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Report

Early Learning in Ethiopia: Effects of pre-primary education on school readiness

Early Learning Partnership Ethiopia Phase 2 report

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Abbreviations

B-G	Benishangul-Gumuz
ECE	Early Childhood Education
ELP	Early Learning Partnership
EMIS	Education Management and Information System
ESDP	Education Sector Development Programme
FCDO	UK Foreign, Commonwealth, and Development Office
GEQIP-E	General Education Quality Improvement Program for Equity
MELE	Measure of Early Learning Environments
MELQO	Measuring Early Learning Quality and Outcomes
MODEL	Measure of Development and Early Learning
MoE	Ministry of Education
MOWCY	Ministry of Women, Children and Youth
NEAEA	Ethiopian National Educational Assessment and Examination Agency
NGO	Non-Governmental Organisation
OLS	Ordinary Least Square
PSM	Propensity Score Matching
PTSA	Parents-Teachers-Students Association
QA	Quality Assurance
QE	Quality Enhancement
QEAP	Quality Enhancement and Assurance Programme
REAL	Research for Equitable Access and Learning
REB	Regional Education Bureaus
RISE	Research on Improving Systems of Education
SD	Standard Deviation
SE	Standard Error
SNNP	Southern Nations, Nationalities and Peoples' Region
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development

Executive Summary

With a growing evidence base and global consensus on the importance of early childhood education, Ethiopia has undergone extensive policy reform in pre-primary education since 2010. This report presents findings from Phase 2 of the five-year longitudinal study of the Early Learning Partnership (ELP) systems research programme in Ethiopia, supported by the UK Foreign, Commonwealth, and Development Office (FCDO) and the World Bank. It provides a synthesis of the key research findings on the effect of pre-primary education programmes on school readiness of young children across six regions in Ethiopia. In measuring the effect of pre-primary school participation, we have tracked the educational trajectory of a sample of pre-primary-school-aged children in the school year of 2019/20 through to 2020/21, when they would be of Grade 1 age. During this time, the education system in Ethiopia (as globally) faced unprecedented challenges due to the COVID-19 pandemic, resulting in schools being closed for 8 months from March to November 2020. Our original research design was therefore adapted to take account of the changes that came about as a result of COVID-19 in order to provide important insights into the effects of COVID-19 on Ethiopia's pre-primary education sector.

We focus in particular on 'O-Class', a reception class for 6-year-olds attached to government primary schools, given O-Class is the main driver for expanding pre-primary education access in Ethiopia since the country's 2010 reforms. The research consists of two overarching parts: the education trajectories of young children in Ethiopia in the context of COVID-19; and the perspectives of key stakeholders on the effect of COVID-19 on pre-primary education system.

In Part 1, we aim to identify the contribution of pre-primary education to school readiness and the progress children make once in primary school (with respect to early numeracy). For this, we compare children who participated in O-Class with those who did not. We pay particular attention to the role of child and family characteristics in predicting children's learning outcomes in the context of COVID-19, and how the effects vary for those from disadvantaged backgrounds. The analysis further compares school readiness of two cohorts of children who entered primary school

before COVID-19 and those who entered after COVID-19. It then explores the relationship between quality of pre-primary school and school readiness. In Part 2, we explore accountability relationships in the pre-primary education system, building on our ELP Phase 1 study (Rossiter et al., 2018), and extend this to identify the views of key stakeholders on the extent to which pre-primary education was incorporated into the COVID-19 response plan. We lastly examine the implications of the pandemic on pre-primary-school-aged children's education during school closures.

In addressing these issues, our research was driven by seven key questions:

Part 1: What are the education trajectories of pre-primary school-aged children in Ethiopia in the context of COVID-19?

1. What are the education pathways in the context of COVID-19 school closures; and what are the predictors of pre-primary school children not returning once schools re-opened?

2. What are the differences in early numeracy outcomes for children who participated in O-Class and those who did not? Have these differences changed between 2019/20 and 2020/21 as a result of the COVID-19 school closures? How do outcomes vary by sub-groups?

3. What are the differences in early numeracy outcomes for children who entered Grade 1 before COVID-19 and those who entered after COVID-19? To what extent are these differences affected by children's participation in O-Class?

4. To what extent are learning trajectories affected by quality improvement interventions for O-Class implemented as part of the government's General Education Quality Improvement Program for Equity (GEQIP-E) in the context of COVID-19 school closures?

5. To what extent are early numeracy outcomes and learning gains affected by the quality of O-Class more generally?

Part 2: What are the perspectives of key stakeholders and caregivers on the effects of COVID-19 on pre-primary education?

6. How have accountability relationships in pre-primary education systems been affected by the GEQIP-E reform and the COVID-19 crisis?

7. To what extent have parents and the community been involved in children's early learning during the COVID-19 school closures?

Part 1 of this report draws on quantitative data collected by the research team using an adapted version of the Measuring Early Learning Quality and Outcomes (MELQO) assessment. This was administered by the team in November/December 2019 and December 2020/January 2021, with 2,645 pre-primary aged children in 78 O-Classes in Ethiopia. Data were collected in partnership with the Ethiopian National Educational Assessment and Examinations Agency (NEAEA). MELQO is a global initiative to promote accurate measurement of children's early learning and development at the start of primary school and the quality of early learning environments administered at scale. MELQO was adapted to the Ethiopian context in 2018, and aligned to the key competencies outlined in the O-Class curriculum. For Part 2, we conducted eight key informant interviews with representatives from the Ministry of Education (MoE), NEAEA, and aid donors to understand accountability relationships, and the extent to which pre-primary education was incorporated into the COVID-19 response. We also carried out mobile phone surveys during the school closures with 480 households to understand how parents and caregivers with pre-primary aged children responded to the global health crisis and school closures in Ethiopia.

Part 1- Main findings

- **Children's educational pathway between 2019/20 and 2020/21 over the COVID-19 school closures:** Following school closures in March 2020, approximately 90% of O-Class children in our sample returned to schools after they re-opened in October 2020. However, of those who had not previously enrolled in pre-primary education prior to school closures, approximately 50% were still not enrolled in 2020. Children living in urban areas were more likely not to return, which could be partially explained by parents' concerns about

schools' safety and sanitation amid the COVID-19 pandemic, as urban schools are more likely to be over-crowded. Among children not in pre-primary education previously, children from poorer families had a higher chance of remaining out of school than those from richer families.

- **Relationship between pre-primary school participation and school readiness:** Overall, learning improved for young children as they got older (from pre-primary school age to Grade 1 age) following COVID-19 school closures. However, there were variations in the degree of learning gains for children depending on whether they attended pre-primary education. Notably, participating in O-Class is a significant predictor of children's subsequent learning outcomes at the start of primary school. Learning gains in early numeracy between the beginning of the school year in 2019/20 and when schools re-opened in 2020/21 were significantly greater for O-Class children (by 8 percentage points) than for those who did not attend pre-primary school, even after accounting for child and family characteristics. As children entered grade 1, the performance of children not in pre-primary education was nearly one academic year behind O-Class children.

- **Learning inequalities between advantaged and disadvantaged***:* There are strong indications of widening inequality in children's learning following COVID-19 school closures. Disaggregated by gender, the learning gains from O-Class participation were significantly larger for boys than girls. O-Class children living with literate caregivers also showed greater learning progress between 2019/20 and 2020/21 than those whose caregivers were not literate.

- **Comparison of school readiness for children at the beginning of primary school before and after COVID-19.** Compared to a cohort of children who entered primary school before COVID-19, those who entered school after COVID-19 show a significantly lower level of school readiness, with a decline in early numeracy test scores of 8 percentage points. Notably, potential learning losses due to COVID-19 school closures were five times larger for children not in pre-primary school compared with O-Class children.

- **Relation of quality improvement interventions for O-Class with school readiness.** As part of the government's large-scale educational reform (GEQIP-E), quality improvement interventions for O-Class have been put in place since 2019. Some schools received enhanced GEQIP-E support for O-class, for example, in-service teacher training focusing on play-based curriculum. However, there were no differential relationships between O-Class participation and school readiness for those schools that were expected to have received the enhanced GEQIP-E interventions. This is not surprising considering the disruption of implementation as a result of the COVID-19 school closures.

- **Quality of pre-primary education.** Overall, O-Classes severely lacked some basic facilities for health and sanitation, which is of particular concern in the context of the on-going pandemic. Less than 20% of O-Classes have handwashing facilities and about half of them have child-sized toilets. In addition, about 70% of O-Classes have either no or only a small number of learning and play materials that could stimulate children's holistic development. Only half of the children in O-Class were observed to be engaged in lessons, and the level of child-teacher interaction varied widely across the pre-primary classrooms.

- **Relationship between O-Class quality and school readiness.** Our analyses of various quality indicators suggest that access to handwashing facilities, teaching experience at the pre-primary level, and children's engagement in lessons are key elements of O-Class quality that were significantly associated with children's learning outcomes and its progress in Ethiopia.

Part 2- Main findings

- **Early learning systems response to the COVID-19 pandemic.** Pre-primary education was not incorporated into the government's COVID-19 response plan, with an absence of distance learning strategies for O-Class children. Interviews with government and donor stakeholders revealed that insufficient coordination and collaboration among governmental and non-governmental actors (such as

UNICEF, World Bank, International and local Non-Governmental Organisations (NGOs), universities and colleges, and private sectors) working on pre-primary education during this time.

- **Families' access to learning resources and information during school closures.** More than half of parents and caregivers reported that they did not have children's books or learning materials at home, with caregivers who are not literate being much less likely to have such resources. Most parents and caregivers also received little support from schools or local government. Only 10% reported that they have been in contact with teachers or principals during school closures.

- **Parental engagement in children's learning during school closures.** Only half of parents and caregivers reported that they were able to engage in supporting educational or learning activities for their young children during school closures, with families living in urban areas or those from wealthier families more likely to be able to support children's learning.

1 Introduction

1.1 Purpose of ELP Phase 2 research in Ethiopia

This report presents findings from Phase 2 of the five-year longitudinal study of the Early Learning Partnership (ELP) systems research programme in Ethiopia (2017-2021), supported by the UK Foreign, Commonwealth, and Development Office (FCDO) and the World Bank.

Building on our ELP Phase 1 research (Rossiter et al., 2018), Phase 2 research primarily aims to identify the effects of pre-primary school participation and quality on children's school readiness at the time of entry into primary school in Ethiopia. To achieve this goal, we tracked the educational trajectory of a sample of pre-primary-school-aged children at the beginning of the school year in Nov/Dec 2019/20, following them up just after schools re-opened around Dec/Jan 2020/21, when they would be of Grade 1 age. During this time, the education system in Ethiopia (as globally) faced unprecedented challenges due to the COVID-19 pandemic, resulting in schools being closed for 8 months from March to November 2020. Subsequently, our original research design was adapted to take account of the changes that came about as a result of COVID-19 in order to provide important insights into the effects of COVID-19 on Ethiopia's pre-primary education sector.

This study focuses on O-Class, a reception class for 6-year-olds (the year before primary school)[1] attached to government primary schools, given O-Class is the main driver for expanding pre-primary education access in Ethiopia since the country's 2010 early childhood education reform.

Importantly, ELP Phase 2 research aims to fill the knowledge gap on the contributions of the government's 2010 reform to expand access to pre-primary education, with the goal of improving school readiness of children from diverse backgrounds. It includes a focus on the equity implications of the government initiative that aims to ensure access to pre-primary education, especially for the most disadvantaged children who are at risk of exclusion, drop-out and under-achievement (MoE, 2015). Our research also provides important evidence on the quality of O-Class in Ethiopia. With the recent large-scale initiative launched in 2018 (General Education Quality Improvement

Program for Equity, GEQIP-E), the government's focus is gradually shifting to improving the quality of O-Class. This is motivated by international evidence showing that the benefits of pre-primary education on improved learning outcomes are conditional on quality (Engle et al., 2011). We therefore looked at the components of quality pre-primary education that are linked to improved children's school readiness. The study highlights the implications of COVID-19 on children's learning outcomes, to capture potential learning losses caused by school closures. We compare school readiness of children who entered primary school after COVID-19 with those who entered before COVID-19. The research also explores how the government has responded to the COVID-19 crisis for young children in Ethiopia through the lens of key stakeholders, including families, teachers and policymakers.

The report consists of two parts. Part 1 addresses the education trajectories of pre-primary school-aged children in Ethiopia in the context of COVID-19. Part 2 investigates the perspectives of key stakeholders and caregivers, in particular with respect to the implications of the COVID-19 crises on pre-primary education. We collected quantitative data through direct learning assessments, household surveys (face-to-face interviews before the pandemic; mobile phone survey during the pandemic), and qualitative interviews with key stakeholders.

In Part 1, the research was driven by five related research questions:

1. What are the early education pathways in the context of COVID-19 school closures; and what are the predictors of pre-primary school children not returning once schools re-opened?

2. What are the differences in early numeracy outcomes for children who participated in O-Class and those who did not? Have these differences changed between 2019/20 and 2020/21 as a result of the COVID-19 school closures? How do outcomes vary by sub-groups?

3. What are the differences in early numeracy outcomes for children who entered Grade 1 before COVID-19 and those who entered after COVID-19?

To what extent are these differences affected by children's participation in O-Class?

4. To what extent are learning trajectories affected by quality improvement interventions for O-Class as part of GEQIP-E in the context of COVID-19 school closures?

5. To what extent are early numeracy outcomes and learning gains affected by the quality of O-Class more generally?

In Part 2, we addressed the following two research questions:

6. How have accountability relationships in pre-primary education systems been affected by the GEQIP-E reform and the COVID-19 crisis?

7. To what extent have parents and the community been involved in children's early learning during the COVID-19 school closures?

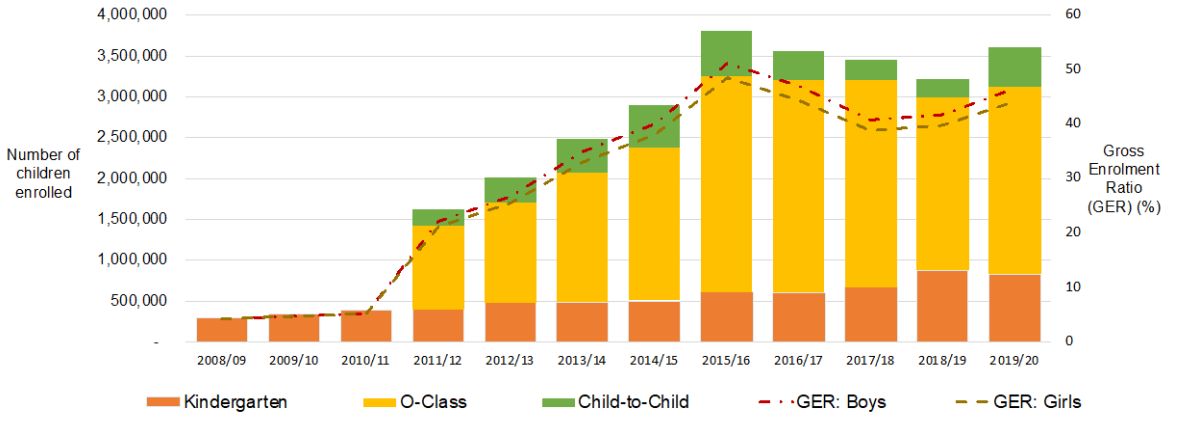
1.2 Contextualising pre-primary education in Ethiopia

Following the ratification of the National Policy Framework on Early Childhood Care and Education in 2010 by the government, the gross enrolment ratio for pre-primary school-aged children in Ethiopia (ages 4 to 6) increased dramatically from around 5% in 2010/11 to 47% in 2019/20 (MoE, 2011; 2020; Figure 1.1). The introduction of O-Class, the government's provision of pre-primary education aimed at improving children's school readiness on the entry into primary school, has made the largest contribution to the increased enrolment. Large-scale government involvement in pre-primary education was formalised in the fifth Education Sector Development Programme (ESDP-V, 2015) with targets, by 2020, to ensure that *all* children receive at least 1-year of pre-primary education and reach an 80% enrolment rate of 4-6-year-olds (MOE, 2015).

Despite significant progress, the gross enrolment ratio of 47% in 2019/20 fell far short of achieving the government's ESDP goal of 80% of pre-primary-aged children by 2020. In terms of the different types of pre-primary school, our Phase 1 findings identified that, among children who attended pre-primary education in 2019/20, 11%

attended kindergarten (3-year pre-primary programmes for ages 4-6, offered largely by private providers in urban areas), 30% attended O-Class, and 6% attended child-to-child programmes (informal pre-primary programmes between older and younger siblings or neighbours). However, even though O-Class targets the 6-year-old population, more than half of children in O-Class are under the age 6, which highlights the issue of under-age enrolment in O-Class. These findings are consistent with our ELP Phase 1 study (Rossiter et al., 2018).

Figure 1.1: Enrolment trends in pre-primary education in Ethiopia (2008/09-2019/20)



An important recent development is that O-Class has become included in the large-scale government GEQIP-E reform for quality education. The Government, jointly with the World Bank, UK's FCDO, Finland's Ministry for Foreign Affairs, and United Nations Children's Fund (UNICEF), launched the Quality Enhancement and Assurance Programme (QEAP) for O-Class associated with GEQIP-E in May 2018 based on international evidence and local experience from the pilot projects in two regions of Ethiopia (Benishangul-Gumuz and Gambella).

QEAP for O-Class aims to provide a comprehensive package of interventions to systemically improve the quality of O-Class provision within a coherent framework (World Bank, 2017). QEAP comprises two key components: Quality Enhancement (QE) and Quality Assurance (QA). The QE component, which focuses on improving pedagogical practices in the classroom, includes teacher preparation and professional development, curriculum and teacher guides for O-Class, and leadership training for O-Class management and supervision. The QA component includes national quality

standards, inspection for O-Class, and expanded Education Management and Information System (EMIS) data collection at the pre-primary level.

Since 2018, a new teacher guide for O-Class was developed based on a revised curriculum with play-based pedagogical approaches. The guide comes with various supporting materials for teachers, including art, music, story, conversation cards, self-activity, and indoor and outdoor activities. The teacher guide was translated and provided in 42 local languages with the most extensive coverage in the country. The QEAP programme also offers in-service training for O-Class teachers and facilitators for 30 days before they start teaching with the new curriculum and teacher guide. Along with these core interventions, leadership training for O-Class supervision and inspection for O-Class has been conducted since 2019. The set of QEAP interventions under GEQIP-E has been rolled out in a phased manner, starting with approximately 2,000 schools (5% of government primary schools nationwide) between July 2019 and June 2020. Their implementation, however, has been severely delayed and interrupted by the COVID-19 pandemic. The recent rapid increase in access to pre-primary education, together with strong political commitment to further expansion with quality and equity, creates a fruitful environment to assess the contribution of these recent developments.

Pre-primary education during COVID-19

The outbreak of COVID-19 and its associated economic and social challenges has led to serious consequences for children and families globally. In Ethiopia, schools were closed due to the pandemic on 16 March 2020. More than 26 million students from over 47,000 schools nationwide were affected by the closure, including 3.2 million young children who had been participating in pre-primary education. Despite the government's recent commitment towards pre-primary education, there has not been a clear response strategy for pre-primary education in light of school closures. Primary and secondary have received relatively better attention, including the provision of remote learning as announced in the government's COVID-19 Response Plan (Ministry of Education, 2020). Although schools gradually started to reopen in Ethiopia from October 2020, little is known about the extent to which children have been able to prepare for primary schooling while they experienced the eight-month long school

closures. Also, it is critical to understand how parents and caregivers had been able to support young children's learning and well-being during school closures. This information helps policymakers and practitioners identify the type of support that children are likely to need to recover from the COVID-19 shocks during their early childhood and mitigate any potential learning losses caused by school closures.

1.3 Structure of the report

This report brings together the key findings of different strands of the research in answer to those questions in six sections:

Section 2 provides an overview of this study's research design, methodology, ethical considerations, and research limitations.

Section 3 presents the main quantitative findings in Part 1 of ELP Phase 2 research, addressing research questions 1 through 5. It focuses on tracking the education trajectories of children who participated in O-Class, comparing them with a comparable group who did not attend pre-primary education, over the time of the COVID-19 school closures. We employed descriptive and inferential statistics to assess the association between pre-primary education participation and children's learning outcomes in early numeracy and its progress in the context of COVID-19. We explore how this association differs across various child and family characteristics and pre-primary education quality (including the government's quality improvement interventions). Additionally, we examined learning outcomes between two different cohorts of children, comparing those who entered Grade 1 before COVID-19 and those who entered after COVID-19.

Section 4 presents the findings in Part 2, focusing on the perspectives of key stakeholders and caregivers on the implications of COVID-19 on pre-primary education (research questions 6 and 7). Through key informant interviews with government officials and donors, this section addresses changes in accountability relationships in pre-primary education systems in the context of the ongoing early learning reform associated with GEQIP-E and the COVID-19 crisis. Moreover, it investigates the short- and medium-term implications of the COVID-19 pandemic on

parental involvement in early learning, drawn from phone surveys with parents and caregivers conducted during the COVID-19 school closures.

Section 5 identifies key messages and policy implications arising from the findings in Sections 3 and 4. These indicate how the findings of this study might inform national policy dialogue and support key stakeholders to increase the investment, political will and capacity needed to expand equitable access to quality early learning programmes in Ethiopia.

2 Methodology

2.1 Instruments

What is the Measuring Early Learning Quality and Outcomes (MELQO) initiative?

The MELQO initiative aims "to promote feasible, accurate, and useful measurement of pupils' development and learning at the start of primary school, and of the quality of their pre-primary learning environments" (UNESCO, et al., 2017, p. 7). The MELQO instruments consist of two modules: 1) the Measure of Development and Early Learning (MODEL), and 2) the Measure of Early Learning Environments (MELE). Table 2.1 summarises the instruments and core items of each module. These two modules are designed to be implemented at scale, and to be feasible for use in low- and middle-income countries.

Table 2.1: Global MELQO modules

Module	Instruments	Core items
Measure of Development and Early Learning (MODEL)	1. Direct child observation 2. Parent or teacher survey	MODEL includes items that are globally comparable in the domains of early numeracy skills, early literacy skills, executive function, social-emotional development, and gross/fine motor skills. Items on children's home and family environments are also included
Measure of Early Learning Environments (MELE)	1. Classroom observation 2. Teacher survey 3. Principal survey	MELE includes key domains of quality in play, pedagogy, interactions, environment, parent/community engagement, personnel and inclusion

Source: UNESCO et al. (2017).

