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Nepal

DATA MUST SPEAK

Unpacking Factors Influencing School Performance

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Foreword

Nepal's school education sector has an incredibly diverse landscape when it comes to context, priorities and needs. The federal transition that was begun by the 2015 promulgation of Nepal's Constitution initiated the devolvement of functions and mandates to the provincial and local governments. School-level education (pre-primary education up to grade 12) became the primary responsibility of the 753 local governments. There are over 35,000 schools across the country, from the more densely populated southern plains of the Terai to the hills and eventually the sparsely populated mid- and far-western regions at the edge of the Himalaya mountain range.

With less than a decade left to 2030, the year set for the Sustainable Development Goals to be achieved, the joint efforts of the Government of Nepal and the development partners and other key stakeholders supporting the school sector have seen solid progress in indicators on access, participation and retention. This is particularly impressive when considering the extremely challenging context that these results have been achieved in, such as the aftermath of the devastating earthquakes in 2015 and the current COVID-19 pandemic.

In this context, the capacity for local governments to engage in needs-based and data-driven planning is paramount in terms of the extent to which national frameworks, targets and standards are translated into local education plans and budgets that are based on the data of their schools and validated by their stakeholders. This is even more relevant given the extreme differences in context, geographical area and needs of the population.

In an attempt to accelerate progress in areas that were lagging in terms of education outcomes or disparities experienced, various modelling exercises and pilots have been initiated over the years. However, these models often end up being difficult to replicate and scale up due to the resources required for them to be successful, or they become primarily focused on things like infrastructure rather than teaching and learning processes.

This positive deviance research is therefore an attempt to identify public schools that have the same context and resources available to them as other schools yet perform better than them. The analysis presented in this report is the first phase of the research, which focuses on the identification of these schools. The next phase of the research will take a closer look at the schools identified in order to understand what enables them to serve as models for schools with similar features and contexts.

I'd like to conclude by recognizing the partnership that the UNICEF Data Must Speak team has built over the years with myself and my colleagues in the Ministry and its line agencies, from the kick-off of the collaboration in 2015, supporting the development of the Equity Index and the transition to the web-based EMIS, to the co-creation sessions run in part of this positive deviance analysis.

We look forward to continuing this joint work.

Dr. Tulashi Thapaliya
Joint Secretary
Ministry of Education, Science and Technology
Government of Nepal

1. Introduction

Introduction

Despite the significant progress made in providing equitable access to education, there remain disparities in participation across geographic and social lines in Nepal. Moreover, learning outcomes have remained stagnant and low since 2012 (Ministry of Education, Science, and Technology of Nepal 2021). The 2018 National Assessments for Student Achievement (NASA) – a nationally representative, large-scale student assessment – indicated:

> **70 per cent of grade 5 students fell below the expected minimum competency level in mathematics, and 55 per cent fell below this level in Nepali. The same data show high disparities in learning levels, with a 91 per cent gap in achievement in mathematics between the highest and lowest performers (Kafle, Acharya and Acharya 2019).**

Nepali students are more likely to attend school today, but they are not learning as much as they should.

While the Government has implemented various impressive reforms over the past decade[1], devastating and unexpected events such as the earthquake in 2015 and the ongoing COVID-19 pandemic have put additional pressures on the education system. Furthermore, Nepal is currently undergoing a major constitutional and institutional transformation. The 2015 Constitution of Nepal introduced a federal transition that devolved a range of governing functions for school education to local governments. This new system has inevitably required increased capacity at the local level and the redefinition of existing roles and responsibilities.

These external and internal changes bring with them a number of challenges but, importantly, they also offer opportunities for education and its delivery to be reimagined in Nepal. As the Nepali Government works on its latest Education Sector Development Plan (2021/22–2030/31), ensuring that the education system is inclusive and equitable in terms of access, participation and learning attainment remains a priority. The Data Must Speak (DMS) Positive Deviance research aims to support the government in achieving these priorities. The same data that show areas where school performance has been lacking in education outcomes also indicates schools that are outperforming their peers, including in the most disadvantaged regions of Nepal.

Important policy insights can be drawn by identifying these 'positive deviant schools' (i.e., high-performing schools) and studying the good practices that explain their success. These insights can promote understanding of the drivers of performance in positive deviant schools and, consequently, the focus areas for improving education outcomes across all schools in Nepal.

By identifying and studying the public schools outperforming their peers in Nepal, the DMS Positive Deviance research aims to amplify relevant local solutions for improving education outcomes. The behaviours and practices of the stakeholders in these positive deviant schools will then be further unpacked so that the solutions identified can be translated into context-specific strategies. Such strategies can support all schools to overcome challenges preventing improved learning through realistic and feasible actions that are already working in similar schools.

1. These reforms include but are not limited to: the expansion of compulsory education to all, the introduction of NASA to track student learning over time, the development of school infrastructure, the introduction of targeted scholarships and incentives, the inclusion of formative assessments, massive recruitment and training of teachers, expansion of Early Childhood Education and Development centres, etc.

This research is part of the global Data Must Speak initiative, which aims to strengthen education systems' use of data to improve learning for all children. DMS began implementation in Nepal in 2015. Led by the Ministry of Education, Science, and Technology (MoEST) with technical support from the United Nations Children's Fund (UNICEF), the initiative initially focused on developing an equity index to inform government planning. In 2020, the DMS initiative was expanded to include a new positive deviance research component. Under this DMS research umbrella, experts from the Nepal MoEST, other central line ministries and several UNICEF branches have come together to identify drivers of school performance and positive deviance more broadly.

The main objective of this report is to identify the resources and contextual factors most associated with good school performance in Nepal. This is the first of five stages in the ongoing positive deviance research (**Appendix A** provides more information on the overall research methodology). Results from this analysis will support MoEST's mission to strengthen its public education system. Key insights have already been incorporated within the 2021 National Education Sector Analysis, and findings from future stages of the research will continue to feed into government education sector planning.

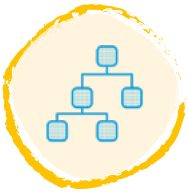
This report is divided into five sections:

Section 1

introduces the Data Must Speak Positive Deviance research in Nepal;

Section 2

provides an overview of the analytical framework, including the research questions, data used, analysis methodology, and limitations;



Section 3

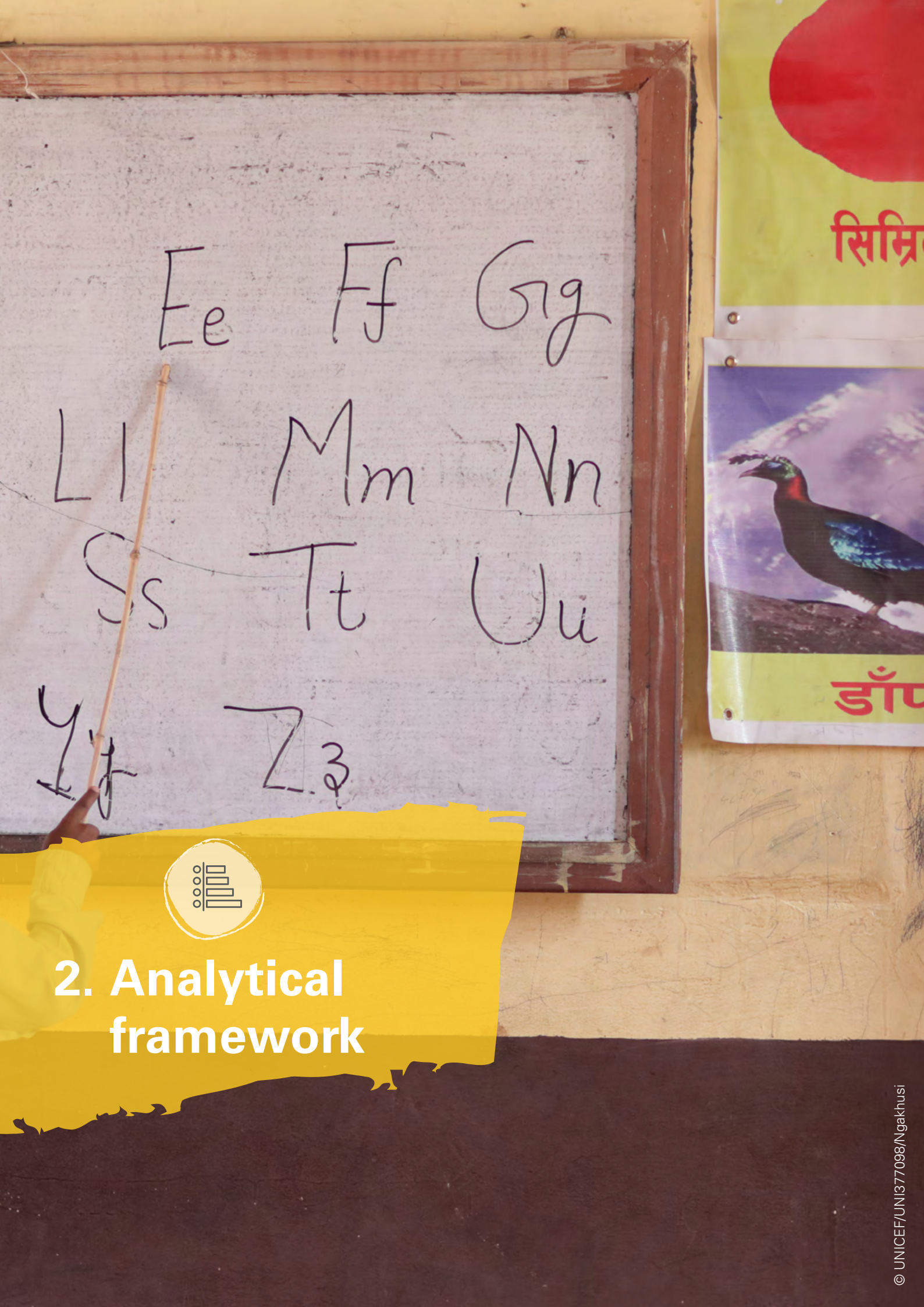
explains the co-creation model through which this research is being conducted;

Section 4

discusses key findings;

Section 5

synthesizes emerging areas for further policy exploration.



2. Analytical framework

Analytical framework

2.1. Methodology and research question

'Positive deviance' methodology is rooted in the premise that there are individuals in every community whose behaviours and practices help them find better solutions than their peers to the same problems, despite operating in similar circumstances (Herington and van de Fliert 2017, as cited in Lévano et al. 2022). The DMS research extends the positive deviance methodology to the education sector in Nepal, as it aims to understand why some schools in the country perform better than their peers even when facing similar conditions and with equivalent access to resources.

The research was designed based on a simple hypothesis. By comparing schools with similar demographic, contextual and resource-based characteristics – but very different performance outcomes – the observable differences in stakeholder behaviours and practices can likely explain why certain schools perform better. Furthermore, by identifying these specific behaviours and practices, the research aims to elevate pre-existing grassroots innovations that respond to persisting challenges in education in Nepal.

The research design comprises five in-country stages and leverages quantitative and qualitative methods. It also draws on different approaches such as positive deviance, behavioural sciences, participatory implementation research and scaling science.

In **Stage 1**, existing secondary data is analysed to understand what factors correlate to Nepal's school performance.

Stage 2 builds on Stage 1 to identify which schools are 'positive deviants', i.e., obtaining higher results even though operating with similar resources and contexts to their peers.

