Social Identity and Learning: Adult literacy Program in India

Sakshi Bhardwaj[a,*,] and Abu S. Shonchoy.[b]

[a] University of Illinois at Urbana Champaign, United States

[b] Florida International University, United States

Abstract: The paper examines the effect of social identity on adult learning within a hierarchical social setting— an important yet often ignored issue for effective adult education. We leverage the random matching of students and teachers from a randomized controlled experiment in India, where illiterate adult female learners aged 18-45 were randomly assigned to a literacy program. We find a positive and significant impact of matching an upper caste teacher with a lower caste adult student on literacy scores. We also find suggestive evidence of an increase in students' confidence measures when matched with an upper caste teacher, indicating a plausible impact mechanism. Our results highlight the need for future research on social identity and its influence on adult learning, particularly in countries with existing deep-rooted hierarchical social constructs.

Keywords: Adult Education, Social Identity, India, Caste.

JEL Codes: I24, I21, J15

[*]Correspondence: Department of Economics, 1407 West Gregory Drive, the University of Illinois at Urbana Champaign, Urbana, IL 61801 USA,

E-mail addresses: sakshib2@illinois.edu (S. Bhardwaj), shonchoy@fiu.edu (A.S. Shonchoy)

1. Introduction

Social identities, such as race, gender, ethnicity, and caste, influence individuals' behavior towards another within society (Akerlof, 1976), impacting choices related to education, employment, housing, marriage, and engagement in criminal activities. Theoretical frameworks suggest that when different social identities coexist, minority groups can either reject the behavioral norms of the majority and maintain distinct identities or assimilate into the societal norms of the majority group (Akerlof, 1997). However, empirical evidence predominantly indicates that minority groups tend to conform to the behavior of their reference groups, leading to societal divergence. For instance, conformity behavior has been linked to detrimental effects on African Americans, including higher crime rates (Case and Katz, 1991), lower educational attainment (Patacchini and Zenou, 2016), and challenges in learning English due to the perception of it being associated with "acting white" and adopting mainstream identities (Austen-Smith and Fryer, 2005; Battu et al., 2007; Selod and Zenou, 2006; Currarini et al., 2009, 2010; DeMartí and Zenou, 2009; Battu and Zenou, 2010; Fryer and Torelli, 2010).

The issue of social identity holds significance within a hierarchical and diverse social framework, particularly crucial in learning environments– in the presence of student-teacher dynamics. Previous research has generally indicated that minority benefit from having same-race and gender mentors in terms of education, career choices, and occupations (Carrell, Page, and West, 2010; Hilmer and Hilmer, 2007). However, considering the detrimental impact of segregation on minorities and the importance of desegregation programs (Echenique and Fryer, 2007; Cutler and Glaeser, 1997; Ananat, 2011; Angrist and Lang, 2004; Case and Katz, 1991), there exists limited evidence on the potential of interactions between individuals from different social groups to weaken social stratification and contribute to the well-being of minority groups.

In this study, we ask the following research question: Can minority group learners integrate and benefit from mentors from socially higher (majority) groups? Leveraging the random matching of students and teachers in an adult literacy program in India, this paper examines the effect of different social identities of mentors and mentees on learning outcomes. With the increasing emphasis on adult literacy programs (and other adult learning activities) and increasing participation of middle-aged to elderly individuals in higher education, including skill and vocational training, studying these questions is important in a diverse population setting.

To causally identify the effect of matching adult learners and teaching instructors, we leverage the experiment conducted in an adult literacy program in India. Participants were illiterate women aged between 18 and 45 and were randomly assigned to the treatment or control group. The treatment group received a 56-day computer-assisted adult literacy program targeting basic numeracy and literacy skills, while the control group was enrolled in the program after the experiment. The random allocation also extended to the teachers, who were randomly assigned to different learning groups of students. Our analysis specifically focuses on the treatment group of students who were randomly assigned to the education program and their corresponding teachers. We examine the interaction effect between the different castes, which serve as a proxy for social identity of the adult learners and teachers on numeracy and

literacy test scores. In our research setting, we had 2 castes of students and 3 castes of teacher where all students belong to lower-middle and lower caste and teachers belong to upper, lower-middle, and lower castes respectively. In our analysis we do not distinguish between the lower-middle and lower caste teachers (as empirically they are not statistically significantly different from each other on observables) and compare teacher-student interaction as either taught by an upper caste teacher or a non-upper caste. All the teachers involved in this experiment hold the same academic qualification (graduate) regardless of their caste and are of similar age which is not statistically significant across castes.

We find that adult students perform better on the literacy test when taught by an upper-caste teacher compared to a teacher of non-upper caste as the adult student. However, there is no statistically discernible effect on numeracy test scores, despite being taught by the same teacher for both literacy and numeracy. We find some suggesting evidence of increase in students' confidence measure when matched with an upper caste teacher as a plausible impact mechanism. Our estimates suggest that the social hierarchy of teachers plays a critical role in effective adult learning, increasing confidence and learning outcomes for marginalized students when taught by an upper-caste teacher. This underscores the importance of educator-learner matching in adult-centric education programs – an essential design feature that requires more attention.

Our study contributes to several strands of literature. Prior literature has studied the effect of teacher-student identity matching on students' educational outcomes (Dee, 2004; Dee, 2005; Carrell, Page, and West, 2010; Gershenson et al., 2018; Lim and Meer, 2017). A variety of such matching have been explored, such as race and ethnicity (Bates & Glick 2013; Dee, 2004, 2005; Egalite et al., 2015; Gershenson et al., 2016; Ouazad, 2014), gender (Dee, 2005; Jansson and Tyrefors, 2018; Lim and Meer, 2020; Muralidharan and Sheth, 2016), socioeconomic status (Vinopal, 2020), religion (Lavy et al., 2018), and caste (Rawal and Kingdon 2010; Karachiwalla, 2019). Existing literature examined the outcomes for K-12 students in the formal education system, neglecting the effects on adult and non-traditional students whose racial and ethnic identities may be more salient. Adult students possess unique learning characteristics, including their experiences, intrinsic motivation, beliefs, and the role of teachers (Knowles, 1968). In contrast to a traditional instructional setup, the teacher-student relationship in adult education is often more collaborative, resembling a co-learning dynamics (Donnelly-Smith, 2011). Our study addresses this gap by examining the impact of student-teacher matching on non-traditional adult students in rural India.