MELQO Ethiopia: Adaptation process

For the purposes of our ELP Ethiopia research, the instruments went through a process of local adaptation and alignment with national standards. The adaptation process of MELQO focuses on two primary goals: first, ensuring alignment with policy documents and cultural priorities; and second, ensuring the feasibility of the measure, including the ability of observers to use the tool reliably (Raikes et al., 2020). During the 2017/18 school year, as part of the Team's ELP phase 1 work, Ethiopia went

through three steps of the MELQO adaptation process: (1) a review of existing policy documents related to early childhood education; (2) a stakeholder workshop comprised of central and regional government officials, NGOs, researchers and other early childhood education stakeholders to generate a draft version of MELQO Ethiopia; and (3) small-scale pilot testing followed by the final revision. ELP Ethiopia researchers closely collaborated with a team at the National Educational Assessment and Examinations Agency (NEAEA) and MELQO Global team throughout the entire adaptation process (See Rossiter et al., 2018 for the details).[2]

In the first stage of this process, we reviewed the core survey modules and focused on its alignment with key policy documents and curriculum for O-Class. MELQO Global team also provided capacity building training to ELP Ethiopia team and experts at the NEAEA. In the second stage, a stakeholder adaptation workshop was organised with a group of attendees representing the MoE, NEAEA, Regional Education Bureaus (REB), aid donors, NGOs, universities and early childhood education institutions. During the workshop, survey modules were reviewed to assess its alignment with national standards and policy goals. Participants, for instance, made recommendations for adjustments to suit the local context and in respect of terminology used (Hagos and Mulugeta, 2021). Based on feedback from the adaptation workshop, pre-field test instruments were developed through the iterative process between MELQO global team and ELP Ethiopia team. When the tools were finalised, they were initially translated into six local languages in Ethiopia: Amharic, Afan Oromo, Af Somali, Berta, Sidamma Afoo, and Tigrinya, and subsequently extended to eight in total by including two additional local languages (Wolaittatto and Hadiyssa).

In the third stage, pre-field test training for supervisors and fieldworkers took place for two weeks with participants drawn from six regions, NEAEA experts and ELP Ethiopia team. After the field-testing, by carrying out the psychometric analysis of the child direct assessment component (i.e., MODEL) of the MELQO tool, the validity of the measuring instrument was established (Koziol, 2018). The results of the pre-field study were presented to leaders and experts from the MOE and NEAEA. The NEAEA acknowledged the importance of data on pre-primary education and committed

themselves to institutionalise the MELQO tools as part of the national assessment instruments. Ethiopia recently initiated its first national assessment of pre-primary education, starting from the academic year of 2021/22.

MELQO Ethiopia: Components

MODEL child direct assessment

The MODEL child-direct assessment includes items pertaining to early learning that are globally comparable in the following domains: early numeracy, early literacy, executive function, fine-motor skills, and socio-emotional development.[3] Overall, the assessment measures constructs related to school readiness, or the set of fundamental skills and competencies contributing to children's school success. The domains of the MODEL child-direct assessment align well with the national curriculum syllabus for O-Class in Ethiopia prepared by the Government (MoE, 2014). Table 2.2 presents the MODEL assessment domains, aligned curriculum competencies (overarching and specific), and skills targeted in the MODEL assessment task item.

Part 1 in this report primarily focuses on early numeracy test scores in relation to pre-primary school participation. Early numeracy test scores were estimated by the mean percentage of correct answers based on seven sub-tasks measuring number concepts and measurement skills. In addressing our third research question comparing children who entered primary school before and after COVID-19 school closures, we used the mean percentage scores based on six sub-tasks of early numeracy, which were administered identically across the two cohorts. Early literacy test scores were not included in the inferential analyses because of difficulties in combining literacy scores across eight local languages. In particular, each language possesses unique linguistic characteristics that are not comparable, and sample sizes would be small if we analyse each language independently.

Table 2: MODEL child direct assessment

MODEL Domain/ Ethiopian O-Class curriculum		MODEL Assessment task	Skills targeted
Overarching competence aligned with Ethiopian curriculum	Specific competence aligned with Ethiopian curriculum		
Early numeracy/ development of basic computational skill	Number concepts (identify and count numbers)	Verbal counting	Knowledge of counting numbers in order orally
		Producing a set	Knowledge of word order, one-to-one correspondence, and cardinal value
		Number identification	Ability to name numerals (number symbols)
		Number comparison	Ability to compare number magnitudes and receptive language in measurement vocabulary
		Simple addition and subtraction	Addition and subtraction skills
	Measurement skills (understand the relationship between things; describe the concept of space)	Receptive spatial vocabulary	Receptive language skills in spatial vocabulary (e.g., “on”, “under”, “in front of”, and “next to”
		Mental transformation	Spatial skills used to transform two shapes into one shape
Early literacy/ language development and utilisation	Speaking (develop communication skills; growth of body parts and sense organs)	Expressive language	Verbal naming/differentiation of names of body parts
		Expressive vocabulary	Verbal naming by category (nutritious foods, animals)
	Pre-reading skills/alphabet knowledge	Letter identification	Letter name identification/knowledge
		Letter sounds identification	Identification of sound in a letter
		Letter sounds discrimination	Discrimination of sound in a latter

	Receptive language	Listening comprehension	Listening comprehension
	Pre-writing skills	Name writing	Name writing
Executive Function	Working memory and inhibitory control	Head toes knees shoulders	Ability to inhibit a normal response and implement a new learned response
		Backward digit span	Ability to recite digit sequence backward
	Short-term memory	Forward digit span	Ability to recite digit sequence from memory
Fine motor skills/ Development creativity and appreciation	Fine motor skills	Shape copying	Copying shapes (X, circle, and rectangle) from model drawings of those shapes
Socio-emotional skills/ Individual, social and emotional development	Relating to oneself (develop self-expression and self-help skill)	Self-regulation	Ability to control emotions and social behaviour in the interest of engagement and participation in both social interactions and independent work
	Relating to others	Social cognition	Ability to read others' emotions and respond appropriately, as well as prosocial behaviour that includes helping others who may be in distress
		Social competence	Ability to coexist and interact with others in a competent manner, essentially getting along with other children and adults
		Emotional well-being	Aspects of optimal mental health that could predict more serious mental health problems

Note: The MELQO assessment (UNESCO et al., 2017) was aligned with Ethiopian Pre-primary O-Class Education Program Syllabus (MOE, 2014).

MELE classroom observation instrument

MELE is an observational instrument developed specifically for assessing pre-primary school quality in low- and middle-income country contexts. Its components are identified to be globally relevant, predictable for children's learning across settings, and critical for protecting children's rights and preserving their well-being (UNESCO et al., 2017). MELE Ethiopia collected information on three key domains that have been shown to influence child development in other studies (see Raikes et al., 2020; Su et al., 2021).

Table 2.3 presents the three domains of MELE classroom observation tool adapted to Ethiopia, its aim, and specific items measured in each domain. The first domain, 'health and facilities', assesses facilities for child health and sanitation and safety issues. The second domain, 'activities and materials', focuses on learning activities in different subjects/areas, teaching materials, and learning materials. The third domain, 'classroom interaction and approaches to learning', assesses how well teachers support children's development of early knowledge, skills, and deeper learning during various learning activities. These domains of MELE are considered imperative and recommended for inclusion in models of preschool quality (Burchinal, 2018).

Table 2.2: MELE classroom observation tool

MELE domain	Aim	Measurement
Health and facilities	Assess the conditions of the school potentially adverse for children's health and safety	- Access to clean/drinking water - Handwashing facilities - Handwashing practices - Access to toilet facilities - Toilet conditions - Safety conditions (exposure to dangerous facilities)
Activities and materials (classroom arrangement, space, and materials)	Measure the range of activities (both curricular and play) children experienced during the observation, including the number and type of materials they engaged with	- Learning activities (math, literacy, expressive language, storybook, fine motor, free play, music, gross motor) - Teaching materials and classroom arrangement (lesson plan, child portfolios, development monitoring, classroom space, seat and writing surface, learning corners, school yard) - Learning materials (writing utensils, art, fantasy play, educational toys or math materials, storybooks, books in local language or English)
Classroom interaction and approaches to learning	Evaluate the multiple aspects of teachers' interactions with children, including use of playful learning, engagement and negativity with children, and teachers' use of individualised instruction	- Teacher engagement - Teacher discipline strategies - Child engagement - Group activities - Child supervised - Thematic activities - Individualised instruction - Respect for diversity

The MELE classroom observation, which was conducted for 135 minutes (over two to three classes including free/play time) by trained field supervisors, documented basic classroom information (e.g., number of girls and boys enrolled in O-Class) and their evaluation on the items in the three domains. We also conducted MELE interviews with school principals and teachers (see a full list of the survey items in Table A4 in the appendix). Interviews with pre-primary teachers asked about teachers' education and professional background, participation in professional development, instructional support provided by school principals or district, engagement with caregivers, and motivation and attitudes towards teaching. For principals, the survey focuses on O-Class management, such as school resources and allocation of school grants. These instruments offer a rich portrait of the child's experience in the pre-primary classroom

in Ethiopia, captured by more than 100 indicators from classroom observation (37 items) and teacher/principal interviews (75 items).

To answer our fifth research question on the relationship between pre-primary school quality and child learning outcomes, this report used selected quality indicators theoretically informed by the existing literature and the context of Ethiopia. In particular, the indicators were informed by two recent studies conducted in Tanzania and rural China using MELE after the adaptation process in each country. Through the analysis of psychometrics property of MELE, Raikes et al., (2020) found that only the composite score of 'activities and materials' was uniquely associated with the children's school readiness outcomes in Tanzania, after controlling for all child, family, class, and school covariates. Notably, the quality constructs and preschool characteristics accounted for over one-quarter of variability (27% to 29%) in the child test scores. Su et al. (2021) assess the relationship between composite score of preschool quality using MELE and children's school readiness outcomes in rural China. Similarly, they found that 'activities and materials' were significantly related to children's school readiness outcomes (b = 0.10~0.11), whereas 'classroom interactions and approach to learning' and 'health and facilities' were not related to children's test scores.

2.2 Sample

Sampling approach

MELQO was administered in a total of 88 schools in the baseline (2019). These same schools were included in the endline in 2020/21, with the exception of 10 schools in Tigray, which could not be reached due to security reasons. The baseline sample includes two groups of children—children who attended O-Class in 2019 and those who did not attend pre-primary education in that year. Those attending O-Class were stratified between children from O-Class who were and were not receiving the quality improvement intervention from GEQIP-E programme quality intervention.

The study used a combination of purposive and random approaches in selecting the 88 ELP Phase 2 sample schools and children. The sample selection followed a two-stage process:

- The first stage was a purposive approach, where the sample schools were partitioned into two groups: O-Classes receiving enhanced GEQIP-E support for pre-primary education and O-Classes not receiving any additional interventions. The former group is pre-primary classes that had been identified by the government and donors to receive GEQIP-E Phase 1 special interventions in 2019/20. In particular, they were assigned to receive the QEAP interventions, which consists of in-service teacher training, play-based teaching and learning materials, and quality assurance program for O-Class.[4] A list of government primary schools nationwide that are included in EMIS was obtained from the MoE.[5] We then restricted a pool of the sample to primary schools with O-Classes that use eight local languages for instruction across seven regions: Amharic (Addis Ababa, Amhara), Affan Oromo (Oromia), Tigrigna (Tigray), Sidamu Afoo, Wolaytta, Hadiyissa (3 languages in Southern Nations, Nationalities and Peoples' Region (SNNP)), Berta (Benishangul-Gumuz), and Somali (Somali).[6] Drawing from the list, we stratified the schools into two groups based on whether they were assigned to Phase 1 schools of the GEQIP-E programme or not.
- At the second stage, we employed a randomised approach, where half of O-Classes were randomly selected from the list of schools receiving QEAP intervention as part of the GEQIP-E programme, and another half of O-Classes were randomly selected from schools not receiving any direct support from QEAP interventions.
- In each selected school, 20-25 children were randomly selected stratified by gender to ensure an equal number of boys and girls. In addition, about 807 children residing in the same village (*kebele*) as the selected schools who were not in pre-primary education, were randomly selected.[7] These children serve as a comparison group to an entire group of children enrolled in O-Class.

We focused on collecting data from O-Class, the main type of pre-primary education serving nearly 70% of pre-primary enrolled children in Ethiopia (MoE, 2020). We did not include children attending other forms of preschools, such as kindergarten provision, given that they serve only a small portion of children who live in urban areas and those from wealthier families. To illustrate, privately-run kindergarten is an urban

phenomenon. It serves all preschool-aged children in Addis Ababa, whereas it serves less than 10% of children in other regions living close to the city center. Regarding the Child-to-Child programme, less than 5% of Ethiopian children are currently attending this informal provision, those are concentrated in only two regions—Tigray and SNNPR.

Table 2.4 presents the ELP Phase 2 Ethiopia sample by O-Class enrolment status and O-Class intervention status associated with GEQIP-E. In total, 3,214 pre-primary aged children and 88 schools with O-Class were selected at baseline (2019/20), and we were able to follow 2,645 children in 78 schools at endline (2020/21). In each school, one school principal and one O-Class teacher were selected for the survey. (More details about the sample by region and by school type can be found in appendix Table A5). Lastly, although our sample captured the country's diverse populations, it was not a nationally representative or sub-geographically (e.g., region, zone, or district) representative sample, thus generalisation to the national Ethiopia population should be avoided.

Table 2.3: ELP Phase 2 Ethiopia sample: by O-Class intervention status

Group		Sample children		Sample schools	
		Baseline (Except Tigray)	Endline	Baseline (Except Tigray)	Endline
O-Class	O-Class receiving GEQIP-E quality enhancement support	1,142 (1,025)	953	43 (38)	38
	General O-Class not receiving GEQIP-E quality enhancement support	1,148 (1,012)	941	45 (40)	40
Not in pre-primary		924 (807)	751	-	-
Total		3,214 (2,844)	2,645	88 (78)	78

Attrition analysis

Given we could not collect endline data in Tigray due to security reasons, we excluded Tigray (370 students in 10 schools) from our comparisons over time, and so these schools are not included in the attrition analysis. For the remainder of the sample, between baseline and endline, 199 children (7% of the total sample) did not participate in the endline survey for the following reasons: 97 migrated (48.7%); 97 could not be tracked (48.7%); and 5 (2.5%) declined to participate. We look at the patterns of attrition by comparing attrition rates over a range of child and family characteristics: gender, age, O-Class participation, whether child has any functional difficulties (e.g., hearing, seeing or communicating), baseline test scores in early numeracy, caregiver's literacy, household wealth index, and location.

Table 2.5 shows whether there are statistical differences in these characteristics between children who left the sample and those who did not. We find that children who left the sample were significantly more likely to:

- be older (5.92 years old vs. 5.67).
- attain a higher score in the baseline early numeracy test (53% vs. 47%)
- live in urban areas (42% vs. 28%).

Although it is not clear why older children were more likely to leave the sample, a reason for higher attrition in urban areas was due to fieldworkers reporting difficulties in tracking children who live in Addis Ababa owing to frequent movement or migration of urban families. This is similar to the attrition pattern observed in the Young Lives Ethiopia longitudinal survey: attrition is primarily an urban phenomenon due to untraceable households (Outes-Leon and Dercon, 2008). For example, in the Young Lives survey, between 2002 and 2016, the attrition rate among urban students was much higher than rural students (24% vs. 16%). In our study, as urban children tend to attain higher scores than rural children, those who attain higher scores at baseline were also more likely to leave the sample. It should be noted that there is no significant difference in the attrition rate related to gender, pre-primary education enrolment status, child's functional difficulties, caregiver's literacy, and household wealth tercile.

Table 2.4: Sample characteristics by survey attrition status

Child/family characteristics	Children who left the sample	Children who remained in the sample	Mean difference	*t*-statistic
	n=199	n=2,645		
Female	0.51	0.50	0.01	0.29
Age	5.92	5.67	0.26	5.02***
Pre-primary education enrolment	0.72	0.72	0.003	0.08
Child has any functional difficulties	0.07	0.05	0.01	0.77
Baseline test scores in early numeracy	53.2	46.6	6.6	2.94***
Caregiver's literacy	0.29	0.32	0.03	0.65
Household wealth tercile	1.96	2.00	0.04	0.64
Living in urban	0.42	0.28	0.14	4.04***

Table 2.6 presents the results of multivariate logistic analysis on predictors of survey attrition. It consistently shows that older children and children living in an urban area had a higher probability of leaving the study sample ($p < 0.01$). However, there were no significant patterns of the sample attrition regarding other key child and family characteristics—such as household wealth and caregiver's literacy—which often predict whether children attend pre-primary school. Based on the information on survey attrition, we estimated attrition weighting and applied this to all regression models in the report.

Table 2.5: Predictors of survey attrition

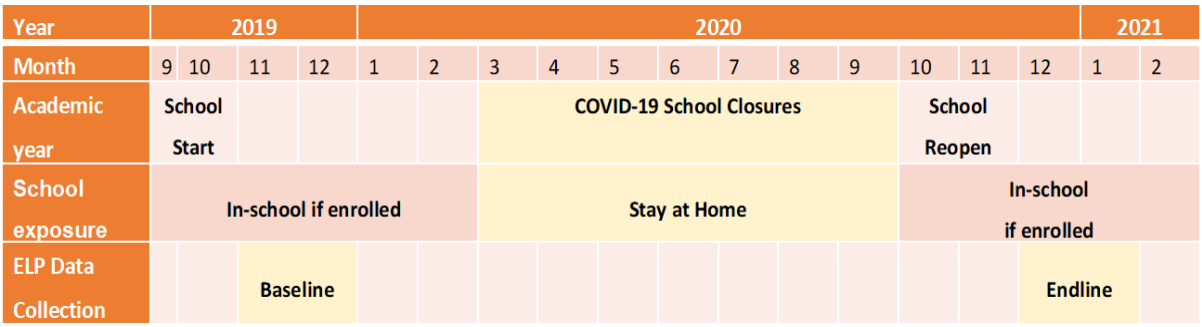
Child/family characteristics	Odds ratio	Standard error	Marginal Probabilities
Female	1.01	0.15	0.00
Age	1.43***	0.14	0.02***
Pre-primary education enrolment	0.74	0.14	-0.02
Child has any functional difficulties	1.16	0.36	0.01
Baseline test scores in early numeracy	1.00	0.00	0.00
Caregiver's literacy	0.85	0.15	-0.01
Household wealth tercile	0.81*	0.09	-0.01*
Living in urban	1.77***	0.31	0.04***
Constant	0.01***	0.01	

Analytic samples

A sample of children who were part of the ELP Phase 2 research was followed longitudinally from the academic year of 2019/20 through to 2020/21. The baseline data collection was conducted between November and December 2019, prior to the COVID-19 pandemic. The endline data collection, which was originally planned in June 2020 at the end of the same academic year, was postponed to December 2020 due to the COVID-19 school closures. After the eight-month long school closures beginning in March 2020, schools started to re-open between October and November 2020 with a phased approach, prioritising schools in rural areas. As the MoE announced an automatic grade promotion policy, children who had been in O-Class were expected to progress directly to Grade 1 after a short period of remedial courses (two to four weeks) after school re-opening. As such, those who had been in O-Class during our 2019 baseline data collection were expected to enrol in Grade 1 of primary school at the 2020 endline.

Due to the COVID-19 school closures, the interval between the planned baseline and endline data collection increased from 7 months to 13 months. The research team collected information at the beginning of the academic year 2019/20 and the beginning of the following academic year 2020/21 on children who participated in O-Class and a comparable group of children who did not participate in any pre-primary school at baseline. Given the school closures, O-Class children at baseline who progressed to Grade 1 were exposed to schooling for approximately five to six months during our data collections (Figure 2.1). This meant that our research shifted focus to take account of school closures. The initial aim was to identify the contribution of O-Class, and GEQIP-E-related reforms specifically, by comparing learning at the beginning and end of a school year. However, given children spent more limited time in school than expected, and the implementation of GEQIP-E reforms was seriously affected by the pandemic, the focus moved to identifying the relationships between O-Class participation and school readiness for primary education in the context of the school closures, including attention to the varied relationships by sub-groups of children.

Figure 2.1: Timeline for school closures and reopening and ELP data collection



The final sample for the analysis included 2,645 children for whom we have both baseline and endline data from child direct assessment. Table 2.7 presents ELP sample distribution across the six regions for female and male students and urban and rural students. The six regions were selected given more than 94% of 4- to 6-year-old Ethiopian children live in these regions (Rossiter et al., 2018). For the three least populous regions (Addis Ababa, Benishangul-Gumuz (B-G), and Somali), the sample size is smaller, with samples were allocated approximately proportionate to regional size for the larger regions (Amhara, Oromia, and SNNP). Across six regions in which we were working, 20% of the population lives in urban areas, thus we included around 20% of schools in urban areas in the sample. We also applied the urban/rural population shares across regions in Ethiopia. Additionally, Table 2.8 shows the sample distribution by O-Class enrolment and intervention status across the six regions of Ethiopia.

Table 2.6: ELP analytic sample distribution by region, gender, and location

Gender					
Region	Girls		Boys		Total
	N	%	N	%	N
Addis Ababa	125	53.9	107	46.1	232
Amhara	268	47.1	301	52.9	569
B-G	149	53.0	132	47.0	281
Oromia	386	49.9	387	50.1	773
SNNP	323	50.2	320	49.8	643
Somali	77	52.4	70	47.6	147
Total	1,328	50.2	1,317	49.8	2,645
Location					
	Urban		Rural		Total
	N	%	N	%	N
Addis Ababa	232	100	0	0	232
Amhara	0	0	569	100	569
B-G	109	38.8	172	61.2	281
Oromia	257	33.3	516	66.8	773
SNNP	38	6.0	605	94.1	643
Somali	111	75.5	36	24.5	147
Total	747	28.2	1898	71.8	2,645

Note: Due to security reasons, the sample in Somali is mostly from urban areas and the sample size is smaller than other regions.

Table 2.7: ELP analytic sample distribution by region and O-Class intervention

Region	O-Class receiving GEQIP-E quality enhancement support		General O-Class not receiving GEQIP-E quality enhancement support		Not in pre-primary education		Total
	N	%	N	%	N	%	N
Addis Ababa	151	65.1	81	34.9	-	-	232
Amhara	214	37.6	202	35.5	153	26.9	569
B-G	75	26.7	129	45.9	77	27.4	281
Oromia	270	34.9	247	32.0	256	33.1	773
SNNP	194	30.2	234	36.4	215	33.4	643
Somali	49	33.3	48	32.7	50	34.0	147
Total	953	36.0	941	35.6	751	28.4	2,645

Note: (1) In the ELP sample, there were no children not enrolled in pre-primary school in Addis Ababa. The gross enrolment ratio for pre-primary education in this region is more than 100, and so it was difficult to find children who were not enrol in pre-primary education before school entry.