In **Stage 3**, the research team will visit the identified 'positive deviants' and a control group of average-performing schools to collect primary data on the behaviours and practices of stakeholders in these schools. This stage aims to identify how positive deviant schools differ from their peers and what practices and behaviours they employ to perform better.

Stage 4 will identify concrete levers and incentives at system, policy, school, and community levels to scale positive deviant practices and behaviours in all schools. It will also propose a scale-up action plan.

Finally, **Stage 5** aims to disseminate this knowledge widely.

Figure 1 below depicts the five research stages, which are also outlined in **Appendix A**.

Figure 1. Stages of the DMS Positive Deviance Research

This report details findings from Stage 1 and addresses the following research question:

What are the contextual and resource factors correlated to school performance (in terms of student learning, internal efficiency or equity) in Nepal?

Secondary data analysis was conducted during this stage using existing administrative and education datasets compiled by MoEST. A comprehensive ethical protocol, approved by the Health Media Lab,[2] was followed throughout data collection and analysis.

2. The Institutional Review Board application for the first two stages of the DMS research was approved on 21 October 2021. It outlines the critical steps that were followed when analysing secondary datasets, including steps to ensure the confidentiality and protection of personally identifiable information.

2.2. Analysis strategy

Multivariate regression analysis was used to understand the relationships between school performance, available resources and prevailing contexts in Nepal. The following regression model was estimated:

$$Y_i = \beta_o + \beta_1 Student_i + \beta_2 Teacher_i + \beta_3 School_i + \beta_4 Other_i + \varepsilon$$

Where:

Y_i	represents school performance for school i as measured by the average promotion rate, average repetition rate or average dropout rate
$Student_i$	is a set of independent variables representing average student characteristics in school
$Teacher_i$	is a set of variables representing average teacher characteristics in school
$School_i$	is a set of variables representing school-level characteristics for school
$Other_i$	is a set of variables representing other contextual information for school
ε	is the stochastic error term

Analysis was carried out at the **school level**.

In the primary models, the **average promotion rate at the school level** was used as the dependent variable, reflecting the ability of schools to enable students to progress through grades and keep them enrolled (also considered an important measure of internal efficiency at the school).[3]

The promotion rate by grade is the proportion of pupils from a cohort enrolled in a given school year who study in the next grade in the following school year (UNESCO 2021). For this analysis, the promotion rate was first calculated for each grade using the formula below and then aggregated at the school level to represent the average promotion rate for a given school.

$$PR_i^t = \frac{NE_{i+1}^{t+1}}{E_i^t}$$

PR_i^t	Promotion rate at grade i in school year t
NE_{i+1}^{t+1}	New entrants to grade i+1 in school year t+1
E_i^t	Number of pupils enrolled in grade i in school year t

3. A possible limitation of this indicator is related to policies of automatic promotion prevalent in certain schools/regions. For instance, if education management authorities engage in automatic promotion practices, this indicator may not capture the true internal efficiency of the system or its ability to teach students what they should know in a specific grade. However, in Nepal, automatic promotion is not practised in schools, making the promotion rate a suitable indicator for this analysis.

Another way to think about average promotion rates (see **formula below**) is as the combination of the average repetition and dropout rates each year.[4]

$$PR_t = 100 - RR_t - DR_t$$

PR_t Average school promotion rate in school year t

RR_t Average school repetition rate in school year t

DR_t Average school dropout rate in school year t

Repetition and dropout rates, the two sub-components of the promotion rate, are analysed separately in secondary models. Only select results from these models are discussed in this report.

In other words, this analysis characterizes **school performance** in terms of the internal efficiency of the school system as defined by student promotions, repetitions and dropouts.

There are multiple other ways to determine school performance, such as students' learning outcomes and equity along various outcomes. The initial plan was to use multiple definitions of school performance, especially measures of student learning, to further bolster this analysis and identify any interesting diversions in performance. However, the team ended up focusing on internal efficiency-related outcomes due to various data considerations. For example, while the NASA dataset collected by the Education Review Office (ERO) within MoEST provides information on learning outcomes, it only collects this information for a small subset of schools for each subject, reducing the sample for analysis.

Since one of the core goals of this research is to identify positive deviant schools from the entire population of Nepali schools, the team chose an indicator for which data for most schools in the country were available (i.e., promotion rates). Additional analysis of the NASA data – which serves as an excellent

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4. Where the dropout rate is the proportion of pupils from a cohort enrolled in a given grade in a given school year who are not enrolled in the following school year, and repetition rate is the proportion of pupils from a cohort enrolled in a given grade in a given school year who study in the same grade in the following school year.

source of high-quality learning measures – was conducted to identify country-level trends. This analysis largely confirms the results of the promotion rates analysis and is included in **Appendix E**.

All independent or explanatory variables included in the analysis were calculated at the school level and refer to the characteristics of either students (gender, caste, etc.), teachers (age, qualification, etc.) or schools (size, governance, etc.).

Independent variables were chosen based on their relevance to the research question (as determined by underlying education theory and the extensive education and policy experience of the research team), their variability,[5] as well as important data considerations.[6]

2.3. Data

The Education Management Information System (EMIS) data from 2018 is the primary dataset used for this analysis.

The EMIS data is an annual census exercise conducted by MoEST. It is a rich administrative dataset that includes descriptive information (hundreds of variables) on every school in Nepal. The 2018 EMIS dataset included information on the following broad categories:

Student enrolment	School type and locality
School audits	Student attendance
School compound details	Staffing levels
Internal examination scores	School resourcing
Staff experience	Students with disabilities
School grants	Staff qualifications
Promotion, repetition and dropouts	Textbooks and curricula
School room details	School opening days

This data is available at the grade level for each school. School heads compile all relevant data, fill out the EMIS questionnaires, and submit them to MoEST. While the EMIS includes data at the grade level, all data used in this analysis were aggregated at the school level.

There are around 33,000 schools in Nepal, of which 21,138 schools (64 per cent) are public schools. **This analysis focuses on public schools.**[7] The decision to narrow the scope of this analysis to public schools was driven by the limited amount of available data on other school types (i.e., private and traditional schools). When reporting on all variables improves, and better data is available, it would be interesting to compare outcomes across different school types – public, private and traditional – to identify differences in performance.

5. Variables with low variation were not included in the models because they contribute little to the results and may introduce multicollinearities.
6. This analysis provides a cross-sectional look at the education sector in Nepal, as only data from 2018 was used. Additionally, certain variables that could have described promotion through school were discarded from this analysis because high-quality data was unavailable on these variables. Variables with a large number of missing values were also discarded.
7. For instance, most of the private and traditional schools report only partially to the EMIS, causing up to 60 per cent of data on these schools to be missing, making it hard to include them in the analysis.

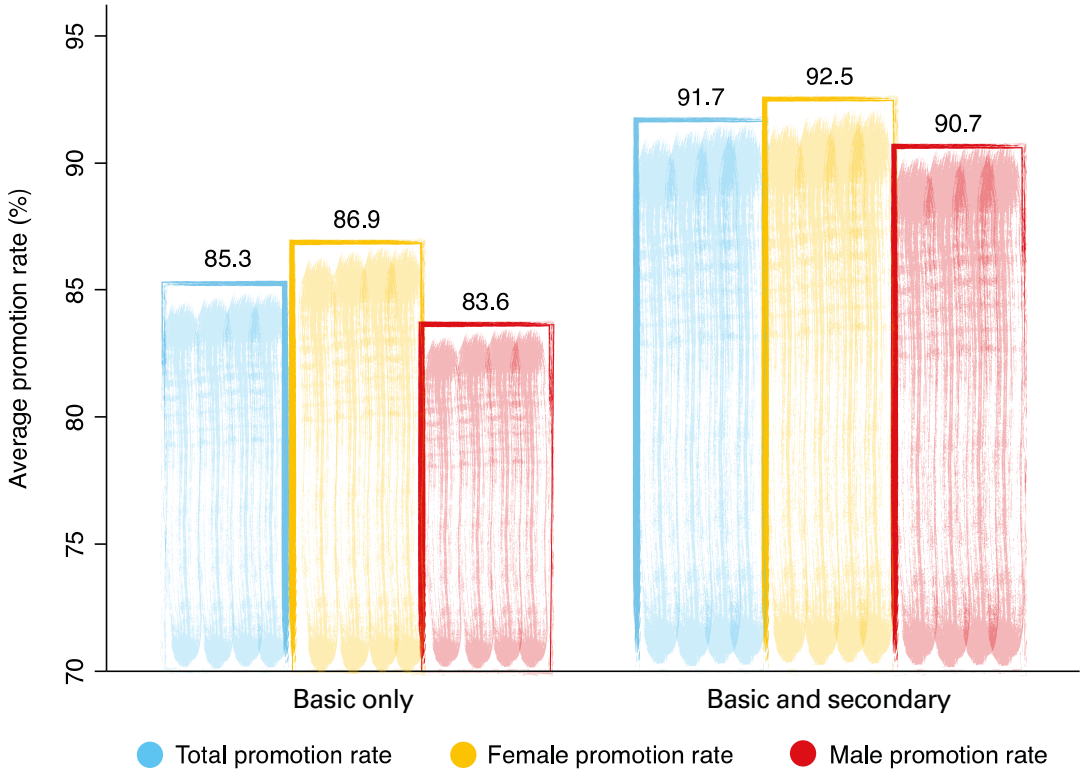
From the sample of 21,138 public schools, the outcome variables – promotion rate, repetition rate and dropout rate – could be estimated for 20,799. Appropriate data was not available for the remaining schools. Only 15,787 schools had data on all the variables included in our data model; hence, the final sample for this analysis was 15,787 schools.

2.4. Descriptive statistics

The education system in Nepal is composed of one year of Early Childhood Education and Development (ECED) and four levels of education: lower basic (grades 1–5), upper basic (grades 6–8), lower secondary (grades 9–10) and higher secondary (grades 11–12). Schools can be composed of multiple levels. For example, one school may only contain basic levels (grades 1–8), whereas another may contain all four levels (grades 1–12).

The analysis differentiates along three education levels: (a) **basic only**, or schools that include basic levels (grades 1–8); (b) schools that include **basic and secondary levels** (grades 1–8 and some or all of grades 9–12); and (c) **secondary only**, or schools that only include secondary levels (grades 9–12). The analysis was differentiated as such to account for differing repetition and dropout rates at different levels. Typically, across education systems, it is more common for older students to dropout compared to younger students. Thus, promotion rates across different education levels are not comparable, and so the analysis accounts for this trend. **Figure 2** depicts promotion rates by school type.

