



The Impact of a Computer-based Adult Literacy Program on Literacy and Numeracy: Evidence from India

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Summary. — With over 700 million illiterate adults worldwide, governments in many developing countries have implemented adult literacy programs. Typically these programs have low rates of success partly because the quality of teaching is heterogeneous. Standardization of teaching provided by computer-aided instruction might be a solution. However, there is little rigorous evidence of the effectiveness of computer-based adult literacy programs in delivering high-quality literacy and numeracy in the developing world. To fill this void in the literature, we study the impact of a computer-based adult literacy program, Tara Akshar Plus, on the literacy and numeracy skills of previously illiterate adult women in the north Indian state of Uttar Pradesh. Through a randomized control trial, we measure learning outcomes with individual-level literacy and numeracy tests and find statistically significant positive impacts of this computer-aided program on literacy and numeracy outcomes of women who undergo the TARA Akshar Plus program—relative to the control group. The effects are statistically significant but small in magnitude for women who were entirely illiterate prior to the program. The learning impacts are substantially larger for learners who knew at least a handful of letters at the beginning of the program. We compare the improvement in learning to that of another adult literacy and numeracy program. We conclude that TARA Akshar Plus is the more effective of the two, but the literacy and numeracy level achieved are not large enough to make many entirely illiterate learners become functionally literate.

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1. INTRODUCTION

The overwhelming majority of the world's 757 million illiterate adults live in developing countries (UIS, UNESCO, 2015). Adult literacy programs aim to improve the skills, and hence the earning potential and other socioeconomic outcomes, of illiterate adults. However, traditional adult literacy programs, typically operated by governments, have been largely ineffective due to low enrollment, high dropout rates, and rapid skill depreciation (Abadzi, 1994, 2003; Ortega & Rodríguez, 2008; Oxenham, 2002). Recent advances in adult literacy programs have sought to integrate modern information and communication technology (ICT) into effective teaching methods (for an insightful overview, see, Wagner & Kozma, 2005). The use of modern ICT, which comprises computers, mobile phones, and tablets, could improve the quality and effectiveness of learning with the aid of interactive tools, the use of animation, and the implementation of effective teaching principles (Iftekhar & Hyeon, 2016).

There is little rigorous evidence of the effectiveness of computer-based adult literacy programs in delivering high-quality literacy and numeracy teaching in the developing world. (Berger (2001) provides a review of the effectiveness computers in adult literacy classes in the US.) By rigorous we mean evidence that allows for the causal attribution of the observed effect to the literacy program, which at a minimum requires a deliberate attempt to account for confounding factors, for example by creating a control or comparison group.

In this paper, we seek to fill this void in the literature by investigating the impact of TARA Akshar Plus (TA+), a systematic computer-based adult literacy and numeracy program

conducted in the state of Uttar Pradesh in northern India, on the literacy and numeracy of neo-literate adult women. TA+ has been implemented by the Indian NGO Development Alternatives (DA),¹ which claims that the success rate of this program is over 90%.² Despite having reached more than 100,000 participant learners, the program has never been scientifically evaluated. Our study provides the first thorough assessment of TA+ and one of the first rigorous studies of the effectiveness of a computer-based adult literacy program on literacy and numeracy within the developing world.

We employ the random assignment of 717 illiterate women from 18 villages into two groups: (i) a treatment group that could undergo the TA+ program immediately and (ii) a control group that could undergo the program only at a later date. Respondents in the treatment and control groups were tested pre- and post-intervention. We present results on the impact of TA+ on learning outcomes by combining the random assignment with individual-level test results.

Our main results are as follows. We find that TA+ has a statistically significant effect on literacy and numeracy in the short run, especially in basic literacy and numeracy skills such as reading letters and words and counting and number recognition. However, the effects on more advanced dimensions of reading and numeracy, such as reading paragraphs and addition/subtraction, are small and suggest that not many learners become functionally literate.

The rest of the paper is organized as follows: Section 2 contains a brief review of related literature; Section 3 gives the

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background to the TA+ program; Section 4 describes the design of the experiment; Section 5 describes the data and presents descriptive statistics; Section 6 presents results of the impact analysis and compares the learning effects of TA+ to results from similar programs; and Section 7 concludes the paper.

2. A BRIEF REVIEW OF RELATED LITERATURE

Impact assessments of adult literacy programs can be grouped into two kinds: one set that measures the direct effects, namely, the acquisition of literacy or numeracy, and the other that measures the indirect or extended effects, such as intrahousehold sharing or child health outcomes. The set that measures the direct or immediate impacts of adult literacy programs, namely, acquisition of literacy and/or numeracy, primarily consists of studies that suffer from some or all of the following problems: very small sample sizes, flawed experimental design (e.g., lack of a comparison group), and poorly designed assessment tools (Carron, 1990; Ortega & Rodríguez, 2008). An exception is Banerji, Berry, and Shotland (2017) who provide a rigorous evaluation of literacy classes on language and math scores in the states of Bihar and Rajasthan in India.