In addressing our third research question, which aims to compare learning outcomes between two cohorts of children entering Grade 1 before and after COVID-19, we used an additional dataset from a related study, the Research for Improving Systems of

Education (RISE) Ethiopia. Launched in 2017, RISE Ethiopia research is a longitudinal study aiming to understand the impact of nationwide educational reforms (GEQIP-E) on improved learning outcomes for primary students in Ethiopia. Importantly, the RISE Grade 1 cohort is comparable with the ELP sample cohort, which are two years apart (covering the period before and after the COVID-19 school closures).

Specifically, RISE Ethiopia collected data from children in Grade 1 at the start of the 2018/19 academic year prior to the pandemic, which is the same time point for the ELP sample children who entered Grade 1 in the 2020/21 academic year during the pandemic. In terms of the sampling approach, ELP research followed similar steps that the RISE research applied (see Hoddinott et al., 2019). In addition, 40 of 88 ELP sample schools at baseline were from the RISE sample school. Tables 2.9 presents the sample distribution of the RISE Grade 1 sample by pre-primary school enrolment status across the six regions of Ethiopia.

Table 2.8. RISE analytic sample distribution by region and pre-primary enrolment

	Pre-primary school enrolment				
	Enrolled in Pre-primary		Not in Pre-primary		Total
	N	%	N	%	N
Addis Ababa	440	89.4	52	10.6	492
Amhara	220	43.2	289	56.8	509
B-G	206	63.4	119	36.6	325
Oromia	139	18.4	617	81.6	756
SNNP	377	93.1	28	6.9	405
Somali	51	20.2	202	79.8	253
Total	1433	52.3	1307	47.7	2740

2.3 Analytical Strategy

The main aim of our quantitative analysis is to ascertain the extent of O-Class children's learning and its progress with respect to early numeracy relative to their peers who did not enrol in any pre-primary school. Our research attempts to address this issue in the context of COVID-19 school closures, with a particular focus on how it differs by child and family characteristics.

To estimate the relationships between O-Class participation and school readiness outcomes measured by early numeracy, we used ordinary least squares (OLS)

regressions with rich controls selected based on a review of related literature, including students' lagged test scores. Our analyses also used propensity score matching (PSM) and OLS with district-fixed effects as a robustness check of our initial regression results (see Appendix 6.2).

A major challenge in identifying the effects of preschool attendance is that selection into pre-primary education is likely not random. For instance, Ethiopian children from wealthier families, having a more educated caregiver and living in an urban area were more likely to attend pre-primary school (Woldehanna, 2016). We note that OLS models explore the average effect of pre-primary school participation by comparing O-Class children with a heterogeneous group of non-participants, some of whom are different from pre-primary participants in baseline characteristics (see descriptive statistics in Table 3.1). To reduce the potential for bias attributable to child, family, and school characteristics, we include a rich set of controls with students' lagged test score, which is expected to capture the contribution of all previous inputs and any past unobservable endowments and shocks (e.g. Glewwe et al., 2017; Singh, 2015). We further estimate how O-Class participation is associated with school readiness on the type of individual who is likely to attend preschools and their counterfactuals (propensity score matching) and among individuals within same village (district-fixed effects).

With respect to missing values, given that our analytical sample was restricted to students who have both baseline and endline test scores from the MELQO assessments, there were no missing values in outcome variables. Some independent variables had missing values, but with very low non-responses, including 0.002% for household wealth index and 0.4% for caregiver's literacy. Thus, we applied listwise deletion (i.e., complete case analysis) that yields approximately unbiased parameter estimation, even when data are not missing at random (Little, 1992).

OLS regression with rich controls (conditional value-added model)

To examine how O-Class participation is associated with individual's early numeracy performance, we started with an OLS model in which each of the outcome variables—learning levels at baseline and endline, and endline learning outcomes conditional on

baseline learning levels—is regressed upon O-Class participation along with a set of covariates related to child and family characteristics. Given our research assessed children's learning at two-time points, this provides us the advantage to examine learning progress between the academic years of 2019/20 and 2020/21. In particular, the OLS model with endline test scores conditional on baseline test scores captures changes in learning between the two time points, which is equivalent to a *conditional* value-added model. The identifying assumption of this model is that the lagged test score fully captures the effect of the complete history of inputs and child innate ability before they started pre-primary school (Todd and Wolpin, 2007), which can be expressed as:

$$Y_{it} = \beta_0 + \beta_1 PRE_i + \beta_2 Y_{(t-1)} + \beta_3 X_i + \varepsilon_i$$

where Y_{it} represents academic achievement of student *i* at time *t* (endline in this study); PRE_i denotes preschool attendance; $Y_{(t-1)}$ represents his or her academic achievement at time *t-1* (baseline in this study)*;* X_i is covariates representing student- and family-level characteristics, and ε_i is an error term of the student-level residual. Our interest is β_1, which captures the relation of pre-primary school participation with students' achievement in early numeracy. To account for the possibility of correlated error across individual nested in district (*woreda* in Ethiopia), all models include robust standard errors clustered at the district level.

To explore differential relations between preschool attendance and learning by sub-groups, we examined whether the relationship was moderated by child and family characteristics such as gender, location, and caregiver's literacy. Moderation by child and family covariates was tested by adding a cross-level interaction term between preschool participation and child and family characteristics.

Propensity score matching (robustness check)

Propensity score matching (PSM) is widely used to draw sound inferences in observational studies when conducting an experiment is not feasible or appropriate. PSM assumes that pre-primary participation is the result of differences in observable covariates between attendees and non-attendees. We thus can use the propensity score (Rosenbaum and Rubin, 1985)—defined as the conditional probability of

participating preschool given child's background characteristics—to simulate a comparison group of preschool attendees that resemble the actual preschool attendees. As long as there are no unobserved confounders independent of observed sample characteristics, comparisons of individual development outcomes based on the matched sample increase the precision and robustness of our estimates over regular regression analysis (Reynolds and Desjardins, 2009). PSM models have been used in numerous studies that evaluated the effect of Early Childhood Education (ECE) (e.g., Goodman and Sianesi, 2005; McCoy, et at., 2017) as it helps researchers mitigate the selection bias in preschool assignments based on various contextual factors, such as household wealth, parental education, and geographic disadvantages.

District-fixed effects (robustness check)

We used a district-fixed effects model to control for variations in observed or unobserved district-level characteristics related to pre-primary participation. One challenge to the OLS estimate is that pre-primary participation may vary across district due to the availability, accessibility, affordability, and quality of O-Classes. To further control for such district-level variance in pre-primary education provisions, we ran the OLS with district-fixed effects which comparing the associations between O-Class participation and learning outcomes among students within the same district. This serves as a robustness check for our estimates from the OLS and PSM to examine the degree of bias (see Appendix 6.2).

In summary, Table 2.10 provides an overview of the ELP Phase 2 research, including research questions, sample, data and methodology used to address the research questions.

Table 2.9: Overview of the ELP Phase 2 research: Research questions, sample, data sources, and methodology

Research Questions	Sample	Data type	Methodology
Part 1: What are the education trajectories of pre-primary school-aged children in Ethiopia in the context of COVID-19?			
Research question 1: Which early education pathways are prevalent among children in the context of COVID-19 school closures? What are the predictors of pre-primary school children not returning once schools re-opened?	- 2,645 ELP sample children	- MELQO: MODEL child direct assessment (Early numeracy) - MELQO household survey	- Logistic regression
Research question 2: What are the differences in early numeracy outcomes for children who participated in O-Class and those who did not? Have these outcomes changed between 2019/20 and 2020/21 as a result of the COVID-19 school closures? How do these vary by sub-groups?	- 2,645 ELP children	- MELQO: MODEL child direct assessment (Early numeracy) - MELQO household survey	- OLS with conditional value-added model (robustness check) - Propensity score matching - District-fixed effects - Difference-in-Difference (see Appendix 6.3) -Interaction effects
Research questions 3: What are the differences in early numeracy outcomes for children who entered Grade 1 before COVID-19 and those who entered after COVID-19? To what extent are these differences affected by children's participation in O-Class?	- 2,645 ELP sample children - 2,740 RISE sample children	- MELQO: MODEL child direct assessment (only 6 sub-tasks in early numeracy administered to both sample cohorts) - MELQO household survey	- *t*-test - OLS
Research question 4: To what extent are learning trajectories affected by quality improvement interventions for O-Class (GEQIP-E) in the context of COVID-19 school closures?	- 2,645 ELP sample children	- MELQO: MODEL child direct assessment (early numeracy)	- OLS with conditional value-added model
Research question 5**:** To what extent are early numeracy achievement and learning gains affected by	- 1,789 ELP sample children attending O-Class	- MELQO: MODEL child direct	- OLS with conditional value-added model

the quality of O-Class more generally?	- 78 school principals - 78 O-Class teachers	assessment (early numeracy) - MELQO: MELE classroom observations - MELQO: MELE teacher/principal survey	
Part 2: What are the perspectives of key stakeholders and caregivers on the effects of COVID-19 on pre-primary education?			
Research question 6: How have accountability relationships in pre-primary education systems been affected by the GEQIP-E reform and the COVID-19 crisis?	8 key informants from the Ministry and aid donors	- Interview (structured, open-ended questions)	Qualitative analysis
Research question 7: To what extent have parents and the community been involved in children's early learning during the COVID-19 school closures?	480 caregivers and parents	- COVID-19 phone survey for caregivers (adapted from MELQO caregiver survey with country-specific items)	Descriptive statistics

2.4 Ethical considerations

Ethical considerations are likely to be particularly pronounced when engaging with young children. Throughout the research, we adhered to the ethical guidance for research and drew on the best practice and experience of our team over decades of education research. To do this, our team:

- Secured dual-site ethical clearance from Addis Ababa University and the Faculty of Education at the University of Cambridge to ensure the integrity of the research in the cultural context of Ethiopia
- Obtained voluntary, informed and verbal consent from all survey participants, including individual children, parents/guardians, school principals and teachers before the commencement of the child-direct assessment, teacher reporting form and the survey questionaries. Obtaining verbal consent is aligned with established processes for obtaining informed consent in Ethiopia since there are cultural and political sensitivities relating to written/signed consent in

Ethiopia. In particular, for children who are under the age of 18 years old, we sought to obtain parents/guardians verbal consent. The participation of children in the study thus was contingent on securing this consent.

- Applied strict measures to assess and respond to risks of undertaking research during COVID-19. All travel (even pre-COVID) has relied heavily on information from the FCDO website, as well as local, on-the-ground information from our team based in Ethiopia. Given COVID-19, fieldworkers were provided with face masks, hand sanitiser, and received training to fulfil the recommended social distancing while conducting the survey.
- Committed to safeguarding the rights and welfare of research participants and ensured appropriate conduct among fieldworkers throughout the study. We followed the policy laid out by the University of Cambridge[8] and the standard research protocol involved in protection of human subjects.
- All data were directly captured through the tablets and uploaded to the designated online storage system. Once anonymised, data were shared internally within the team, on a General Data Protection Regulation-compliant secure platform.

3 Findings: Tracking the learning progress in the context of COVID-19

3.1 Descriptive statistics

Pre-primary school participation and control variables

The descriptive statistics for pre-primary school participation and all control variables are presented in Table 3.1. As we purposively selected the sample depending on their pre-primary enrolment status (see our sampling approach in section 2.2), 72% of children participated in O-Class in the academic year of 2019/20.

On average, children in our sample were 5.7 years old at the time of baseline assessment, so close to the expected age of 6 years old.[9] The age for those in O-Class ranged from 4 to 7. The vast majority of caregivers (94%) reported that their children were in good health. The sample was divided into three groups based on the household wealth index.[10] A higher proportion of children who were not in pre-primary school lived in poorer households, while more children who were in O-Class were from the relatively richer households. About one-third of caregivers could read and write using direct assessment during household survey, and more literate caregivers sent their children to pre-primary school than caregivers who are not literate. Approximately 38% of children were living in relatively large households, with more than six family members, with a similar pattern regardless of whether they attended pre-primary education.

More than half of families (57%) reported having sufficient food in the past 12 months in 2019, with fewer reported having sufficient food amongst those not in pre-primary education. About 72% of families of the sample children are living in rural areas, which were purposively sampled in line with the regional average rural-urban population ratio. More children not in pre-primary school were living in rural areas. Overall, the estimates from the *t-test* indicated a statistically significant difference between O-Class children and those not in pre-primary school for the following characteristics: child's age, health condition, functional difficulties, household wealth, primary caregiver's literacy, households having sufficient food, and living in rural areas.[11]

Table 3.1: Descriptive statistics: Control variables

	Overall sample		By pre-primary school participation				
			Participated in O-Class		Not in pre-primary school		
	% or Mean	SD	% or Mean	SD	% or Mean	SD	*t-test*
Pre-primary school participation							
Participated in O-Class	72%		-	-	-	-	
Child characteristics							
Age	5.67	(0.67)	5.80	(0.66)	5.34	(0.57)	***
Girl (1=Yes)	50%		51%		48%		
Child health condition is good (1=Yes)	94%		95%		91%		***
Child has any functional difficulties (1=Yes)	5%		4%		7%		***
Household characteristics							
Household wealth tercile 1 (poorest)	33%		31%		40%		***
Household wealth tercile 2	33%		33%		34%		
Household wealth tercile 3 (richest)	33%		36%		25%		***
Primary caregiver's literacy (1=Yes)	32%		34%		26%		***
Household size (1= larger than 6)	38%		37%		40%		
Household has sufficient foods in last 12 months	57%		60%		48%		***
Living in rural area	72%		70%		77%		***

Note: SD=Standard deviation.

Outcome variables

Table 3.2 presents descriptive statistics for outcome variables, comparing mean test scores (% of correct answers) of O-Class children with those not in pre-primary school in four MELQO domains: early numeracy, early literacy, executive function, and fine motor skills. The assessment items administered in baseline and endline are identical, hence it enables us to use the mean percent scores to estimate children's learning progress between baseline and endline.

On average, the mean test score in early numeracy was 40% at baseline and this increased to 59% at endline, indicating learning gains of 19 percentage points over the period Nov/Dec 2019/20 to Dec/Jan 2020/21. For O-Class children, the mean test score was 46% at baseline and this rose to 64%. For those not in pre-primary school, the mean test score was 26% at baseline and this increased to 46%. Overall, the increase for O-Class children in early numeracy was 18 percentage points and 20 percentage points for those not in any pre-primary school, demonstrating strong learning progress from both groups.

In early literacy, the average percentage scores were 34% at baseline and this rose to 44% at endline. Yet, considering distinctive linguistic characteristics of different local languages, we have avoided using the average scores in early literacy. When we look at early literacy outcomes by local languages, children from all seven language groups showed learning progress between 2019/20 and 2020/21 from an increase of 5 percentage points in Sidama (SNNP) to 20 percentage points in Somali. Similarly, learning progress in other two domains—executive function and fine motor skills—was apparent, which showed a significant increase in mean test scores.

Table 3.2: Descriptive statistics: Outcome variables I

MELQO Domains		Overall sample		By pre-primary school participation				
				Participated in O-Class		Not in pre-primary school		
		Mean	SD	Mean	SD	Mean	SD	*t-test*
Early Numeracy Test Scores (% of correct answers)								
Baseline (2019/20)		39.96	(26.10)	45.65	(25.48)	25.59	(21.77)	***
Endline (2020/21)		59.09	(25.70)	64.45	(23.93)	45.57	(25.07)	***
Early literacy								
Total Average	Baseline	34.02	16.14	37.37	16.50	25.56	11.43	***
	Endline	43.81	18.73	47.22	19.13	35.20	14.48	***
- Amharic	Baseline	35.34	17.28	38.47	17.44	23.96	10.62	***
	Endline	47.44	21.11	51.30	21.00	33.47	14.62	***
- Berta	Baseline	26.36	12.16	27.86	12.35	22.27	10.77	**
	Endline	33.21	15.38	36.42	14.69	24.42	13.94	***
- Af-Oromo	Baseline	26.57	9.85	28.18	10.08	23.32	8.50	***
	Endline	33.33	11.43	35.26	12.07	29.41	8.82	***
- Af-Somali	Baseline	41.42	15.10	43.84	14.83	36.72	14.63	***
	Endline	61.06	15.78	66.09	14.67	51.29	13.13	***
- Sidama	Baseline	41.75	15.52	46.87	14.40	32.04	12.72	***
	Endline	46.89	16.40	49.31	16.23	42.28	15.80	***
- Wolaytta	Baseline	38.46	17.14	44.95	15.38	24.69	11.72	***
	Endline	47.48	14.95	51.38	14.18	39.20	13.09	***
- Hadiya	Baseline	35.72	20.20	43.91	20.28	20.27	6.28	***
	Endline	46.92	14.23	49.33	13.76	42.36	14.25	**
Executive function								
Baseline (2019/20)		54.27	(38.61)	59.60	(38.19)	40.83	(36.36)	***
Endline (2020/21)		75.42	(40.38)	79.46	(39.41)	65.25	(41.05)	***
Fine motor								
Baseline		20.33	(26.75)	24.61	(28.18)	9.54	(18.83)	***
Endline		32.84	(34.84)	37.63	(35.41)	20.76	(30.18)	***
Observation		2,645		1,894		751		

Table 3.3 shows descriptive statistics of children's socio-emotional skills reported by O-Class teachers, including self-regulation, social recognition, social competence, and emotional well-being. This assessment was administered only for children in our sample who attended O-Class. We estimate the standardised scores (z-score) of socio-emotional skills with a mean of 1 and a standard deviation of 0 to ease of reference. On average, among those who attended O-Class, rural children showed higher socio-emotional skills than urban children at baseline. Yet, at endline following

the COVID-19 school closures, this pattern is reversed with higher socio-emotional skills for urban children than rural children.

Table 3.3: Descriptive statistics: Outcome variables II

MELQO Domains		Overall sample		By location				
				Urban		Rural		
		Mean	SD	Mean	SD	Mean	SD	*t-test*
Socio-emotional skills								
Total average	Baseline	0.00	0.64	-0.07	0.66	0.03	0.62	***
	Endline	0.00	0.76	0.05	0.78	-0.02	0.75	*
- Self-regulation	Baseline	0.00	1.00	-0.14	1.02	0.06	0.99	***
	Endline	0.00	1.00	0.07	1.01	-0.03	0.99	*
- Social recognition	Baseline	0.00	1.00	-0.15	1.08	0.06	0.96	***
	Endline	0.00	1.00	0.04	1.02	-0.01	0.99	
- Social competence	Baseline	0.00	1.00	0.18	0.95	-0.07	1.01	***
	Endline	0.00	1.00	0.07	1.01	-0.03	0.99	*
- Emotional well-being	Baseline	0.00	1.00	0.18	0.95	-0.07	1.01	***
	Endline	0.00	1.00	0.01	1.05	0.00	0.98	
Observation		1,894		576		1,318		

Note: (1) We used the standardised scores (z-score) for socio-emotional skills with a mean of 1 and a standard deviation (SD) of 0. (2) Regarding internal consistency of the measure, Cronbach α for each measure was acceptable between 0.7 and 0.8.

Early numeracy: Percent of correct scores by sub-tasks

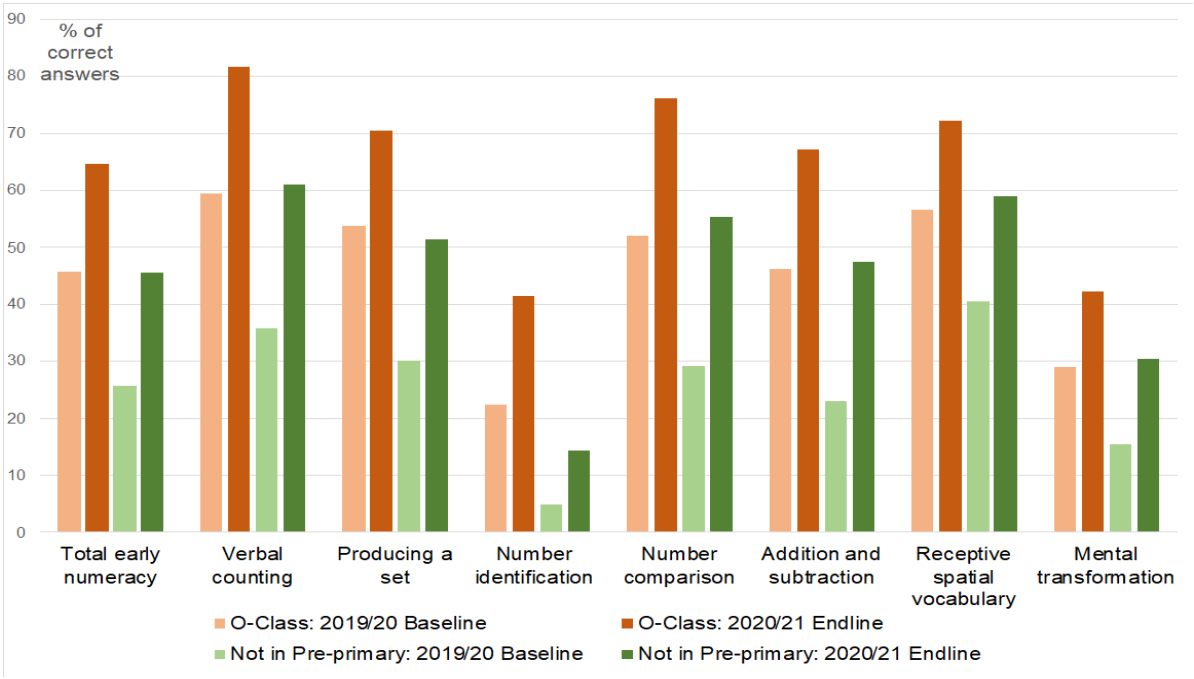
Our main interest is early numeracy outcomes among five MELQO domains of child development. Figure 3.1 shows the mean percent scores on the baseline and endline early numeracy sub-tasks comparing O-Class children and those who were not in pre-primary school. For example, results indicate that the mean percent score for O-Class children in verbal counting (i.e., counting to 20) was 59% at baseline, increasing to 82% at endline. For children not in pre-primary school, the mean percent score was 36% at baseline, increasing to 61% at endline. The increase for O-Class students in this sub-task was 22 percentage points and 25 percentage points for children not in pre-primary education.

O-Class children performed better than those not in pre-primary school across seven sub-tasks in early numeracy (Figure 3.1). Despite the COVID-19 school closures, children demonstrated learning progress from baseline to when schools re-opened,

ranging from 10 to 26 percentage points. This could be attributed to child development supported by home-based learning or exposure to schooling (albeit limited) before and after the school closures, including the three- to four-week remedial course children might receive right before taking the MELQO assessment.

There was similar learning progress between the two time periods regardless of whether young children attended pre-primary education. However, in 2020/21, given their different starting points, those not in pre-primary school only remained at the learning level of O-Class children in the 2019/20 baseline. This reveals stark disparities in school readiness between the two groups, implying that those not in pre-primary school could lag behind nearly one academic year of learning than O-Class children on entry into primary school.

