knowledge and attitudes indexes of Tables 3 and 4.
[18] The OLS estimate in Columns 1 and 3 is smaller possibly because adolescents who engage in more risky sexual practices become more sexually knowledgeable as a result, biasing the estimate downwards.

Friendship network interactions and spillovers

In this subsection, we analyze treatment and spillover effects, differentiating between students for whom a small or a large percentage of friends was also treated. In the surveys, students were asked to identify their closest friends by name, school and classroom. We used this information to match each student's social network to the list of students in the treatment and spillover groups. Table 7 presents summary statistics about the network treatment distribution. Note that there are relatively few friendship links across classrooms, as this affects the precision of the spillover estimates.

With this information, we obtain the proportion of the student's network of closest friends who were treated.[19] If a student and her entire network of close friends were all in the same treatment classroom, then the proportion is equal to one, but if the network of friends includes students from other classrooms or from outside the school, then the proportion is reduced. One shortcoming of our network analysis is that the questionnaire did not clearly differentiate between friendship and romantic relationships.

For this part of the analysis, we modify the baseline specification so that the main effects are now interacted with the proportion of friends in the network who were treated (F_{ij}). The specification becomes:

$$Y_{ijt} = \alpha_3 + \beta_{16}T_j + \beta_{17}(F_{ij} \times T_j) + \beta_{18}S_j + \beta_{19}(F_{ij} \times S_j) + \beta_{20}Y_{ij0} + \varepsilon''_{ijt}, \qquad (3)$$

as before, with standard errors clustered at the classroom level. In tables 8-10, the interpretation of the main effect (T_j) now becomes the effect of assignment to treatment for someone who has zero friends also treated, whereas the coefficient on ($F_{ij} \times T_j$) is the additional effect of the course for someone whose full set of friends are also treated (analogously for S_j).

Table 8 provides clear evidence of a reinforcing interaction effect for students in the treatment group in terms of knowledge about symptoms and causes of STIs, prevention of STIs, and pregnancy prevention. In the first case, the effect goes from 0.13 SD if the treated teen has no close friends taking the course to 0.31 SD if all of his closest friends took the course. In the case of knowledge of STI prevention, the effect goes from 0.37 SD to 0.64 SD if the whole network is in the same treatment classroom. Improvements in knowledge of pregnancy prevention almost double to 0.43 SD if the whole network is treated. Knowledge

[19] We use the word "treated" throughout this section as shorthand for "assignment to the intent to treat group" (see equation 1).

of condom use also shows larger effects for students with larger proportions of treated friends, but the effect is not statistically significant. Column 6 aggregates the knowledge questions into a single index. We are able to identify an effect of 0.48 SD in knowledge for wholly treated networks, as opposed to a 0.26 SD effect if the student's network is not treated. In contrast, we do not find significant effects for spillover students, even if their network was fully treated. As noted before, we obtain large standard errors for the spillover estimates due to the small number of spillover students with treated networks. At the bottom of each column we report the p-value from a test of equality of the friendship interaction effects for treatment and spillover students.

Table 9, on attitude indicators, finds an even starker reinforcing interaction effect. In this case, the effects are significant *only* if the student's friendship network also took the course. For example, if the full network was treated, the student is predicted to have a 0.30 SD higher attitude index score, whereas the estimated effect is only 0.03 SD if no one in the friendship network was treated. Similar outcomes are observed in each of the subcomponents of the index. As in Table 8, there is no network spillover effect for a student that did not take the course, but the standard errors are fairly large.

Table 10 reports results for behavioral outcomes. The effects reported in Table 10 shed light on previously undocumented effects of the role of friendship networks on sexual education program impacts. We had learned in Table 5 that the program had scant effects on individuals' self-reported sexual behavior. However, when examined more closely by degree of intensity within social networks, we find strong reinforcement effects for the overall sexual behavior index (0.18 SD). In particular, the reinforcement effects are significant for number of sexual relationships, frequency of sex, and number of partners over the past six months. This provides evidence that the relevant group for a reinforcement effect is the network of friends, as suggested in Sacerdote (2011). Note that in each of these cases, the straight treatment effect (i.e., the point estimate for those with no friends assigned to treatment) is actually positive (i.e., riskier behavior) and statistically significant for one of the three outcomes (frequency of sex). While sexual behavior effects could be purely mechanical (i.e. the partner of an adolescent who used a condom during the last sexual encounter obviously also used a condom), the knowledge and attitude effects are not, and hence provide direct evidence of peer interaction effects.

The last column in Table 10 shows that treatment students are 0.09 percentage points more likely to redeem their vouchers than the control group even if none of their close friends were treated. However, we find no evidence for reinforcing effects when a larger proportion of the student's network is treated. Column 9 also shows a puzzling result in which spillover students whose entire friend networks were

treated are 0.16 percentage points less likely to redeem their condom vouchers than the control group. This is inconsistent with column 4, in which spillover students whose network was fully treated report fewer STIs six months after treatment.

As a robustness check, we verified that our results were robust to exclusion of the single-sex classrooms in the sample and found very similar estimates and significance levels except for the condom voucher result, which became slightly smaller and no longer significant with the exclusion of those observations (results available upon request).

List randomization

Following Karlan and Zinman (2012), we implement a list randomization strategy[20] to elicit misreporting in two sensitive questions: (1) "Did you have sex without a condom in the last six months?" and (2) "Did you have sex in the last six months?" The technique is simple: half of survey respondents are given a set of three innocuous true/false statements, and asked to report how many of them are true. The other half are given the same three innocuous statements, as well as one of the additional "sensitive" statements, for a total of four statements. Column 1 in Table 11 shows the average total number of statements with which students agree in the set of statements which includes the sensitive question (k+1 statements). Column 2 shows the average total number of statements with which students agree in the non-sensitive question set (k statements). Due to randomization, the difference in prevalence presented in column 3 reflects the proportion of individuals who respond affirmatively to the sensitive question. The list randomization suggests that 17.4% of treatment students had sex without a condom, and 29.3% of treatment students had sex in the last six months. These prevalences are not statistically different from those in the control group, due to large standard errors. Hence, the list randomization exercise suggests that there were no classroom-level changes attributable to the course in terms of sexual activity and sex without a condom in the last six months, consistent with Table 5.

In column 4 we present the self-reported answers to the same questions, but asked directly in the survey. We find that treatment students individuals are 8 percentage points *more* likely to report having sex without a condom when asked directly than when asked indirectly, the reverse of the expected effect, in which individuals may be embarrassed to admit having to sex without a condom and thus reveal higher

[20] See Ahart and Sackett (2004), Droitcour et al (2004), Holbrook and Krosnick (2010), Tsuchiya et al (2007), and Tourangeau and Yan (2007) for use and reliability of the item count technique for sensitive questions.

prevalence rates when are asked indirectly. Interestingly, both treatment and control students are estimated to be 8 percentage points more likely to report unsafe sex when asked directly instead of indirectly, although this estimate is statistically significant only for the treatment group.