Our study provide early evidence that minorities who are matched with mentors from different social categories, particularly higher social status, can achieve better outcomes. These findings are important and policy relevant. First, adult learning programs in developing countries play a crucial role in poverty alleviation, as they contribute to improved health, increased labor force participation, and higher income (Blunch, 2009; Blunch and Porter, 2011; Blunch, 2017). UNESCO report on adult learning and education statistics highlights the growing participation rates in education and learning programs among adults, particularly in low-income countries (Boeren & Field, 2019). In developing countries, these programs encompass a broad range of offerings, ranging from basic skill education to technical and

vocational certificate programs (Abadzi, 2003). Given the resource and capacity limitations faced by developing countries, it is essential to understand the effectiveness of adult learning programs to maximize learning efficiency and effectiveness.

Secondly, there has been a noticeable increase in the number of non-traditional students, particularly for middle-aged or older adult learners (Anderson, 2016). These students now comprise approximately 40% of undergraduate students in the USA, for example, and have diverse roles, including parents, caregivers, full-time employees, and retirees (CLASP, 2015). This trend is driven by changes in the job market, such as the rise of technology-driven occupations and the increased demand for flexible work arrangements, which has been further accelerated by the COVID-19 pandemic. As a result, it is crucial for policymakers and educational institutions to develop effective strategies that can cater to the unique needs and circumstances of adult learners.

The remainder of the paper is organized as follows: In Section 2, we discuss the conceptual framework analysing the social identities of adult students and teachers and their effect on the learning level. Section 3 describes our data, while Section 4 explains the empirical framework and presents our results. In Section 5, we present heterogeneity analysis and shed light on the mechanisms involved, and finally, we conclude in Section 6.

2. Background and Conceptual framework

2.1 Caste in India

In India, the caste system is a prevalent social hierarchy, comprising four main categories: *Brahmins*, *Kshatriyas*, *Vaishya*, and *Shudra*, which were traditionally aligned to their occupations of priests, warriors, farmers/traders, and manual laborers, respectively. Those excluded from this classification and the "so-called untouchables" are referred to as Scheduled Castes (SC), other socio-economically disadvantaged castes, such as '*shudras*,' are categorized as Other Backward Classes (OBC), and individuals from the highest caste are assigned to the General or Forward class. The socially lower caste status of SC remains a significant factor contributing to low school enrollment and limited social mobility gaps among the population (Drèze and Kingdon, 2001; Borooah and Iyer, 2005; Dostie and Jayaraman, 2006; Drèze and Gazdar, 1997).

Education is widely recognized as a catalyst for substantial economic gains, including improved employment prospects, higher income, and increased productivity. However, historically marginalized groups in India face economic disadvantages, poverty, and limited opportunities in low-skilled occupations, leading to significant social stratification based on education, occupation, and income. In response, the Indian government has implemented policies such as affirmative action in education and public sector employment, aimed at enhancing the social and economic mobility of SC and OBC groups. These policies have proven effective in expanding access to education and narrowing the wage and consumption gaps in India (Hnatkovska, V., Lahiri, A., & Paul, S., 2012).

2.2 Non -Pecuniary returns to Education

Anthropological studies have highlighted that education holds non-pecuniary and significant cultural value beyond its economic benefits, particularly for historically marginalized groups. Despite the vertical caste hierarchy and the rigid nature of caste identity in India, education has the power to transform the perception of marginalized communities from being associated with lower castes to being seen as civilized and progressive. Through education, lower caste groups can shed their inherited, essentialized, and derogatory lower-caste identities and embrace positive identities aligned with progress and civility (Ciotti, 2006). In rural Uttar Pradesh, the same region as the context of this paper, Jeffrey, C., Jeffery, P., & Jeffery, R. (2004) conducted ethnographic research that revealed how even unemployed Scheduled Caste (SC) men, despite lacking economic returns from education, embraced their "educated identities" as a form of embodied cultural distinction from traditional village identities. Education not only provides marginalized groups with cultural capital that grants advantages in social situations but also defines their notion of civilization.

2.3 Conceptual Framework

Social identity influences individuals' behavior towards others (Akerlof, 1976), and education has the potential to enhance an individual's self-image or identity (Akerlof and Kranton, 2005). We conceptualize that in an interactive social setting, individuals with different castes rank their socially constructed identities and perceive them in relation to other caste groups (White, 2008). This ranking is determined by social distance, a concept in social psychology that measures the distance between steps on a promotion ladder (Haslam, 2004). Individuals lower on the ladder, with stigmatized identities, may either embrace others with different social identities and move up and closer to those groups or further embrace their marginalized social identity and remain lower on the ladder (Jetten and Branscombe, 2009).

We hypothesis that to enhance their self-image in relation to groups occupying higher positions on the ladder, marginalized groups tend to learn more when the social distance or rank of the teacher is greater. This hypothesis aligns with the evidence that people exhibit heterophily, a bias towards individuals who are different, in terms of income levels and socioeconomic status (Mele, 2020). For individuals from lower castes, those from higher castes can provide valuable resources such as information, financial support, and sponsorship (Lin, 2001; Lin and Erickson, 2008). We conceptualize that being matched with an upper-caste teacher compared to the student may serve as a motivation for marginalized students to learn even more, bridge social gaps, perceive themselves as less unequal, and develop a sense of unity with their teacher. A formal theoretical model outlining these dynamics is provided in the Appendix A.

3. Intervention, experimental design, and econometric approach

The intervention and experimental design utilized in this study have been thoroughly documented in Gupta, Ksoll, & Maertens (2021), Deshpande et al. (2017), and Deshpande et

al. (2023). However, to provide an overview of the trial, we are providing a brief summary below.[1]

3.1. Intervention

The TARA Akshar Plus (+) (TA+ hereafter) program was developed in 2004 as an adult literacy/numeracy program, designed by Readingwise UK and implemented by the Indian NGO named Development Alternatives (DA) among illiterate rural women.[2] This innovative, interactive, group-based, computer-aided program trains rural women to read and write in Hindi and acquire basic mathematical skills in 56 days, with classes held 6 days a week for 2 hours each day. The TA program is divided into two parts: 37 days of literacy training and 19 days of numeracy classes. Drawing insights from cognitive psychology and memory techniques, TA instructors utilize software, flash and playing cards to effectively teach the students. For example, to teach the alphabet, the shape of the letter is transformed into a cartoon that resembles an object starting with that letter. The TA program has been successful in significantly improving the numeracy and literacy skills of illiterate women (Despande et al., 2017).

3.2. Experimental design and timing

The experimental sample consists of illiterate adult women selected from relatively marginalized 20 hamlets within 12 villages in Uttar Pradesh (UP), India. These hamlets are caste-specific settlements, and due to restrictions on inter-caste interactions, they were used as units of randomization. Consequently, each hamlet had one TA group-lesson roster allocation, with all students belonging to the same caste. Furthermore, each group had a single assigned teacher from the central administration who could belong to any caste. Throughout the experiment period, the same teacher conducted all the scheduled lessons for each group. In two cases, same teacher was teaching more than one group in the morning and in the evening shifts.