Figure 3.1: Differences in early numeracy sub-task outcomes depending on pre-primary school attendance (% of correct answers)



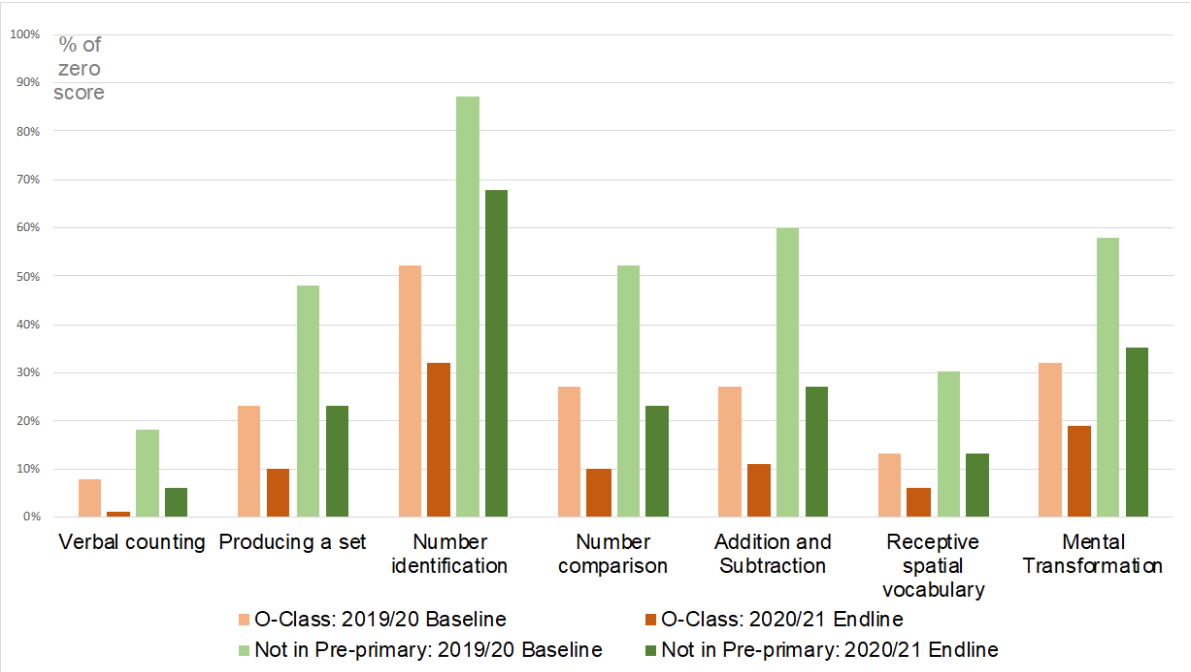
Early numeracy: Zero score comparisons by sub-tasks

In addition to mean percent scores, we compared zero scores of O-Class children and those not in pre-primary school. Zero scores indicate the percentage of students who were unable to correctly answer a single item on a given sub-task. Examining zero

scores enables an investigation of learning progress for students at the lowest end of the achievement spectrum.

Figure 3.2 presents zero score estimates from the baseline and endline assessments. Similar to the trends in the mean percent score noted above, there were considerable reductions in zero scores over time, indicating an improvement in learning. O-Class children showed a significantly lower share of zero scores than those not in pre-primary school across all early numeracy sub-tasks. Interestingly, the learning gaps between two groups were reduced between the 2019/20 baseline and 2020/21 endline. For instance, in 'number comparison', the differences in zero scores between the two groups were 26 percentage points at baseline yet it reduced to 13 percentage points at endline. This captures how outcomes of children who participated versus did not participate in pre-primary school converge over time as the non-attenders start to catch-up (see Yoshikawa et al., 2013). Although there is not yet strong evidence on the reasons why such convergence occurs as children get older, a number of factors may be involved—for example, low quality of primary schooling, particularly for students in disadvantaged areas, may fail to build on the gains created by pre-primary education (Yoshikawa et al., 2013).

Figure 3.2: Differences in early numeracy sub-task outcomes depending on pre-primary school attendance (% zero score)

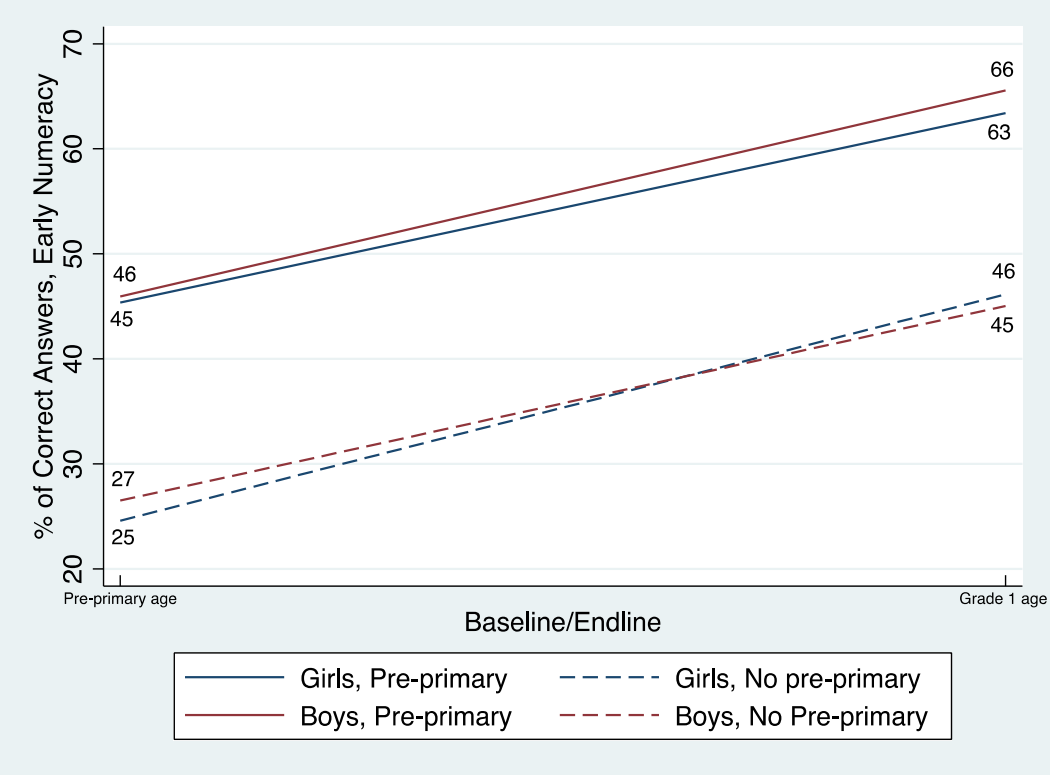


Learning patterns by sub-groups

Appendix table A6 summarises the difference in numeracy mean percent scores by sub-group, including gender, location, household wealth, caregiver's literacy and regions with the *t*-test results. We present some of the main patterns below.

Gender. Figure 3.3 shows that there were no significant learning gaps between girls and boys at baseline and this pattern was maintained at endline. Among those who participated in O-Class, gender learning gaps became wider between baseline and endline, whereas the gender learning gaps slightly decreased over time among those who were not in pre-primary school. However, these differences are not statistically significant.

Figure 3.3: Differences in early numeracy outcomes by gender for O-Class children and pre-primary non-participants

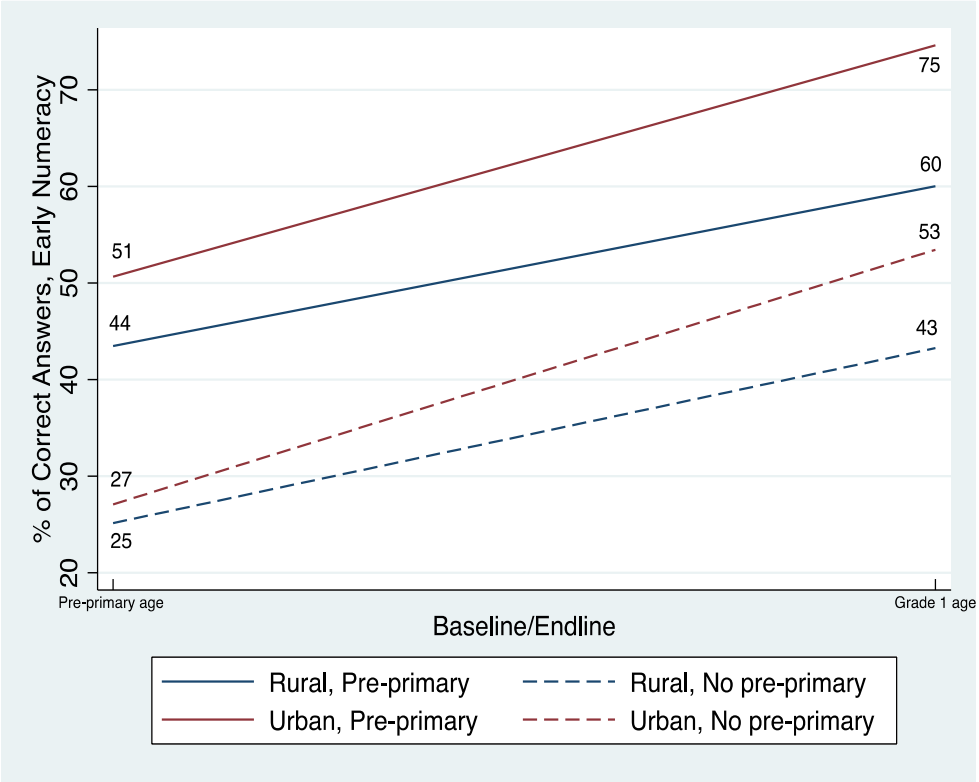


Urban-rural location. Figure 3.4 shows that learning gaps between urban and rural children were observed at baseline. Following school closures, a widening divide in learning between the two groups is apparent. For those who participated in O-Class, learning gains were greater for urban children compared with rural children, nearly

doubling the gap. A growing gap between urban and rural children who did not attend any pre-primary school is even more noticeable, with the gap becoming five times wider. This results in rural children who did not attend pre-primary school being even further left behind.

The widening learning gap between children from rural and urban areas is likely to be related to the different opportunities to keep education going during school closures. Our evidence collected via phone surveys during school closures (see Section 4 for details) identified that teachers in rural areas were less able to support children's learning remotely and that rural households had more limited access to technology and faced other pressures that meant they were less able to support children's learning at home.

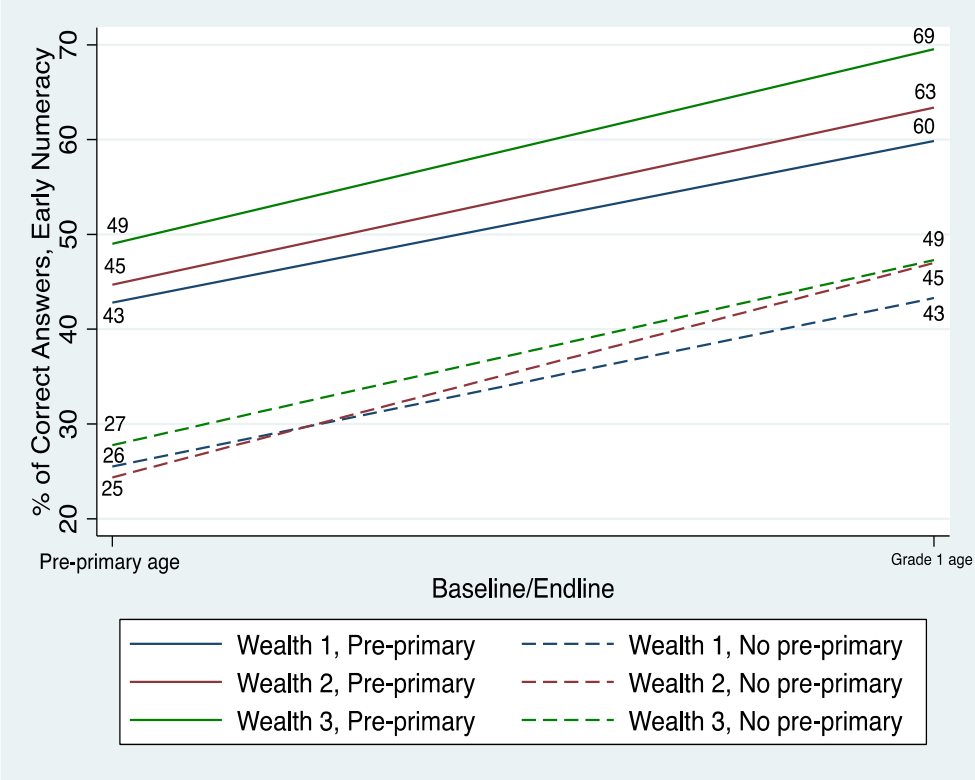
Figure 3.4: Differences in early numeracy outcomes by location for O-Class children and pre-primary non-participants



Household wealth. A similar pattern is evident for those in different wealth groups, as shown in Figure 3.5. A learning gap is apparent at baseline between children from richer households and those from poorer households. This divide between the two

groups widened when they were supposed to enter Grade 1 after the school closures. For O-Class children, learning gains were more significant for those from richer families than poorer families, making the learning gap wider. A learning gap between the richest and the poorest is more pronounced for those not in pre-primary school, with the gap becoming three times wider.

Figure 3.5: Differences in early numeracy outcomes by wealth tercile for O-Class children and pre-primary non-participants



Note: Wealth 1 = poorest households; wealth 3 = richest households.

Overall, an alarming pattern of a widening learning gap between advantaged and disadvantaged children emerges following school closures. During the COVID-19 crisis, for children living in rural areas and those who are from poorer families, the existing learning inequalities are likely to be compounded by other sources of inequality, such as families' economic hardship, unemployment and limited access to financial support and information (which they used to receive by in-person meetings or local offices' household visit prior to the pandemic).

In addition, descriptive statistics highlight that there were relatively large learning disparities between children who attended O-Class and those who did not, which reaffirms the issue of selectivity in families who were able to send their children to pre-primary school. To explore these patterns further, in the following section, we adopt a conditional value-added model and propensity score matching to enable us to take account of selectivity in pre-primary participation based on various contextual factors, such as household wealth, parental education, geographic advantages, and prior academic achievement. We extend this analysis by comparing our sample of children who entered primary school after COVID-19 to a related sample of children who entered primary school before COVID-19.

3.2 Results

Children's educational pathway between 2019/20 and 2020/21

Research question 1: Which early education pathways are prevalent among children in the context of COVID-19 school closures? What are the predictors of pre-primary school children not returning once schools re-opened?

We begin by addressing our first research question on which education pathways are prevalent among pre-primary-aged children in the context of COVID-19 school closures and on predictors of children not returning to school once schools re-opened. Figure 3.6 shows the grade progression of the sample children between 2019/20 and 2020/21. Following the COVID-19 school closures, among 1,894 O-Class children in our sample, 70% of children progressed to Grade 1. Despite the intended automatic grade promotion to Grade 1, 22% remained in O-Class, and 8% did not return to school. Among the 751 who had not been enrolled in pre-primary education in 2019, 20% of children entered Grade 1 directly, 30% joined O-Class, while 50% remained not enrolled in any pre-primary or primary school.

Figure 3.6: Children's grade progression between 2019/20 and 2020/21

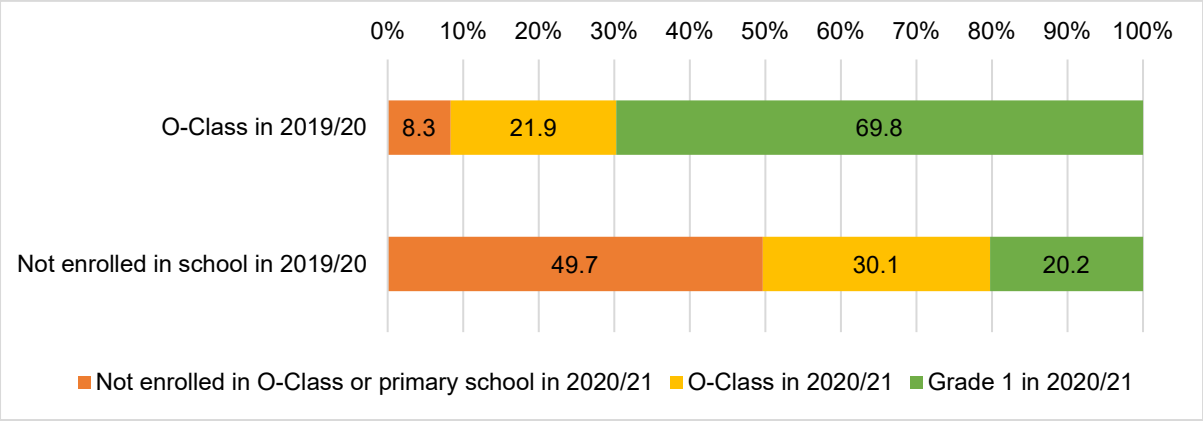


Table 3.4 presents results from logistic regression models that examine the factors predicting children's grade progression between 2019/20 and 2020/21. For children who had been enrolled in O-Class in 2019/20, households with sufficient food and those living in urban areas were strongly associated with a higher probability that a child would not return to school after school closures: these were associated with a 5 and 12 percentage point higher probability of not returning to schools. In the meantime, the child's gender, age, and health status were not found to be associated significantly with them not returning to school once they re-opened. Household wealth, caregiver's literacy, and household size were also not strong predictors for children's grade progression.

Although it might seem counter-intuitive that, on some indicators, those who could be considered more advantaged (with sufficient food and urban areas) were less likely to return to school, this could be explained by parents' fear of their child catching COVID-19 from school. In particular, parents in urban areas could be reluctant to send their children back to school because of concerns about safety and sanitation amid the COVID-19 pandemic, with urban schools more likely to be over-crowded. Also, families from urban areas and those who have no difficulty in securing food all year around may be more likely to be able to continue to support their young children's learning at home.

Similarly, for children who were not in pre-primary education in 2019,/20 households with sufficient food and those living in urban areas were also strong predictors for

children still not being in school in 2020/21: these were associated with a 7 and 10 percentage point higher probability of not enrolling in any pre-primary or primary school in 2020/21. However, household wealth was strongly associated with a higher chance of these children being enrolled in school once they re-opened. As such, children from poorer families were more likely to remain not enrolled even once they were at the age for joining Grade 1 of primary school.

Table 3.4: Predictors of not returning to school following school closures

Group	(1)			(2)		
	O-Class in 2019			Not in Pre-primary in 2019		
Variable	Odds ratio	(SE)	Marginal prob.	Odds ratio	(SE)	Marginal prob.
Female	1.05	(0.18)	0.003	0.90	(0.14)	-0.024
Age	0.98	(0.01)	-0.001	0.94***	(0.01)	-0.014***
Child health condition is good	0.76	(0.33)	-0.020	0.64	(0.18)	-0.100
Household wealth tercile 2 (middle)	0.74	(0.18)	-0.023	0.63**	(0.12)	-0.100**
Household wealth tercile 3 (richest)	0.70	(0.18)	-0.027	0.59**	(0.13)	-0.115**
Caregiver's literacy	0.84	(0.17)	-0.013	1.20	(0.23)	0.040
Household size	0.96	(0.18)	-0.003	0.98	(0.16)	-0.005
Household has sufficient food	1.96***	(0.39)	0.050***	1.37*	(0.24)	0.070*
Living in urban	5.35***	(1.35)	0.124***	1.54*	(0.36)	0.100*
Regional dummy	Y			Y		
Constant	0.01***	(0.01)		6.46***	(3.20)	
Observations	1,789			751		

Note: To ease the interpretation of the multivariate logit analysis, we describe marginal probabilities, the probability of the outcome happening, which are similar to predicted values in linear regression models but calculated when all other predictors are at their mean values. Y=Yes. SE=Standard errors.

Relationship between pre-primary school participation and school readiness

Research question 2: What are the differences in early numeracy outcomes for children who participated in O-Class and those who did not? Have these differences changed between 2019/20 and 2020/21 as a result of the COVID-19 school closures? How do outcomes vary by sub-groups?

In our second research question, we examine the extent to which pre-primary participation contributes to students' early numeracy outcomes. We focus on learning 'progress' measured by endline test scores conditional on the baseline test scores (i.e., prior learning level or lagged test scores) along with the learning 'levels' at baseline and endline.

Table 3.5 presents the results of our regression analyses after accounting for child and family characteristics and the lagged test scores (models 1 to 3). We present learning outcomes as 'percent of correct answers' and use this in the interpretation of the results below. We also provide the results in 'standard deviations (SD)' in the Appendix 6.4. On average, O-Class participation was significantly associated with higher scores in early numeracy at baseline (model 1), endline (model 2), and endline achievement conditional on baseline achievement (model 3). Model 3 is equivalent to the lagged or conditional value-added specification and could be interpreted as learning progress between the two time periods between 2019/20 and 2020/21. The average test score differences for O-Class children versus those who were not in pre-primary school were 15 percentage points at baseline and 14 percentage points at endline when controlling for all covariates. Notably, learning gains of O-Class children were 8 percentage points greater than those who did not attend any pre-primary schools. Further robust evidence was established: using propensity score matching and district-fixed approaches, regression analyses yield consistent results in learning progress associated with O-Class participation (see appendix tables A1 and A2). Overall, the results suggest that participating in O-Class is a significant predictor of children's subsequent learning outcomes and progress. Despite the COVID-19 school closures, it demonstrated the benefits of pre-primary participation for improving children's school readiness when they enter primary school.

In the fully specified models with the lagged test scores (model 3), the signs of the coefficients on the control variables that could affect learning gains are generally consistent with other model specifications (models 1 and 2) but do not fully correspond to a priori expectations (see Tiruneh et al., 2021). Children who performed well in baseline and older children show significantly higher gains in early numeracy. Primary caregiver's literacy is positively associated with higher learning gains, but the coefficient is small.[12] Notably, living in rural areas is negatively associated with learning progress over the academic year, with the early numeracy test score being 9 percentage points lower compared with their urban counterparts.

No significant differences in learning gains were observed between girls and boys, between children who were reportedly healthy and those who were not, and across the groups by household wealth tercile, household size, and food shortages.[13] Learning gains varied by regions. Compared to Addis Ababa, children's learning gains were significantly lower in Benishangul-Gumuz and Oromia. Children's learning gains were higher in Somali than Addis Ababa, yet it is mainly due to the purposive sampling of urban samples in Somali due to security reasons.