Attrition

Attrition was 13% between baseline and first follow up, and 10% between baseline and second follow up. Table 12 shows that there is no differential attrition between control and treatment students. There is a small excess attrition for the spillover students at second follow up (2.4%). Given that the results we present were all obtained for the control-treatment comparison, we argue that differential attrition rates are not influencing our results.

We also analyze attrition for the condom voucher offer. Because students had to provide a cell phone number and/or email in order to be offered the condom voucher, the offer could not be made to every student in the study. In fact, the offer could not be made to 31% of students who were missing both pieces of information either due to non-response, misspelled email addresses or invalid phone numbers. Table 12 shows that there was no difference in condom voucher offers between control and treatment groups, although there was a significantly different attrition rate for the spillover group. Simulating the worst-case and other sensible scenarios for the non-observed cases, as in Kling and Liebman (2004) and Karlan and Valdivia (2011), we find that the positive effect on condom voucher in Table 5 (0.094** (0.042)) still holds after imputing the mean minus 0.10 standard deviations of the observed treatment distribution to the non-respondents in the treatment group, and after imputing the mean plus 0.10 standard deviations of the observed control distribution to non-respondents in the control group.[21]

Cost Effectiveness and Cost-Benefit Analysis

The marginal cost of the Profamilia course is $14.6 per student. The bulk of this cost ($10) is accounted for by the remote tutor, the rest comes from internet platform costs and computer depreciation. In this calculation, we do not include opportunity costs of the time of the students (e.g., some alternative educational activity, or leisure or work outside of school).[22] Compared to non-computer-based sexual

[21] Results of these simulations are not presented here but are available upon request.
[22] In our calculations, we also exclude the wage cost of the person supervising students in the computer lab because it is unlikely that a school would hire personnel exclusively for the course. This is in line with guidelines by Dhaliwal et al (2011), who argue that cost effectiveness should use marginal costs of adding the program, assuming fixed costs are incurred with or without the program.

health interventions in the U.S., which range from $69 to over $10,000 per student,[23] the Profamilia course is extremely low cost.

We evaluate the benefits of the course mainly using the reduction in STIs for sexually active teens (column 4 in Table 5), and measure these improvements against the costs of the course in order to conduct a cost-benefit analysis. The benefits of improving knowledge and attitudes about sexual behavior and the increase in demand for condoms as measured by the higher voucher redemption are hard to monetize, so we focus solely on the reported reduction in STIs (which has been monetized previously in the literature). We deal with the uncertainty regarding durability of impacts by presenting two estimates of benefits: a lower bound for impacts assuming that the effects disappear completely after six months, and a less pessimistic estimate which assumes a rate of decay of 25% per year.[24]

To link the reduction in STIs to disability adjusted life years (DALYs), we use the gender-specific distribution of STIs and the implied DALYs lost per STI incident from Ebrhaim et al (2005). We estimate that for every STI episode, 0.11 DALYs are lost.[25] Using the estimate of value per DALY of $7,142 in Brent (2005)[26] suggests that the benefit of averting an STI is $785. We obtain a similar estimate ($634) if we use the lifetime costs of an STI presented in Ruger et al (2012).

Table 13 summarizes our cost-effectiveness and cost-benefit analysis. The first column of the Table presents results under the assumption that the effect on STI reductions only persists for the first six months after the course and disappears afterwards. The second column in the Table assumes the effect decays at an annual rate of 25%. Our cost effectiveness estimates imply that every $1,000 spent on the Profamilia online course generates a reduction of 1.2 (column 1) to 10.5 (Column 2) STIs. This implies a cost per averted STI of $95 under the gradual decay assumption. Hence, the benefit to cost ratio for the Profamilia course is quite high at 8.26 under a reasonable assumption about the decay of course impacts of 25%. In the most pessimistic scenario, in which the course impact on STIs after the six month follow up were to be ephemeral, the benefit to cost ratio falls to around one. The difference in results between the two columns is a bit extreme, but we view the gradual decay scenario (Column 2) as more realistic partly because of the slow decay patterns observed throughout the results tables, as well as because an adolescent sexual education course is primarily intended to improve sexual health in the transition to a

[23] Chin et al (2012), pp280, with inflated estimates to 2012 dollars.
[24] We also use a 10% discount rate in the evaluation of future benefits, as well as population estimates of sexual initiation and STI prevalence by age.
[25] $E(\Delta DALY|STD = 1) = \sum_{i=1}^{k} DALY_i \cdot \Pr(STD = i|STD = 1)$, where i represents {Chlamydia, gonorrhea, trichomoniasis, syphilis, other curable STDs, PID, genital herpes, cervical cancer, hepatitis B, hepatitis C, HIV}.
[26] Implied by his estimate of $6,300 (2005 dollars) and an inflation of 13.3% between 2005 and 2011.

sexually active life. For this reason, any cost effectiveness calculation using objective health outcomes while students are not yet sexually active will ignore potentially important impacts at later ages. Naturally this wide difference should motivate further research, to measure the decay rate of any such education intervention on sexual health.

5. Conclusions

Widespread availability of internet-enabled computers in schools throughout the world as well as accelerated improvements in software quality make web-based education a plausible alternative in a context of tight budget constrains in public education. Sexual health education is at the forefront of this revolution because it is currently neglected in school curricula, opening an opportunity for low-cost online courses. In societies where teachers may be unwilling or unable to provide sexual education, online courses may also prove a useful substitute for in-person instruction.

We evaluate the effectiveness of a six month web-based sexual education course in Colombian public schools. The course showed itself effective in improving students' knowledge and attitude indicators in the short and medium term, and led to a reduction in self-reported STIs among the sexually active at baseline.

A key methodological component in our study is the use of condom vouchers to measure changes in condom demand. This measure provides plausible evidence that the course was effective in changing safe sex practices. A second analytical innovation is the focus on spillovers, through a two-stage experimental design. The results indicate that spillovers from treated to untreated classrooms in the same school are negligible.

We did find strong indications that effects of the course were reinforced when treated individuals had larger percentages of their friend networks in treatment classrooms. The evidence is robust across a large set of sexual health attitude, knowledge and sexual behavior indicators. In particular, we found that students whose networks were more intensely treated had significant reductions in frequency of sex, number of partners and number of sexual relations, which we interpret as reinforcement effects or complementarities.

The results presented here have important policy implications. As governments, multilateral aid agencies and non-profit organizations increasingly demand evidence of program effectiveness before providing

funding to sexual education and other public health programs (DHHS, 2010), our results provide an optimistic assessment of the use of ICT to generate improved sexual health outcomes among youth. Indeed, using an instrumental variables approach, we estimate that a 1 SD improvement in knowledge and attitudes generates a 0.22 SD improvement in sexual behavior. Additionally, the cost-benefit analysis suggests that because internet-based sexual health education programs are extremely low cost, their measurable benefits in terms of medium term STI reductions actually justify the costs. In spite of this positive result, we point out that better compliance with the administration of the course has the potential to substantially bolster cost effectiveness.