Figure 2. Average promotion rate by school type

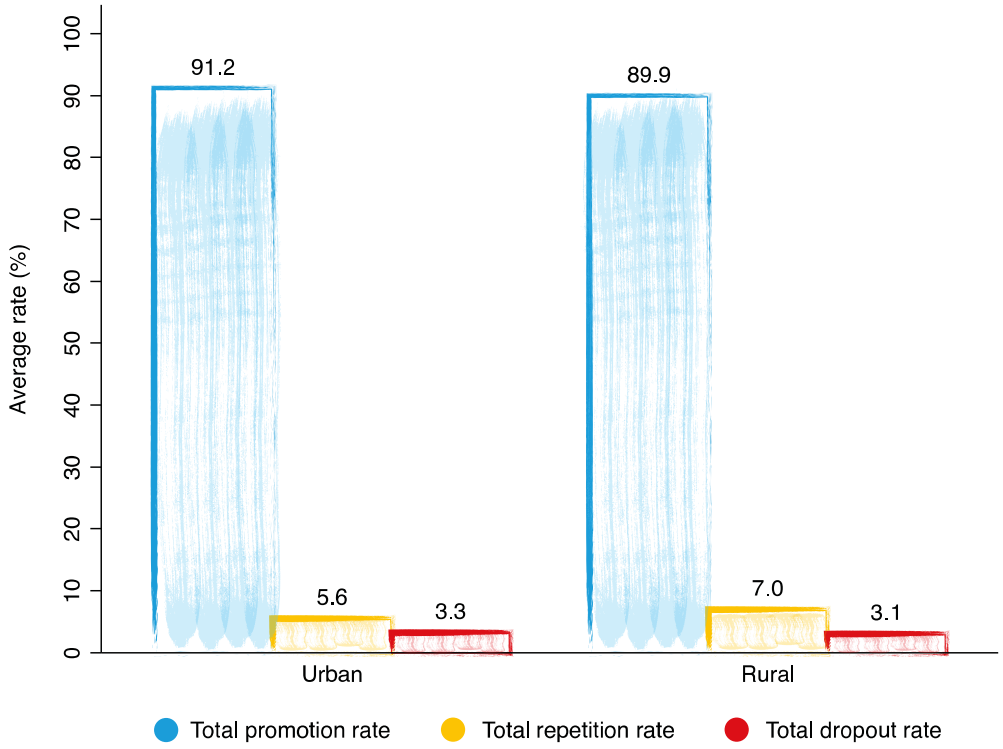


In the sample of all public schools with information available regarding their type, 53 per cent of schools are basic only, 46 per cent include both basic and secondary grades, and less than 1 per cent include secondary grades only.[8]

In addition, 45 per cent of the schools are located in urban areas, with the remaining 55 per cent located in rural areas.

Figure 3 below shows the average promotion, repetition and dropout rates for students in rural and urban areas in Nepal. The sample is also geographically representative of all seven provinces in the country.

Figure 3. Average promotion, repetition and dropout rates by school location



In terms of the student characteristics of the sample, on average, 52 per cent of the student body is female, although there is some variation across schools. Most of the students across these public schools are from indigenous (Janajati) households (38 per cent), followed by students from Brahman-Chhetri households (25 per cent) and Dalit households (21 per cent). A significant minority were characterized as children from 'other caste' households (16 per cent). While these average figures give a sense of the overall demographic profile of the public schools in the sample, the composition often varies between schools.

8. Data on school type is missing for roughly 9 per cent of schools in the dataset.

The Nepali teachers in the sample also come from different backgrounds and have diverse profiles. **The average Nepali teacher is 40 years old**, although teacher age ranges from 17 to 65. On average, **39 per cent of teachers are female**. A large proportion (40 per cent) of the teacher workforce comprises temporary or Rahat teachers.[9] Finally, most teachers (69 per cent) have a bachelor's degree or above, 25 per cent have intermediate-level education,[10] and a small minority (only 6 per cent) have a grade 10 school leaving certificate as their highest academic qualification.

Detailed summary statistics on all the variables used in the multivariate analysis are included in **Appendix B**.

2.5. Limitations of the research

There are a few limitations to this research that must be kept in mind when interpreting the results and using them to inform action and policy:

Available data only partially explains school performance	The dataset used in this analysis contains information collected at the school level; however, it does not include demographic or socio-economic information about students, their backgrounds or their relationships with their parents. The research team will collect additional primary data in Stages 3 and 4 to better understand the other factors influencing learning in Nepali schools.
Data inconsistencies	Despite the data collection process being comprehensive, the administrative data used in this analysis contained some inaccuracies. The research team (composed of MoEST/Centre for Education and Human Resource Development [CEHRD] and UNICEF representatives) thoroughly reviewed the data to address existing inconsistencies. The discrepancies identified in the data review exercise and during the analysis allowed further improvements to data quality and helped address some of these issues in the database.
Correlation, not causation	Results should be interpreted with caution as the analysis does not reveal if the correlations observed represent causal effect. For example, promotion rates are higher in the data when teachers are older. However, this does not necessarily mean hiring or retaining older teachers will improve promotion rates. It could instead be the case that schools that have older teachers (or 'more experienced' teachers) are also better equipped along other dimensions (such as better equipment, more classrooms, etc.), all of which could be contributing to the high promotion rates. While the analysis accounts for various school-level resources and other essential variables representing such differences, there may be unobservable characteristics not present in the EMIS dataset (such as the leadership skills of the school director). Hence, results should not be interpreted as causal and must instead be considered in tandem with other similar research and available analysis. Future stages of this research will also aim to bolster the findings of this first phase.

9. Temporary teachers are those who have been appointed to government positions by the School Management Committee but who are yet to sit the teacher selection test. They enjoy a full government salary, but do not receive benefits such as increments, provident funds, pensions, promotions or unpaid leave. Rahat teachers are hired by the School Management Committee to fixed-term government positions. They get a fixed salary, normally less than the pay scale enjoyed by permanent and temporary teachers (Khanal 2011)

10. Intermediate-level education includes teachers with at least a grade 12 leaving certificate and in some cases a teaching diploma.

3. Operationalizing the research

Operationalizing the research

A core tenet of this research is *co-creation*, meaning that the research is undertaken jointly by external researchers and technical experts in the education system. Co-creation ensures that the research fully incorporates existing in-country knowledge and data and responds to policymakers' and planners' needs and knowledge gaps. Ultimately, the goal is to produce policy-relevant and timely information that is useful for the Government.

What is co-creation, and how is this research being co-created? Quite simply, this research leverages a participatory process for co-creation. All aspects of the research – ranging from design to implementation to analysis – are collectively executed with MoEST experts, its central line agencies and other key education stakeholders in Nepal. Two distinct groups of relevant stakeholders participate in co-creation processes:

a) Technical Reference Group, and
b) Core Technical Team.

The Technical Reference Group comprises 20 members, including Nepali quantitative experts, representatives from MoEST, CEHRD, ERO, national academic institutions, bilateral and multilateral development partners that support the Nepali education sector plan following a sector-wide approach, and experts from UNICEF. This group acts as an advisory committee providing high-level input into the design, methodology, implementation plan and timelines of the research. It also supports the interpretation of all findings across the different research stages. The Core Technical Team is a smaller, more specialized team of monitoring and evaluation experts and statisticians from the Government. This team includes representatives from the EMIS and ERO departments within MoEST – the key departments responsible for compiling and maintaining the datasets used in this research. This team was involved in the day-to-day implementation of Stage 1, including reviewing and analysing the data, and will play a similar role in future stages.

The Core Technical Team spearheaded Stage 1 by meeting regularly for 'Technical Co-Creation Sessions'. They used these sessions to review the data and make critical analytical decisions. Initially, these technical sessions were planned to take place in person. However, the rapid spread of the COVID-19 pandemic a few weeks after the research was initiated affected these plans, and the sessions were adapted and conducted remotely to adhere to the travel and mobility restrictions imposed during the COVID-19 pandemic.

In addition to the findings from Stage 1 of the research, **the co-creation process produced recommendations for improving data collection. These will support the technical experts in CEHRD and ERO to inform future strengthening of the education data infrastructure in the sector.** Nepal is one of the first countries where the DMS Positive Deviance research was operationalized. This MoEST-UNICEF partnership will inform research in all future countries across Africa, Asia and Latin America.

4. Discussion of findings

Discussion of findings

This section has three parts. The first sub-section (**4.1**) presents findings from the primary econometric models, which use average promotion rates as the dependent variable. The second sub-section (**4.2**) discusses notable results from secondary models that use repetition and dropout rates as their dependent variables. The final sub-section (**4.3**) shares insights on school grants and how they are used, as this was an area of particular interest for MoEST.

Municipality-level fixed effects were also included as a robustness check for all the models discussed in this section. Including these fixed effects did not significantly influence the direction and significance of the results. While this section presents the results from models that do not include fixed effects, results from the fixed-effects models are also discussed in **Appendix C**.

Finally, similar econometric models as those used in the primary analysis (with promotion rates as the dependent variable) were also analysed using examination data collected by NASA as the dependent variable (**4.1**). Most of the estimated coefficients in these NASA models largely confirm the results of the primary promotion rate models. Results from this analysis are included in **Appendix E**.

4.1. Determinants of school promotion rates

This section presents the findings of the four main models used in the analysis. Model 1 estimates the determinants of average promotion rates at the school level. Model 2 estimates determinants of the average female-only promotion rates and model 3 does the same for the average male-only promotion rates. Finally, model 4 estimates the determinants for the average promotion rate of schools with basic levels (or primary grades) only. Each result was modelled according to Equation 2.2.1 and included data on a maximum of 15,787 public schools spread across Nepal.

Table 1 below presents the determinants for the different promotion rates used in each model. In the rest of this section, the promotion rate determinants are presented and grouped into four categories: student characteristics, teacher characteristics, school characteristics and other characteristics.

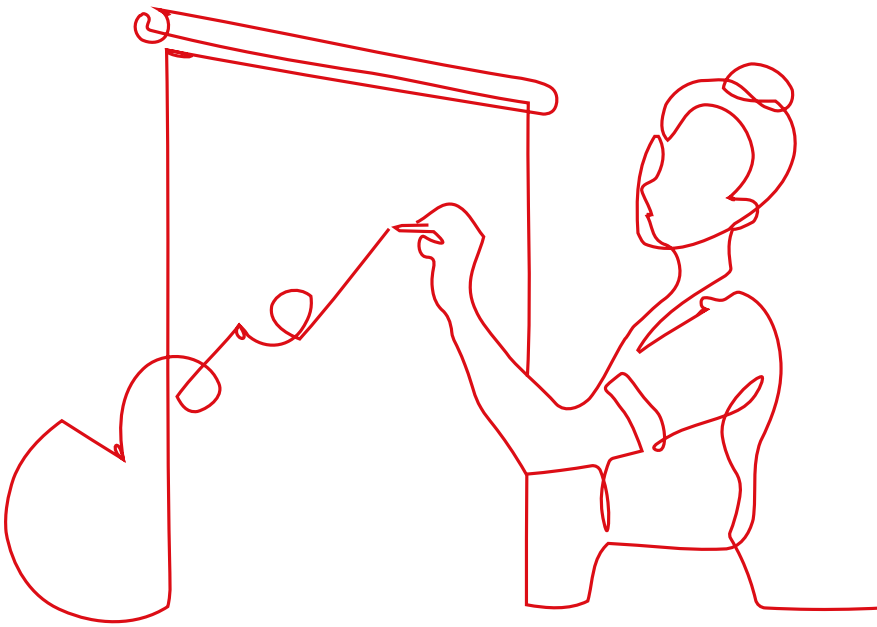


Table 1. Determinants of school promotion rates

	Model 1	Model 2	Model 3	Model 4
Variables	Promotion rate	Female promotion rate[11]	Male promotion rate	Primary-only promotion rate
Student characteristics				
Percentage of female students	0.018	-0.077***	0.058***	0.031**
Percentage of students from Dalit households	-0.009*	-0.006	-0.011*	-0.005
Percentage of students from Janajati households	-0.009**	-0.001	-0.015***	-0.011**
Percentage of students from households categorized as other castes	0.017***	0.016***	0.012*	0.008
Percentage of students with ECED experience	0.068***	0.063***	0.072***	0.099***
Teacher characteristics				
Percentage of female teachers	0.017***	0.020***	0.014***	0.014**
Percentage of teachers from Dalit households	-0.008	-0.002	-0.013	-0.018*
Percentage of teachers from Janajati households	0.001	0.004	-0.002	0.003
Percentage of teachers from households categorized as other castes	-0.003	-0.002	-0.004	-0.004
Student-teacher ratio	-0.044***	-0.051***	-0.044***	-0.105***
Average age of teachers	0.163***	0.182***	0.156***	0.214***
Percentage of native Nepali-speaking teachers	-0.007***	-0.005**	-0.009***	-0.003

11. The estimated coefficients of the promotion rate model 1 may not be the exact average of the estimated coefficients in the female 2 and male 3 promotion rate models as these models are estimated separately. This is likely due to different weightings based on the gender composition of the school, e.g., if a school has 10 boys and 100 girls, then the total weighted promotion rate for this school will be closer to the female promotion rate, as the boys' experience in this school is weighted less (since they are fewer). However, when using the male promotion rate for this school in the male promotion rate model 3, the same boys are weighted more in the regression (than they were in model 1). Ultimately, these kinds of weighting situations may result in the coefficients estimated in model 1 not being the exact average of models 2 and 3.