The project was conducted in two phases - Phase I and Phase II. For each phase, the sequence of data collection was as follows: the research team conducted a baseline survey, which was followed by the intervention (i.e., the TA+ program), and then an endline survey. Phase I covered 6 villages comprising of 8 hamlets, and Phase II covered 6 villages comprising of 12 hamlets.[3] For Phase I, TA+ was implemented during October and November 2013, and the second phase of the program was implemented between June and August 2014.

In each hamlet, through door-to-door solicitation, a list of all women between 18 and 45 years who were illiterate and agreed to participate in the intervention was created, regardless of the time of implementation. After completion of the baseline survey in all the hamlets, the women were requested to assemble at a central location to participate in the public lottery. Each list of potential participants was entered into a public lottery to determine who would be assigned to the treatment group (i.e., enrolled in the TA+ program). The women who formed the control group were invited to participate in TA+ in a subsequent round of classes conducted

[1] More info can be found on the project site: https://sites.google.com/view/tara-akshar-research-project/welcome?authuser=0

[2] https://www.taraakshar.org/

[3] The sample selection is not stratified.

after the endline survey. In total, the research team assigned 910 illiterate adult women to a treatment (434) or an experimental control group (476).

Moreover, the random assignment also extended to the teachers, who were centrally assigned to different learning groups of students comprising the same caste. Teachers of the TA+ program were equally educated (had an undergraduate degree) and centrally applied for the instructor jobs. These teachers were then trained and assigned to the learning groups of students. Thus, the allocation of the TA+ teacher for the group-lesson was orthogonal to the caste of the students. Once the TA+ classes began, students learned about the caste of the teacher through knowing the surname of the teacher. This paper's sample consists of all 434 illiterate adult female students of the treatment group who were randomly assigned to the education program and their corresponding teachers.

3.3. Data and Variables

We administered a battery of literacy and numeracy tests to all the women before and after the program.[4] The literacy tests were developed by Pratham – the largest education NGO in India – based on the model used in the DIBELS (Dynamic Indicators of Basic Early Literacy Skills) tests (Good III, Simmons, & Kame'enui, 2001). The literacy tests encompassed timed tasks where participants were allotted one minute to read a variety of items: 52 letters (Task 1), 63 syllables (Task 2), 52 words (Task 3), 48 non-sensical words (Task 4), a 64-word Grade 1–level paragraph (Task 5), and an 88-word Grade-2 level paragraph (Task 6). The test also included a number of "discontinuation rules" to ensure that the test would not progress to more difficult tasks if the learners could not achieve a minimum level on an earlier task. For each task, we computed the total count of letters, syllables, words, etc. that could be read within the one-minute timeframe. In cases where a participant completed a task in less than a minute, the time taken was converted to minutes, and the corresponding count for letters, syllables, words, and others tests per minute was calculated. To determine the literacy score, we summed the per minute scores across Task 1 to Task 6 which provides an aggregate measure of participants' reading ability.

On the other hand, the numeracy tests were not timed. Respondents were asked to complete seven tasks: (i) count three objects orally; (ii) recognize digits; (iii) count objects and circle the correct written number; (iv) count objects and write the correct number; (v) fill in the missing digit in two series; (vi) add two to three one- and two-digit numbers; and (vii) subtract one- and two-digit numbers. Based on the results of these tasks, we created an overall numeracy score.

Further, household-level variables, individual-specific controls, which were collected as part of the household and women questionnaire, and teacher-specific controls such as caste, age, and gender are used as co-variates. Finally, the study utilizes the teachers' and students' castes to examine the effect of teacher-student pairing on numeracy and literacy test scores.

[4] The data of this project is available at https://figshare.com/articles/dataset/Tara_Akshar_Research_Project/7205696

We divide the caste into three categories based on the official caste categorization of India: General (Gen), Other Backward Class (OBC), and Scheduled Caste (SC). The General caste is the most economically and socially advanced (Bharti, 2018).

Panel A of Table 1 presents descriptive statistics for the 434 participants in the treatment group (those who participated in the TA program) and Panel B of Table 1 provides characteristics of the TA teacher.

Table 2 shows the average endline numeracy and literacy scores for students taught by teachers belonging to different castes, presented as cross-tabulation.[5] Panel A shows the literacy score, and panel B shows the numeracy score. As shown in Panel A, OBC and SC students, on average, received a higher grade when taught by a teacher from a General caste.

3.4. Balance Test

If high-achieving students are more likely to be assigned to a particular type of teacher, then the estimates of student-teacher matching will be biased in our experiment. Our estimates may also be biased if unobserved teacher characteristics correlate with student learning outcomes, such as unobserved caste-specific differences in teacher quality. We verify the orthogonality of the student-teacher matching using two methods. First, in our sample, neither students nor teachers were allowed to change the assigned learning session. The administrative roster checks allowed us to verify that the composition of the assigned learning session did not change throughout the intervention. Second, to demonstrate that unobserved teacher characteristics do not appear to have a significant influence on our results, we follow the method of Hansen and Bowers (2008), Bruhn and McKenzie (2009), and Antecol et al. (2015) and regress the teacher caste dummies on student characteristics, baseline controls, and baseline test score.

Table 3 presents the coefficient and the F-statistic and p-value from a Wald test of the joint significance of the regressors for three regressions where the dependent variable is a dummy for whether a teacher belongs to Gen, OBC, or SC caste. Specifically, we regress the following equation where the caste of the teacher, a dummy variable, is regressed on the student's caste along with baseline controls and test scores. Columns (1) — (3) of Table 3 present results for Gen, OBC, or SC caste teachers, estimated using the following equation.

$$\text{Caste of } \textbf{Teacher}_{j,} = \alpha + \beta_1 \textbf{ SC-Caste-Student} + \beta_2 \textbf{ OBC-Caste-Student} + \beta_3 X_i + \beta_4 \text{ Baseline-Test Score}_i + \varepsilon_i \qquad \text{(i)}$$

Where "*Caste of the Teacher*" is a dummy variable of whether the teacher *j* belongs to caste *c*, "*SC-Caste-Student*" is a dummy variable that takes the value of 1 for SC and zero otherwise, the "*OBC-Caste-Student*" dummy takes the value of 1 for OBC and zero otherwise. $X_{i,c}$ are individual level controls, "*Baseline-Test Score*" is the baseline test score of literacy and numeracy of a student *i* belonging to caste *c*, and $\varepsilon_{i,c}$ is the error term.

[5] Due to a small sample of General caste students, we do not present results. None of them were significant.