The studies that measure the indirect or extended effects of adult literacy programs include the assessment of a large-scale Ghanaian adult literacy program on household consumption (Blunch & Pörtner, 2011); the assessment of maternal participation in adult literacy programs on child mortality in rural Ghana (Blunch, 2013); and the assessment of the positive impact of maternal literacy on children's math scores in India (Banerji *et al.*, 2017). These studies reveal that adult literacy programs can have a positive effect on participants' literacy, though the increases are small in magnitude. Adult literacy programs have also been evaluated (mainly through a comparison of literate and illiterate adults) in terms of their impact on outcomes such as interhousehold sharing (Maddox, 2007), individual earnings (Basu, Narayan, & Ravallion, 2001), and children's height-for-age (Gibson, 2001). However, the results of these comparisons are not necessarily attributable to specific adult literacy programs.

The broader literature on education highlights the robust positive correlations between education and several desirable socioeconomic outcomes. The positive correlation between maternal education and child outcomes has been well documented (see, among others, Gakidou, Cowling, Lozano, & Murray, 2010; Haddad, 1999; Hopkins, Levin, & Haddad, 1994; Paxson & Schady, 2007; Senauer & Garcia, 1991; Senauer, Garcia, & Jacinto 1988; Strauss & Thomas, 1995; Thomas, 1990; White & Masset, 2003). Higher education levels for women and girls are also positively correlated with lower fertility; improved health, hygiene, and education; better saving practices; and increased gender equity (Gakidou *et al.*, 2010; Haddad, 1999; Hopkins *et al.*, 1994; Paxson & Schady, 2007; Senauer *et al.*, 1988; Strauss & Thomas, 1995; Thomas, 1990; White & Masset, 2003).

Turning to ICT-based or ICT-enhanced adult literacy programs in developing countries, there is generally little information about their impacts. A study conducted by Aker, Ksoll, and Lybbert (2012) provided evidence that teaching completely illiterate adults to use mobile phones within the context of adult literacy classes in rural Niger can increase math and reading test scores by 25%. Chudgar (2014) reported basic cross-tabulations from a survey of 409 illiterate adults in semi-urban locations in Gujarat, India, that highlighted the

potential role of mobile phones in addressing adult literacy. Also in the Indian context, Wagner, Daswani, and Karnati (2010) study the impact of a computer-assisted mother-tongue literacy program among out-of-school youth in the state of Andhra Pradesh. Using a quasi-experimental design, they find modest but promising impacts of this program on learning outcomes.

The literature on the effectiveness of computer-assisted learning in schools is large enough that a number of meta-analyses have been conducted, though these largely comprise studies in developed country settings. Tamim, Bernard, Borokhovski, Abrami, and Schmid (2011) provide a second-order meta-analysis—a meta-analysis of meta-analyses—that finds that the use of computer technology has an average effect size of 0.33–0.35 standard deviations on student learning. The effect sizes are, however, reduced to about half the size when only rigorous studies are included in the meta-analysis. Cheung and Slavin (2012) provide a meta-analysis that focusses on reading outcomes and find that technology has an average effect size of 0.16 standard deviations on reading outcomes. Using similar restrictive inclusion criteria for studies, Cheung and Slavin (2013) find an average effect size of math-focused programs on math outcomes of 0.15 standard deviations.

The literature on the impacts of computer-assisted learning on student outcomes in developing countries is rapidly growing. It reveals mixed finding related to the effectiveness of computer-assisted learning. Barrera-Osorio and Linden (2009) and Beuermann, Cristia, Cueto, Malamud, and Cruz-Aguayo (2015), find either no or mixed effects of the introduction of computers in schools on children's learning outcomes (e.g., test scores) or cognitive skills in a range of settings. These limited results may be due to the failure to incorporate computers into the educational process. On the other hand, Mo *et al.* (2013) examine the “One Laptop per Child (OLPC)”³ program in migrant schools in Beijing schools and find that six months of access to a computer improved standardized math scores by 0.17 standard deviations, as well as raising student scores on a computer skills' scale by 0.33 standard deviations. Lai *et al.* (2013) study a remedial computer-assisted learning program in minority schools in rural China and find that it increases learning by 0.14–0.20 standard deviations. Banerjee, Cole, Duflo, and Linden (2007) find that a computer-assisted learning program involving math-focused games improved math scores among schoolchildren in India by 0.47 standard deviations.

3. BACKGROUND

About one-third of the world's illiterate population lives in India, where illiteracy affects primarily girls and women. The female literacy rate—defined as including all females aged 7 and over who can read and write—is 65%, whereas the male literacy rate is over 80%. Females constitute 64% of the total illiterate population aged 7 and above (Director of Census, 2011). Although India has been successful in raising the primary enrollment rates of boys and girls through programs such as *Sarva Shiksha Abhiyan* and the midday meal scheme (raising the net primary enrollment rate to 93% in 2011⁴), progress on adult literacy has been comparatively limited (Kapur & Murthi, 2011).

The National Literacy Mission (NLM) was launched in 1988 to increase functional literacy among 15- to 35-year olds in India. Because these individuals are in the “productive and reproductive period of life,” the NLM offers them “a second

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