	Model 1	Model 2	Model 3	Model 4
Variables	Promotion rate	Female promotion rate[11]	Male promotion rate	Primary-only promotion rate
Percentage of teachers with intermediate-level education	-0.011**	-0.007	-0.012*	-0.014**
Percentage of teachers with a bachelor's degree or above	-0.002	0.002	-0.003	-0.000
Percentage of teachers who are temporary or Rahat	0.009***	0.014***	0.005	0.015***
School characteristics				
Number of SMC meetings	-0.023	-0.031	-0.008	-0.038
Compound made of Kachhi (temporary) materials	-0.231	-0.290	-0.111	-0.168
Compound made of other materials	0.320*	0.347*	0.316	0.356
Resource index	0.035	0.011	0.052	0.226**
Toilets per 100 girls	0.019	0.011	-0.047	0.013
School has never had a social audit	0.266*	0.241	0.190	0.307
School has a first aid kit	0.197	0.179	0.395*	0.430*
School has a children's club	0.412**	0.340**	0.347*	0.515**
Textbooks per student	-0.175	-0.178	-0.190	-0.052
Classrooms per 100 students	0.179***	0.189***	0.168***	0.218***
Number of students (total enrolment)	0.002***	0.002***	0.002***	0.027***
Other characteristics				
Urban	0.865***	0.758***	0.880***	0.915***
Other controls				
Percentage of students in lower secondary	0.125***	0.108***	0.137***	

	Model 1	Model 2	Model 3	Model 4
Variables	Promotion rate	Female promotion rate[11]	Male promotion rate	Primary-only promotion rate
Percentage of students in secondary	0.121***	0.112***	0.126***	
Percentage of students in higher secondary	0.090***	0.083***	0.090***	
Constant	73.865***	79.072***	71.079***	67.839***
Observations	**15,787**	15,787	**15,787**	**7,989**
R-squared	**0.161**	0.135	**0.132**	**0.131**

*, **, *** statistically significant at 10 per cent, 5 per cent and 1 per cent levels of significance, respectively.

The findings depicted in **Table 1** above are also largely confirmed by the NASA exam results model (model 15 in **Appendix E**). **A greater percentage of students with ECED experience and a higher number of female teachers are associated with a better NASA score, whereas the student-teacher ratio (STR) is negatively associated with the NASA exam score.** Better school characteristics, as captured by the resource index or the building material of the school, are associated with better NASA score results, possibly reflecting the fact that student performance benefits in better learning environments. Finally, students in larger schools tend to do better in NASA assessments.

4.1.1. Student characteristics

Various student-level characteristics were included in all four models – specifically, the gender, caste and ethnicity composition of the student body and students' experience of ECED were examined.[12]

Promotion rates do not vary significantly between male and female students when averaged across all grades. However, female students are more likely to be promoted in primary grades. While there is a slight positive difference – 1.8 percentage points (pp) – between the promotion rates of male and female students in the all-grades model 1, it is not statistically significant.[13] However, in the primary-only model 4, a positive and statistically significant difference between the promotion rates of female and male students can be observed. Female students are 3.1 pp more likely to be promoted compared to male students in primary grades.

Female promotion rates fare better in classrooms with more male students. The percentage of female students in a school appears to be statistically significantly correlated to the female promotion rate (2) and male promotion rate (3) at these schools, albeit in different ways. The female promotion rate is *negatively correlated* to the percentage of female students in a school, suggesting that female students perform

12. Ideally, this analysis would have included the demographic characteristics of student families (such as the socio-economic profile and education levels of their parents) as global literature indicates that these may influence student participation in the classroom and consequently student outcomes. However, the EMIS dataset does not include parent-related information since it only collects data at the school level. At least some of the effects of these demographic characteristics are likely to be captured in the ECED experience, student ethnicity and caste, and various school-level variables included in the model.

13. The difference is also slightly smaller than the raw difference between the coefficients of the female and male promotion rates (see models (2) and (3)). This is notably due to female students being more likely to be enrolled in large and urban schools with higher promotion rates. Therefore, some of the differences observed between boys' and girls' promotion rates can be attributed to differences in enrolment location.

better in schools with a relatively higher number of boys. On the other hand, the male promotion rate is positively correlated to the percentage of female students in the school.

Differences in the caste and ethnicity composition of the student body also influence promotion rates; however, these effects are small. Schools with a larger percentage of students belonging to Dalit or Janajati households have a lower promotion rate than schools with Brahman-Chhetri household students (the reference category in the model) but, again, the effects are relatively small. For example, a school where 100 per cent of students come from Janajati households would be expected to have a promotion rate 1 pp lower than a similar school where 100 per cent of students are from Brahman-Chhetri households. Roughly 10 per cent of students belong to households whose caste is categorized as 'other' and their presence is associated with a better promotion rate.

While it is encouraging to see that the estimated differences in promotion rates based on the caste and ethnicity composition of the student body are small, this remains an important area of focus given the history of systemic ethnic/caste-based inequality in Nepal.

These different promotion rates may reflect the underlying socio-economic disparities between different ethnic groups and castes. While this model controls for school inputs (which likely capture the general wealth in each region to some extent), socio-economic information about students' families is not included. As such, it is hard to know if the estimated coefficients are due to discrimination or differences in wealth between ethnic groups and castes.

In general, the results suggest some school performance inequalities even after controlling for school inputs.

Students who attend ECED programmes perform better. There is a relatively large positive association between ECED experience and promotion rate. Schools in which all students have ECED experience are likely to have a promotion rate 6.8 pp higher than schools with no students with ECED experience.

In the absence of a suitable variable that accounts for parental socio-economic status, the effect of caste and ECED might be over-estimated and may capture other underlying trends. For example, for ECED, the coefficient may capture the fact that wealthier families, families in urban or semi-urban areas, and families with working mothers are more likely to send their children to an ECED centre. Regardless, this effect is consistent with evidence across global literature, which repeatedly shows the importance of ECED for better education outcomes (Muroga et al. 2020; United Nations Children's Fund 2021; World Bank 2017). In addition, ECED experience has a more significant effect on promotion rates for primary grades (model 4), where ECED experience is likely to matter the most.

4.1.2. Teacher characteristics

Teachers play a critical role in educating students. The analysis modelled various important teacher characteristics, accounting for roughly 14 per cent of the explained variance in promotion rates. The gender, caste and ethnicity composition, average age, native language and education qualifications of the teacher population were examined, as well as the student-teacher ratio and its relationship with promotion rates.

Female teachers positively influence promotion rates for all, especially for girls. There is a small, albeit statistically significant, link between the proportion of female teachers in a school and promotion rates. On average, about 48 per cent of the teachers in Nepal are female. The primary model 1 suggests that if all teachers were women, the promotion rate would increase by 1.7 pp. Although male students do benefit from being in a school with more female teachers (model 3), the effect of female teachers is more substantial for female students (model 2). A school with all women teachers would improve the promotion rate for boys by 1.4 pp, and the promotion rate for girls by 2 pp.

These findings are consistent with global literature that has found that the presence of female teachers has a favourable effect on girls. Since all the regression models control for other teacher characteristics that could influence performance – such as their age and qualifications – the estimated effect of female teachers is likely not driven by these characteristics. Instead, it may be due to female teachers having different teaching practices or behaviours in the classroom.

Global literature has also shown that female teachers are more likely to act as role models for girls, which could be another driver of the estimated effect (Muralidharan and Sheth 2016). In general, further exploration of how female teachers conduct their classes and how they interact with their students, especially girls, could provide important policy insights.

Teacher caste and ethnicity characteristics are not related to promotion rates. The estimated coefficients of the variables representing teacher caste and ethnicity are statistically insignificant across models. And while there is a negative correlation between higher numbers of native Nepali-speaking teachers and promotion rates, the magnitude of this correlation is minimal.

The STR is negatively associated with promotion rates, particularly in primary grades. However, this effect is extremely small. STR is commonly used as a proxy for education resource allocation, although it is unclear to what extent it influences quality (understood as effective learning outcomes) and what an optimal STR should be (United Nations Conference on Trade and Development 2016). In Nepal, the average STR across public schools was 36 in 2018. However, this figure varies widely, ranging from an average of 21 in the quarter of schools with the lowest STR to 46 in the top quarter. The analysis shows that there is negative correlation between STR and the average promotion rate – one additional student per teacher decreases the school promotion rate by 0.04 pp.

This negative effect is more pronounced in basic schools (model 4), with one additional student per teacher decreasing promotion rates by 0.11 pp. Overall, while statistically significant, STR has a small effect on promotion rates, especially at higher grades.

There is positive correlation between Nepali teachers' average age and student promotion rates, with older teachers associated with higher promotion rates. If teachers are on average 10 years older, the promotion rate is 1.6 pp higher across grades (model 1) and 2.1 pp higher in primary grades (model 4). It is unclear how older teachers may act differently from younger teachers inside the classroom. It could be that they are more experienced since they have more years of teaching under their belt or they may be less strict concerning repetition criteria. Alternatively, it could be that older teachers are more likely to be allocated to certain types of schools, which are in turn more likely to have higher promotion rates. This trend will be explored further during the subsequent phases of the DMS research to understand the reasons behind it better.

Teachers' academic qualifications do not affect school promotion rates. In this analysis, teacher qualifications are captured by two variables: the percentage of teachers with an intermediate level of education and the percentage of teachers with a bachelor's degree or higher. The reference category was teachers with a school leaving certificate or lower. While a larger share of teachers with an intermediate level of education is associated with a lower promotion rate (model 1), the size of this effect is relatively small. There is no observed difference in performance between teachers with a bachelor's degree or higher and teachers with a school leaving certificate or less. This trend is consistent with global findings that have revealed that observable teacher qualifications such as formal education and certification status do not consistently correlate with improved student outcomes (Hanushek, Piopiunik and Wiederhold 2019; Lauwerier and Akkari 2015; Sharma, Shotland and Komaragiri 2021).