Table 3.5: Relationship between pre-primary participation and early numeracy outcomes (% of correct answers)

		Early numeracy		
		OLS Value-added		
		Model 1	Model 2	Model 3
		2019/20 Baseline	2020/21 Endline	Endline | Baseline
Early childhood education (ECE) participation (ref: children not enrolled in ECE)		**15.08*** (1.66)**	**13.81*** (1.48)**	**8.14*** (1.39)**
Prior learning level (baseline score)				0.38***
				(0.03)
Age		0.77***	0.70***	0.41***
		(0.10)	(0.12)	(0.08)
Child is a girl		-1.23	-1.41	-0.95
		(1.13)	(1.12)	(0.89)
Child health condition is good (ref: poor/ average)		0.75	0.77	0.49
		(2.22)	(2.00)	(1.79)
Household wealth: middle (ref: poorest)		1.34	1.86	1.35
		(1.54)	(1.25)	(1.25)
Household wealth: richest		5.51**	2.69	0.62
		(1.87)	(1.63)	(1.51)
Primary caregiver is literate		-0.75	1.81*	2.09*
		(1.17)	(0.89)	(0.96)
Household size (ref: smaller than 6)		3.29*	-0.16	-1.39
		(1.23)	(0.89)	(0.93)
Household has sufficient food in last 12 months		-1.86	-0.15	0.55
		(1.93)	(1.57)	(1.32)
Living in rural		-4.32	-10.46***	-8.83***
		(2.86)	(2.02)	(2.28)
Region (ref: Addis Ababa)				
	Amhara	-7.93*	-5.24	-2.26
		(3.87)	(3.22)	(3.01)
	Benishangul-Gumuz	-13.62***	-18.44***	-13.32***
		(3.31)	(2.97)	(3.04)
	Oromia	-15.39***	-12.31***	-6.53*
		(3.77)	(2.69)	(2.92)
	SNNP	2.13	-0.88	-1.68
		(4.28)	(3.15)	(3.03)
	Somali	-3.62	12.12***	13.48***
		(2.87)	(1.42)	(1.79)
Constant		12.39	38.37***	33.71***
		(5.42)	(5.57)	(4.12)
Observation		2,540	2,540	2,540
R^2		0.28	0.30	0.40

Note: Robust standard errors clustered at district level in parentheses. All models include attrition weights. *** p<0.01, ** p<0.05, * p<0.1

In order to investigate further the associations between pre-primary participation and children's early numeracy outcomes differed by gender, urban-rural location, and caregiver's literacy, we next stratify the association by sub-groups (e.g., comparison of boys who attended O-Class with boys who did not attend). In addition, we assess the heterogeneity in the relation of pre-primary participation with learning outcomes between the two groups. It includes interaction terms in which the indicator for O-Class participation interacts with one potential moderator—gender, location, and caregiver's literacy. This approach in particular helped us see who would benefit more from pre-primary participation—between girls and boys, children living in rural versus urban areas, and children with literate caregivers versus those with not literate caregivers. For instance, we can compare whether boys' outcomes are significantly different from girls' outcomes when both participated in O-Class. We used three outcomes measured at baseline, endline, and endline scores conditional on baseline scores (models 1-3), and interpretation focuses on model 3 given its primary interest of this study.

Gender. Table 3.6 shows that the relationship between O-Class participation and learning progress was pronounced for both boys and girls. Learning gains for boys participating in O-Class were 10 percentage points higher than those for boys who did not. Learning gains for O-Class girls were also 6 percentage points higher than gains for girls who did not attend pre-primary. Taking account of interaction effects of pre-primary participation and gender and accounting for other factors, the results suggest that learning gains for girls who participated in O-Class were 4 percentage points lower than boys who participated in O-Class. In other words, the preschool benefits of achieving a greater learning gain in early numeracy were significantly larger for boys than girls.

One possible partial explanation for a larger gain for boys in Ethiopia is that girls could have less time to be engaged in learning activities during the COVID-19 school closures because of their roles in taking care of household chores and caring for their younger siblings. This calls for a need to measures of how to support girls' learning in particular following the pandemic.

Location. We found a strong association between O-Class participation and learning progress for children living in urban areas, as well as those living in rural areas. Urban children participating in O-Class showed 12 percentage points higher learning gains than urban peers who did not attend pre-primary school. Learning gains for rural children participating in O-Class were 6 percentage points higher than rural peers who did not. When introducing interaction terms between pre-primary participation and location, preschool benefits associated with higher learning progress no longer differ by urban and rural areas after accounting child and family characteristics. This is contrary to the descriptive learning patterns of urban and rural children (Figure 3.4), which indicate a widening learning gap between the two groups following school closures. One potential explanation is that urban children who attended O-Class are from relatively disadvantaged backgrounds, which could be similar to those of rural children, given that most urban children attended kindergarten run by private entities or NGOs, which is more predominant form of pre-primary education. As such, this could explain why the rural-urban difference is no longer notable once socio-economic status is taken into account, for example.

Caregiver's literacy. The strong relationship between O-Class participation and learning progress is apparent by caregiver's literacy. Children with literate caregivers who participated in O-Class gained 13 percentage points more than their peers who did not attend pre-primary school. O-Class children whose caregivers were not literate only gained 6 percentage points more than non-participants. After considering interaction terms between pre-primary participation and caregiver's literacy, the results suggest that learning gains for O-Class children with literate caregivers were 7 percentage points higher than O-Class children whose caregivers were not literate. This could be related to the information gathered from our phone surveys (see Section 4) identifying that literate caregivers were more likely to be engaged in home-based learning activities with their children during the school closures compared with whose caregivers were not literate.

Household wealth. We found a strong association between O-Class participation and learning progress by different wealth groups. The difference in learning gains between preschool participants and non-participants was larger among children from the richest

households (12 percentage points) than the poorest households (9 percentage points). After accounting for interaction terms of pre-primary participation and household wealth, there was a statistically significant difference in preschool benefits between children from the richest and poorest households. Children from richer families gained more from O-Class participation (5 percentage points) than children from poorer families. This suggests that differential relationship between pre-primary participation and learning outcomes by household wealth could lead to wider learning gaps between children from richer and poorer households. In addition, our data suggest that there are some associations with household wealth in relation to the quality of provision that they receive. For example, children from richer households are three times more likely to attend O-Classes with handwashing facilities than those from poorer households (see more details on pre-primary education quality in Table 3.11). This implies that more attention is needed on how to support children from poorer households with high-quality provision to ensure they are able to reap the benefits of pre-primary education.

Heterogeneous effects of pre-primary participation by gender, caregiver's literacy, and household wealth provide evidence that preschool participation appears to reinforce the learning gaps between advantaged and disadvantaged groups once children return to or enter primary school. Our evidence shows that the benefits of pre-primary school participation for improving school readiness are apparent despite the school closures. However, girls, children whose caregivers are not literate, and those from poorer households could not reap as much benefit as their peers (boys, those living with literate caregivers, and those from the richest households). In the exceptional circumstances of COVID-19, our findings are contrary to previous evidence showing that the benefits of preschool are greater for the disadvantaged than the advantaged (e.g., Burger, 2010; Magnuson and Duncan, 2017), which indicate that pre-primary education could provide compensatory support to those from more disadvantaged backgrounds. This calls for proactive measures to compensate for potential widening learning inequalities due to school closures, particularly for those who are from disadvantaged backgrounds and had no chance to attend O-Class.

Table 3.6: Relationship between pre-primary participation and early numeracy by sub-groups (% of correct answers)

Sub-group	Obs.	Variable	Early Numeracy		
			Model 1	Model 2	Model 3
			2019/20 Baseline	2020/21 Endline	Endline | Baseline
Gender					
Boys	N=1,269	O-Class participation	14.60***	15.65***	10.24***
			(2.21)	(1.80)	(1.60)
		R^2	0.26	0.31	0.41
Girls	N=1,271	O-Class participation	15.75***	12.04***	6.02***
			(1.84)	(1.96)	(2.03)
		R^2	0.30	0.30	0.41
Interaction	N=2,540	O-Class X Girls	1.28	-3.18	-3.66**
			(2.37)	(2.17)	(1.81)
		R^2	0.28	0.30	0.41
Urban-rural location					
Urban	N=647	O-Class participation	15.25***	15.70***	12.26***
			(3.31)	(4.03)	(3.84)
			0.30	0.38	0.43
Rural	N=1,893	O-Class participation	14.61***	12.61***	6.16***
			(1.63)	(1.54)	(1.40)
		R^2	0.28	0.23	0.37
Interaction	N=2,540	O-Class X Rural	0.45	-0.43	-0.60
			(4.09)	(3.45)	(3.35)
		R^2	0.28	0.30	0.40
Caregiver's literacy					
Literate	N=807	O-Class participation	17.49***	19.93***	12.92***
			(2.92)	(2.86)	(3.07)
		R^2	0.29	0.30	0.42
Not literate	N=1,733	O-Class participation	13.84***	11.43***	6.43***
			(1.51)	(1.24)	(1.34)
		R^2	0.28	0.31	0.40
Interaction	N=2,540	O-Class X Caregiver is literate	4.44*	8.59***	6.93**
			(2.49)	(2.56)	(2.63)
		R^2	0.28	0.30	0.41
Household wealth					
Wealth 1 (Poorest)	N=872	O-Class participation	13.79***	14.14***	9.14***
			(2.08)	(2.17)	(2.14)
		R^2	0.25	0.28	0.37
Wealth 2 (Middle)	N=842	O-Class participation	16.06***	10.56***	3.64*
			(1.96)	(1.86)	(1.99)
		R^2	0.33	0.22	0.36
Wealth 3 (Richest)	N=826	O-Class participation	15.27***	17.64***	12.15***
			(2.40)	(2.32)	(1.90)
		R^2	0.29	0.37	0.47
Interaction	N=2,540	O-Class X Wealth 2 (Ref: Wealth 1)	1.82	-2.11	-2.79
			(2.21)	(2.51)	(2.32)

		R^2	0.28	0.30	0.41
	N=2,540	O-Class X Wealth 3 (Ref: Wealth 1)	1.67	5.14*	4.51*
			(2.53)	(2.69)	(2.30)
		R^2	0.28	0.30	0.41
Control variables		Prior learning level			Y
		Child characteristics	Y	Y	Y
		Family characteristics	Y	Y	Y

Note: Robust standard errors clustered at district level in parentheses. All models include attrition weights.
Wealth T 1 = Lowest household wealth tercile; Wealth T 3 = Highest household wealth tercile
*** p<0.01, ** p<0.05, * p<0.1. Y=Yes included

School readiness of children at Grade 1 entry: A comparison of two cohorts from before and after COVID-19

Research question 3: What are the differences in early numeracy outcomes for children who entered Grade 1 before COVID-19 and those who entered after COVID-19? To what extent are these differences affected by children's participation in O-Class?

We further compare early numeracy outcomes between two cohorts of children who entered Grade 1 two years apart: one in Oct/Nov 2018/19; and the other in Oct/Nov 2020/21, and so once schools re-opened following the pandemic. Both cohorts included children of the same age (age 7, the official age for starting primary schooling in Ethiopia). Descriptive statistics of the two cohorts show considerable differences in sample composition between the two cohorts (Table 3.7). Overall, a greater proportion of the sample of children who entered Grade 1 after schools re-opened following the pandemic had participated in O-Class prior to the pandemic, compared with the sample of children who entered Grade 1 two years previously (72% vs. 52%). However, it is important to note that the children in the 2020/21 sample were purposively sampled according to O-Class participation (see Section 2.2). As such, it is not possible to infer anything on trends in pre-primary participation from this comparison. In addition, more children in the more recent sample (2020/21) lived in rural areas, while a larger share of them lived with literate caregivers and from wealthier families.

Table 3.7: Descriptive statistics of the two cohorts entering primary school before and after COVID-19

Year	2018/19		2020/21	
Variable	Cohort entering grade 1 before COVID-19		Cohort entering grade 1 after COVID-19	
	% or Mean	SD	% or Mean	SD
Child and family characteristics				
Participated in O-Class	52%		72%	
Girl (1=Yes)	49%		50%	
Living in rural area	63%		72%	
Primary caregiver's literacy (1=Yes)	28%		48%	
Household wealth index	0.29	(0.15)	0.36	(0.13)
Region				
Addis Ababa	18%		9%	
Amhara	19%		22%	
BG	12%		11%	
Oromia	28%		29%	
SNNP	15%		24%	
Somali	9%		6%	
Observation	2,740		2,645	

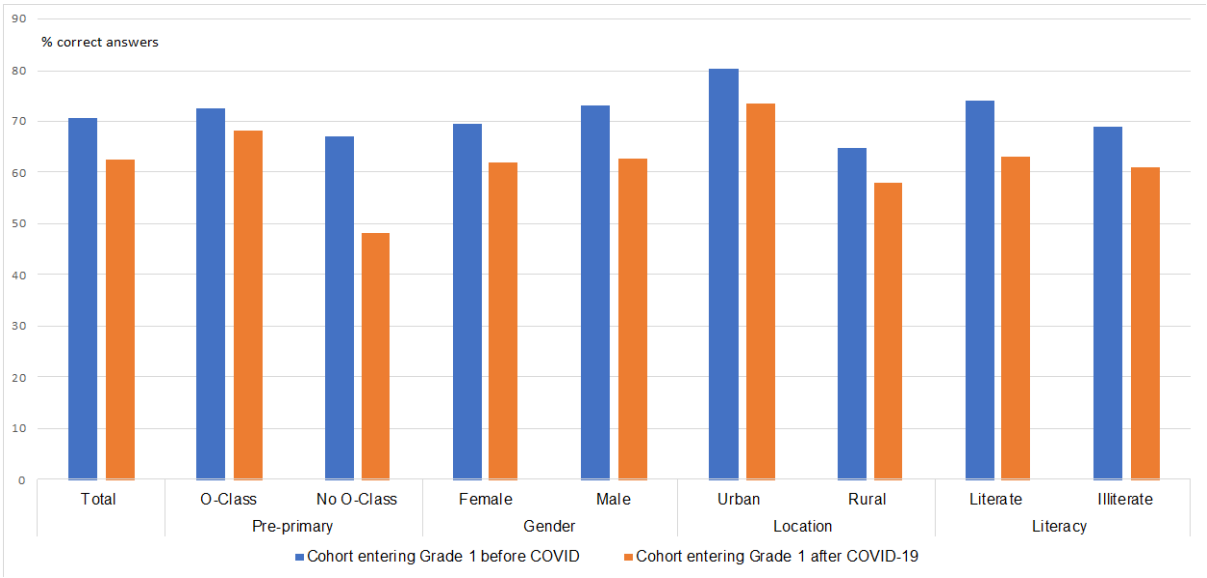
Figure 3.7 presents early numeracy outcomes for children who entered Grade 1 before COVID-19 and those who entered Grade 1 after schools re-opened. On average, the mean percent scores between the two cohorts declined from 70% in 2018/19 to 62.6% in 2020/21, resulting in a 7.4 percentage point difference between before COVID-19 and after school reopening). This is despite the fact that the more recent sample is more advantaged in terms of wealth and literacy of caregivers, for example and so, if anything, could expect their numeracy scores to be better than the earlier cohort.

Among O-Class children, learning outcomes were 5 percentage points lower for the cohort joining Grade 1 after schools re-opened, compared with those joining two years earlier. In contrast, learning among children not in pre-primary education was 19 percentage points lower following the pandemic. These differences, that are statistically significant, imply alarming learning losses for children not in pre-primary school following the COVID-19 school closures, which were four times larger than O-Class children.

Across the whole sample, there is little difference in these trends by gender and rural/urban location. However, given learning amongst those in rural areas was initially

lower, the reduction means that they continue to lag behind. Children with literate caregivers showed a greater reduction in learning between the two years than children with caregivers who are not literate. As those whose caregivers are literate were initially scoring higher, the reduction means that there was little difference in learning between the two cohorts in 2020/21.

Figure 3.7: Difference in early numeracy outcomes between cohorts entering Grade 1 before and after COVID-19



In Table 3.8, we present the results of regressions which account for a set of child and family characteristics in order to isolate the difference in early numeracy outcomes in each of the cohorts. Even after taking account of sample characteristics, the lower early numeracy outcomes following the COVID-19 school closures remains statistically significant. We found that early numeracy performance was substantially lower in Dec/Jan 2020/21 compared with Nov/Dec 2018/19 for children entering grade 1 of primary school. Importantly, children's participation in O-Class plays a role in mitigating the learning losses, along with household wealth. Girls and children living in rural areas experienced a higher rate of decline in learning levels of early numeracy compared to boys and children living in urban areas. Taking account of other factors, caregiver's literacy does not affect the learning loss.

Table 3.8: Difference in early numeracy outcomes between the two cohorts entering primary school before and after school closures due to COVID-19 (% of correct answers)

	(1)	(2)
Variables	Early numeracy test score	Early numeracy test score
Cohort entering Grade 1 after COVID-19 (ref: Cohort entering Grade 1 before COVID-19)	**-7.44*** (0.74)**	-7.46*** (0.74)
Participated in O-Class		8.75*** (0.80)
Female		-1.82*** (0.70)
Living in rural area		-8.09*** (1.00)
Primary caregiver's literacy (1=Yes)		-0.31 (0.81)
Household wealth index		1.72*** (0.52)
Region (ref: Addis Ababa)		
Amhara		-12.39*** (1.53)
Benishangul-Gumuz		-21.44*** (1.63)
Oromia		-9.59*** (1.45)
SNNP		-7.01*** (1.56)
Somali		-0.31 (1.75)
Constant	69.90*** (0.52)	78.25*** (2.05)
Observations	5,385	5,235
R-squared	0.02	0.16

Note: Robust standard errors clustered at district level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Lastly, we look at the difference in learning outcomes between the two cohorts by early numeracy sub-tasks (Table 3.9). Among the entire sample, the largest learning decline was observed in number identification (-21 percentage points) and producing a set (-20 percentage points), followed by number comparison and addition and subtraction (-13 percentage points for each task). These four sub-tasks tend to require instruction by teachers or adults in the classrooms, which is likely to be a reason for the steeper decline in test scores.

Through this analysis, we have identified the change in early numeracy outcomes following the COVID-19 school closures. The lower level of learning for the cohort who entered primary school after COVID-19 calls for more intensive support for children who returned to schools following school closures. Moreover, there is a need to prevent increasing learning inequality due to the pandemic among children from different socio-demographic backgrounds. Given the mitigating effect that pre-primary education is found to have on the reduction in learning, ensuring all children have access to this is vital. In addition, as learning losses vary by sub-groups, interventions that can reduce the imbalances among children as they enter primary school are needed, for example in access to catch-up classes, remote learning, and supplementary tutoring.

Table 3.9: Difference in early numeracy sub-task outcomes between the two cohorts entering primary school before and after COVID-19 (% of correct answers)

Year	2018/2019		2020/2021		*Difference*
Cohort	Cohort entering Grade 1 before COVID-19		Cohort entering Grade 1 after COVID-19		
Sample size	n=4,135		n=2,192		
Sub-tasks	%	SD	%	SD	
Verbal counting	89.0	21.4	75.8	30.5	-1.32
Producing a set	84.8	26.4	65.1	34.9	-19.7
Number identification	54.9	39.7	33.8	39.3	-21.1
Number comparison	83.7	29.4	70.3	36.2	-13.4
Addition and Subtraction	74.6	33.0	61.5	37.2	-13.1
Receptive spatial vocabulary	67.0	33.5	68.3	32.3	1.3
Total	70.6	23.7	62.4	27.0	-8.2

Learning trajectories by government's quality improvement interventions

Research question 4: To what extent are these learning trajectories affected by quality improvement interventions for O-Class (GEQIP-E) in the context of COVID-19 school closures?

GEQIP-E reform. One of the primary purposes of ELP Phase 2 research was intended to be an assessment of the differential contribution of O-Class on school readiness, given that some of O-Classes were assigned to receive quality improvement interventions as part of the GEQIP-E reform. As noted above, since 2018, GEQIP-E has been implemented in a phased manner across schools nationwide in Ethiopia. This reform includes the QEAP interventions for O-Class, which aims to improve the quality of O-Class and school readiness of young children. As described in the sampling approach, the sample of O-Class participants were partitioned into two groups: students receiving GEQIP-enhanced support O-Class and others in O-Class receiving GEQIP-E support more broadly, but not the enhanced support.

However, the overall implementation of the GEQIP-E interventions was severely interrupted by the COVID-19 school closures in 2020. In-service training targeted for O-Class teachers under the GEQIP-E reform was being rolled out since late 2019, but the majority of O-Class teachers in Phase 1 schools were not able to complete this 30-days training due to the eight-month long school closures. According to the survey conducted with school principals in 2020/21, only six schools (8%) out of 78 schools were reported to participate in this training offered by the MoE. In addition, given that a large proportion of O-Class children were promoted to Grade 1 in 2020/21 after the school closures, there were limited opportunity for children in our sample to be exposed to the teachers who completed the in-service training offered as part of GEQIP-E interventions.

Even though we would be unlikely to see any substantial changes related to these reforms given this context, we have undertaken analysis to see if anything has been discernible. Table 3.10 presents early numeracy outcomes of the children who participated in GEQIP-enhanced O-Class and others in O-Class compared to children not enrolled in any pre-primary education. As anticipated, our results indicate no

significant difference between students participating in GEQIP-enhanced O-Class and others in O-Class, while both groups significantly outperformed children who had not attended any pre-primary education. Regardless of whether children belong to GEQIP-enhanced O-Class or not, the magnitude of the learning gains between O-Class participants and children not enrolled in any pre-primary school was 8 percentage points on average. As mentioned, the lack of differential learning gains for those in O-Class receiving the GEQIP-enhanced intervention is not surprising given the disruption to implementation as a result of the COVID-19 school closures.

Table 3.10: Association between pre-primary participation and early numeracy by O-Class quality interventions related to GEQIP-E reform (% of correct answers)

	Early Numeracy		
	OLS		
	Model 1	Model 2	Model 3
	2019/20 Baseline	2020/21 Endline	Endline | Baseline
O-Class participation (ref: not enrolled in any pre-primary school)			
General O-Class	16.76***	14.85***	8.56***
	(2.04)	(1.76)	(1.69)
O-Class receiving GEQIP-E quality enhancement support	13.34***	12.72***	7.72***
	(2.00)	(1.82)	(1.72)
Prior learning level			Y
Child characteristics	Y	Y	Y
Family characteristics	Y	Y	Y
Constant	13.40*	38.99***	33.97***
	(5.36)	(5.50)	(4.76)
R	0.28	0.30	0.40
Observation	2,540	2,540	2,540

Note: Robust standard errors clustered at district level in parentheses. All models include attrition weights. *** p<0.01, ** p<0.05, * p<0.1. Y = Yes, included

Relationship between O-Class quality and school readiness

Research question 5: To what extent are early numeracy achievement and learning gains affected by the quality of O-Class more generally?

Our last research question in this section focuses on the overall quality of O-Class in Ethiopia measured by the MELE tool. This encompasses direct classroom observation and surveys for school principals and pre-primary teachers. We use this to identify the relationship between O-Class quality indicators and children's learning outcomes.