Finally, the results demonstrate the positive externalities of the public provision of sex education: when an individual takes a sex education course, this decision has positive effects on sexual health outcomes among her close friends, suggesting underprovision of sexual education without collective action, given positive externalities. We find a wide range in cost-benefit estimates, ranging from benefits of 95% of costs to benefits 826% of costs, depending on the long term impacts of such a program, which should motivate studies to measure the long term impact of interventions that shift knowledge and awareness of sexual health matters.

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Table 1. Experimental Design

		Schools	Classrooms	Students
Treatment Schools	Treatment Classrooms	46	46	1522
	Spillover Classrooms		46	1600
Control schools	Control Classrooms	23	46	1477
Total		69	138	4599

First, schools were randomly assigned to treatment and control, then two classrooms from each school were randomly selected to participate in the study. In treatment schools one of the classrooms was assigned to treatment and the other one to no treatment (referred to as a *spillover classrooms*). In control schools both (untreated) classrooms are referred to as *control classrooms*.

Table 2. Baseline Summary Statistics and Balance

PANEL A: Variables Available at Random Assignment	Treatment students (1)	Spillover students (2)	Control students (3)	Difference (1-3)	Difference (2-3)
Schoolyear begins in January (=1)	0.720	0.731	0.699	0.020	0.032
	(0.07)	(0.07)	(0.07)	(0.10)	(0.10)
Single shift school (=1)	0.606	0.623	0.577	0.028	0.046
	(0.07)	(0.07)	(0.07)	(0.11)	(0.11)
Morning shift (=1)	0.637	0.658	0.652	-0.016	0.006
	(0.07)	(0.07)	(0.07)	(0.10)	(0.10)
City with more than 600,000 people (=1)	0.260	0.239	0.251	0.009	-0.011
	(0.07)	(0.07)	(0.06)	(0.09)	(0.09)
9th grade classrooms in school	3.281	3.316	3.180	0.102	0.136
	(0.18)	(0.18)	(0.17)	(0.25)	(0.25)
Average number of students in each classroom	39.870	40.113	39.515	0.355	0.598
	(0.94)	(0.92)	(0.80)	(1.24)	(1.22)
Number of computers in school	38.314	38.921	37.052	1.262	1.869
	(2.73)	(2.77)	(3.07)	(4.11)	(4.14)
School does not teach sexual education (=1)	0.175	0.174	0.139	0.036	0.036
	(0.06)	(0.06)	(0.05)	(0.08)	(0.08)
p-value from F-test of joint significance on all above variables				0.82	0.73
PANEL B: Baseline Variables not Available at Random Assignment					
Male (=1)	0.414	0.402	0.490	-0.076***	-0.088**
	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Single gender classroom (=1)	0.165	0.144	0.054	0.111	0.090
	(0.06)	(0.06)	(0.04)	(0.07)	(0.07)
Not sexually active (=1)	0.672	0.657	0.660	0.013	-0.003
	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)
Age	14.935	15.020	14.977	-0.042	0.043
	(0.07)	(0.08)	(0.07)	(0.10)	(0.11)
Mother's years of education	12.706	12.641	12.584	0.121	0.056
	(0.09)	(0.07)	(0.08)	(0.12)	(0.11)
Father's years of education	12.672	12.579	12.503	0.169	0.076
	(0.09)	(0.09)	(0.09)	(0.13)	(0.13)
Socioeconomic level	2.175	2.170	2.162	0.013	0.008
	(0.08)	(0.08)	(0.08)	(0.11)	(0.11)
PC at home (=1)	0.323	0.305	0.326	-0.003	-0.021
	(0.02)	(0.02)	(0.03)	(0.04)	(0.03)
Cellphone (=1)	0.742	0.737	0.716	0.026	0.022
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
Does not use internet in school (=1)	0.447	0.512	0.482	-0.035	0.031
	(0.05)	(0.05)	(0.05)	(0.07)	(0.07)
Does not use internet (=1)	0.238	0.252	0.252	-0.014	0.000
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Religion is important (=1)	0.619	0.601	0.618	0.001	-0.017
	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
p-value from F-test of joint significance on all above variables.				0.700	0.470

Notes: Each coefficient is from a different regression. Standard errorrs clustered at the classroom level. Panel A variables were available before the baseline survey and were used to verify orthogonality of the randomization. Variables in panel B are self-reported from the baseline survey, and were not available when randomization took place.

*** p<0.01, ** p<0.05, * p<0.1

Table 3. Knowledge Indicators

OLS Estimation Standardized Indexes	Knowledge of Syptoms and Causes of STIs		Sexual Violence Knowledge		Prevention of STIs Knowledge		Pregnancy Prevention Knowledge		Condom Use Knowledge		Knowledge Index	
	One week post intervention	*Six months post intervention*	*One week post intervention*	*Six months post intervention*	*One week post intervention*	*Six months post intervention*	*One week post intervention*	*Six months post intervention*	*One week post intervention*	*Six months post intervention*	*One week post intervention*	*Six months post intervention*
	(1)		(2)		(3)		(4)		(5)		(6)	
Panel A												
Treatment students	0.298***	0.219***	0.230***	0.117**	0.062*	0.508***	0.288***	0.334***	0.255***	0.167***	0.374***	0.377***
	(0.050)	(0.065)	(0.051)	(0.047)	(0.037)	(0.120)	(0.046)	(0.074)	(0.044)	(0.060)	(0.044)	(0.077)
Spillover students	0.026	0.084	0.032	-0.008	0.023	0.137	0.038	0.064	0.054	0.028	0.015	0.013
	(0.045)	(0.057)	(0.049)	(0.051)	(0.040)	(0.128)	(0.047)	(0.078)	(0.052)	(0.059)	(0.045)	(0.082)
Observations	4,059	3,542	4,291	3,783	4,353	3,772	4,262	3,590	4,292	3,735	4,388	3,903
Panel B: By sexually active at baseline and gender												
Treatment students	0.355***	0.268***	0.205***	0.067	0.087*	0.622***	0.321***	0.344***	0.244***	0.248***	0.389***	0.390***
	(0.070)	(0.097)	(0.062)	(0.055)	(0.046)	(0.171)	(0.059)	(0.092)	(0.069)	(0.080)	(0.057)	(0.101)
Spillover students	-0.025	0.056	0.039	-0.072	0.012	0.097	0.029	-0.066	0.013	0.084	-0.021	-0.076
	(0.063)	(0.090)	(0.066)	(0.062)	(0.047)	(0.190)	(0.068)	(0.091)	(0.078)	(0.077)	(0.062)	(0.107)
Treatment * Sex active	0.013	-0.251	0.050	0.046	0.058	0.244	-0.022	0.058	0.158	-0.144	0.119	0.048
	(0.157)	(0.186)	(0.117)	(0.096)	(0.127)	(0.264)	(0.124)	(0.155)	(0.143)	(0.126)	(0.118)	(0.188)
Treatment * Male	-0.060	-0.045	-0.039	0.054	-0.121	-0.267	-0.088	-0.142	-0.037	-0.118	-0.107	-0.113
	(0.096)	(0.135)	(0.104)	(0.102)	(0.090)	(0.220)	(0.079)	(0.118)	(0.093)	(0.108)	(0.085)	(0.134)
Spillover * Sex active	0.100	0.089	0.036	-0.009	0.179	0.408	0.092	0.530***	0.154	-0.034	0.144	0.288
	(0.126)	(0.174)	(0.132)	(0.112)	(0.117)	(0.289)	(0.127)	(0.162)	(0.110)	(0.131)	(0.103)	(0.190)
Spillover * Male	0.153*	0.001	-0.045	0.165	0.066	-0.065	-0.079	0.059	-0.007	-0.110	0.052	0.121
	(0.091)	(0.133)	(0.123)	(0.109)	(0.089)	(0.258)	(0.093)	(0.114)	(0.112)	(0.113)	(0.086)	(0.140)
Treatment * Sex active * Mal	-0.223	0.237	0.092	-0.051	-0.001	-0.411	-0.102	0.046	-0.195	0.088	-0.167	-0.006
	(0.189)	(0.245)	(0.176)	(0.159)	(0.178)	(0.334)	(0.156)	(0.198)	(0.171)	(0.174)	(0.153)	(0.239)
Spillover * Sex active * Male	-0.239	-0.035	-0.010	-0.063	-0.349**	-0.474	-0.087	-0.446**	-0.073	0.042	-0.257*	-0.442*
	(0.172)	(0.233)	(0.188)	(0.178)	(0.172)	(0.368)	(0.146)	(0.201)	4002.000	(0.179)	(0.145)	(0.233)
Observations	3,648	3,236	3,843	3,453	3,890	3,446	3,811	3,289	3,835	3,417	3,919	3,552