Schools with a higher proportion of temporary or Rahat teachers seem to have higher promotion rates, but this effect is relatively small. For example, a school where all teachers are temporary or Rahat would have a promotion rate that is 1 pp higher. While there are only hypotheses about how temporary and Rahat teachers influence student performance, global literature and education theory do provide some clues. These teachers face different accountability structures and are more likely to lose their jobs if they perform poorly, which incentivizes better performance. This trend does not justify keeping teachers under the temporary or Rahat appointment status. However, perhaps policymakers can draw from this system and explore appropriate accountability structures and incentives for all teachers to improve performance on the margins.

4.1.3. School characteristics

Next, this analysis explored school-level characteristics, which accounted for the largest explained variance in promotion rates (31 per cent). The following school characteristics were included: variables capturing school governance (such as the number of School Management Committee (SMC) meetings or the incidence of official school audits), variables capturing infrastructure and resources (such as the

material used to construct the compound, a resource index that included information on various infrastructural resourcing at each school,[14] the presence of a first aid kit, and the number of classrooms available for learning), resources for female students, other learning-related resources and activities such as textbooks per student and the existence of a children's club.

Observable school governance mechanisms (such as the number of SMC meetings held and the incidence of social audits) do not appear to influence promotion rates. For example, the number of SMC meetings held in a year has a small positive coefficient (0.023 pp) that is not statistically significant. Similarly, while mildly statistically significant, there was small positive correlation between the occurrence of social audits and promotion rates.

Organized student clubs – the Children's Clubs of Nepal – are associated with improved promotion rates. Children's Clubs are a unique student institution in Nepal. They are often self/co-managed by children and provide students with the opportunity to participate in the governance of their schools. These clubs operate via regular meetings and aim to impart essential socio-emotional skills to students and promote personal growth. This analysis shows that the presence of a children's club is associated with a 0.41-pp improvement in school promotion rates across grades. This effect is higher in schools with only primary grades (0.5 pp in primary-only schools compared to 0.41 pp across all schools). There could be various mechanisms through which children's clubs influence promotion rates; it could be that they offer students an important space for development and self-expression, thereby promoting attendance, or it may be that schools with children's clubs are inherently different from their peers – they may be better governed or managed, in which case the impacts of children's clubs are overestimated. Either way, this is an exciting and potentially helpful policy lever to improve internal efficiency in Nepali schools and will be investigated in future stages of the research.

Various school infrastructure and resource-related characteristics were not strongly associated with higher promotion rates. A large portion of the school budget is spent on infrastructure and resources. This analysis included variables representing some of this expenditure to explore how it relates to school promotion rates. While many of the variables included – building material for schools, information on books, computers, and electricity, and the presence of a first aid kit – are positively associated with promotion rates, these estimated effects are not statistically significant.

These results do not imply that infrastructure is not important. On the contrary, global evidence shows that fully functioning schools are conducive to student learning (Glewwe et al. 2011). However, how these resources are used and how they influence student-teacher interactions in the classroom is more important than the presence of more resources. Infrastructure and resources are essential, but they work best when they can improve classroom interactions between teachers and students (Sharma, Shotland and Komaragiri 2021). This analysis does not capture how these resources and infrastructure are used (or not used) in schools; future stages of the DMS research will conduct deeper qualitative investigations to understand if and how infrastructure plays a role in better outcomes.

Sufficient physical classroom space for students is associated with higher promotion rates. The analysis examined the number of classrooms per 100 students to understand if there is sufficient space for all students in Nepali classrooms. Results showed that the classrooms per

14. Specifically, this index was calculated by adding together dummy resourcing variables (variables taking values 1 or 0), which measured the presence of the following resources in the school: books in the library, computers, computers for teachers, computers for learning, electricity and internet. As such, a school that scored 0 had none of these resources, and a school that scored 6 had them all.

100 students ratio (or classroom-student ratio) has a large and statistically significant effect across all four models.[15] This effect is highest for primary grade-only schools. There is much variability in the number of classrooms per 100 students; schools in the bottom quarter in terms of available classrooms have on average 2.7 classrooms per 100 students, while those in the top quarter have 9.4 classrooms per 100 students. However, this difference translates into only a small improvement in promotion rates. For instance, increasing the number of classrooms per 100 students by 1 improves the overall promotion rate by 0.18 pp (model 1). While the availability of physical space seems to influence promotional rates slightly, there is a need for further research to understand the mechanism through which this happens. Theoretically, more classrooms could ensure that students are comfortably seated, that teachers across grades/subjects do not have to share a classroom, and that teachers can give more attention to students – all of which may contribute to a better-quality teaching environment.

Finally, large schools (measured by the number of students enrolled) perform better than smaller schools. There could be various reasons for this trend. Larger schools may be better organized. It is also possible that larger schools are better managed and have more and higher-quality administrative staff that contribute to better outcomes. Alternatively, there could be a reverse trend whereby larger schools are large precisely because they are better at attracting and retaining people and students. Finally, the location of these schools is also likely to play a role; larger schools are more likely to be located in urban areas,[16] are likely better endowed and have better access to higher-quality human capital. Even though the school's location was controlled for in the model, the data reveal that schools in urban areas tend to be larger than those in rural areas. This trend will be closely investigated in future stages of the research.

4.1.4. Other characteristics

The last few variables included in the models describe the school's location and the grade composition of its student body. These account for the remaining 43 per cent of the explained variance in average promotion rates.

Schools in urban areas outperform schools in rural areas. On average, a school in an urban region is likely to have a promotion rate 0.9 pp higher than a school in a rural region – a sizeable and statistically significant association. To some extent, this is expected. While the models used in this analysis control for the observable differences in resources and staff quality, there are other differences on which data is unavailable or unobservable. For example, urban schools often cater to students from higher socio-economic backgrounds, who are often better prepared for school.

This difference in outcomes between urban and rural schools highlights an important area of focus for future education policy decisions and resource allocation. In 2018, MoEST operationalized an Equity Strategy by developing an equity index (with support from the DMS initiative) to prioritize the local governments with the highest disparities in education outcomes for targeted interventions and additional funding. While these initiatives have enabled MoEST to take significant steps towards addressing inequity in the system, there is a need to continue focusing on equity-based policies.

15. Note that the ratio of physical classrooms to students is different from the STR. The STR is in many ways a proxy for the amount of teacher attention received by each student on average. The classroom-student ratio is a proxy for space in a school. A low classroom-student ratio (<1 per 100 students) is problematic because it suggests that students may not even have the physical space to learn in a school. These two variables are negatively correlated to each other (Pearson correlation coefficient of -0.49). To account for possible multicollinearities in the estimates, robustness checks were conducted by (a) running all models with only the STR variable, and (b) running all the models with only the classrooms per 100 students variable. There were no significant differences in the output between (a) and (b) and between these models and the results presented in the main text here. The results from the original model have been included in the main text for this analysis.

16. The average number of students in an urban school is 246 compared to 166 in rural schools.

Finally, the last set of variables in this category controls for the percentage of students in lower secondary, secondary and higher secondary levels in the school (with the reference category being students at the primary level). These variables were added as controls in the analysis to account for the fact that promotion rates vary across grades and tend to be much higher at the secondary level than the primary level. This difference may reflect different educational practices regarding repetition in different grades. Further conversations with educators at these different grade levels are needed to unpack the reason for this observed difference.

4.2. Determinants of school repetition and dropout

The promotion rate of a given school is the result of two components: (a) the repetition rate, and (b) the dropout rate (see **section 2.2**).

In addition to promotion rates, additional analysis was conducted using repetition and dropout rates as the outcome variables in regression models in order to understand how different factors influence these key components of the promotion rate. **Table 2** shows the key results for the repetition and dropout rate models.

Table 2: Determinants of repetition and dropout

	Model 5	**Model 6**
VARIABLES	Repetition rate	Dropout rate
Student characteristics		
Percentage of female students	-0.018	0.000
Percentage of students from Dalit households	0.007	0.002
Percentage of students from Janajati households	0.010***	-0.001
Percentage of students from households categorized as 'other castes'	-0.027***	0.011***
Percentage of students with ECED experience	-0.055***	w
Teacher characteristics		
Percentage of female teachers	-0.014***	-0.003**
Percentage of teachers from Dalit households	0.002	0.006**
Percentage of teachers from Janajati households	-0.002	0.001
Percentage of teachers from households categorized as 'other castes'	0.002	0.001
STR	0.037***	0.007***
Average age of teachers	-0.155***	-0.008
Percentage of native Nepali-speaking teachers	0.007***	-0.001

	Model 5	Model 6
VARIABLES	Repetition rate	Dropout rate
Percentage of teachers with intermediate-level education	0.011**	-0.000
Percentage of teachers with a bachelor's degree or above	-0.003	0.005***
Percentage of teachers who are temporary or Rahat	-0.007**	-0.002*
School characteristics		
Number of SMC meetings	0.040**	-0.017**
Compound made of Kachhi (temporary) materials	0.193	0.038
Compound made of other materials	-0.198	-0.122*
Resource index	-0.090**	0.055**
Toilets per 100 girls	-0.008	-0.011*
School has never had a social audit	-0.572***	0.307***
School has a first aid kit	-0.201	0.005
School has a children's club	-0.190	-0.222***
Textbooks per student	0.282*	-0.107
Classrooms per 100 students	-0.145***	-0.034***
Number of students (total enrolment)	-0.002***	0.000
Other characteristics		
Urban	-0.813***	-0.052
Percentage of students in lower secondary		
Percentage of students in secondary	-0.102***	-0.019***
Percentage of students in higher secondary	-0.074***	-0.016***
Constant	22.171***	3.963***
Observations	15,787	15,787
R-squared	0.160	0.046

*, **, *** statistically significant at 10 per cent, 5 per cent and 1 per cent levels of significance, respectively.

Most variables behave similarly across the two models (repetition and dropout), and the results are broadly consistent with the promotion rate models. However, there are a few notable differences, which are discussed below.

The STR is positively correlated to repetitions and dropouts, consistent with the negative relationship between STR and promotion rates. However, the association is larger in the repetition rate model (model 5). This result may primarily be driven by the automatic relationship between STR and repetitions: in schools where there is more repetition, all other things equal, the STR is automatically higher as children stay in the same grade for longer. Furthermore, variables at the teacher level, such as the age of teachers, their qualifications, or them being a native Nepali speaker, mostly matter in the repetition rate model, suggesting that teachers influence promotion rates mainly via affecting repetition.

Some school-level characteristics have contrasting effects on repetitions and dropouts. For instance, SMC meetings are associated with more repetitions but fewer dropouts. Additionally, a lack of social audits is associated negatively with repetitions but positively with dropouts. There could be various explanations for these results. For instance, schools with more SMC meetings may be better run and may manage to keep students enrolled even if they have to repeat a grade. More research is needed to test some of these burgeoning hypotheses and allow conclusive understanding of the reasons behind the trend.

Children's clubs may help keep students in school. Interestingly, the presence of children's clubs is negatively (and statistically significantly) correlated to the dropout rate (model 6). This suggests that children's clubs influence promotion rates to a large extent by keeping students in school, which is a potentially powerful policy lever for educators.