It should be noted that some of the analysis of quality indicators (notably related to the classroom observations) included in this section are exploratory. During the pilot study (Rossiter et al., 2018), some concerns were raised with the reliability of the MELE classroom observation instrument, particularly as a structured observation in a multi-lingual context aiming to look at aspects of play, for example. This stems from weak inter-rater reliability related to subjective judgement of the types of classroom activities and interactions that are observed. Meanwhile, elements of the MELE observation tool have been used to inform the government's quality assurance processes, including the national quality standards for O-Class and inspection framework introduced in 2019/20. It is thus useful to explore what constitutes pre-primary school quality in Ethiopia, and to consider how to use the results of classroom observation to inform policy and practices, as well as to seek a way to improve its accuracy.

School/teacher characteristics. Table 3.11 presents descriptive statistics of school/teacher characteristics measured by the MELE surveys. Approximately 85% of schools received school grants for O-Class in the 2019/20 academic year. These school grants, which were introduced in the 2016/17 school year under GEQIP-II, are the primary source of financing for pre-primary education. The process of school grant allocation to O-class is identical across regions: annually, 60 Ethiopian Birr (approximately USD2) is expected to be transferred to every school for each 6-year-old child enrolled in O-Class.[14] For the academic year of 2019/20, the distribution of school grants started in December 2019 before the COVID-19 school closures in March 2020.

School grants are spent based on decisions made by the school committee and can be used on activities that could enhance the teaching and learning process. According to interviews with school principals, the vast majority of schools (93%) used the school grants received in 2019/20 (prior to the pandemic) to purchase teaching and learning materials, such as notebooks, blackboards, chairs, or balls. About one-third of school principals also reported that they used school grants to support home-based learning during school closures by printing supplementary learning materials. However, approximately one-fifth of schools reported that the school grant allocated to O-Class has been redirected to primary grades for remote learning activities or classroom rearrangement to ensure social distancing imposed by COVID-19.

Approximately 65 % of the schools are resource cluster centres, which are intended to channel education resources (e.g., teacher training, school library, or resources for special needs students) to groups of schools rather than individual schools. These schools are likely to have relative advantages with respect to their location, school resources, and leadership. There are five to seven nearby schools grouped together for every school cluster.

Regarding teacher characteristics, on average, O-Class teacher have 4 years' experience in teaching at the pre-primary level, with about one-third of O-Class teachers having more than five years' experience in teaching at this. The share of teachers having more teaching experience was nearly double in urban schools than rural schools (40% vs. 24%). This could potentially be due to the relative recent expansion of pre-primary education in rural areas.

There are four categories of pre-primary teachers' qualifications in Ethiopia: (1) Grade 10 or 12 graduates with no teacher certification or diploma; (2) Post Grade 10 with a one-year certificate; (3) Post Grade 10 with a three-year diploma or technical and vocational education and training (TVET) qualification; and (4) University degree (Batchelors or Masters). About one-third of O-Class teachers are Grade 10/12 graduates and another one-third are Grade 10 graduates with a one-year certificate. About 44% of teachers are Grade 10 graduates with a diploma. Only three percent of teachers hold a university degree related to education.

MELE domain (1): Health and facilities. Table 3.11 also presents descriptive statistics of O-Class quality indicators measured by the MELE instrument. Only 17% of schools were reported to have available handwashing facilities (27% for urban and 13% for rural schools). Most of them used a shared basin or hand-poured water, which is unlikely to be of a sufficient standard to prevent the spread of viruses, including COVID-19. About half of the schools have a toilet (57% for urban and 51% for rural schools), with most being pit latrines, buckets or composting toilets.

MELE domain (2): Activities and materials. This domain measures the range of activities (both curricular and play) children experienced during the classroom observation. About 78% of teachers offered learning opportunities to develop children's maths skills during the observation, and 67% of the teachers had received the O-Class teacher guide. This O-Class teacher guide that was revised in 2018 recommends using children's portfolios to track their learning progress and organising O-Class into 4 to 5 learning areas to encourage students to explore materials by domain in a self-directed manner.[15] Yet, only 16% of the O-Class used child portfolios and 27% of the O-Class used learning corners for young children. Notably, there was a wider urban-rural gap in teachers' use of child portfolios than other quality indicators, with very few using these in rural areas (48% for urban vs. 2% for rural schools) and using learning corners (46% for urban vs. 19% for rural schools). Various learning materials (writing utensils, art, fantasy play, blocks, educational toys, storybooks) were available in only around one third of the O-Classes. This indicates that many schools still have either none or just a few materials for teaching and learning. A lack of such resources that assist the teacher in providing quality learning experiences could limit children's learning opportunities.

MELE domain (3): Classroom interactions and approaches to learning. With respect to the lesson observation (which as noted above is exploratory), approximately 55% of children were found to be engaged most of the time. The classroom observation also included a 4-point scoring rubric to assess to what extent a child and teacher interact in the classroom (1 = negative or fewer to 4 = positive or more). Areas observed include teacher engagement, disciplinary strategies, the exhibition of negative interactions, how to organise group work, supervision by an adult(s), using

themes to organise activities, individualised interaction, encouragement for equal participation of boys and girls and different groups. When we estimated the child-teacher interaction index based on the average of 9 items observed in the classroom, the index was 2.6 out of 4 points. For example, 43% of O-Class teachers taught using one element of play, 27% of O-Class teachers taught using two or more elements of play, whereas 25% of O-Class teachers taught using repetition only (5% did not occur).

Table 3.11: Descriptive statistics: O-Class characteristics

School characteristics	Overall sample	(n=78)	Urban O-Class	(n=24)	Rural O-Class	(n=54)	*t-test*
	Mean	SD	Mean	SD	Mean	SD	
School/teacher characteristics							
School received school grants for O-Class	0.85	(0.36)	0.76	(0.43)	0.89	(0.31)	***
School is a resource cluster centre	0.65	(0.48)	0.58	(0.49)	0.69	(0.46)	***
Teacher has more than 5yrs experience	0.29	(0.45)	0.40	(0.49)	0.24	(0.43)	***
Teacher qualification: - Grade 10/12	0.27	(0.45)	0.21	(0.41)	0.28	(0.45)	**
Teacher qualification: - Post G10-certificate	0.26	(0.44)	0.38	(0.48)	0.23	(0.42)	***
Teacher qualification: - Post G10-diploma/TVET	0.44	(0.50)	0.37	(0.48)	0.48	(0.50)	***
Teacher qualification: - University degree	0.03	(0.16)	0.04	(0.20)	0.02	(0.14)	***
MELE domain (1): health and facilities							
O-Class has handwashing facilities	0.17	(0.38)	0.27	(0.44)	0.13	(0.34)	***
O-Class has toilet	0.53	(0.50)	0.57	(0.50)	0.51	(0.50)	**
MELE domain (2): activities and materials							
Learning activities for math skills were observed	0.78	(0.42)	0.82	(0.38)	0.76	(0.43)	***

Teacher has the O-Class teacher guide	0.67	(0.47)	0.66	(0.47)	0.67	(0.47)	
O-Class students has their own portfolio	0.16	(0.36)	0.48	(0.50)	0.02	(0.13)	***
O-Class has learning corners	0.27	(0.44)	0.46	(0.50)	0.19	(0.39)	***
Learning material index	0.37	(0.32)	0.27	(0.33)	0.42	(0.31)	***
MELE domain (3): classroom interactions and approaches to learning							
Child's engagement in the classroom	0.55	(0.50)	0.54	(0.50)	0.55	(0.50)	
Child-teacher interaction Index (min 1; max 4)	2.62	(0.61)	2.40	(0.61)	2.71	(0.58)	***

Note: Learning material index is based on the average of observed materials in the classroom, including writing utensils, art, fantasy play, blocks, educational toys, storybooks (6 items in total, dummy variable) (Cronbach α=.77). Child-teacher interaction index is based on the average of observed classroom interactions and learning approaches in the classroom (9 items in total, scale 1-4) (Cronbach α=.80).
*** p<0.01, ** p<0.05, * p<0.1

Relationship between O-Class quality and early numeracy test scores. We further examine the extent to which the O-Class quality indicators are associated with students' early numeracy test scores at endline conditional on baseline test scores. For this analysis, we restricted our sample to the children who participated in O-Class in the 2019/20 data collection (N=1,789). Tables 3.12 to Table 3.15 present the associations of O-Class quality indicators on child outcomes by school/teacher characteristics and each of the three MELE domains. We check the joint significance of the quality variables in each specification and confirm that they are statistically significant except the classroom interactions and approaches to learning variables (see the *F*-test results in the table notes). Across Models 1 to 3, we introduce control variables related to prior test scores to child/family characteristics and school/teacher characteristics. In these models, we include regional variables only, not urban and rural location to avoid multicollinearity between region and rural-urban location. Overall, only three of the thirteen associations between O-Class quality and child early numeracy scores were significant after controlling for all covariates.[16]

Specifically, teachers' years of teaching experience at the pre-primary level presents statistically significant associations with students' learning gains in early numeracy

over the academic years (Table 3.12). Equipping schools with handwashing facilities presents small but statistically significant associations with students' early numeracy scores (Table 3.13). Child engagement in the classroom, captured by the share of children who were paying attention, looking at the teacher, and focusing on their lesson or work, was associated with child scores in early numeracy (Table 3.15). However, none of the quality indicators related to learning activities and materials were associated with child outcomes (see Table 3.14), unlike previous studies in Tanzania and rural China (Raikes et al., 2020; Su et al., 2021).[17] This does not necessarily mean that learning activities, materials, and teacher-child interaction are not critical quality indicators that affect a child's numeracy outcomes. As mentioned previously, the instrument faced reliability challenges, which stem from weak inter-rater reliability (Rossiter et al., 2018). Although the analysis of quality indicators requires extra caution, it sheds light on the need for improving the accuracy of quality measurement to inform policy and practice.

Table 3.12: Empirical associations between school/teacher characteristics and early numeracy (% of correct answers)

		Between 2019/20 and 2020/21	
		Model 1	Model 2
		Endline | Baseline	Endline | Baseline
School/teacher characteristics			
School received school grants for O-Class		7.76**	3.25
		(3.27)	(2.60)
School is a resource cluster center		3.12	3.16
		(2.25)	(1.91)
Teacher has more than 5yrs experience		4.91*	4.25**
		(2.61)	(2.03)
Teacher qualification (ref: Grade 10/12)	Post G10-certificate	4.16	1.04
		(3.14)	(2.48)
	Post G10-diploma/TVET	3.80	2.91
		(2.92)	(2.46)
	University degree	-1.99	-5.94
		(3.43)	(6.40)
Prior learning level		Y	Y
Child/family characteristics			Y
Observation		1,894	1,789
Number of schools		78	78
R^2		0.30	0.35

Note: Robust standard errors clustered at school level in parentheses. All models include attrition weights. F-test result (F(4,77) = 4.16, prob > F = 0.004) indicates that the school/teacher quality indicators jointly are good indicator. *** p<0.01, ** p<0.05, * p<0.1. Y= Yes, included

Table 3.13: Empirical associations between pre-primary class quality and early numeracy: Facilities and safety (% of correct answers)

	Model 1	Model 2	Model 3
	Endline | Baseline	Endline | Baseline	Endline | Baseline
MELE domain (1): health and facilities			
O-Class has handwashing facilities	8.18**	3.46*	3.71*
	(3.37)	(1.81)	(1.92)
O-Class has toilet	0.39	-0.50	0.12
	(2.51)	(2.13)	(2.18)
Prior learning level	Y	Y	Y
Child/Family characteristics		Y	Y
School/Teacher characteristics			Y
Observation	1,894	1,789	1,789
Number of schools	78	78	78
R^2	0.28	0.37	0.38

Note: Robust standard errors clustered at school level in parentheses. All models include attrition weights. F-test result (F(2,77) = 3.95, prob > F = 0.0232) shows that the indicators on health and facilities jointly are good indicator. *** p<0.01, ** p<0.05, * p<0.1. Y = Yes, included

Table 3.14: Empirical associations between pre-primary class quality and early numeracy: Activities and materials (% of correct answers)

	Model 1	Model 2	Model 3
	Endline | Baseline	Endline | Baseline	Endline | Baseline
MELE domain (2): Activities and materials			
Learning activities for math skills were observed	0.11	1.42	0.87
	(2.51)	(1.79)	(1.75)
Teacher has the O-Class teacher guide	-2.07	-0.06	-0.77
	(2.57)	(1.84)	(1.81)
O-Class students has their own portfolio	10.40***	-0.07	-2.19
	(2.91)	(2.92)	(4.21)
O-Class has learning corners	1.20	2.14	1.73
	(1.83)	(1.64)	(1.70)
Learning material index (blocks, toys, writing utensils) (alpha=0.77)	-1.04	-0.53	-0.20
	(1.04)	(0.91)	(0.89)
Prior learning level	Y	Y	Y
Child/Family characteristics		Y	Y
School/Teacher characteristics			Y
Observation	1,894	1,789	1,789
Number of schools	78	78	78
R^2	0.30	0.37	0.38

Note: Robust standard errors clustered at school level in parentheses. All models include attrition weights. F-test result (F(5,77) = 4.41, prob > F = 0.0014) indicates that the classroom activity and material indicators jointly are good indicator. *** p<0.01, ** p<0.05, * p<0.1. Y = Yes, included.

Table 3.15: Empirical associations between pre-primary class quality and early numeracy: Classroom interactions and approaches to learning (% of correct answers)

	Model 1	Model 2	Model 3
	Endline | Baseline	Endline | Baseline	Endline | Baseline
MELE domain (3): Classroom interactions and approaches to learning			
Child's engagement in the classroom	1.28	3.30*	3.62*
	(2.57)	(1.93)	(1.90)
Child-teacher interaction Index (alpha = 0.80)	-3.17	0.44	0.19
	(2.07)	(1.79)	(1.63)
Prior learning level	Y	Y	Y
Child/family characteristics		Y	Y
School/teacher characteristics			Y
Observation	1,894	1,789	1,789
Number of schools	78	78	78
R^2	0.28	0.37	0.38

Note: Robust standard errors clustered at school level in parentheses. All models include attrition weights. F-test result (F(2,77) = 4.41, prob > F = 0.32) shows that the indicators on classroom interaction and approaches to learning jointly are poor indicator. *** p<0.01, ** p<0.05, * p<0.1

4 Perspectives of stakeholders on the pre-primary education system in Ethiopia

In this section, we address the overarching question of Part 2: What are the perspectives of key stakeholders on the implications of COVID-19 on pre-primary education systems? Firstly, through the key informant interviews with ministry officials and aid donors, we explore if there has been any change in accountability relationships in the education systems in the context of the GEQIP-E reform. In addition, we look at the extent to which education systems prioritised pre-primary education in response to the COVID-19 crisis. Secondly, using the mobile phone survey, we assess to what extent parents and community were involved in young children's learning and well-being during the COVID-19 school closures.

4.1 Perspectives of government and aid donors

In this section, we explore how accountability relationships in pre-primary education systems have changed as GEQIP-E reforms have begun to be implemented, and subsequently in the light of COVID-19.

Methods

In April 2021, the team carried out semi-structured interviews with representatives from the MoE and aid donors involved in pre-primary education. We interviewed a total of six key informants, including four government officials at the national level and two from aid donors. The government officials include representatives of the Teacher and Educational Leader Development Directorate, School Improvement Directorate and the NEAEA. The interviews covered the roles and responsibilities of each stakeholder, especially in the context of COVID-19, views on the education system response to the crisis, the status of finance, information flow, and preparation for school re-opening. All interviews were conducted face-to-face, following social distancing measures set by the Government of Ethiopia.

Accountability relationships in Ethiopia's pre-primary education system

Our ELP Phase 1 study identified the policy actors and their relationships within Ethiopia's pre-primary education system through applying a model of accountability relationships (Pritchett, 2015). The model has the premise that "governmental (sub)

systems of education 'work' when there is an adequate flow of accountability in the system" (p.18, Pritchett, 2015). The accountability relationship among diverse policy actors has four 'design elements' which determine action: delegation, finance, information and motivation. Through an in-depth diagnostic analysis of Ethiopia's education system, our ELP Phase 1 study identified three levers for reform in pre-primary education: scope of programme, finance, and monitoring (see Rossiter et al., 2018 for details).

Building on the findings from the Phase 1 study, we further look at whether there was any change in these levers, as well as the relationships among policy actors, in the context of the ongoing reform of pre-primary education associated with GEQIP-E and COVID-19 crisis in Ethiopia.

Policy actors within the education system

Since 2006, government, international donors and NGOs coalesced to promote pre-primary education.[18] In recent initiatives such as the QEAP programme of GEQIP-E, the MoE has collaborated with the international aid donors and NGOs such as the World Bank, UNICEF, Global Partnership for Education, World Vision, Education Development Trust and Plan International on this agenda.

In 2018, several taskforce teams related to pre-primary education were established, for instance: GEQIP-E Taskforce for O-Class jointly led by the MoE and World Bank, Taskforce for Early Childhood Development led by U.S. Agency for International Development (USAID), as well as multi-sectoral steering boards across the MoE, Ministry of Health, and Ministry of Women, Children and Youth (MOWCY). Although this approach contributes to facilitating collaborative efforts among key stakeholders, it faced some challenges in coordination and communication across multiple agencies:

> *There is no harmonisation and coordination among these actors. It seems that stakeholders and donors have different interests and priorities towards pre-primary education resulting in duplication of efforts, ineffective utilization of limited resources and lack of harmonisation in strategies and implementation.*

The Ministry of Education should take the lead to coordinate and enhance the quality and accessibility of these efforts.

Government official

Taskforce teams also faced even greater difficulties in communication during the pandemic, especially with the stakeholders at the zone, district, and school levels, given the need for technology to join virtual meetings at a distance that was often lacking at lower levels of the system.

Finance for pre-primary education

Delegation in the context of Ethiopia's education system relates to the mission and commitment of the government to provide quality and equitable pre-primary education for *all* children. There should be coherence between what was delegated and the adequacy of the finance allocated. However, our ELP Phase 1 study found that the expansion of O-Class had been achieved with no dedicated budget for pre-primary education (Rossiter et al., 2018). Instead, regions have relied on local contributions and capitation school grants, which fell far short of providing a safe and stimulating learning environment for young children. As a result, the amount and structure of finance available to regions have not supported the national goals and lead to inequitable access to early learning.

All respondents indicated that financing for the pre-primary education sector, allocated by the government and aid donors, is still not sufficient. There are obstacles to securing funding for O-Class, and often the small amount of funding intended to be for O-Class were actually used for primary education or other purposes. Also, due to the absence of budget information specifically for pre-primary education, it is difficult for the government to make informed decisions about how to allocate the funds to pre-primary education:

Firstly, the expenditure per child at the pre-primary level needs to be estimated and should be shown against what has been spent at the primary and secondary levels. The calculation of returns to investment for each level would be useful. High-level government officials need to make an informed decision

on what is being spent and what is the return of that investment. My guess is ECE has the highest return on investment but is probably the area where the least investment is being made. Secondly, it is a relatively new sub-sector and needs higher initial investment as higher education exists more than 10 years. For example, the government could consider budget reallocation between general education and higher education [by] introducing more cost sharing in higher education so that some government resources could be freed to fund ECE.

Donor

The respondents shared some suggestions to increase financing for pre-primary education as follows:

- Diversify financial sources for O-Class through community mobilisation;
- Strengthen the existing funding channels such as GEQIP-E or other initiatives supported by the aid donors (e.g., World Bank, UNICEF, USAID);
- Allocate an independent budget dedicated to O-Class by the government; and,
- Monitor the budget utilisation to meet the purpose of funding and its requirements.

Monitoring and assuring quality

As explained previously, in 2018, the MoE launched the QEAP for O-Class as part of the GEQIP-E programme. Along with the quality enhancement component of the programme, the quality assurance component focuses on creating a mechanism to improve and ensure the quality of O-Class. It entails the establishment of national standards and school inspection for O-Class.

After the establishment of the national standards for O-Class in 2018, the inspection framework for O-class was developed in 2019 by the School Inspection Directorate at the MoE. It has three focus areas: inputs (i.e., school facilities, learning environment, and human and financial resources), process (i.e., learning and teaching, parental and

community engagement, and curriculum), and outputs (i.e., access to preschool, O-Class management, participation of parents and community). The inspection for O-Class has been rolled out nationwide from the school year of 2019/20 and reached more than 3,000 O-Classes in 2020/21. It helped school principals and teachers aware of the minimum quality of O-Class. The MoE and REB also organised a session/workshop to share the school inspection results with schools and provide guidance/advice on how to improve their practices. The two respondents who were actively involved in this process said that it includes comprehensive standards reflecting all key aspects of the O-Class quality. However, one respondent expressed some concerns about the O-Class inspection system in terms of the reliability of classroom observation by different inspectors and its focus on inputs and processes than outputs:

> *It is useful to have some minimum standards for O-Classes and a mechanism to monitor and guide towards these standards. But inspection has limitation as it heavily depends on value judgement as well as focuses on input and process than outcomes. It needs to be complemented by child development assessments.*
>
> Donor

Additionally, in order to measure children's development and school readiness, the MoE and NEAEA have been preparing to administer the MELQO at scale. Based on their collaboration with the global MELQO team, ELP team, and the World Bank, the Ethiopian Government aims to collect early childhood development data from a nationally representative sample starting from 2021/22. The ELP team have engaged closely with NEAEA and MoE from the very start in this endeavour. The ELP team were involved in decisions on the study design, instruments, and languages during the ELP Phase 2 study. One expert from NEAEA said:

> *Data on early learning was non-existent and the O-Class management has no basis for informed decision-making. The introduction of MELQO, which is now integrated with the activities of the NEAEA, is hoped to facilitate the assessment of early learning with guaranteed institutional sustainability.*

Besides, NEAEA is planning to bring all available early learning assessment instruments on board and create an open data hub or platform, which will be launched soon. All stakeholders will be invited to contribute to the platform and data sharing activities.

Government official

Parental and community involvement

As an effort to promote parental and community engagement in O-Class, national standards for O-Class and inspection standards set in 2018 included measures to strengthen parental and community involvement. Yet, little is known about to what extent Parent-Teachers-Student Association (PTSA) has been involved in the O-Class management:

O-Class standards require parental and community involvement in O-Class, especially through Parent-Teachers-Students Association. The standards clearly indicate that O-Class teachers need to have regular communications with parents through PTSA or other channels. However, this has not been practiced on the ground. ECE may not have a standalone PTSA and the issues of O-Class may be overshadowed by other issues in primary school where the O-Class is attached.

Donor

The respondent also highlights the importance of using the existing structure of PTSA, which governs the school improvement plan and the usage of school grants, while special attention should be given to support O-Class parents to participate in this process. Moreover, they note a need for professional development for school leaders and teachers to facilitate the involvement of parents and communities in O-Class management.