Dependent variable is an index of related questions. All outcome variables and indexes are standardized to mean 0 and standard deviation 1, based on the control group sample frame at baseline. Standard errors clustered at the classroom level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

All regressions include controls for baseline dependent variable unless otherwise indicated.

Panel B specification also includes dummies for sexually active, male, and an interaction between sexually active and male which are not reported for space reasons.

(1) Knowledge of symptoms and causes of STI index: Respondent knows STI symptoms include: a) Abnormal discharges from the penis/vagina; b) Lesions/sores in genitals, and c) Painful urination; Respondent knows: d) Vomiting and headache are not STI symptoms; e) HIV can be transmitted by having sexual intercourse without a condom; f) HIV can be transmitted by a contaminated blood tranfusion; g) HIV transmission does not depend on hygiene; h) HIV cannot be transmitted via food sharing, i) clothes sharing, or j) being in a pool with an HIV-positive person. Respondent knows that k) HIV is not transmitted if a condom is used while having sexual intercourse with an HIV-positive individual.

(2) *Sexual violence knowledge index:* Respondent identifies a) Nonconsensual touching of genitalia, buttocks, breasts, inner thigh, as abusive sexual contact; b) Forcible sex by husband on his wife as a form of sexual abuse; c) Having sex with a person who is impaired due to alcohol as a form of rape; d) If an individual changes his/her mind about sex even at the last minute, sex is nonconsensual and hence a form of sexual abuse; e) The use of threats to obtain sex is a form of sexual abuse; Respondent knows: f) sexual abuse is more often than not perpetrated by a known person not a stranger.

(3) Prevention of STI knowledge index: Respondent knows one of the safest methods to prevent an STI is the use of condoms† whereas the calendar-based methods†, hormone injections† and penis withdrawal† are not.

(4) *Pregnancy prevention knowledge index:* Respondent disagrees with: a) Penis withdrawal is a safe method to avoid pregnancy†; Respondent knows: b) Women can become pregnant in their first sexual relationship; c) Safe methods to prevent a pregnancy include injections and condoms†; d) unsafe methods to prevent a pregnancy include calendar-based methods and penis withdrawal†; Respondent knows that e) emergency post-coital contraception pills have secondary effects.

(5) Condom use knowledge index:Respondent knows a) One of the safest methods to prevent an STI is the use of a condom†; b) Condoms can be used only one time; c) HIV can be transmitted by having sex without a condom†; d) HIV is not transmitted if a condom is used even if the person in HIV positive †; e) One of the safest methods to prevent a pregnancy is by using a condom†.

(6) *Knowledge index:* contains all variables used in the other columns of the table.

† Question format changed from list at baseline to yes/no at follow-up.

Table 4: Attitude Indicators

OLS Estimation Standardized Indexes	Condom Use Attitudes		Sexually Conservative Attitudes		Sexual Abuse Reporting Attitudes		Attitudes Index	
	One week post intervention	*Six months post intervention*	*One week post intervention*	*Six months post intervention*	*One week post intervention*	*Six months post intervention*	*One week post intervention*	*Six months post intervention*
	(1)		(2)		(3)		(4)	
Panel A								
Treatment students	0.174***	0.108**	0.060	0.132**	0.264***	0.116**	0.240***	0.172***
	(0.049)	(0.054)	(0.044)	(0.053)	(0.045)	(0.052)	(0.048)	(0.055)
Spillover students	0.033	-0.010	-0.011	0.088*	0.038	0.017	0.026	0.023
	(0.050)	(0.054)	(0.041)	(0.052)	(0.045)	(0.049)	(0.047)	(0.051)
Observations	4,169	3,631	4,225	3,670	4,344	3,854	4,391	3,906
Panel B: By sexually active at baseline and gender								
Treatment students	0.175***	0.111*	-0.005	0.085	0.338***	0.148**	0.256***	0.165***
	(0.054)	(0.062)	(0.044)	(0.058)	(0.067)	(0.067)	(0.048)	(0.057)
Spillover students	0.079	-0.003	-0.040	0.017	0.074	-0.014	0.065	-0.015
	(0.061)	(0.057)	(0.039)	(0.055)	(0.067)	(0.069)	(0.055)	(0.057)
Treatment * Sex active	-0.027	0.016	0.005	0.145	-0.083	-0.116	-0.109	-0.011
	(0.103)	(0.146)	(0.085)	(0.116)	(0.110)	(0.125)	(0.091)	(0.137)
Treatment * Male	-0.074	-0.067	0.112	0.108	-0.201**	-0.019	-0.083	0.011
	(0.090)	(0.093)	(0.079)	(0.102)	(0.100)	(0.086)	(0.086)	(0.091)
Spillover * Sex active	0.026	0.074	-0.139*	0.080	-0.042	0.056	-0.124	0.073
	(0.114)	(0.138)	(0.078)	(0.108)	(0.117)	(0.142)	(0.092)	(0.141)
Spillover * Male	-0.134	-0.004	0.062	0.133	-0.105	-0.041	-0.089	0.044
	(0.099)	(0.098)	(0.089)	(0.120)	(0.105)	(0.093)	(0.096)	(0.096)
Treatment * Sex active * Male	0.104	-0.127	-0.032	-0.291**	0.106	0.064	0.140	-0.153
	(0.143)	(0.174)	(0.134)	(0.141)	(0.154)	(0.162)	(0.139)	(0.160)
Spillover * Sex active * Male	-0.129	-0.393**	0.025	-0.244	0.099	0.060	0.032	-0.284
	(0.160)	(0.183)	(0.155)	(0.163)	(0.153)	(0.171)	(0.151)	(0.188)
Observations	3,734	3,313	3,782	3,352	3,885	3,523	3,922	3,555

Dependent variable is an index of related questions. All outcome variables and indexes are standardized to mean 0 and standard deviation 1, based on the control group sample frame at baseline. Standard errors clustered at the classroom level in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

All regressions include controls for baseline dependent variable unless otherwise indicated.