Gender-specific toilets may keep girls enrolled in schools. In the overall (girls and boys) dropout model (model 6), the number of toilets per 100 female students (toilet-females ratio) is only mildly statistically significant. However, this effect almost doubles when the model is restricted to the dropout rate for girls only – the existence of female toilets has a negative 0.017pp effect on the dropout rate for girls (statistically significant at the 1 per cent level). This effect suggests that more toilets for girls may help these students stay enrolled for longer. It is consistent with the global evidence, which suggests that separate-sex toilets are associated with a higher level of female enrolment in school (see Oh 2020 for instance).

Interestingly, repetition rates are lower in urban areas, while dropout rates do not differ between urban and rural areas. This is particularly interesting from a policy perspective as repetitions might be influenced more by school- or teacher-level actions. Hence, schools and education policymakers may have more avenues to influence repetitions through school-level policy.

4.3. What does the analysis show with regard to school grants?

As MoEST continues to increase the volume of funds allocated through different support schemes, including pro-poor scholarships, there was particular interest in understanding how the new grant allocation policy influences promotion.

To understand the effectiveness of grants per student, a different model (model 11 in **Appendix D**) was estimated, identical to model 1 but excluding variables that are correlated to grants (representing inputs

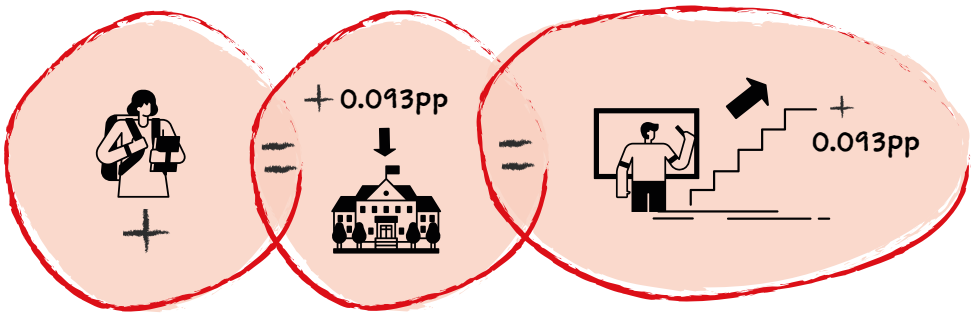
financed by grants), such as information about the number of classrooms, teachers, textbooks and toilets.[17]

A higher grant amount per student is associated with a higher promotion rate. The analysis estimates a positive effect of 0.093 pp on the promotion rate for every additional 1,000 rupees allocated per student. This coefficient was estimated using information on the average amount of money that schools receive per student from the centre.

However, this coefficient may be biased because grants are targeted to certain schools and because it is not possible to control for all targeting variables. Future research would ideally account for all targeting variables to estimate the effects of school grants more precisely.

Regardless, the positive association of the grant amount with school inputs (which are positively associated with promotion rates), and the association of grants to student promotion rates, suggests that grants are likely being applied towards relevant school improvements.

While this analysis cannot comment on the efficiency of grant usage, it is nevertheless encouraging that the grants are correlated to positive outcomes. In future stages of this research, a deeper exploration of grant usage will be carried out to identify recommendations/technical guidance for school administrators on best practices for leveraging these grants effectively.



17. The EMIS dataset includes information on grants received by schools. This information was not included in the primary models as school grants are used to pay for inputs that are already included in the models. In other words, the grant amount per student correlates with a better STR, more textbooks, more classrooms and more toilets.

5. Policy areas for further exploration

Policy areas for further exploration

The analysis presented in this report is the first part of the broader DMS Positive Deviance research endeavour. It brings to light various interesting insights that can be inputs in ongoing policy conversations or other research efforts in this space. If interpreted with caution (i.e. treating estimated coefficients as correlation and not causal effects) and supported by additional analysis and data, these results can be a valuable tool for policymakers, practitioners and researchers.

In the remainder of this section, policy areas for further exploration are presented based on the results of this analysis.

Early childhood education

Early childhood education is a promising tool for improving promotion rates and other important outcomes.

According to the analysis, ECED experience is correlated to higher promotion rates in Nepal. Global evidence from other low- and middle-income countries shows that ECED is critical for improving foundational learning outcomes and various socio-emotional and economic outcomes later in life (Muroga et al. 2020; United Nations Children's Fund 2021; World Bank 2017). Given the relatively low incidence of ECED in Nepal – less than half the student body has ECED experience – there is scope to improve outcomes via appropriate expansion of ECED access.

Currently, the official MoEST recommendation is one year of ECED for all four-year-olds, with the possibility of an additional year provided through local partnerships for three-year-olds (Ministry of Education, Science, and Technology of Nepal 2021). These results, coupled with global trends, suggest piloting different ways to increase access to ECED and improve the quality of ECED could be beneficial.

The government has already invested heavily in this; however, moving forwards, ECED can be bolstered even further by:

- identifying persisting bottlenecks to ECED take-up;
- designing a strategy to address the bottlenecks identified;
- piloting the new strategy;
- scaling up the appropriate measures.

Persisting bottlenecks can be identified in close conversations with parents and education stakeholders in future stages of this research. For instance, if a lack of knowledge about the importance of ECED is the issue, then a public information campaign that educates parents on its importance could be organized. On the other hand, if the bottleneck is a lack of affordable ECED options, then something more involved (such as vouchers for parents) may need to be designed. This should be closely investigated, key bottlenecks identified and appropriate strategies developed.

Teacher placement

In Nepal, while there is a national average of 36 pupils per teacher, the STR ranges from as low as 2 to as high as 100, **suggesting that there are existing areas for improvement in terms of equity of teacher placement across schools and regions.**

This is a complex issue to solve. However, some innovative incentive models exist, such as the salary increase model in Zambia (Chelwa, Pellicer and Maboshe 2019) and salary premiums in the Gambia (Pugatch and Schroeder 2014), both of which increased teacher retainment in rural areas. Another option could be a hardship allowance for teachers working in the most challenging regions, which was implemented by the Government of the Philippines (with technical support from the DMS initiative). Any of these models would need to be further piloted and contextualized to Nepal.

Female teachers

Female teachers may enable students, particularly girls, to remain in school for longer. MoEST should consider studying how the practices of female teachers differ from their male peers and scaling up effective methods.

The analysis reveals that schools with a higher proportion of female teachers have better promotion rates in Nepal, particularly for female students. This finding is consistent with evidence from other countries showing that female teachers are more effective at improving student learning, particularly for girls (Muralidharan and Sheth 2016).

Hence, female teachers could potentially even be more beneficial for improved student learning (although the team were unable to test this in the analysis). In the short term, it is worth investigating what these female teachers are doing differently in their classrooms by studying their behaviours, practices and relationships with students. Such investigations may reveal important behaviours that MoEST could incorporate in teacher training to ensure all teachers (male and female) are leveraging them. These will be further explored in **Stage 3** of this DMS research. In the longer term, MoEST could consider expanding the hiring and retainment of female teachers to reduce the gender gap in student promotion and learning outcomes.

Children's clubs

Children's clubs could be a low-cost policy lever to keep students in school. According to the analysis, the presence of a children's club helps children stay in school. While more research is needed to understand how

these children's clubs influence a child's likelihood of staying in school for longer, they could be a cost-effective lever to reduce dropout rates.

School grants

School grants are correlated with higher promotion rates. While this trend is encouraging, there could be room for even more effective use of funds, which is hard to identify without a thorough understanding of grant utilization processes and activities. It may be beneficial to investigate further.

This research has revealed interesting insights and raised new questions. Going forward, it will be important to bolster this analysis with:

- similar exploration for other important education outcomes;
- repeating this analysis with multiple years of data;
- collecting additional data to investigate observed trends more closely.

In future stages of this research, most prominently in Stage 3, DMS plans to collect primary data from positive deviant schools and investigate the concrete behaviours and practices that help them perform better than their peers.

6. Appendices

Appendix A: Research questions and stages of the research

This positive deviance research focuses on four research questions contextualized to Nepal and is made up of five stages to address these questions and disseminate the findings of the research.

Research questions

The following research questions were co-created with in-country stakeholders and guide the DMS research in Nepal.

What are the human and material resources and contextual factors most associated with good school performance[18] in Nepal?
Which schools outperform their peers in the same context and with the same level of operating resources?
What are the practices and behaviours of stakeholders at the district, school, classroom and community levels that make a difference in positive deviant schools, compared to the practices and behaviours in the other lower-performing schools? In other words, what are the behaviours/ practices that typify high-performing schools in contexts where other schools struggle?
What policy, system and community levers can incentivize the scaling-up of the positive deviant practices and behaviours to low-performing schools, addressing the 'know-do' gap?

Research design/methodology summary

The DMS research team will leverage a mixed-methods and staged approach to collect and analyse empirical data to address the above questions. The research design has five stages.

Stage 1	**Analysis of resources and context associated with school performance (Quantitative research)**	This first stage (findings shared in this report) employs statistical analysis using existing education datasets to identify the human and material resources and contextual factors driving school performance in Nepal.
Stage 2	**Identification of positive deviant schools and school typologies (Positive deviance)**	This stage will categorize schools according to their contexts and will identify positive deviant schools in each contextual and resource environment.

18. Good school performance indicators will be defined and calculated hand-in-hand with relevant in-country stakeholders.

Stage 3	**Understanding school-level positive deviant behaviours and practices (Behavioural sciences)**	The third stage will investigate why positive deviant schools perform better using mixed-methods primary data. Behaviours and practices in the high-performing 'positive deviant' schools and average-performing 'control schools' will be compared using data collection instruments such as interviews, surveys, and classroom and school observations. Other data collection instruments will include questionnaires and interviews with key stakeholders at all levels – country, province, district, school and community. The data collected will help identify positive deviant practices and behaviours in different contexts.
Stage 4	**Investigating levers for optimal scale (Behavioural sciences, participatory implementation research and scaling science)**	This stage will use participatory action research to identify concrete levers and incentives at the system, school and community levels to scale up positive deviant practices and behaviours to all Nepali schools. This stage involves various stakeholders to identify practical, scalable and feasible policy levers to incentivize low-performing schools to adopt the behaviours and practices of the positive deviant schools and, in turn, become high-performing themselves.
Stage 5	**Country-level knowledge use and global mobilization**	This stage is related to the local and global dissemination of the research findings and will be an ongoing process throughout the research.

Appendix B: Descriptive statistics on variables used in primary analysis

Summary statistics for all variables included in the data models used in this analysis are included below.