As expected, none of the coefficients are statistically significant at conventional levels. Our F-test fails to reject the null that all regressors together are not significant predictors of being taught by a particular caste teacher. Therefore, these results suggest that teacher caste and student characteristics were not correlated.

3.5. Empirical strategy

To estimate the impact of adult student/teacher caste-matching and learning achievement, we conducted the following regression analysis.

$$\textbf{Test Score}_{i,t} = \alpha + \beta_1 SC_i + \beta_2 \textbf{SC}_i \text{ X } \textbf{Upper-Caste-Teacher} + \beta_3 \textbf{OBC}_i \text{ X } \textbf{Upper-Caste-Teacher} + \beta_4 X_{i,} + \varepsilon_{i,} \quad \text{(ii)}$$

where, *Testing Score* $_{i,,t}$ is the literacy or numeracy test scores of student *i* measured in the endline *t*, SC dummy takes value 1 for SC student and 0 for OBC student, *Upper-Caste-Teacher* dummy takes value 1 for General caste teacher and 0 otherwise. $X_{i,}$ are individual level baseline controls as reported in Table 1,, and ε_i is the error term. Standard errors are clustered at the group (or hamlet) level. β_2 and β_3 are the estimate of the change in literacy or numeracy achievement associated with being taught by an upper-caste teacher for SC and OBC student. Our sample consists of students of OBC and SC castes hence OBCs students are the default category.

4. Results

This section describes our empirical strategy and presents our main empirical results. First, we present the results for the overall numeracy and literacy scores. Later, we present the results for different sections of the literacy and numeracy.

4.1. Total Numeracy and Literacy Test Scores

Table 4 presents regression results for total literacy and numeracy scores, respectively. In Column (1), we present the outcomes for the literacy tests, while Column (2) reports numeracy scores. As the literacy test score is the sum of the per-minute scores across reading Task 1 to Task 6, there is no maximum possible score. Table 4 shows that being taught by an upper-caste teacher leads to statistically significant increase in literacy scores for OBC and SC students by 59.14 and 40.19 points, respectively. This corresponds to an increase of 163% and 113% from the mean of the OBC students taught by non-upper caste mentor, respectively. We do not observe any significant effect on the numeracy test scores for SC students and find a statistically significant positive effect at the 10% level on the numeracy scores of OBC students.

Since we compared multiple dependent variables, it becomes increasingly likely that the sample may appear to be differ on at least one attribute due to random sampling error. As a result, our confidence that a result will generalize to independent data should be weaker if it is observed as a part of an analysis that involves multiple comparisons rather than an analysis that involves only a single comparison. We estimate Bonferroni-Holm inference adjusted p-values to tackle this important issue.

In Table 4, the multiple inference adjusted p-values denoted the probability that at least one of the two hypotheses ($\beta_2 = \beta_3 = 0$ for literacy and numeracy) is statistically significant. In columns (1) of Table 4, Bonferroni-Holm P-values indicate significant effects of having a teacher from an upper caste on the literacy score of both SC and OBC student. We find that p-value for multiple hypothesis testing are lower than 0.05 for the literacy score.

Furthermore, we employ (nonparametric) randomization inference to reliably assess causal effects with a limited number of observations, with clustered randomization. Randomization inference calculates p-values based on the observable variability in hypothetical treatment assignments (the assignment of an upper caste teacher), using the randomization procedure as the basis of variation for the estimate. In this process, the experimental sample is treated as constant, with the only random aspect being the allocation to an upper caste teacher. In Table 4, we also report randomization inference p-values. The randomization inference p-values are below 0.1 for the Literacy test score and are not statistically significant for the Numeracy test score.

4.2. Effect on Section Specific Literacy and Numeracy Tests

Table 5 focuses on investigating the impact on individual sections specific literacy tests, including letters per minute, syllables per minute, words per minute, non-words per minute, words in passage 1, and words in passage 2. Furthermore, we introduce two additional literacy scores derived from the performances in passages 1 and 2 for these estimations. Total literacy score presented in Table 4 reflects the collective count of letters, syllables, words, and related components that a learner was able to read. This total score, however, excludes the scores obtained from the two passages (passages 1 and 2). These passages entail orally presented questions based on the content of the respective passages. Further elaboration on these scoring aspects is provided in the Appendix B.

The coefficients of OBCxUpper-Caste-Teacher are positive and statistically significant for all but one test. Similarly, the coefficient of SCxUpper-Caste-Teacher is positive and statistically significant for all but two tests. In Columns (1) and (2) of Table 5, the results indicate that being taught by an upper caste teacher increases the reading ability of letters by 7.7 (54%) and 5.5 (37%) for OBC and SC students, and the reading ability of syllables by 14.07 (212%) and 10.27 (153%) for OBC and SC students. Moving to Column (3) and (4), we find that being taught by an upper caste teacher result in a rise in word learning by 9.37 (216%) for OBC students and by 5.63 (130%) for SC students. Additionally, it leads to an increase in non-sensical word reading ability by 6.2 (331%) and 3.2 (176%) for OBC and SC students respectively. Columns (5) and (6) shows that being taught by an upper caste teacher enhances reading grade I level passage ability by 12.5 (273%) and 8.54 (185%) for OBC and SC students. Similarly, it leads to an increase of 9.04 (217%) and 6.93 (166%) in reading grade II level passage for OBC and SC students. In column (7), we find an increase of 1.04 points in answering grade level I passage comprehension questions for OBC students. Achieving an improvement in letters, words and overall reading ability within a short literacy program is a significant accomplishment, particularly considering that majority of the students were unable to read even a single letter during the baseline assessment.

In Table 6, we outline the impact on distinct sections of numeracy tests. The coefficients for OBCxUpper-Caste-Teacher are observed to be statistically insignificant for all sections, except for two tests. The coefficients related to the letter recognition test and the fill-in missing digit section exhibit positive values at the 10% significance level. Importantly, we do not find any negative effects (detrimental effects of being matched with an upper caste teacher) for any section of the numeracy test. Furthermore, the coefficient for SCxUpper-Caste-Teacher remains statistically insignificant across all sections.

Given that both numeracy and literacy were taught by the same teachers, the absence of a highly significant effect on numeracy against a positive effect on literacy could be attributed to various factors. One noteworthy distinction between the two interventions pertains to the duration of program delivery. The 56-day TA+ adult education program encompasses a 36-day literacy program and an 18-day numeracy program. As a result, students had more extensive interaction time with teachers in the literacy segment compared to the numeracy component in our literacy program. We observe a small positive effect but do not find any negative effect of being matched with an upper caste teacher on numeracy skills. It is possible that we might have observed a highly positive and significant impact if numeracy had been taught for a longer duration.