Panel B specification also includes dummies for sexually active, male, and an interaction between sexually active and male which are not reported for space reasons.

(1) *Condom use attitudes index:* Respondent disagrees with statements: a) "It's not right to carry a condom because people may think that I planned to have sex"; b) "If a woman wants to have sex without condom, the man must not refuse", c) "Only women are responsible for unwanted pregnancies"; Respondent is d) Confident of requesting that a condom be used; e) Willing to delay sex if condoms are unavailable; Respondent thinks f) he/she will use a condom in his/her next sexual relationship.

(2) *Sexually conservative attitude index:* Respondent thinks that: a) It is not right when people of their age have sex with several partners in the same month; b) People of their age should wait to have sex; Respondent's answer to c) Age at which men and women should start having sex. Respondent is d) confident he/she will have sex only when emotionally ready.

(3) *Sexual abuse reporting attitudes index:* Respondent thinks that when a teenager is suffering from sexual violence a) He/she must tell his/her family; b) He/she must tell the authorities; c) In case of rape, the afflicted individual must seek medical help; Respondent disagrees with the idea that in case of rape the person d) Must not tell anyone.

(4) A*ttitude index:* contains all variables used in the other columns of the table.

Table 5. Sexual Behavior (Six months post intervention)

OLS Estimation	Sexual Relationship last 6 months+	Frequency of Sex last 6 months+	Number of Partners last 6 months	STI presence	Pregnancy	Procured Contraceptives last 6 months	Procured Condoms last 6 months	Behavior index	Real Measure of Condom Demand: Redeemed Voucher for Free Condoms |*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A									
Treatment students	-0.003	0.027	-0.009	-0.005	0.000	0.006	0.021	-0.042	0.094**
	(0.027)	(0.043)	(0.03)	(0.003)	(0.005)	(0.029)	(0.023)	(0.057)	(0.042)
Spillover students	0.023	0.051	0.043	-0.001	0.007	-0.013	0.003	0.109	0.040
	(0.028)	(0.046)	-0.03	(0.004)	(0.006)	(0.030)	(0.021)	(0.066)	(0.036)
Observations	4,372	3,857	3,881	3,774	4,252	3,833	3,809	4,413	3,358
Treatment students	-0.010	0.019	-0.000	0.002	0.002	0.056**	0.035*	-0.047	0.122**
	(0.022)	(0.033)	(0.030)	(0.002)	(0.005)	(0.027)	(0.018)	(0.047)	(0.050)
Spillover students	-0.005	0.014	0.001	0.003	0.005	0.018	0.020	0.019	0.048
	(0.025)	(0.038)	(0.032)	(0.002)	(0.006)	(0.028)	(0.016)	(0.059)	(0.038)
Treatment * Sex active	0.073	0.051	-0.077	-0.054**	-0.033	0.029	0.038	-0.396	-0.101*
	(0.068)	(0.127)	(0.091)	(0.023)	(0.030)	(0.058)	(0.053)	(0.259)	(0.058)
Treatment * Male	0.008	-0.025	-0.037	-0.002	-0.003	-0.043	-0.036	0.044	-0.056
	(0.032)	(0.047)	(0.042)	(0.002)	(0.008)	(0.050)	(0.042)	(0.086)	(0.053)
Spillover * Sex active	0.048	-0.015	0.022	-0.018	0.023	-0.004	0.010	0.056	-0.031
	(0.069)	(0.128)	(0.098)	(0.029)	(0.033)	(0.059)	(0.049)	(0.289)	(0.055)
Spillover * Male	0.014	0.022	0.007	-0.003	-0.012	0.040	-0.047	-0.008	-0.038
	(0.035)	(0.056)	(0.050)	(0.002)	(0.008)	(0.056)	(0.038)	(0.092)	(0.053)
Treatment * Sex active * Male	-0.083	-0.001	0.104	0.041	0.052	-0.068	0.012	0.444	0.129*
	(0.088)	(0.155)	(0.126)	(0.028)	(0.036)	(0.074)	(0.091)	(0.308)	(0.070)
Spillover * Sex active * Male	-0.006	0.064	0.095	-0.004	-0.016	-0.100	0.049	0.069	0.074
	(0.091)	(0.164)	(0.135)	(0.034)	(0.037)	(0.079)	(0.080)	(0.329)	(0.074)
Observations	3,965	3,522	3,539	3,443	3,864	3,497	3,477	4,002	3,053
Mean of dependent variable	0.269	0.390	0.377	0.008	0.023	0.450	0.206		0.232

Dependent variables not standarized, except for column 8 which is a sum of standardized variables, based on the control group sample frame at baseline. All outcome variables are assessed six months after treatment. Standard errors clustered at the classroom level in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

Panel B regression includes also dummies for sexually active, male, and interaction between sexually active and male which are not reported.

All regressions include controls for baseline dependent variable unless otherwise indicated.

Columns (1) and (5) include students attrited for written survey but later tracked over the phone.

+ Does not control for baseline value of the dependent variable, because they were not measured at baseline.

(8) Behavior index: contains self reported data on a) Number of partners in the last six months, b) STI presence, c) Pregnancies, d) Had sexual relationships in the last six months, e) frequency of sex in the last six months, f) Procured contraceptives in the last 6 months (excluding condoms), and g) Procured condoms in the last six months (f and g enter negatively in the index).

|* Profamilia administrative data. 3,358 students of the full sample agreed to be contacted for this part of the study. Per Profamilia policies, condom voucher redemption includes a brief consultation with a social worker. Specification also includes as controls distance, distance^2, has a cellphone, and whether the bus was reimbursed; but does not control for baseline values because the voucher was only offered once (6 months after treatment).

Table 6. The Effect of Knowledge and Attitudes on Behavior (Instrumental Variable Analysis)

Dep. Var:	Behavior Index	Behavior Index	Behavior Index	Behavior Index
Estimation:	OLS	IV	OLS	IV
Knowledge and Attitudes Index	-0.028	-0.095	-0.038**	-0.224*
	(0.018)	(0.118)	(0.019)	(0.115)
Sexually active at baseline and Male controls	-	-	Yes	Yes
F-stat first stage	-	18.01	-	16.84
Observations	2,638	2,638	2,410	2,410

Standard errors clustered at the classroom level in parentheses. All regressions control for baseline dependent variable.