Table 3: Descriptive statistics on primary model variables

Variable name	Number of observations	Mean	Std. deviation	Minimum	Maximum
Outcome variables					
Promotion rate – total	20,799	90.6	7.8	21.1	100
Promotion rate – female	20,799	91.6	7.9	0	100
Promotion rate – male	20,799	89.4	9.3	0	100

Variable name	Number of observations	Mean	Std. deviation	Minimum	Maximum
Repetition rate	20,799	6.2	7.2	0	78.9
Dropout rate	20,799	3.2	3.3	0	66.7
Variables representing student characteristics					
Percentage of female students	21,130	52.2	5.7	0	100
Percentage of students from Dalit households	21,130	20.8	17	0	100
Percentage of students from Janajati households	21,130	37.7	30.8	0	100
Percentage of students from households categorized as 'other castes'	21,130	16.4	25.9	0	100
Percentage of students with ECED experience	20,422	37.2	24.4	0.1	100
Variables representing teacher characteristics					
Percentage of teachers who are temporary or Rahat	21,130	39.1	20.6	0	100
Percentage of teachers from Dalit households	21,130	3.9	8.7	0	100
Percentage of teachers from Janajati households	21,130	24.5	26.2	0	100
Percentage of teachers from households categorized as 'other castes'	21,130	49.3	31.3	0	100
STR	21,130	36	21.1	0.2[20]	100
Average age of teachers	21,130	40	4.9	17	65
Percentage of native Nepali-speaking teachers	21,130	61.6	36.5	0	100
Percentage of teachers with intermediate-level education	21,130	24.8	21.9	0	100
Percentage of teachers with a bachelor's degree or above	21,130	69.1	25.8	0	100
Percentage of teachers who are temporary or Rahat	21,130	39.6	23.3	0	100
Variables representing school-level characteristics					
Number of SMC meetings	21,129	7.8	4.7	0	12
Compound made of Kachhi (temporary) materials	18,368	0.2	0.4	0	1
Compound made of other materials	18,368	0.2	0.4	0	1
Resource index	20,925	3.2	2.3	0	6
Toilets per 100 girls	21,093	1.1	1.9	0	100

20. It is possible that schools reported unfinished classrooms and/or temporary classroom structures as 0 (or no classroom) in the EMIS dataset. As an additional robustness check, the analysis was conducted by dropping all schools with 0 classrooms. This did not change the direction and significance of key findings.

Variable name	Number of observations	Mean	Std. deviation	Minimum	Maximum
School has never had a social audit	21,130	0.5	0.5	0	1
School has a first aid kit	21,130	0.7	0.5	0	1
School has a children's club	21,130	0.6	0.5	0	1
Textbooks per student	21,130	0.3	0.4	0	1
Classrooms per 100 students	21,130	3.3	3.4	0[21]	50
Number of students (total enrolment)	21,130	547.2	526.7	1[22]	4,014
Other controls					
Urban	21,130	0.5	0.5	0	1
Percentage of students in lower secondary	19,049	27.1	15.6	0	100
Percentage of students in secondary	19,049	16.2	13.8	0	100
Percentage of students in higher secondary	19,049	7.3	12.3	0	100

Appendix C: Fixed-effects models for promotion rates

Since there are likely some inherent characteristics and differences between the various municipalities in Nepal, the outcome and predictor variables are expected to act differently within each municipality. To account for this potential difference and identify the 'pure' effect of a predictor variable, multivariate regressions with fixed-effects models were run. **Table 4** below shows the fixed-effects coefficients for each model. Models 1 to 4 are the same models discussed in **section 4** of the main text. Models 7 to 10 are the corresponding fixed-effects models for each primary model, including municipality-level fixed effects.

For models 7 to 10, the following fixed-effects model was estimated:

$$Y_i = \beta_o + \beta_1 Student_i + \beta_2 Teacher_i + \beta_3 School_i + \beta_4 Other_i + \beta_5 Z_i + \varepsilon$$

21. It is possible that schools reported unfinished classrooms and/or temporary classroom structures as 0 (or no classroom) in the EMIS dataset. As an additional robustness check, the analysis was conducted by dropping all schools with 0 classrooms. This did not change the direction and significance of key findings.

22. It is possible that extremely small schools in the hilly regions of Nepal had less than five students (including just one student) in the class at certain times. To avoid removing these smaller schools from the analysis, these observations were retained. However, as an additional robustness check, the analysis was conducted by dropping all schools with less than five students. This did not change the direction and significance of key findings. As a final robustness check, the analysis was also run by dropping all observations mentioned in footnote 20 (schools with STR <2), footnote 21 (schools with 0 classrooms), and this footnote (schools with <5 students). This also did not result in any changes in the direction and significance of key findings.

Where:

Y_i	represents school performance for school i as measured by the average promotion rate, average repetition rate or average dropout rate.
$Student_i$	is a set of independent variables representing average student characteristics in school i
$Teacher_i$	is a set of variables representing average teacher characteristics in school i
$School_i$	is a set of variables representing school-level characteristics for school i
$Other_i$	is a set of variables representing other contextual information for school i
Z_i	are unobserved time-invariant heterogeneities across each municipality i
ε	is the stochastic error term

The sample of 15,787 schools was spread across 671 municipalities, both urban and rural, from all districts of the country.

Table 4: Determinants of promotion rates after including municipality-level fixed effects

	Main models				Fixed-effects models			
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 7**	**Model 8**	**Model 9**	**Model 10**
Variables	Promotion rate	Female promotion rate	Male promotion rate	Primary-only promotion rate	Promotion rate	Female promotion rate	Male promotion rate	Primary-only promotion rate
Student characteristics								
Percentage of female students	0.018	-0.077***	0.058***	0.031**	0.017	-0.074***	0.054***	0.037**
Percentage of Dalit students	-0.009*	-0.006	-0.011*	-0.005	-0.024***	-0.023***	-0.026***	-0.022***
Percentage of Janajati students	-0.009**	-0.001	-0.015***	-0.011**	-0.023***	-0.022***	-0.023***	-0.025***
Percentage of students from households categorized as 'other castes'	0.017***	0.016***	0.012*	0.008	-0.016**	-0.021**	-0.015	-0.027**
Percentage of students with ECED experience	0.068***	0.063***	0.072***	0.099***	0.067***	0.061***	0.072***	0.099***

	Main models				Fixed-effects models			
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 7**	**Model 8**	**Model 9**	**Model 10**
Variables	Promotion rate	Female promotion rate	Male promotion rate	Primary-only promotion rate	Promotion rate	Female promotion rate	Male promotion rate	Primary-only promotion rate
Teacher characteristics								
Percentage of female teachers	0.017***	0.020***	0.014***	0.014**	0.008**	0.010**	0.006	0.004
Percentage of teachers from Dalit households	-0.008	-0.002	-0.013	-0.018*	-0.009	-0.001	-0.014	-0.016
Percentage of teachers from Janajati households	0.001	0.004	-0.002	0.003	-0.002	-0.000	-0.004	-0.004
Percentage of teachers from households categorized as 'other castes'	-0.003	-0.002	-0.004	-0.004	-0.001	0.000	-0.002	-0.003
STR	-0.044***	-0.051***	-0.044***	-0.105***	-0.040***	-0.043***	-0.041***	-0.095***
Average age of teachers	0.163***	0.182***	0.156***	0.214***	0.114***	0.126***	0.114***	0.157***
Percentage of native Nepali-speaking teachers	-0.007***	-0.005**	-0.009***	-0.003	-0.005	-0.008**	-0.003	-0.003
Percentage of teachers with intermediate-level education	-0.011**	-0.007	-0.012*	-0.014**	-0.005	-0.002	-0.004	-0.007
Percentage of teachers with a bachelor's degree or above	-0.002	0.002	-0.003	-0.000	0.004	0.007	0.005	0.007
Percentage of teachers who are temporary or Rahat	0.009***	0.014***	0.005	0.015***	0.008***	0.012***	0.004	0.014***
School characteristics								
Number of SMC meetings	-0.023	-0.031	-0.008	-0.038	-0.013	-0.020	-0.001	-0.021
Compound made of Kachhi (temporary) materials	-0.231	-0.290	-0.111	-0.168	0.133	0.183	0.158	0.050

	Main models				Fixed-effects models			
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 7**	**Model 8**	**Model 9**	**Model 10**
Variables	Promotion rate	Female promotion rate	Male promotion rate	Primary-only promotion rate	Promotion rate	Female promotion rate	Male promotion rate	Primary-only promotion rate
Compound made of other materials	0.320*	0.347*	0.316	0.356	0.121	0.206	0.074	0.076
Resource index	0.035	0.011	0.052	0.226**	-0.021	-0.054	0.018	0.121
Toilets per 100 girls	0.019	0.011	-0.047	0.013	0.017	0.010	-0.052	0.012
School has never had a social audit	0.266*	0.241	0.190	0.307	-0.139	-0.159	-0.205	-0.272
School has a first aid kit	0.197	0.179	0.395*	0.430*	0.159	0.118	0.366*	0.497*
School has a children's club	0.412**	0.340**	0.347*	0.515**	0.498***	0.481***	0.387*	0.519*
Textbooks per student	-0.175	-0.178	-0.190	-0.052	-0.040	-0.066	-0.064	0.166
Classrooms per 100 students	0.179***	0.189***	0.168***	0.218***	0.123***	0.134***	0.114***	0.144***
Number of students (total enrolment)	0.002***	0.002***	0.002***	0.027***	0.002***	0.002***	0.002***	0.024***
Other characteristics								
Urban	0.865***	0.758***	0.880***	0.915***	0.685	0.348	1.083	0.478
Other controls								
Percentage of students in lower secondary	0.125***	0.108***	0.137***		0.116***	0.099***	0.128***	
Percentage of students in secondary	0.121***	0.112***	0.126***		0.101***	0.092***	0.104***	
Percentage of students in higher secondary	0.090***	0.083***	0.090***		0.079***	0.070***	0.080***	
Constant	**73.865*** **	**79.072*** **	**71.079*** **	**67.839*** **	**77.631*** **	**83.792*** **	**73.792*** **	**72.122*** **
Observations	**15,787**	**15,787**	**15,787**	**7,989**	**15,787**	**15,787**	**15,787**	**7,989**
R-squared	**0.161**	**0.135**	**0.132**	**0.131**	**0.266**	**0.231**	**0.224**	**0.262**

*, **, *** statistically significant at 10 per cent, 5 per cent and 1 per cent levels of significance, respectively.

The primary models (1–4) show that while differences in the caste and ethnicity composition of the student body influence promotion rates, these effects are small and not statistically significant at the 1 per cent significance level. However, after applying municipality-level fixed effects, the proportion of students from Dalit or Janajati households in the school becomes highly statistically significant (at the 1 per cent significance level). After including fixed effects, schools with more students from Dalit or Janajati households have lower promotion rates than schools with students from Brahman-Chhetri households. These effects are higher than in the original models and are statistically significant at the 1 per cent level. For example, a school with only Janajati household students is expected to have a promotion rate 2 pp lower than a similar school with only Brahman-Chhetri household students; almost twice the effect seen in the original model. The effect size is similar for schools with a higher proportion of Dalit students.

Possible reasons for the differences observed: Adding municipality-level fixed-effects may account for the demographic effects of areas with higher or lower levels of Dalit or Janajati households on average. The effect sizes in the fixed-effects models then account for higher or lower levels of students from a specific ethnicity or caste, given the average baseline level of that ethnicity or caste in each municipality. In other words, the analysis may be capturing the effects of schools catering to socio-economically backwards communities, as proxied by the ethnicity and caste composition of the school student body.

Applying fixed effects also reduces the effect of a teacher's gender. While it was observed that the presence of female teachers had a positive effect on overall promotion rates and female-only promotion rates (albeit with a lower magnitude and statistical significance), this effect disappears when it comes to male-only promotion rates and primary-only promotion rates. This suggests that geographical location explains part of the effect of female teachers in the original models. The female teacher composition of schools varies across municipalities in Nepal for unknown reasons. The 'pure' effect of teacher gender is lower when accounting for these differences.

The original model showed that having many native Nepali-speaking teachers in a given school had a small negative effect. Including fixed effects reduces this effect in the overall and male-only promotion models. Similarly, fixed effects further mediate the small negative impacts of teachers with intermediate-level education, bolstering the finding that observable teacher academic qualifications do not consistently correlate to better performance.