Second, the teacher's contribution to learning outcomes can differ across subjects, and the impact of student-teacher matching may vary accordingly (Bell et al., 2016; Cohen et al., 2018; Clotfelter et al., 2006). Our findings align with the observations of Rawal and Kingdon (2010), which underscore the potentially divergent influence of teachers based on the subjects they instruct. Third, the learners entered the program with a relatively low baseline literacy level, with nearly 90% unable to read any letters prior to joining the TA+ initiative. However, they possessed some level of numeracy skills at baseline (about 20% numeracy level). The average percentage increase in literacy and numeracy scores subsequent to the TA+ program is 818% and 135%, respectively , indicating the effect of the TA program is concentrated in improving literacy skills.

5. Heterogeneity and Mechanism

To assess whether students of a specific profile derive varying advantages from being matched with an upper-caste teacher, we first conduct a heterogeneity analysis based on the median baseline test score of students. This analysis covers three distinct baseline scores: baseline numeracy test, baseline cognitive test 1, and baseline cognitive test 2. Here by Cognitive Test 1 we mean the forward digit span test, which assesses the participants' ability to orally recall randomly presented sequences of digits. Similarly, Cognitive Test 2 is the Rapid Automatic Number test, in which respondents are shown several squares of different colors and are required to rapidly name the colors of each square. These tests are designed to measure cognitive abilities and were administered at both baseline and endline. These cognitive tests are further described in Appendix B.

Table 7, Table 8, and Table 9 present the heterogeneous effects on literacy and numeracy scores based on the baseline numeracy, cognitive test 1 and 2 scores. This analysis aims to uncover whether the baseline abilities of lower caste students influence their learning

outcomes when taught by an upper caste teacher. In Table 7, we observe no differential effects based on low or high baseline numeracy scores. However, in Table 8 and Table 9, we find that the impact of being matched with an upper caste teacher is more pronounced among those with a higher baseline cognitive test score. We could not conduct similar exercise based on baseline literacy as the majority of the students (90%) had a baseline literacy score of zero, indicating an inability to read any letters at the baseline.

To shed light on the underlying mechanisms, we explore some intermediary outcomes associated with being matched with an upper-caste teacher. In Table 8, our findings indicate that the benefits of being matched with an upper-caste teacher are more pronounced among individuals with higher baseline cognitive test scores. This suggests that such matching with an upper caste teacher might enhance cognitive performance. However, when we turn our attention to Table 9 and 10, where we analyze the impact on endline cognitive test scores for Cognitive Test 1 and Cognitive Test 2, the results do not reveal any statistically significant effects for either Scheduled Caste (SC) or Other Backward Class (OBC) students who are matched with upper-caste teachers. Consequently, it appears that being taught by an upper-caste teacher may not lead to a noticeable increase in cognitive skills.

Subsequently, we turned our attention to assessing the impact on the participants' incentivized knowledge and confidence measures. The knowledge assessment involved posing general knowledge questions related to participants village, safe health practices, and education. For each correct answer, they were promised a reward of one pencil (serving as a proxy for cash), which could also be exchanged for other stationary items. Each correct answer was assigned a score of 1, contributing to an overall general knowledge score.

After the completion of the knowledge text, confidence was evaluated by prompting students to indicate how much they were willing to pay (how many pencils they were willing to forfeit) to view the answer options of the knowledge test. This action would then enable them to revise their original answers. A lower willingness to pay indicated higher confidence in their knowledge test results. This confidence measure was conducted following a modified Becker-DeGroot-Marschak (BDM) mechanism (Becker, DeGroot, and Marschak 1964) where a random price was drawn. If a participant's willingness to pay to view answer options was lower than the drawn price, they were not shown the multiple-choice options. Conversely, if their willingness to pay was equal to or greater than the drawn price, they paid the specified price (in terms of the number of pencils) and could decide whether to revise or retain their original answers. Detailed information about this particular test to measure knowledge and confidence is available in Appendix B.

Table 11 presents the findings regarding the impact of being matched with an upper caste teacher on both knowledge and the willingness to pay for the opportunity to view possible answer choices. The results indicate that there is no significant impact mechanism through knowledge channel. However, a notable negative effect is observed on the willingness-to-pay for the chance to see the correct answers. The decreased willingness-to-pay for the option to view correct answers (higher confidence) by the lower caste students matched with upper caste teachers implies that such students show greater confidence which is a plausible mechanism for higher achievement in literacy scores.

6. Conclusion

Social identities such as race, gender, ethnicity, and caste play a significant role in shaping individuals' behaviors and choices within society. This paper aimed to address the question of whether minorities benefit from mentors of different social groups, focusing on the context of an adult literacy program in India. While prior research has extensively studied teacher-student dynamics in formal education, there remains a gap in understanding these dynamics within adult education.

Leveraging a randomized experiment, we investigated the impact of student-teacher caste-matching on learning outcomes among adult learners. We observed that being taught by an upper-caste teacher had a positive and significant effect on literacy scores for both OBC and SC students, representing 163% and 113% increases from the sample mean. We do not find any effect on numeracy test scores partly due to higher baseline numeracy scores by the illiterate adults. We identified that this effect was more pronounced among students exhibiting higher cognitive skills as measured during the baseline assessment. To shed light on mechanism, we find some evidence suggesting an increase in students confidence measure when matched with an upper caste teacher.

Our results have important implications for policies and interventions aimed at promoting social integration and reducing inequalities. While prior studies have suggested the benefits of same-group mentors, our findings suggest that exposure to mentors from higher social categories can also lead to improved outcomes for minorities. The notable improvement in literacy scores for lower caste students when paired with an upper-caste teacher underscores the potential of cross-group interactions to positively impact education. Our study highlights the intricate interplay between social identities, education, and mentorship, providing valuable insights into the potential of cross-group interactions to enhance learning outcomes for adult learners.