*** p<0.01, ** p<0.05, * p<0.1

Behavior index is standardized to mean 0 and standard deviation 1, based on the control group sample frame at baseline. Index is composed of self-reported data on a) Number of partners in the last six months, b) STI presence, c) Pregnancies, d) Procured contraceptives in the last 6 months, and e) Procured condoms in the last six months (d and e enter negatively in the index so that lower values of the index indicate safer behavior).

Knowledge and Attitudes index: Contains all variables in the knowledge and attitude indexes of Tables 3 and 4. Instrumental variable for Knowledge and Attitudes Index is the Assignment to Treatment dummy.

Table 7. Friendship Networks Summary Statistics

		Cases	Percent
Treatment students with:	No friends treated	366	21.2%
	1 friend treated	277	16.0%
	2 friends treated	266	15.4%
	3 friends treated	227	13.1%
	4 friends treated	286	16.6%
	5 friends treated	183	10.6%
	6 friends treated	123	7.1%
Spillover students with:	No friends treated	1482	88.8%
	1 friend treated	133	8.0%
	2 friends treated	11	0.7%
	3 friends treated	7	0.4%
	4 friends treated	7	0.4%
	5 friends treated	13	0.8%
	6 friends treated	15	0.9%

Friendship link treatment status is established by matching self reported list of friends with list of names of students answering the survey at (either) followup survey. The number of friends treated for students in control schools is equal to zero.

Table 8. Knowledge: Network Spillover & Reinforcing Interaction Effects

OLS Estimation Standardized Indexes	**Knowledge of Syptoms and Causes of STIs**	**Sexual violence Knowledge**	**Prevention of STI Knowledge**	**Pregnancy prevention Knowledge**	**Condom use knowledge**	**Knowledge Index**
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment student	0.134*	0.063	0.365***	0.233***	0.116*	0.259***
	(0.077)	(0.049)	(0.138)	(0.089)	(0.070)	(0.080)
Spillover student	0.095	-0.016	0.129	0.062	0.028	0.021
	(0.059)	(0.051)	(0.128)	(0.078)	(0.058)	(0.080)
Treatment student * % of friends treated	0.177**	0.106	0.271*	0.193*	0.105	0.222**
	(0.081)	(0.073)	(0.152)	(0.115)	(0.075)	(0.097)
Spillover student * % of friends treated	-0.250	0.169	0.195	-0.035	0.029	-0.074
	(0.187)	(0.163)	(0.355)	(0.216)	(0.192)	(0.207)
P-value treatment*(% of friends)=spillover*(% of friends)	0.04	0.72	0.85	0.34	0.71	0.198
Observations	3,534	3,777	3,765	3,585	3,728	3,888

Dependent variable is an index of related questions. All outcome variables are assessed six months after treatment round. Indexes are standardized to mean 0 and standard deviation 1, based on the control group sample frame at baseline. Standard errors clustered at the classroom level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

All regressions include controls for baseline dependent variable unless otherwise indicated. Friendship established if individual lists the person among his/her friends at (either) followup survey.

(1) Knowledge of symptoms and causes of STI index: Respondent knows STI symptoms include: a) Abnormal discharges from the penis/vagina; b) Lesions/sores in genitals, and c) Painful urination; Respondent knows: d) Vomiting and headache are not STI symptoms; e) HIV can be transmitted by having sexual intercourse without a condom; f) HIV can be transmitted by a contaminated blood tranfusion; g) HIV transmission does not depend on hygiene; h) HIV cannot be transmitted via food sharing, i) clothes sharing, or j) being in a pool with an HIV-positive person. Respondent knows that k) HIV is not transmitted if a condom is used while having sexual intercourse with an HIV-positive individual.

(2) *Sexual violence knowledge index:* Respondent identifies a) Nonconsensual touching of genitalia, buttocks, breasts, iner thigh, as abusive sexual contact; b) Forcible sex by husband on his wife as a form of sexual abuse; c) Having sex with a person who is impaired due to alcohol as a form of rape; d) If an individual changes his/her mind about sex even at the last minute, sex is nonconsensual and hence a form of sexual abuse; e) The use of threats to obtain sex is a form of sexual abuse; Respondent knows: f) sexual abuse is more often than not perpetrated by a known person not a stranger.

(3) Prevention of STI knowledge index: Respondent knows one of the safest methods to prevent an STI is the use of condoms† whereas the calendar-based methods†, hormone injections† and penis withdrawal† are not.

(4) *Pregnancy prevention knowledge index:* Respondent disagrees with: a) Penis withdrawal is a safe method to avoid pregnancy†; Respondent knows: b) Women can become pregnant in their first sexual relationship; c) Safe methods to prevent a pregnancy include injections and condoms†; d) unsafe methods to prevent a pregnancy include calendar-based methods and penis withdrawal†; Respondent knows that e) emergency post-coital contraception pills have secondary effects.

(5) Condom use knowledge index:Respondent knows a) One of the safest methods to prevent an STI is the use of a condom; b) Condoms can be used only one time; c) HIV can be transmitted by having sex without a condom; d) HIV is not transmitted if a condom is used even if the person in HIV positive; e) One of the safest methods to prevent a pregnancy is by using a condom†.

(6) *Knowledge index:* contains all variables used in the other columns of the table.

† Question format changed from list at baseline to yes/no at follow-up.

Table 9. Attitudes: Network Spillover & Reinforcing Interaction Effects

OLS Estimation Standardized Indexes	Condom Use Attitudes	Sexually Conservative Attitudes	Sexual Abuse Reporting Attitudes	Attitudes Index
	(1)	(2)	(3)	(4)
Treatment student	-0.009	0.049	0.028	0.034
	(0.067)	(0.072)	(0.066)	(0.068)
Spillover student	-0.013	0.089*	0.022	0.029
	(0.052)	(0.052)	(0.050)	(0.051)
Treatment student * % of friends treated	0.217***	0.163**	0.169*	0.261***
	(0.079)	(0.073)	(0.086)	(0.072)
Spillover student * % of friends treated	-0.045	-0.017	-0.029	-0.046
	(0.189)	(0.110)	(0.126)	(0.143)
P-value treatment*(% of friends)=spillover*(% of friends)	0.22	0.16	0.18	0.06
Observations	3,624	3,663	3,840	3,891

Dependent variable is an index of related questions. All outcome variables are assessed six months after treatment. Indexes are standardized to mean 0 and standard deviation 1, based on the control group sample frame at baseline. Standard errors clustered at the classroom level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

All regressions include controls for baseline dependent variable unless otherwise indicated. Friendship established if individual lists the person among his/her friends at (either) followup survey.

(1) *Condom use attitudes index:* Respondent disagrees with statements: a) "It's not right to carry a condom because people may think that I planned to have sex"; b) "If a woman wants to have sex without condom, the man must not refuse", c) "Only women are responsible for unwanted pregnancies"; Respondent is d) Confident of requesting that a condom be used; e) Willing to delay sex if condoms are unavailable; Respondent thinks f) is going to use a condom in his next sexual relationship.