A lack of political prioritisation of pre-primary education during COVID-19 school closures

Responding to the COVID-19 pandemic

Despite the unprecedented public interest in pre-primary education since the 2010 reform, there were no response strategies for pre-primary education due to a lack of leadership and coordination among the government and key stakeholders. Pre-primary education was not part of the 'Concept Note for Education Sector: COVID-19 Preparedness and Response Plan', which was announced by the MoE in April 2020. Unlike remote learning strategies for primary and secondary education, there were no such strategies at the pre-primary level. This gap could be partially explained by a lack of radio or TV educational programmes for pre-primary-aged children before the pandemic and an absence of an independent governance structure working for pre-primary education within the Ministry. Given O-Class is attached to government primary schools, pre-primary education is often overlooked by the government as a downward provision of primary education despite its distinctive features related to early childhood development:

> *The home-based learning programmes for primary and secondary are built on existing radio or TV programs. Since there was none for O-Class, the sub-sector has been missed. Additionally, there is no specific directorate for pre-primary education within the Ministry, hence it created a gap in the response given most of the Ministry staff also worked from home without any connectivity. These barriers made it difficult to discuss the strategies to reach O-Class during school closures and develop any subsequent actions.*
>
> Donor

> *Early childhood education as a policy priority is being indicated by the government repeatedly but not having a dedicated department and/or personnel left a vacuum with no one being accountable for activities in the sub-sector.*
>
> *Donor*

However, there were some efforts initiated by the regional government, aid donors, and private providers. For example, the Addis Ababa Bureau of Labour and Social Affairs and UNICEF jointly launched a pilot radio programme for parents of children under 6-year-olds as part of the Urban Productive Safety Net Programme. Using the local radio programme (e.g., FM Radio of Fana and Sheger), the programme focused on empowering parents to support play-based learning at home with their children. This has been well accepted by parents and caregivers in Addis Ababa, and the regional bureau raised the need for scaling it up to benefit more children and families nationwide even after schools reopened. Some urban and private schools used Telegram or other mobile message systems to send messages related to home-based learning for parents and caregivers. Although there were some efforts to reach out to young children and their families, this was viewed as being more prevalent in urban areas and those who already had access to technologies, which implies a widening gap between the advantaged and the disadvantaged in their engagement with home-based learning during the pandemic (see also next Section).

The MoE did make efforts to develop digitalised training materials for O-Class teachers to expand their opportunities to participate in professional development during the pandemic. The Teacher and Educational Leader Development Directorate led this work, offering an online training course from the Regional Education Bureau or College of Education, which could be cascaded to local levels (district, school), with the aim of strengthening the capacity building of O-Class teachers in developmentally appropriate teaching/instruction. Such in-service training modules are viewed as a way to support narrowing the quality gap observed in O-Class across different communities.

School reopening

In August 2020, the Ethiopian Government conducted a nation-wide survey on school reopening for all levels of education through interviews with key stakeholders, including school principals, administrators, teachers, parents, and students.[19] Based on the survey findings, the MoE developed the 'Guideline for School Reopening during COVID-19' in collaboration with the Ministry of Health. To distribute the guidelines on

safe school reopening, the MoE held a workshop in September 2020 with regional education bureaus, civil society organisations, and teachers' associations. The guidelines, for example, indicate that all students should wear masks *except for pre-primary children* considering young children's breathing sensitivity to wearing masks for 4 to 6 hours.

> *Class sizes have been reduced by splitting students into two groups and each group attends class on every other day. Sanitary materials such as masks and sanitisers have been distributed to schools, although not sure to what extent it is sufficient.*
>
> Government official

> *There were some campaigns for students to return to school launched by the Minister, as well as school and community level activities. But these are for the entire general education system and not particularly for O-Class.*
>
> Government official

O-Classes reopened in a phased approach November and December 2020, following the reopening of primary and secondary schools in October and November 2020. According to interviews with the MoE, there were more concerns for pre-primary school-aged children due to their breathing sensitivity and difficulties in following social distancing measures in the classroom. In addition, with the fear of catching COVID-19 from school, some parents were reluctant to send their children back to school when it reopened. The respondents mentioned the following challenges for young children:

- not returning to schools or attending regularly;
- failing to bring a cup or bottle for drinking water, and in some instances, they were forced to drink water directly from the water tap, which may expose them to contamination;
- avoiding/ forgetting to wear masks;
- failing to keep the necessary physical distance while engaing in indoor and outdoor play.

After schools reopened, the government encouraged them to implement a three- to four-week remedial course to mitigate children's learning losses during school closures. However, the extent to which these courses have been implemented at the school level remains unknown. A government respondent pointed out that this was likely to affect teacher motivation due to extra teaching loads without being compensated.

In sum, according to the interviews with key informants, there continues to be 'incoherence' in accountability relationships among various policy actors largely due to insufficient information flow, inadequate resource allocation, weak alignment between national goals and local preferences, and a lack of communication among actors. In addition, the study reveals that there was no policy prioritisation of pre-primary education during the COVID-19 crisis, despite the government's response for primary and secondary education. Although there have been considerable efforts to strengthen pre-primary education systems in Ethiopia, a lack of coordination and collaboration among governmental and non-governmental actors becomes an obstacle to strengthen the pre-primary education system in Ethiopia. Strengthening the coordination and collaboration among key stakeholders within the system is essential for delivering effective and equitable pre-primary education for all.

4.2 Perspectives of parents and caregivers during school closures

As part of the ELP Phase 2 study, the team carried out mobile phone surveys between August and September 2020 in the midst of the COVID-19 school closures. The survey aimed to understand how parents and caregivers with pre-primary aged children responded to the COVID-19 crisis in Ethiopia. Of the ELP sample with more than 3,000 households, the perspectives of 480 parents and caregivers across six regional states and city administrations (Addis Ababa, Amhara, Benishangul-Gumuz, Oromia, SNNP, Tigray) were included in the study. Specifically, the study assessed what information and resources parents and caregivers had access to, how they were able to engage in supporting their children's learning at home during school closures, and their perspectives on the reopening of schools. We summarise here an overview of the key findings based on the fuller study (see Kim et al. 2021 for full information of the methodology and findings):

Information and support for families during school closures

1. *Access to resources that help parents and caregivers engage in children's learning at home is limited, especially for the most disadvantaged.* More than half of parents and caregivers reported that they do not have children's books or learning materials at home, with caregivers who are not literate being much less likely to have such books. A large difference between urban and rural locations was also observed for families' access to electricity and technologies to support children's learning indicating a more significant disadvantage in rural or remote areas.

2. *Most parents and caregivers received little support from schools or local governments.* Only 10% of caregivers reported that they have been in contact with pre-primary teachers or school principals, with significant differences by household wealth and across regions.

Parental engagement in children's learning at home during COVID-19

1. *Very limited learning activities took place at home during school closures.* Only half of parents and caregivers reported that they were engaged in supporting educational or learning activities for pre-primary children, which favours families living in urban areas. Mothers are most likely to be responsible for supporting children's learning at home; yet mothers are less likely to be literate and more likely to face challenges supporting their children's learning at home.

2. *Fewer children from rural, low-income families and families where parents are illiterate were engaged in learning activities during school closures.* Around three quarters of caregivers reported that they played more often with their child since the COVID-19 crisis than before, with about half of caregivers telling stories or singing songs more often to their child during school closures. However, caregivers from poorer households or who are illiterate were less likely to engage in such activities.

3. *There were no distance education strategies for pre-primary education.* In the absence of the government's support to providing radio educational programmes for pre-primary aged children, only 12% of parents and caregivers interviewed said that they used radio lessons with their children since schools were closed.

4. *Families and young children faced increased hardship during school closures.* Nearly 80% of households experienced the economic impact of COVID-19 as their total income was lower than before the crisis, with poorer families disproportionately affected. During this unexpected disruption to their daily lives and welfare, about half of caregivers reported that their child was less motivated to learn during school closures. About one third of children cried more often since the crisis, and some were speaking less well or destroying or damaging things more often. An increased incidence of child corporal punishment was also reported, being more apparent in families with boys and those living in rural areas. It highlights the importance of putting measures in place to respond to child protection risks.

Overall, our findings highlight that pre-primary-school-aged children and their families received very limited support from education systems during school closures, especially for those living in rural areas or from disadvantaged backgrounds. There is an urgent need for policies that mitigate the effects of school closures to prevent learning gaps that would emerge in early childhood and could be exacerbated due to the global health crisis. This includes the need for strategies to support parents in encouraging children's relevant play and educational activities at home and creating a stimulating home learning environment.

5 Key messages and policy implications

5.1 Key findings

The findings of this study on pre-primary education programmes in Ethiopia provide strong evidence on the vital role of pre-primary school participation in determining primary school readiness. Overall, the evidence suggests that it is possible to provide a smooth transition from pre-primary to primary education for young children through O-Class, which is designed to be developmentally appropriate for 6-year-old children and support them to prepare formal schooling. Even in the context of COVID-19, including the eight-month long school closures in 2020, O-Class children outperformed those who did not attend pre-primary education, with greater learning gains in early numeracy between 2019/20 and 2020/21.

However, our results also suggest that the significant learning gains from pre-primary education for those who attended, compounding with the unprecedented global health crises, can *reinforce* the learning gaps between children from advantaged and disadvantaged backgrounds. Despite the equaliser role that previous studies have found early childhood education can play for vulnerable children (e.g., Engle et al., 2011), we found that the benefits of O-Class participation were particularly pronounced for boys and children with literate caregivers than girls and those with non- literate caregivers. It reveals the importance of paying attention to the learning needs of children from disadvantaged backgrounds who may face multiple challenges during the COVID-19 crisis.

In the context of COVID-19, tracking children's learning trajectories is a key step towards mitigating the pandemic's consequences. The study has assessed the magnitude of such losses in Ethiopia by comparing two cohorts of children who entered primary school before COVID-19 and after schools reopened. A significant decline in early numeracy test scores was apparent for those who entered Grade 1 following school closures, with a steeper fall in learning for children who had not attended pre-primary school compared with those who had been in O-Class prior to the pandemic. This calls for practical measures to mitigate learning losses from school closures, given that around one in three countries are not yet implementing

accelerated or remedial learning programmes post COVID-19 school closures as of July 2021 (UNESCO et al., 2021).

The study highlights that the overall quality of pre-primary education (with respect to O-Class programmes) in Ethiopia is low. The study identified an association between pre-primary teachers' teaching experience, children's engagement in the classroom, and basic facilities such as handwashing facilities and toilets, with improved learning outcomes, which point to critical priorities for future quality improvement. Although O-Class quality improvement interventions led by the government did not contribute to improved school readiness, this is primarily due to severe disruption in programme implementation caused by the COVID-19 school closures. Given that the benefits of pre-primary education are conditional on its quality (Engle et al., 2011, McCoy and Wolf, 2018), our findings call for more attention on the quality of pre-primary education in Ethiopia.

Table 5.1: Overview of the ELP Phase 2 survey: Key findings

Research questions	Key findings
Part 1: What are the education trajectories of pre-primary school-aged children in Ethiopia in the context of COVID-19?	
Research question 1: Which early education pathways are prevalent among children in the context of COVID-19 school closures? What are the predictors of pre-primary school children not returning once schools re-opened?	• About 90% of O-Class children returned to schools in 2021 following the schools re-opening in October 2020 • About 50% of children who had not previously enrolled in pre-primary education remained unenrolled in 2021 • Children living in urban areas and those from households with sufficient food were more likely not to return to school, partially explained by parents' concerns about schools' safety and sanitation amid the COVID-19 pandemic • Children from poorer families were more likely to remain unenrolled when they reached the official age for primary education
Research question 2: What are the differences in early numeracy outcomes for children who participated in O-Class and those who did not? Have these differences changed between 2019/20 and 2020/21 as a result of the COVID-19 school closures?	• O-Class participation is a significant predictor of children's subsequent learning outcomes and learning gains between 2019/20 and 2020/21 • Learning gaps vary by gender and parental literacy. Boys and children with literate caregivers showed greater learning progress between 2019/20 and 2020/21 than girls and those with illiterate caregivers

How do outcomes vary by sub-groups?	
Research question 3: What are the differences in early numeracy outcomes for children who entered Grade 1 before COVID-19 and those who entered after COVID-19? To what extent are these differences affected by children's participation in O-Class?	• Compared to a cohort of children who entered primary school before COVID-19, those who entered school after COVID-19 show a lower level of school readiness at the start of primary school • Potential learning losses caused by COVID-19 were five times larger for children not in pre-primary school than those who had previously attended O-Class
Research question 4: To what extent are learning trajectories affected by quality improvement interventions for O-Class (GEQIP-E) in the context of COVID-19 school closures?	• There were no differential associations between the GEQIP-E quality improvement interventions and children's school readiness, which can be explained by the severe disruption in the implementation of the interventions due to the COVID-19 school closures
Research question 5: To what extent are early numeracy achievement and learning gains affected by the quality of O-Class more generally?	• O-Class suffered from the lack of facilities for health and sanitation, unavailability of curriculum guidelines and learning materials, and professional support for teachers to improve their pedagogical approaches for young children • Among various quality indicators, access to handwashing facilities, teachers' teaching experience, and children's engagement in learning was associated with improved school readiness and its progress of young children
Part 2: What are the perspectives of key stakeholders on the effects of COVID-19 on pre-primary education systems?	
Research question 6: How have accountability relationships in pre-primary education systems being affected by the context of the GEQIP-E reform and the COVID-19 crisis?	• The government did not prioritise pre-primary in the COVID-19 response plan in 2020 • There was a lack of coordination and collaboration among key stakeholders in pre-primary education in Ethiopia in responding to the COVID-19 crisis, especially between the government and non-governmental actors, including donors and NGOs
Research question7: To what extent have parents and community been involved in children's early learning during the COVID-19 school closures?	• About 50% of caregivers did not have children's books or learning materials at home • During school closures, only about 50% of caregivers were able to engage in supporting educational or learning activities for their children. Families living in urban areas or wealthier families were more likely to support home-based learning activities

5.2 Policy implications

The following are key policy implications drawn from our findings:

- *Prioritise expanding access to quality pre-primary education for all.* Our research findings reaffirm the significant benefits of pre-primary participation on children's school readiness despite the COVID-19 crises. Moreover, pre-primary education plays a critical role in mitigating the potential learning losses as a result of school closure. Given the interruption of implementation of quality reforms associated with GEQIP-E during school closures, it will be important to prioritise these reforms to enable recovery from the double crises in learning and global health.

- *Continue to track the recovery of children, families, teachers, and pre-primary education programmes.* The findings of the research highlight the need for up-to-date, timely evidence related to pre-primary education to inform policymakers on how to support the recovery of children, families, and schools from the COVID-19 pandemic. Monitoring the effects of the crisis on children's learning outcomes in the medium- to long-term, the supply and quality of pre-primary education programmes, and pre-primary teachers' experiences once school re-opened is essential for targeting supports and ensuring equitable solutions. In particular, measuring learning outcomes for young children are critical for meeting young children where they are, targeting resources effectively, and guiding investment decisions.

- *Prioritise support on children hit hardest by the COVID-19 crisis to help them mitigate learning losses.* Our research indicates that, due to pre-pandemic systemic inequities, the effects of the COVID-19 on children and families have been unequal, especially for those who are vulnerable. Remedial instruction is vital to help children who have missed out on school get back on track. This needs to be prioritised towards girls and children whose caregivers are not literate, who were out of reach during school closures. Moreover, data on some population groups are sparse, including children with disabilities and children

living in conflict-affected areas, and so attention will also be needed for these children.

- *Collect systematic data on the quality of pre-primary education to ensure high-quality experiences for young children.* As documented in this study, pre-primary education in Ethiopia suffered many challenges even before the COVID-19 crisis, such as the lack of trained teachers, the unavailability of curriculum and guidelines, and a lack of developmentally appropriate learning materials and adequate facilities. In the face of new crises, the pre-primary education system needs to be more responsive to new professional development needs, including training on health and safety, remote learning, and the needs for child-oriented pedagogy that help young children engage in learning.

- *Pay greater attention to prioritising pre-primary education in the government's crises and recovery planning.* Despite the recent gains in access to pre-primary education in Ethiopia, pre-primary education was not part of the government's immediate response to COVID-19 announced in April 2020. It is imperative to prioritise pre-primary education in the government's planning for COVID-19 recovery, as well as in relation to other on-going and future security and crisis situations, in order to mitigate the effects of school closures and prevent learning gaps that would emerge in early childhood that could be exacerbated due to the crisis. This calls for more harmonised actions by diverse stakeholders involved in the pre-primary sector that harness their resources to provide equitable and high-quality education.

In the short-term, our research aims to help policymakers make evidence-informed choices about how to leverage resources to recover from the crises. Ultimately, it seeks to support efforts to build a stronger pre-primary education system, that meets the needs of all children and families and that supports pre-primary education programmes and teachers to provide the high-quality learning opportunities young children need to thrive.

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7 Appendix

7.1 ELP Phase 2 outputs

Journal 1—Kim, J., Araya, M., Hagos, B., Rose, P., and Woldehanna, T. (2021). The implication of COVID-19 for Early Childhood Education in Ethiopia: Perspectives from parents and caregivers. *Early Childhood Education Journal, 49*, p.855-867.

Journal 2—Kim, J., Hagos, B., Rose, P., Rossiter, J., Teferra, T., and Woldehanna, T. (2022). Persistent inequalities in early years' access and learning: Evidence from large-scale expansion of early childhood education in Ethiopia. *Early Childhood Research Quarterly, 58*, p. 103-114.

Journal 3—Kim, J., Robinson, N., Härmä, J., Jeffery, D., Rose, P., and Woldehana, T. (2022). Misalignment of policy priorities and financing for early childhood education: Evidence from Ethiopia, Liberia, and Mainland Tanzania. *International Journal of Educational Research, 111*, 101891.

Journal 4—Anderson, K., Kim, J., Aslam, M., Baum, D., Hagos, B., Jeffery, D., Rose, P., and Saheed, S. (Accepted, forthcoming). The COVID-19 pandemic and early childhood education in Ethiopia, Liberia, and Pakistan: Perspectives of pre-primary school teachers. ECE Teachers in COVID-19. Educating the Young Child, Springer.

Working Paper 1—REAL Centre Research and Policy Paper 20/11 (October, 2020): The Implications of COVID-19 on early learning continuity in Ethiopia: Perspectives of parents and caregivers

Blog 1: UKFIET/RISE (May, 2020)—The threat of COVID-19 on Ethiopia's recent gains in pre-primary education

Blog 2: UKFIET/RISE (September, 2020)—Implications of COVID-19 for pre-primary education in Ethiopia: perspectives of parents and caregivers

Blog 3: UKFIET/RISE (April, 2021)—Practical and ethical challenges of doing distance research in the global south during a global pandemic

Blog 4: ECD Measure (April, 2021)—Ethiopia Builds its First National Assessment of Pre-primary Education

Blog 5: RISE/UKFIET (May, 2021)—Learning inequalities widen following COVID-19 school closures in Ethiopia

7.2 Robustness check

Propensity score matching analysis

We ran models using the propensity score matching (PSM) approach to check the robustness of our main findings. The distribution of the probability of preschool attendance before matching for each group of children (children who had participated in O-Class and those who had not enrolled in any pre-primary school) is presented in the left part of Figure A1. The distribution for children without preschool exposure is sharply skewed to the left, with around 44.2% (n=332) having a probability of less than 0.5 of attending preschools. In contrast, the distribution for the O-Class participants is skewed to the right, and the percentage of participants having a probability of less than 0.5 of attendance is only around 9.9% (n=164).

Because the group of children without preschool exposure is smaller than O-Class enrolled children, most of the children in the comparison group (i.e., no preschool) were matched with a child enrolled in O-Class (equal to or within 0.1 standard deviations of the propensity score). Specifically, the matching only resulted in 78 children who enrolled in O-Class being dropped. The right part of Figure A1 shows the probability densities after matching for the O-Class participants and non-participants, a total of 2,325 students in common areas. The matching achieved satisfactory overlap between the two groups. The sufficient overlap, together with satisfactory balance on all covariates (Figure A2), justifies subsequent analyses based on the matched sample. The results of PSM on the relationship between pre-primary participation and early numeracy outcomes are presented in Table A1, which are consistent with the results from OLS value-added model presented in Table 3.5.