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Declarations of interest

None

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Tables and Figures

Table 1: Descriptive Statistics

Characteristics	Observation	Mean	Std. Dev
	(1)	(2)	(3)
Panel A - Students (Treatment group Women)			
Proportion of students belonging to General Caste (Gen)	434	0.035	0.183
Proportion of students in Other Backward Caste (OBC) caste	434	0.495	0.501
Proportion of students in Schedule Caste (SC) caste	434	0.470	0.500
Age of student	434	34.048	10.523
Proportion of students having a personal mobile phone	434	0.362	0.481
Number of children in the household	434	4.396	3.101
Proportion of students who are married	434	0.901	0.299
Proportion of students who are widowed	434	0.044	0.205
Proportion of students whose household is landless	434	0.018	0.135
Proportion of student households having a Below Poverty Line (BPL) card	434	0.283	0.451
Proportion of students whose household is electrified	434	0.297	0.458
Proportion of students whose household has a brick house	434	0.603	0.490
Proportion of students whose household has sanitary toilet	434	0.069	0.254
Proportion of students whose household had safe water access	434	0.323	0.468
Proportion of students whose household uses safe fuel	434	0.018	0.135
Proportion of students whose household has heating equipment	434	0.044	0.205
Proportion of students whose household has a sewing machine	434	0.145	0.353
Panel B - Teachers			
Age of the instructor	20	27.848	4.567
Proportion of male instructor	20	0.747	0.435
Proportion of instructors belongs to General caste (Gen)	20	0.065	0.246
Proportion of instructors belongs to Other Backward Caste (OBC)	20	0.664	0.473
Proportion of instructors belongs to Schedule Caste (SC)	20	0.272	0.445

Notes: Column (1) lists the number of students and teachers, and columns (2) and (3) list the mean and standard deviation, respectively.

Table 2: Literacy and Numeracy Score

	(1)	(2)	(3)
		Caste of the Teacher	
	General	**OBC**	**SC**
Caste of the Student			
		Panel A: Literacy	
General		88.11	127.14
		(170.90)	(171.83)
OBC	96.89	34.91	38.98
	(120.79)	(77.52)	(68.05)
SC	57.84	30.08	51.56
	(84.99)	(48.61)	(65.18)
		Panel B: Numeracy	
General		22.08	22.66
		(7.94)	(8.32)
OBC	20.33	16.58	16.35
	(11.21)	(9.32)	(9.96)
SC	12.6	15.61	17.43
	(11.14)	(9.28)	(9.92)
Observations			
General	0	12	3
OBC	18	140	57
SC	10	136	58

Notes: Panel A and B present cross-tabulations of literacy and numeracy scores, respectively. Each column represents the caste of the teacher, and each row represents the student's caste.

Table 3: Test for Randomisation: the dependent variable is the caste of a teacher

	(1)	(2)	(3)
VARIABLES	**General Teacher**	**OBC Teacher**	**SC Teacher**
SC student	0.0511	-0.134	0.0825
	(0.0660)	(0.127)	(0.120)
OBC student	0.0861	-0.150	0.0636
	(0.0659)	(0.127)	(0.120)
Baseline Numeracy	-0.000829	0.00381	0.00279
	(0.0127)	(0.0246)	(0.0231)
Baseline Literacy	0.000604	-0.00469	0.00409
	(0.0127)	(0.0245)	(0.0231)
Joint test	0.86	0.36	0.17
(F-statistic [p-value])	[0.48]	[0.83]	[0.95]
R-squared	0.008	0.003	0.002
N	434	434	434

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

Notes: Columns (1)—(3) present regression estimates for Gen, OBC, or SC caste teachers. The table also shows the F-statistic and p-value for a Wald test of the joint significance of the regressors. These reported estimators also controls for students' and teachers' observable characteristics described in Table 1.

Table 4: Overall effect of being taught by an Upper-Caste Teacher (measured using total score)

VARIABLES	(1) Literacy	(2) Numeracy
SC	2.456	0.0107
	(8.007)	(1.147)
OBC x Upper Caste Teacher	59.14**	3.639*
	(25.18)	(2.006)
P-value	0.01	0.06
Bonferroni-Holm P- value	0.03	0.06
Randomization inference p-value	0.03	0.20
SC x Upper Caste Teacher	40.19***	-1.962
	(12.02)	(1.655)
P-value	0.00	0.23
Bonferroni-Holm P- value	0.00	0.23
Randomization inference p-value	0.08	0.47
Mean score for OBC students	36.09	16.51
Observations	404	404

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

Notes: The table presents regression estimates of Endline test scores of literacy and numeracy on a binary indicator of whether the student is SC, with interactions between caste of students (SC or OBC) and upper-caste teacher, as well as controls for students' and teachers' observable characteristics described in Table 1. Columns (1) and (2) present regression estimates of literacy and numeracy test scores.

Table 5: Effect being taught by an Upper-Caste Teacher on various literacy tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	**Letters per minute**	**Syllables per minute**	**Words per minute**	**Nonsensical words per minute**	**Words in passage 1 per minute**	**Words in passage 2 per minute**	**Score in passage 1**	**Score in passage 2**
SC	0.647	0.718	0.455	0.338	0.0820	0.217	0.200	0.0808
	(1.567)	(1.845)	(1.118)	(0.706)	(1.804)	(1.659)	(0.146)	(0.0570)
OBC x Upper Caste Teacher	7.860**	14.07**	9.373**	6.270**	12.51**	9.048*	1.048***	0.0965
	(3.651)	(6.076)	(3.748)	(2.545)	(5.812)	(4.356)	(0.310)	(0.156)
P value	0.03	0.02	0.01	0.01	0.03	0.03	0.00	0.53
Randomization inference p-value	0.13	0.05	0.03	0.03	0.03	0.03	0.02	0.4
SC x Upper Caste Teacher	5.515*	10.27***	5.639**	3.325*	8.505*	6.934*	0.277	0.229
	(3.045)	(2.231)	(2.301)	(1.723)	(4.147)	(4.069)	(0.445)	(0.185)
P value	0.07	0.00	0.01	0.05	0.04	0.08	0.53	0.21
Randomization inference p-value	0.08	0.02	0.15	0.13	0.10	0.20	0.49	0.18
Mean score for OBC students	14.52	6.61	4.32	1.87	4.58	4.16	.24	.08
Observations	404	404	404	404	404	404	404	404

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

Notes: The table presents regression estimates of Endline test scores for various literacy tests on a binary indicator of whether the student is SC, with interactions between caste of students (SC or OBC) and upper-caste teacher, as well as controls for students' and teachers' observable characteristics described in table 1.