(2) *Sexually conservative attitude index:* Respondent thinks that: a) It is not right when people of their age have sex with several partners in the same month; b) People of their age should wait to have sex; Respondent's answer to c) Age at which men and women should start having sex. Respondent is d) confident he/she will have sex only when emotionally ready.

(3) *Sexual abuse reporting attitudes index:* Respondent thinks that when a teenager is suffering from sexual violence a) He/she must tell his/her family; b) He/she must tell the authorities; c) In case of rape, the afflicted individual must seek medical help; Respondent disagrees with the idea that in case of rape the person d) Must not tell anyone.

(4) *Attitude index:* contains all variables used in the other columns of the table.

Table 10. Sexual Behavior (Six months post intervention): Network Spillover & Reinforcing Interaction effects

OLS Estimation	**Sexual relationships last 6 months+**	**Frequency of Sex last 6 months+**	**Number of Partners last 6 months**	**STI**	**Pregnancy**	**Procured Contraceptives last 6 months**	**Procured Condoms last 6 months**	**Behavior index**	**Real Measure of Condom Demand: Redeemed Voucher for Free Condoms|***
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treatment student	0.041	0.105*	0.049	-0.001	-0.005	0.044	0.032	0.020	0.085*
	(0.035)	(0.055)	(0.037)	(0.005)	(0.007)	(0.033)	(0.031)	(0.070)	(0.045)
Spillover student	0.018	0.039	0.033	0.000	0.006	-0.013	0.002	0.086	0.048
	(0.029)	(0.046)	(0.030)	(0.004)	(0.006)	(0.031)	(0.021)	(0.060)	(0.036)
Treatment student * % of friends treated	-0.098**	-0.153**	-0.117***	-0.008	0.006	-0.076	-0.024	-0.175**	0.022
	(0.041)	(0.069)	(0.040)	(0.006)	(0.009)	(0.049)	(0.037)	(0.072)	(0.041)
Spillover student * % of friends treated	0.094	0.186	0.158	-0.012*	0.037	-0.013	0.053	0.218	-0.156**
	(0.084)	(0.135)	(0.111)	(0.006)	(0.037)	(0.088)	(0.088)	(0.236)	(0.060)
P-value treatment*(% of friends)=spillover*(% of friends)	0.04	0.02	0.02	0.61	0.41	0.52	0.40	0.109	0.02
Observations	4,246	3,843	3,868	3,763	4,139	3,826	3,802	4,294	3,334
Mean of dependent variable	0.263	0.388	0.376	0.008	0.021	0.450	0.206		0.233

Dependent variables not standarized, except for column 8 which is a sum of standardized variables, based on the control group sample frame at baseline. All outcome variables are assessed six months after treatment. Standard errors clustered at the classroom level in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

All regressions include controls for baseline dependent variable unless otherwise indicated. Friendship established if individual lists the person among his/her friends at (either) followup survey.

+ Does not include controls for baseline values.

(8) Behavior index: contains self reported data on a) Number of partners in the last six months, b) STI presence, c) Pregnancies, d) Had sexual relationships in the last six months, e) frequency of sex in the last six months, f) Procured contraceptives in the last 6 months (excluding condoms), and g) Procured condoms in the last six months (f and g enter negatively in the index).

|* Profamilia administrative data. 3,358 students of the full sample agreed to be contacted for this part of the study. Per Profamilia policies, condom voucher redemption includes a brief consultation with a social worker. Specification also includes as controls distance, distance^2, has a cellphone, bus was reimbursed, however, but does not control for baseline values because the voucher offer only done 6 months after treatment.

Table 11. List Randomization (Means and standard errors)

	Sensitive question set	Control questions set	List randomization prevalence	Self-reported prevalence	Difference in prevalence
	(1)	(2)	(1) - (2)	(4)	(5)
Sensitive question: Had sex without a condom in the last six months†					
Treatment	1.537	1.363	0.174*	0.258	-0.084*
	(0.058)	(0.048)	(0.056)	(0.020)	(0.049)
	[313]	[358]	[671]	[1359]	[2030]
Control	1.646	1.446	0.200*	0.280	-0.080
	(0.053)	(0.049)	(0.067)	(0.019)	(0.054)
	[308]	[332]	[640]	[1247]	[1887]
Diff: T-C	-0.109	-0.083	-0.027	-0.022	-0.004
	(0.078)	(0.068)	(0.087)	(0.028)	(0.073)
	[621]	[690]	[1311]	[2606]	[3917]
Sensitive question: Had sex in the last six months††					
Treatment	1.656	1.363	0.293*	0.257	0.036
	(0.045)	(0.048)	(0.062)	(0.019)	(0.056)
	[605]	[358]	[963]	[1505]	[2468]
Control	1.703	1.446	0.257*	0.262	-0.005
	(0.047)	(0.049)	(0.058)	(0.019)	(0.052)
	[619]	[332	[951]	[1431]	[2382]
Diff: T-C	-0.047	-0.083	0.036	-0.005	0.041
	(0.065)	(0.068)	(0.085)	(0.027)	(0.076)
	[1224]	[690]	[1914]	[2936]	[4850]

Standard errors clustered at the classroom level in parentheses. Number of observations in brackets. *** p<0.01, ** p<0.05, * p<0.1

† Direct question is "Did you use a condom in every sexual experience you had for the last six months?"

†† Direct question is "Have you had any sexual relationship in the last six months?"

Non sensitive questions: Set 1: I have a bicycle, my favorite color us blue, I live with my father. Set 2: I have more than 3 cousins, I have internet at home, I have a dog.

Table 12. Atrition

Dep. Var.: Attrited=1	*One week post intervention*	*Six months post intervention*	*Condom Voucher*
Treatment students	0.009	0.012	-0.008
	(0.012)	(0.011)	(0.017)
Spillover students	0.013	0.024*	0.045***
	(0.012)	(0.012)	(0.017)
Constant	0.126***	0.100***	0.313***
	(0.009)	(0.008)	(0.012)

*** p<0.01, ** p<0.05, * p<0.1.

Attrition=1 for students observed at baseline but not at first follow up (column 1), second follow up (column 2), or without working cellphone or email for voucher offer 6 months after intervention (column 3).

Table 13. Cost Effectiveness and Cost Benefit Analysis

	Effects disappear after 6 months	25% annual decay
Cost Effectiveness		
Marginal cost of course per student[a]	$14.60	$14.60
Averted STIs per $1,000 spent	1.210	10.54
90% Confidence Interval	[0.36, 2.06]	[1.74, 19.34]
Cost Benefit		
Cost per averted STI[b]	$824	$95
Benefit per averted STI[c]	$785	$785

[a] All figures in 2012 US dollars. Marginal costs correspond to remote tutor wage per student ($10), internet platform costs ($2.1), and depreciation cost of computers ($2.5).