Appendix D: School grants analysis

For better understanding of the link between school grants and promotion rates, the same model as depicted in **Appendix C** was used, with a few key differences. Certain variables that are highly correlated to school grants and that represent inputs financed by school grants were excluded from the analysis. These included variables capturing the number of classrooms, teachers, textbooks and toilets.

Models 11 to 14 all include municipality-level fixed effects. The sample of 15,802 schools was spread across 644 municipalities, both urban and rural, from across all districts of the country.

Table 5: School grants and promotion rates (including municipality-level fixed effects)

	Model 11	Model 12	Model 13	Model 14
Variables	Promotion rate	Female promotion rate	Male promotion rate	Primary-only promotion rate
Grants				
Percentage of female students	0.014703	-0.014337	0.060253***	0.0313**
Percentage of students from Dalit households	-0.031361***	-0.024259***	-0.032015***	-0.0293***
Percentage of students from Janajati households	-0.026270***	-0.019558***	-0.024795***	-0.0285***
Percentage of students from households categorized as 'other castes'	-0.022086***	-0.024735***	-0.019588**	-0.0320***
Percentage of students with ECED experience	0.068008***	0.063615***	0.073086***	0.101***
Student characteristics				
Percentage of female teachers	0.009706**	0.015632***	0.007065	0.00590
Percentage of teachers from Dalit households	-0.008637	0.001224	-0.013779	-0.0165
Percentage of teachers from Janajati households	-0.000593	0.003987	-0.003127	-0.00241
Percentage of teachers from households categorized as 'other castes'	-0.001392	0.002835	-0.002401	-0.00352
Teacher characteristics				
Average age of teachers	0.128710***	0.151139***	0.123556***	0.180***
Percentage of native Nepali-speaking teachers	-0.003220	-0.005759	-0.001990	-0.00123
Percentage of teachers with intermediate-level education	-0.005698	-0.003824	-0.004216	-0.00741
Percentage of teachers with a bachelor's degree or above	0.002457	0.002661	0.003811	0.00389
Percentage of teachers who are temporary or Rahat	0.009359***	0.013093***	0.004799	0.0163***

	Model 11	Model 12	Model 13	Model 14
Variables	Promotion rate	Female promotion rate	Male promotion rate	Primary-only promotion rate
School characteristics				
Number of SMC meetings	-0.016825	-0.011860	0.001861	-0.0180
Compound made from Kachhi (temporary) materials	0.126027	0.184971	0.139727	0.0722
Compound made from other materials	0.142529	0.334891*	0.082609	0.160
Resource index	-0.026788	-0.017562	0.030019	0.186*
School has never had a social audit	-0.170387	-0.247971	-0.244141	-0.346
School has a children's club	0.508198***	0.598245***	0.468882**	0.755***
Number of students (total enrolment)	0.000654**	0.001411***	0.000981**	0.00211
Other characteristics				
Urban	0.845599	0.513701	1.181677	0.460
Other controls				
Percentage of students in lower secondary	0.105282***	0.076518***	0.120433***	-
Percentage of students in secondary	0.094835***	0.080489***	0.100369***	-
Percentage of students in higher secondary	0.076208***	0.057309***	0.078491***	-
Grant received in quarter 1 (1 = yes, 0 = no)	-0.004782	0.258316	-0.142166	-0.111
Grant received in quarter 2 (1 = yes, 0 = no)	-0.178406	-0.358490	-0.281901	-0.208
Constant	77.952237***	79.507131***	73.658162***	73.07***
Observations	**15,802**	**15,802**	**15,802**	**7,994**
R-squared	**0.257373**	**0.203849**	**0.219765**	**0.249**

*, **, *** statistically significant at 10 per cent, 5 per cent and 1 per cent levels of significance, respectively.

Appendix E: NASA data analysis

This analysis used NASA data. NASA is a sample-based assessment of grade 5 student learning outcomes in Mathematics and Nepali conducted by MoEST's ERO. ERO has implemented this assessment every few years since 2012 to compare improvements in student learning over time. NASA data collected between 2011 and 2015 used a simple 0–100 assessment scale, whereas NASA data from 2018 used a standardly distributed scale similar to the Programme for International Student Assessment.

The NASA sample includes 2,313 schools. **Table 6** below shows key summary statistics of the schools in the NASA sample compared to national averages.

Table 6: Summary statistics of schools in the NASA sample versus the national census

	NASA sample data (2012–2015)	National EMIS data (2018)
Proportion of schools in urban areas	50.9%	45.1%
School size	708 students	547 students
Resource index score	3.2 (out of 6)	2 (out of 6)
Proportion of schools that have both primary and secondary levels	89.5%	46.7%

The DMS research team used the same model as discussed in the main text (model 1), with the best NASA score of the schools over the period 2012–2015 as a dependent variable. This index contained the maximum average score of any subject between 2012 and 2015. It was created to maximize the number of data points available for analysis.

Results from the NASA sample-based data tend to be very similar to the average promotion rate models. The main difference is that variables at the student level matter more for the NASA score. The percentage of female students in the school is associated with a lower NASA score, suggesting that girls perform worse than boys. In contrast, no differences were found between boys and girls for the promotion rate, except for primary-only schools where female students performed better than male students. This discrepancy in gender equity between the two performance indicators is hard to explain and will need to be explored further.

The rest of the estimated coefficients in the NASA model largely confirm the results of the primary promotion rate models. A greater percentage of ECED students and more female teachers are associated with a better NASA score, whereas the STR is negatively correlated to the NASA score. Better school characteristics, as captured by the resource index or the building material of the school, are associated with better NASA score results, possibly capturing the fact that student performance benefits in a better learning environment. Finally, students in larger schools tend to do better in the NASA assessment, a result in line with the promotion rate model. Even after controlling for school resources, larger schools tend to do better than smaller schools, potentially reflecting different behaviours and practices of stakeholders at the school level.

Table 7: Determinants of NASA score

	Model 15
VARIABLES	**NASA best score 2012–2015**
Student characteristics	
Percentage of female students	-0.199***
Percentage of students from Dalit households	-0.107***
Percentage of students from Janajati households	-0.052**
Percentage of students from households categorized as 'other castes'	-0.127***
Percentage of students with ECED experience	0.036**
Teacher characteristics	
Percentage of female teachers	0.056**
Percentage of teachers from Dalit households	0.019
Percentage of teachers from Janajati households	-0.026
Percentage of teachers from households categorized as 'other castes'	0.008
STR	-0.068**
Average age of teachers	-0.098
Percentage of native Nepali-speaking teachers	-0.000
Percentage of teachers with intermediate-level education	0.031
Percentage of teachers with a bachelor's degree or above	0.064*
Percentage of teachers who are temporary or Rahat	-0.009
School characteristics	
Number of SMC meetings	-0.299***
Compound made of Kachhi (temporary) materials	-2.203**
Compound made of other materials	-1.497

	Model 15
VARIABLES	**NASA best score 2012–2015**
Resource index	0.621**
Toilets per 100 girls	0.136
School has never had a social audit	0.127
School has a first aid kit	-1.070
Schools has a children's club	0.420
Textbooks per student	-0.380
Classrooms per 100 students	-0.032
Number of students (total enrolment)	0.010***
Other characteristics	
Urban	0.552
Percentage of students in lower secondary	-0.084***
Percentage of students in secondary	-0.140***
Percentage of students in higher secondary	-0.260***
Constant	60.458***
Observations	1,862
R-squared	0.080

*, **, *** statistically significant at 10 per cent, 5 per cent and 1 per cent levels of significance, respectively.

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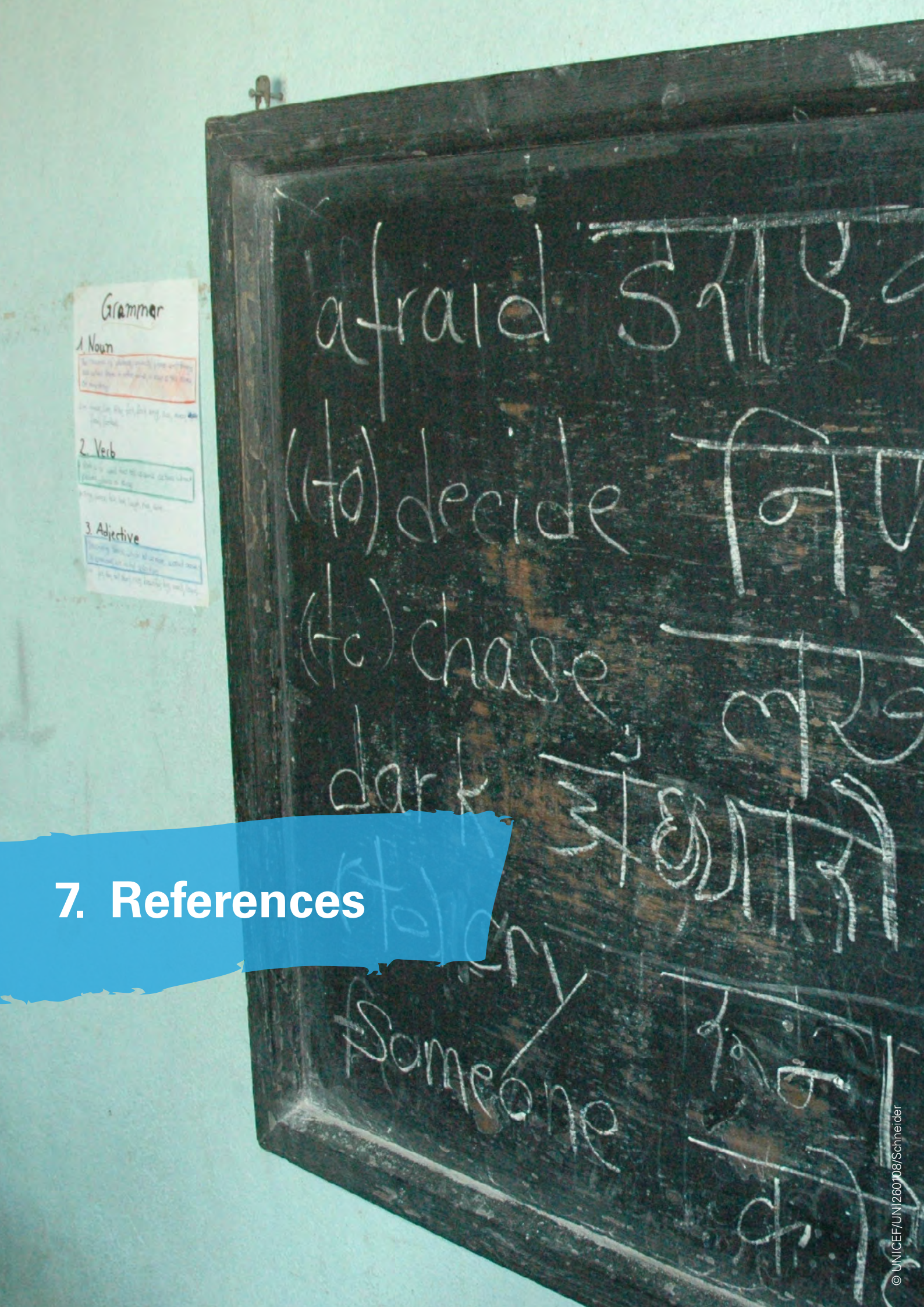

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