Table 6: Effect being taught by an Upper-Caste Teacher on various Numeracy tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	**Orally count the objects**	**Digit recognition**	**Count objects and circle the correct number**	**Count objects and write the correct number**	**Fill in the missing digit**	**Addition**	**Subtraction**
SC	0.0238	0.00565	-0.00853	0.162	0.0166	0.0339	-0.0986
	(0.0218)	(0.734)	(0.111)	(0.0998)	(0.0931)	(0.215)	(0.0862)
OBC x Upper Caste Teacher	0.00945	1.884*	0.185	-0.0227	0.264*	0.498	0.408
	(0.105)	(1.004)	(0.180)	(0.322)	(0.148)	(0.512)	(0.250)
P value	0.92	0..06	0..30	0.94	0.07	0.33	0.10
Randomization inference p-value	0.90	0.25	0.46	0.65	0.13	0.26	0.06
SC x Upper Caste Teacher	0.0468	-1.758	-0.309	-0.452	-0.0424	0.0214	0.116
	(0.0792)	(1.085)	(0.408)	(0.342)	(0.302)	(0.301)	(0.214)
P value	0.554	0.105	0.449	0.186	0.888	0.943	0.586
Randomization inference p-value	0.59	0.32	0.31	0.35	0.86	0.63	0.52
Mean score for OBC students	2.93	9.23	1.44	1.06	0.54	0.99	0.30
Observations	404	404	404	404	404	404	404

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

Notes: The table presents regression estimates of Endline test scores for various numeracy tests on a binary indicator of whether the student is SC, with interactions between caste of students (SC or OBC) and upper-caste teacher, as well as controls for students' and teachers' observable characteristics described in table 1.

Table 7: Effect by Median Baseline Numeracy Score

	(1)	(2)	(3)	(4)
	Below Median Baseline Numeracy		Above Median Baseline Numeracy	
VARIABLES	Literacy	Numeracy	Literacy	Numeracy
SC	4.796	0.661	-0.789	-0.974
	(8.256)	(1.656)	(27.88)	(1.610)
OBC x Upper Caste Teacher	51.07*	3.714*	90.95	0.952
	(24.46)	(2.036)	(80.25)	(10.18)
SC x Upper Caste Teacher	12.28	-2.877	85.69	11.81
	(18.61)	(3.297)	(68.82)	(8.480)
Mean score for OBC students	20.91	14.05	75.27	22.87
Observations	289	289	115	115

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

Notes: The table presents regression estimates of Endline test scores of literacy and numeracy on a binary indicator of whether the student is SC, with interactions between caste of students (SC or OBC) and upper-caste teacher, as well as controls for students' and teachers' observable characteristics described in Table 1. Columns (1) and (2) present regression estimates of literacy and numeracy test scores for students with below median baseline numeracy test score and Columns (3) and (4) present regression estimates of literacy and numeracy test scores for students with above median baseline numeracy test score.

Table 8: Effect by Median Baseline Cognitive Test 1 Score

	(1)	(2)	(3)	(4)
	Below Median Baseline Score		Above Median Baseline Score	
VARIABLES	Literacy	Numeracy	Literacy	Numeracy
SC	7.364	-1.523	8.078	0.210
	(11.24)	(1.913)	(14.49)	(1.638)
OBC x Upper Caste Teacher	48.59	1.646	182.8**	13.53**
	(32.10)	(2.652)	(81.21)	(5.342)
SC x Upper Caste Teacher	22.75	-1.136	99.05***	4.414
	(24.02)	(4.114)	(23.06)	(2.637)
Mean score for OBC students	29.40	15.35	45.27	18.12
Observations	222	222	182	182

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

Notes: The table presents regression estimates of Endline test scores of literacy and numeracy on a binary indicator of whether the student is SC, with interactions between caste of students (SC or OBC) and upper-caste teacher, as well as controls for students' and teachers' observable characteristics described in Table 1. Columns (1) and (2) present regression estimates of literacy and numeracy test scores for students with below median baseline cognitive test score and Columns (3) and (4) present regression estimates of literacy and cognitive test scores for students with above median baseline cognitive test score . Cognitive test is Forward digit span test and is described in the Appendix B.

Table 9: Effect by Median Baseline Cognitive Test 2 Score

	(1)	(2)	(3)	(4)
	Below Median Baseline Score		**Above Median Baseline Score**	
VARIABLES	**Literacy**	**Numeracy**	**Literacy**	**Numeracy**
SC	-3.958	-3.703	10.28	2.503*
	(9.447)	(2.586)	(11.43)	(1.317)
OBC x Upper Caste Teacher	3.717	-0.874	109.9***	8.116***
	(24.21)	(3.034)	(21.19)	(2.362)
SC x Upper Caste Teacher	15.59	2.169	68.13*	1.392
	(33.33)	(4.311)	(34.89)	(2.717)
Mean score for OBC students	35.28	15.45	36.49	17.05
Observations	149	149	255	255
	*** p<0.01, ** p<0.05, * p<0.1			

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

Notes: The table presents regression estimates of Endline test scores of literacy and numeracy on a binary indicator of whether the student is SC, with interactions between caste of students (SC or OBC) and upper-caste teacher, as well as controls for students' and teachers' observable characteristics described in Table 1. Columns (1) and (2) present regression estimates of literacy and numeracy test scores for students with above median baseline cognitive test score and Columns (3) and (4) present regression estimates of literacy and numeracy test scores for students with below median baseline cognitive test score. Cognitive test is Rapid Automatic numbering test and is described in the Appendix B.

Table 10: Effect on Cognitive Test

	(1)	(2)
VARIABLES	**Cognitive test 1 (FDS)**	**Cognitive Test 2 (RAN)**
SC	0.115	-0.336
	(0.181)	(0.658)
OBC x Upper Caste Teacher	-0.737	-1.058
	(0.533)	(1.023)
SC x Upper Caste Teacher	0.0454	0.441
	(0.464)	(0.628)
Mean score for OBC students	5.45	46.23
Observations	404	404

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

Notes: The table presents regression estimates of Endline test scores cognitive tests on a binary indicator of whether the student is SC, with interactions between caste of students (SC or OBC). and upper-caste teacher, as well as controls for students' and teachers' observable characteristics described in table 1. Cognitive test 1 is Forward digit span (FDS) test and cognitive test 2 is Rapid Automatic numbering (RAN) test.

Table 11: Effect on Knowledge and Confidence

VARIABLES	(1) **Knowledge**	(2) **Willingness to Pay to view answer options (lower value entails higher confidence)**
SC	0.150	22.97
	(0.311)	(20.26)
OBC x Upper Caste Teacher	-0.232	-16.72**
	(0.680)	(6.589)
SC x Upper Caste Teacher	-0.560	-39.96*
	(0.455)	(19.64)
Mean score for OBC students	6.01	19.39
Observations	404	404

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

Notes: The table presents regression estimates of Endline test scores knowledge score and willingness to pay measure on a binary indicator of whether the student is SC, with interactions between caste of students (SC or OBC) and upper-caste teacher , as well as controls for students' and teachers' observable characteristics described in table 1.

APPENDIX A

A model of Identity and Education

Utilizing the utility function, where the motivation of learning depends both on pecuniary incentives toward education and non-pecuniary incentives such as gain in utility from enhancing their 'self-image' or 'identity' (Akerlof and Kranton, 2005), we derive a simple theoretical model of learning. The model shows that identities, which can be a combination of social identities such as race, ethnicity, and gender, have an explanatory power beyond standard economic factors for learning outcomes.