[b] Cost in column 1 is obtained from the coefficient on STI presence in Table 5, marginal cost per student, percentage sexually active at baseline, and standard deviation of STIs for control group. In the second column, a 10% discount rate is used, sexual initiation age pattern is taken from ENDS (2010), age-specific STD prevalence is obtained from National Longitudinal Study of Adolescent Health (waves I-III), and effect of course on STI presence is assumed to decay at 25% per year.

[c] Benefit obtained from STI distribution and DALYs per incident in Ebrhaim et al (2005), and value of DALY from Brent

Appendix - Summary statistics at baseline

INDEX	INDIVIDUAL VARIABLES		MEAN	SD	MIN	MAX	Q25	Q75	N
Knowledge of Symptoms and Causes of STD Index Variables	Respondent knows:	Vomiting is not an STD symptom	0.101	0.301	0	1	0	0	4305
		Headache is not an STD symptom	0.105	0.307	0	1	0	0	4211
	Respondent knows STD symptoms include:	Abnormal discharges from the penis/vagina	0.307	0.461	0	1	0	1	4331
		Lesions/sores in genitals	0.185	0.388	0	1	0	0	4221
		Painful urination	0.320	0.467	0	1	0	1	4334
	HIV transmission does not depend on hygiene		0.665	0.472	0	1	0	1	4512
	HIV cannot be transmitted:	via food sharing	0.907	0.291	0	1	1	1	4512
		being in a pool with an HIV-positive person	0.924	0.265	0	1	1	1	4512
		if a condom is used while having sexual intercourse with an HIV-positive individual	0.628	0.483	0	1	0	1	4512
	HIV can be transmitted by:	having sexual intercourse without a condom	0.791	0.407	0	1	1	1	4512
		a contaminated blood tranfusion	0.684	0.465	0	1	0	1	4512
Sexual Violence Knowledge Index Variables	Respondent identifies as abusive sexual contact or abuse:	Nonconsensual touching of genitalia, buttocks, breasts and inner thigh	0.845	0.362	0	1	1	1	4490
		Forcible sex by husband on his wife	0.758	0.429	0	1	1	1	4490
		Having sex with a person who is impaired due to alcohol	0.759	0.427	0	1	1	1	4490
		If an individual changes his/her mind about sex even at the last minute	0.569	0.495	0	1	0	1	4490
		The use of threats to obtain sex	0.670	0.470	0	1	0	1	4490
	Respondent knows sexual abuse is more often than not perpetrated by a known person, not a stranger		0.181	0.385	0	1	0	0	4343
Prevention of STI Knowledge Index Variables	Respondent knows one of the safest methods to prevent an STD are not	Calendar-based methods	0.929	0.256	0	1	1	1	4504
		Hormone injections	0.795	0.404	0	1	1	1	4504
		Penis withdrawal	0.905	0.293	0	1	1	1	4504
	Respondent knows one of the safest methods to prevent an STD is the use of condoms		0.737	0.440	0	1	0	1	4504
Pregnancy Prevention Knowledge Index Variables	Respondent disagrees Penis withdrawal is a safe method to avoid pregnancy		0.562	0.496	0	1	0	1	4477
	Respondent knows women can become pregnant in their first sexual relationship		0.723	0.448	0	1	0	1	4506
	Respondent knows unsafe methods to prevent a pregnancy include:	Calendar-based methods	0.875	0.330	0	1	1	1	4516
		Penis withdrawal	0.791	0.407	0	1	1	1	4516
	Respondent knows safe methods to prevent a pregnancy include:	Injections	0.471	0.499	0	1	0	1	4516
		Condoms	0.759	0.428	0	1	1	1	4516
	Respondent knows that emergency post-coital contraception pills have secondary effects		0.143	0.351	0	1	0	0	4477
Condom Use Knowledge Index Variables	Respondent knows condoms can be used only one time		0.608	0.488	0	1	0	1	4485
	Respondent knows one of the safest methods to prevent an STD is the use of a condom		0.737	0.440	0	1	0	1	4504
	Respondent knows HIV can be transmitted by having sex without a condom		0.791	0.407	0	1	1	1	4512
	Respondent knows HIV is not transmitted if a condom is used even if the person is HIV		0.628	0.483	0	1	0	1	4512
	Respondent knows one of the safest methods to prevent a pregnancy is by using a condom		0.759	0.428	0	1	1	1	4516
Condom Use Attitudes Index Variables	Respondent disagrees with statements:	It's not right to carry a condom because people may think that I planned to have sex	2.894	1.168	1	4	2	4	4500
		If a woman wants to have sex without condom, the man must not refuse	2.835	1.176	1	4	2	4	4525
		Only women are responsible for unwanted pregnancies	3.516	0.931	1	4	3	4	4514
	Respondent is confident of requesting that a condom be used		1.552	0.716	0	2	1	2	4533
	Respondent is willing to delay sex if condoms are unavailable		0.678	0.467	0	1	0	1	4518
	Respondent thinks he/she will use a condom in his/her next sexual relationship.		0.805	0.396	0	1	1	1	4438
Sexually Conservative Attitudes Index Variables	Respondent thinks that	It is not right when people of their age have sex with several partners in the same month	3.683	0.729	1	4	4	4	4520
		People of their age should wait to have sex	3.395	0.904	1	4	3	4	4544
	Respondent's answer to:	Age at which women should start having sex	19.577	3.296	10	30	18	20	4501
		Age at which men should start having sex	18.449	3.248	10	30	16	20	4509
	Respondent is confident he/she will have sex only when emotionally ready		1.411	0.776	0	2	1	2	4525
Sexual Abuse Reporting Attitudes Index Variables	Respondent disagrees with the idea that in case of sexual violence the person must not tell anyone.		0.983	0.131	0	1	1	1	4481
	Respondent thinks that when a teenager is suffering from sexual violence he/she …	Must tell his/her family	0.713	0.452	0	1	0	1	4502
		Must tell the authorities	0.741	0.438	0	1	0	1	4502
		In case of rape, must seek medical help	0.596	0.491	0	1	0	1	4502
		Must tell someone such as teachers, friends, etc.	0.021	0.144	0	1	0	0	4502
Behavior Index Variables	Had any sexual relationship in the last 6 months+		0.262	0.440	0	1	0	1	1429
	Frequency of sex last 6 months+		0.363	0.659	0	2	0	1	1251
	Number of partners last 6 months		0.436	0.765	0	3	0	1	1455
	STI presence		0.006	0.075	0	1	0	0	1433
	Has been pregnant or girlfriend has been pregnant		0.017	0.128	0	1	0	0	1144
	Procured contraceptives last 6 months (excludes condoms)		0.525	0.500	0	1	0	1	1445
	Procured condoms last 6 months ++		0.114	0.318	0	1	0	0	1456

+ Not available at baseline. Refers to second follow up data statistics which correspond to the values used to standardize variables for the index.

++ Question at baseline asked for last month instead of last six months