3.1. Utility and Identity

Based on the work of Akerlof and Kranton (2000), we propose a utility function that describes the motivation to learn where motivation is not only economic such as the increase in literacy level, employment opportunities, productivity gains but also non-pecuniary such as concern for status in the society.

A student chooses the amount of learning '**x**' to maximize welfare, which consists of the economic returns and the extrinsic value of learning.

For any student, we assume the economic returns to the learning **x** is

$$-\alpha x^2 + \beta x + c,$$

where $\beta - 2\alpha x > 0$ and $\alpha > 0$, meaning economic return to learning is increasing and convex in the level of learning '**x**.'

The extrinsic return to learning is defined as the utility of feeling less unequal to the teacher, which is related to the relative position of the student and teacher in the society, and the student's education level. The amount of learning is not only determined by the intrinsic gain students get from learning but also depends on whom students think they are as defined by the social category and where they should see themselves relative to teachers in the learning environment.

Let us assume that a student and a teacher belong to a social hierarchy, and "**d**" measures the distance between the student and the teacher. Using Akerlof (1997), where trade value depends inversely on the final and initial geographical positions of the two players, the extrinsic value of learning level '**x**' is given by

$$\frac{e}{d_0\left(d_0 - d_1(x)\right)}$$

Here **e** is a positive constant, and **x** is the level of learning. The distance between a student and a teacher is d_0 before any learning by the student, i.e., the student believes that he/she is d_0 lower than the teacher's social standing in society. With **x** amount of learning, the student reduces the distance by $d_1(x)$, where $d_1(x)$ is an increasing and concave function of the level of learning **x.** Thus, d_0 and $d_0 - d_1(x)$ are the initial and final social distance between the student and the teacher, respectively. The extrinsic utility change can be

interpreted as the gain derived from moving up and closer to the teacher in terms of social status.

A utility maximising student chooses **x** to maximize the total value of learning given by

$$\frac{e}{d_0\big(d_0 - d_1(x)\big)} - \alpha x^2 + \beta x + c.$$

The first-order condition with respect to the level of learning **x** is given by

$$\frac{e.d_1'(x)}{d_0\big(d_0 - d_1(x)\big)^2} - 2\alpha x + \beta = 0$$

The change in the optimal amount of learning **x** to the initial social distance d_0 is:

$$\frac{\partial x}{\partial d_0} = \frac{(-2\alpha x + \beta)\big(3d_0 - d_1(x)\big)}{2d_1'(x)d_0(-2\alpha x + \beta) + 2\alpha d_0\big(d_0 - d_1(x)\big) - \frac{ed_1''(x)}{(d_0 - d_1(x))}} > 0$$

The above expression conveys that the greater the social distance between the student and the teacher, the greater the extent of the learning. In the context of India's caste system, the model's finding that the learning level **x** increases with the social status of the teacher d_0 implies that students learn more if taught by an upper caste than a non-upper caste teacher.

APPENDIX B – Data and Outcome Variables

Literacy Test

1. The first measure evaluates the number of letters the respondent can read in one minute. The test had 52 letters.
2. The second measure assesses the respondent's ability to read consonant-vowel combinations within one minute. The test had 63 syllables.
3. The third measure gauges the respondent's reading proficiency by counting how many words they can read in one minute. The test had 52 words. Some examples of words are Lion, apple, shoes.
4. The fourth measure focuses on the respondent's reading speed of nonsensical words within one minute. The test had 48 non-words. Some example are shele , fani which does not have any meaning in Hindi language,
5. The fifth measure involves reading a paragraph at the first-grade level having 64 words and syllables.
6. The sixth measure assesses the respondent's reading of a paragraph at the second-grade level having 88 words and syllables.

For each measure 1 to 6, we computed the total count of letters, syllables, words, etc. that could be read within the one-minute timeframe. In cases where a participant completed a task in less than a minute, the time taken was converted to minutes, and the corresponding count for letters, syllables, words, etc. per minute was calculated. To determine the literacy score, we summed the per minute scores across Task 1 to Task 6 which provides an aggregate measure of participants' ability.

7. The seventh measure encompasses answering four comprehension questions related to the first-grade level paragraph read, with a maximum score of 4.
8. The eighth measure involves responding to two comprehension questions based on the second-grade level paragraph read, with a maximum score of 2.

Numeracy Test

We assess numeracy using a set of 7 measures:

1. Oral counting of depicted objects, with a maximum score of 3.
2. Recognition of single and double-digit randomly selected numbers, with a maximum score of 20.
3. Counting objects and circling the correct number, with a maximum score of 2.
4. Counting objects and writing the correct number, with a maximum score of 2.
5. Filling in the missing digit in two number series, with a maximum score of 2.
6. Adding 2 to 3 single and double-digit numbers, with a maximum score of 4.
7. Subtracting single and double-digit numbers, with a maximum score of 2.

The total math score is computed as the sum of scores obtained across all seven measures, providing an overall assessment of numeracy proficiency.

Cognitive Test 1 – Forward Digit Span

In the Forward Digit Span test, respondents are presented with random sequences of digits and asked to orally recall them in the same order they were presented. The length of the sequences gradually increases, and a total of 16 questions are administered. The maximum possible score for this test is 16.

Cognitive Test 2 – Rapid Automatic Number

In the Rapid Automatic Number test, respondents were presented with four rows of six colored squares. Their task was to quickly name the colors of each square. The squares featured five primary colors and were arranged randomly in a matrix on the page. The maximum possible score for this test is 48.

Knowledge and Confidence Test

The Knowledge and Confidence Test consisted of two parts. In Part I, participants were presented with 12 questions focusing on general knowledge topics, including village governance, health, and education. For each correct answer, they were promised a reward of one pencil (serving as a proxy for cash), which could also be exchanged for other stationary items. Each correct answer was assigned a score of 1, contributing to an overall general knowledge score. This score serves as the measurement for the knowledge variable used in Table 11.

In Part II, respondents were given the option to view two answer choices for each question, with one being the correct answer. They were then allowed to reconsider their answers from Part I. To assess confidence, participants were asked how many pencils they were willing to forfeit in order to view the answer options. A lower willingness to pay indicated higher confidence. This measure of confidence is employed in Table 11.

Subsequently, a random price was drawn. If a participant's willingness to pay was lower than the drawn price, they were not shown the multiple-choice options. Conversely, if their willingness to pay was equal to or greater than the drawn price, they paid the specified price (in terms of the number of pencils) and could decide whether to revise or retain their original answers. In the end, participants received pencils as rewards for correct answers, which could also be exchanged for other stationary items.