Figure A1: Common support areas for O-Class children and children not being enrolled in pre-primary school

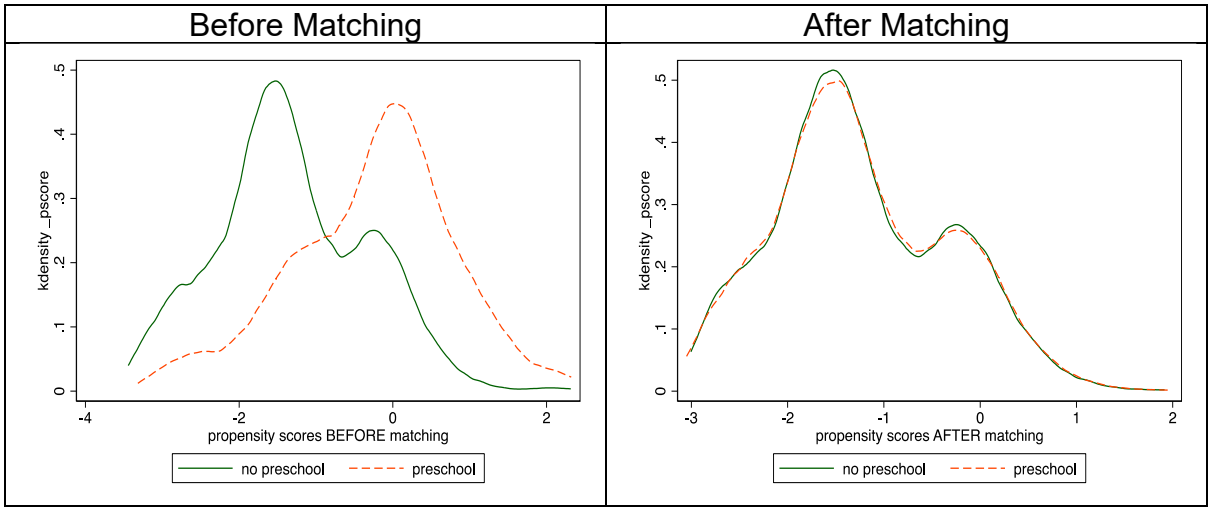
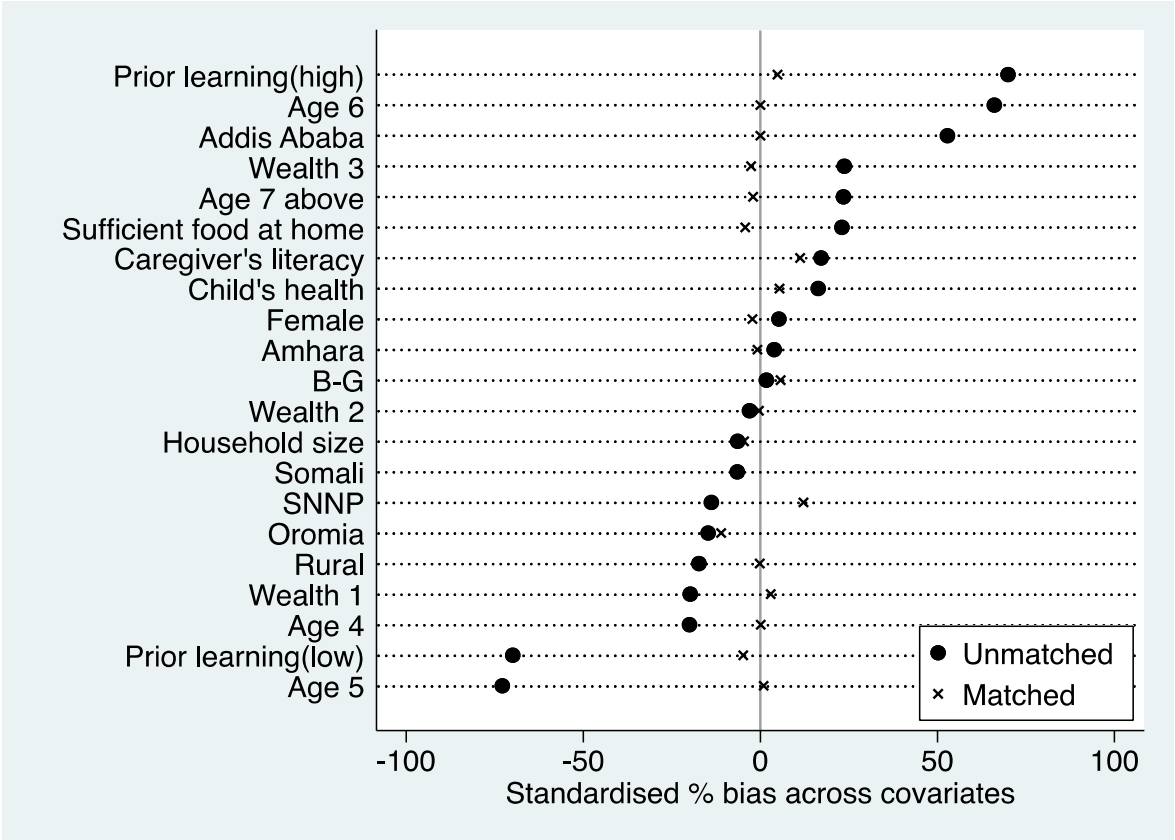


Figure A2: Covariate balance between matched and unmatched groups



Note: Wealth 1 = poorest households; wealth 3 = richest households.

Table A1: Propensity score matching: Relationship between pre-primary participation and early numeracy outcomes

		Early Numeracy					
		PSM (% of correct answers)			PSM (SD)		
		Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
		2019/20 Baseline	2020/21 Endline	Endline | Baseline	2019/20 Baseline	2020/21 Endline	Endline | Baseline
ECE participation (Ref: no ECE participation)		14.54***	13.33***	8.01***	0.56***	0.52***	0.31***
		(1.02)	(1.07)	(1.05)	(0.04)	(0.04)	(0.04)
Prior learning level (baseline score)				0.37***			0.37***
				(0.02)			(0.02)
Age		0.78***	0.74***	0.46***	-0.06*	-0.07**	-0.05
		(0.08)	(0.08)	(0.08)	(0.03)	(0.03)	(0.03)
Child is a girl		-1.62*	-1.83**	-1.23	0.03***	0.03***	0.02***
		(0.91)	(0.89)	(0.83)	(0.00)	(0.00)	(0.00)
Child health condition is good (ref: poor/ average)		-0.53	0.63	0.82	-0.02	0.02	0.03
		(1.98)	(2.08)	(1.83)	(0.08)	(0.08)	(0.07)
Household Wealth: middle (ref: poorest)		0.75	1.72	1.44	0.03	0.07	0.06
		(1.09)	(1.11)	(1.03)	(0.04)	(0.04)	(0.04)
Household wealth: richest		3.39***	1.35	0.11	0.13***	0.05	0.00
		(1.24)	(1.26)	(1.18)	(0.05)	(0.05)	(0.05)
Primary caregiver is literate		-1.90*	1.04	1.73*	-0.07*	0.04	0.07*
		(1.03)	(1.03)	(0.97)	(0.04)	(0.04)	(0.04)
Household size (ref: smaller than 6)		3.42***	-0.07	-1.32	0.13***	-0.00	-0.05
		(0.96)	(0.93)	(0.87)	(0.04)	(0.04)	(0.03)
Household has sufficient food in last 12 months		-2.15**	-0.14	0.64	-0.08**	-0.01	0.02
		(0.98)	(0.98)	(0.91)	(0.04)	(0.04)	(0.04)
Living in rural area		-5.42***	-11.43***	-9.45***	-0.21***	-0.44***	-0.37***
		(1.41)	(1.27)	(1.23)	(0.05)	(0.05)	(0.05)
Region (ref: Amhara)							
	Amhara	-	-	-			
		-	-	-			
	Benishangul-Gumuz	-5.53***	-11.85***	-9.83***	-0.21***	-0.46***	-0.38***
		(1.65)	(1.95)	(1.84)	(0.06)	(0.08)	(0.07)
	Oromia	-5.91***	-5.78***	-3.61***	-0.23***	-0.22***	-0.14***
		(1.32)	(1.44)	(1.28)	(0.05)	(0.06)	(0.05)
	SNNP	11.84***	5.74***	1.41	0.45***	0.22***	0.05
		(1.38)	(1.46)	(1.34)	(0.05)	(0.06)	(0.05)
	Somali	5.45**	18.21***	16.21***	0.21**	0.71***	0.63***
		(2.71)	(2.12)	(2.08)	(0.10)	(0.08)	(0.08)
Constant		12.43*	6.57*	32.59***	-1.28***	-1.03***	-0.56***
		(5.42)	(3.49)	(3.59)	(0.13)	(0.14)	(0.13)
Observation		2,540	2,325	2,325	2,325	2,325	2,325
R^2		0.26	0.27	0.37	0.26	0.27	0.37

Note: In PSM, children living Addis Ababa was excluded from the common areas for the matched sample. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

District-fixed effect analysis

As a robustness check for our OLS and PSM results, we also used a district-fixed effect model aiming to control for variations in observed or unobserved district-level characteristics related to pre-primary participation. In the ELP sample, there were 73 schools and 43 districts (*woredas*), but we run district-fixed effect models only since our sample includes children who are not in school. As shown in Table A3, the coefficients for O-Class participation are consistent across the three models (OLS, PSM, and district-fixed effect model), which confirms the robustness of our findings.

Table A2: District-fixed effect model- Relationship between pre-primary participation and early numeracy outcomes

	Early numeracy					
	District-fixed effects (% of correct)			District-fixed effects (SD)		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	2019/20 Baseline	2020/21 Endline	Endline | Baseline	2019/20 Baseline	2020/21 Endline	Endline | Baseline
O-Class participation (ref: not enrolled in any pre-primary school)	15.60***	14.25***	8.56***	0.60***	0.55***	0.33***
	(1.64)	(1.49)	(1.45)	(0.06)	(0.06)	(0.06)
Prior learning level (baseline score)			0.36***			0.37***
			(0.04)			(0.05)
Age	0.62***	0.61***	0.39***	0.02***	0.02***	0.01***
	(0.08)	(0.11)	(0.08)	(0.00)	(0.00)	(0.00)
Gender: girls	-1.11	-1.24	-0.84	-0.04	-0.05	-0.03
	(1.15)	(1.14)	(0.84)	(0.04)	(0.04)	(0.04)
Child health condition is good (ref: poor/ average)	-1.69	-1.39	-0.77	-0.06	-0.05	-0.03
	(1.64)	(1.78)	(1.73)	(0.06)	(0.07)	(0.06)
Household wealth tercile (ref: poorest)						
Wealth: middle	1.81	2.05	1.39	0.07	0.08	0.05
	(1.37)	(1.29)	(1.23)	(0.05)	(0.05)	(0.05)
Wealth: richest	4.71**	1.80	0.08	0.18**	0.07	0.00
	(1.69)	(1.50)	(1.42)	(0.06)	(0.06)	(0.06)
Primary caregiver is literate	1.13	2.97**	2.56**	0.04	0.12**	0.10**
	(1.05)	(1.02)	(0.87)	(0.04)	(0.04)	(0.03)
Household size (ref: smaller than 6)	4.09**	0.67	-0.82	0.16**	0.03	-0.03
	(1.25)	(0.97)	(0.91)	(0.05)	(0.04)	(0.04)
Household has sufficient food in last 12 months	1.36	1.71	1.22	0.05	0.07	0.05
	(1.68)	(1.17)	(0.93)	(0.06)	(0.05)	(0.04)
Living in rural	-6.82	-15.37***	-12.88***	-0.26	-0.60***	-0.50***
	(4.32)	(2.05)	(0.91)	(0.17)	(0.08)	(0.03)
Woreda-fixed effects	V	V	V	V	V	V
Constant	17.37**	44.27***	37.94***	-0.87***	-0.58*	-0.26
	(6.06)	(6.98)	(4.98)	(0.23)	(0.27)	(0.22)
Observation	2,540	2,540	2,540	2,540	2,540	2,540
R^2	0.36	0.35	0.44	0.36	0.35	0.44

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7.3 Difference-in-difference analysis

To further examine the effect of pre-primary participation on children's learning outcomes over time, a difference-in-difference (DID) estimation approach was applied. The DID approach allows for biases to be removed in the time point after participating in pre-primary school between children enrolled in O-Class and those not enrolled in any pre-primary education, which could arise from pre-participation differences between groups (Difference 1: preschool participation status), as well as biases from comparisons over time (Difference 2: time). DID is applied as an interaction term between the group by their participation in educational provision (i.e., pre-primary participation) and time variables (i.e., waves 1 and 2) in a regression model.

Table A4 shows three linear regressions with DID approach to estimate the effect of pre-primary participation on children's learning progress between baseline (2019/20) and endline (2020/21). Model 1 estimates changes in early numeracy scores over the academic years for the raw sample of O-Class children and those not enrolled in any pre-primary school. Model 2 involves estimated changes for the raw sample with controls including age, gender, child's health status, household wealth, caregiver's literacy, household size and food shortage, living in rural areas, and regional dummies. Model 3 estimated changes in test scores for a matched sample of O-Class children and those not being enrolled in any pre-primary provision.

Across the three models, the effect of O-Class participation on children's early numeracy progress over the academic years (Pre-primary participation*wave) was not found to be statistically significant, although the coefficients for pre-primary participation remain significant. This is in part because of the similar learning growth rates between O-Class children and those who were not in pre-primary education. As shown in Table 3.2, both groups achieved an approximately 20 percentage point increase in early numeracy scores between 2019/20 and 2020/21. However, when children entered Grade 1, the learning levels of children not enrolled in pre-primary were nearly one year behind those who participated in O-Class, implying their large learning gaps would not be narrowed over the academic years.

The findings of the DID models are based on students' growth (i.e., improvement in test scores) depending on preschool attendance regardless of whether they were high-performing or low-performing to begin with. However, the value-added models used in the main report (Table 4.7) are meant to approximate the contribution of pre-primary school participation after accounting for students' prior test scores and other characteristics.

Table A3: Difference-in-difference estimates empirical associations between pre-primary participation and early numeracy (% of correct answers)

	Early numeracy		
Variables	Model 1 Without controls	Model 2 With controls	Model 3 PSM matched sample
Pre-primary participation	21.25***	16.55***	15.78***
	(2.35)	(2.15)	(2.18)
Wave	19.99***	19.99***	19.98***
	(1.26)	(1.13)	(1.13)
Pre-primary participation*wave	**-1.18**	**-1.41**	**-1.25**
	(1.49)	**(1.35)**	**(1.37)**
Child characteristics		Y	Y
family characteristics		Y	Y
Region-fixed effects		Y	Y
Constant	25.59***	13.13***	-0.37
	(0.79)	(2.80)	(2.63)
	5,290	5,080	4,650

Table A4: Difference-in-difference estimates empirical associations between pre-primary participation and early numeracy (SD)

	Early numeracy		
Variables	Model 1 Without controls	Model 2 With controls	Model 3 PSM matched sample
Pre-primary participation	0.77***	0.60***	0.57***
	(0.08)	(0.08)	(0.08)
Wave	0.72***	0.72***	0.72***
	(0.04)	(0.04)	(0.04)
Pre-primary participation*wave	**-0.04**	**-0.05**	**-0.05**
	(0.05)	**(0.05)**	**(0.05)**
Child characteristics		Y	Y
family characteristics		Y	Y
Region-fixed effects		Y	Y
Constant	-0.87***	-1.32***	-1.81***
	(0.03)	(0.10)	(0.10)
	5,290	5,080	4,650

7.4 Supplementary tables I

The following tables show the main results in Section 3 using learning outcomes in 'standard deviations (SD).'

Table A5: Relationship between pre-primary participation and early numeracy outcomes (SD) (Related to Table 3.5)

		Early numeracy		
		OLS Value-added		
		Model 1	Model 2	Model 3
		2019/20 Baseline	2020/21 Endline	Endline | Baseline
ECE participation (ref: children not enrolled in ECE)		0.58***	0.54***	0.32***
		(0.06)	(0.06)	(0.06)
Prior learning level (baseline score)				0.38***
				(0.05)
Age		0.03***	0.03***	0.02***
		(0.00)	(0.00)	(0.00)
Child is a girl		-0.05	-0.06	-0.04
		(0.04)	(0.04)	(0.04)
Child health condition is good (ref: poor/ average)		0.03	0.03	0.02
		(0.09)	(0.08)	(0.07)
Household wealth: middle (ref: poorest)		0.05	0.07	0.05
		(0.06)	(0.05)	(0.05)
Household wealth: richest		0.21***	0.10	0.02
		(0.07)	(0.06)	(0.06)
Primary caregiver is literate		-0.03	0.07**	0.08**
		(0.04)	(0.03)	(0.03)
Household size (ref: smaller than 6)		0.13**	-0.01	-0.05
		(0.05)	(0.03)	(0.03)
Household has sufficient food in last 12 months		-0.07	-0.01	0.02
		(0.07)	(0.06)	(0.05)
Living in rural area		-0.17	-0.41***	-0.34***
		(0.11)	(0.08)	(0.08)
Region (ref: Addis Ababa)				
	Amhara	-0.30**	-0.20	-0.09
		(0.15)	(0.13)	(0.11)
	Benishangul-Gumuz	-0.52***	-0.72***	-0.52***
		(0.13)	(0.12)	(0.12)
	Oromia	-0.59***	-0.48***	-0.25**
		(0.14)	(0.10)	(0.11)
	SNNP	0.08	-0.03	-0.07
		(0.16)	(0.12)	(0.10)
	Somali	-0.14	0.47***	0.52***
		(0.11)	(0.06)	(0.05)
Constant		-1.06***	-0.81***	-0.40**
		(0.21)	(0.22)	(0.17)
Observation		2,540	2,540	2,540
R^2		0.28	0.30	0.40

Note: Robust standard errors clustered at district level in parentheses. All models include attrition weights. *** p<0.01, ** p<0.05, * p<0.1

Table A6: Relationship between pre-primary participation and early numeracy by sub-groups (SD) (Related to Table 3.6)

Sub-group	Obs.	Variable	Early numeracy		
			Model 1	Model 2	Model 3
			2019/20 Baseline	2020/21 Endline	Endline | Baseline
Gender					
Boys	N=1,269	O-Class participation	0.56***	0.61***	0.40***
			(0.08)	(0.07)	(0.06)
		R^2	0.26	0.31	0.41
Girls	N=1,271	O-Class participation	0.60***	0.47***	0.23***
			(0.07)	(0.08)	(0.08)
		R^2	0.30	0.30	0.41
Interaction	N=2,540	O-Class X Girls	0.05	-0.12	-0.14**
			(0.09)	(0.08)	(0.07)
		R^2	0.28	0.30	0.41
Urban-rural location					
Urban	N=647	O-Class participation	0.58***	0.61***	0.48***
			(0.13)	(0.16)	(0.15)
			0.30	0.38	0.43
Rural	N=1,893	O-Class participation	0.56***	0.49***	0.24***
			(0.06)	(0.06)	(0.05)
		R^2	0.28	0.23	0.37
Interaction	N=2,540	O-Class X Rural	0.02	-0.02	-0.02
			(0.16)	(0.13)	(0.13)
		R^2	0.28	0.30	0.40
Caregiver's literacy					
Literate	N=807	O-Class participation	0.67***	0.78***	0.50***
			(0.11)	(0.11)	(0.12)
		R^2	0.29	0.30	0.42
Not literate	N=1,733	O-Class participation	0.53***	0.44***	0.25***
			(0.06)	(0.05)	(0.05)
		R^2	0.28	0.31	0.40
Interaction	N=2,540	O-Class X Caregiver is literate	0.17*	0.33***	0.27**
			(0.10)	(0.10)	(0.10)
		R^2	0.28	0.30	0.41
Household wealth					
Wealth 1 pPoorest)	N=872	O-Class participation	0.53***	0.55***	0.36***
			(0.08)	(0.08)	(0.08)
		R^2	0.25	0.28	0.37
Wealth 2 (middle)	N=842	O-Class participation	0.62***	0.41***	0.14*
			(0.07)	(0.07)	(0.08)
		R^2	0.33	0.22	0.36
Wealth 3 (richest)	N=826	O-Class participation	0.59***	0.69***	0.47***
			(0.09)	(0.09)	(0.07)
		R^2	0.29	0.37	0.47
Interaction	N=2,540	O-Class X wealth 2 (ref: wealth 1)	0.07	-0.08	-0.11
			(0.08)	(0.10)	(0.09)
		R^2	0.28	0.30	0.41
	N=2,540	O-Class X wealth 3 (ref: wealth 1)	0.06	0.20*	0.18*
			(0.10)	(0.10)	(0.09)
		R^2	0.28	0.30	0.41
Control variables		Prior learning level			Y
		Child characteristics	Y	Y	Y
		Family characteristics	Y	Y	Y

Note: Robust standard errors clustered at district level in parentheses. All models include attrition weights.
Wealth T 1 = Lowest household wealth tercile; Wealth T 3 = Highest household wealth tercile
*** p<0.01, ** p<0.05, * p<0.1

Table A7: Difference in early numeracy outcomes between the two cohorts entering primary school before and after school closures due to COVID-19 (SD) (Related to Table 3.8)

	(1)	(2)
Variables	Early numeracy test score	Early numeracy test score
Cohort entering G1 AFTER COVID-19 (ref: Cohort entering G1 BEFORE COVID-19)	-0.27*** (0.03)	-0.27*** (0.03)
Participated in O-Class		0.32*** (0.03)
Female		-0.07*** (0.03)
Living in Rural		-0.29*** (0.04)
Primary caregiver's literacy (1=Yes)		-0.01 (0.03)
Household wealth index		0.06*** (0.02)
Region (ref: Addis Ababa)		
Amhara		-0.45***
Benishangul-Gumuz		(0.06) -0.78***
Oromia		(0.06) -0.35***
SNNP		(0.05) -0.26***
Somali		(0.06) -0.01
Constant	0.13*** (0.02)	0.44*** (0.07)
Observations	5,385	5,235
R-squared	0.02	0.16

Note: Robust standard errors clustered at district level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A8: Association between pre-primary participation and early numeracy by O-Class quality interventions related to GEQIP-E reform (SD) (Related to Table 3.10)

	Early numeracy		
	OLS		
	Model 1	Model 2	Model 3
	2019/20 Baseline	2020/21 Endline	Endline | Baseline
O-Class participation (ref: not enrolled in any pre-primary school)			
General O-Class	0.64***	0.58***	0.33***
	(0.08)	(0.07)	(0.07)
O-Class receiving GEQIP-E quality enhancement support	0.51***	0.50***	0.30***
	(0.08)	(0.07)	(0.07)
Prior learning level			Y
Child characteristics	Y	Y	Y
Family characteristics	Y	Y	Y
Constant	-1.02***	-0.78***	-0.39*
	(0.21)	(0.21)	(0.17)
R	0.28	0.30	0.40
Observation	2,540	2,540	2,540

Note: Robust standard errors clustered at district level in parentheses. All models include attrition weights. *** p<0.01, ** p<0.05, * p<0.1

Table A9: Empirical associations between school/teacher characteristics and early numeracy (SD) (Related to Table 3.12)

		Between 2019/20 and 2020/21	
		Model 1	Model 2
		Endline | Baseline	Endline | Baseline
School/teacher characteristics			
School received school grants for O-Class		0.30**	0.13
		(0.13)	(0.10)
School is a resource cluster center		0.12	0.12
		(0.09)	(0.07)
Teacher has more than 5yrs experience		0.19*	0.17**
		(0.10)	(0.08)
Teacher qualification (ref: Grade 10/12)	Post G10-certificate	0.16	0.04
		(0.12)	(0.10)
	Post G10-diploma/TVET	0.15	0.11
		(0.11)	(0.10)
	University degree	-0.08	-0.23
		(0.13)	(0.25)
Prior learning level		Y	Y
Child/family characteristics			Y
Observation		1,889	1,789
Number of schools		78	78
R^2		0.30	0.35

Note: Robust standard errors clustered at school level in parentheses. All models include attrition weights. *** p<0.01, ** p<0.05, * p<0.1

Table A10: Empirical associations between pre-primary class quality and early numeracy: Facilities and safety (SD) (Related to Table 3.13)

	Model 1	Model 2	Model 3
	Endline | Baseline	Endline | Baseline	Endline | Baseline
MELE domain (1): health and facilities			
O-Class has handwashing facilities	0.32**	0.13*	0.14*
	(0.13)	(0.07)	(0.07)
O-Class has toilet	0.02	-0.02	0.00
	(0.10)	(0.08)	(0.08)
Prior learning level	Y	Y	Y
Child/family characteristics		Y	Y
School/teacher characteristics			Y
Observation	1,894	1,789	1,789
Number of schools	78	78	78
R^2	0.28	0.37	0.38

Note: Robust standard errors clustered at school level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A11: Empirical associations between pre-primary class quality and early numeracy: Activities and materials (SD) (Related to Table 3:14)

	Model 1	Model 2	Model 3
	Endline | Baseline	Endline | Baseline	Endline | Baseline
MELE domain (2): activities and materials			
Learning activities for math skills were observed.	0.00	0.06	0.03
	(0.10)	(0.07)	(0.07)
Teacher has the O-Class teacher guide.	-0.08	-0.00	-0.03
	(0.10)	(0.07)	(0.07)
O-Class students has their own portfolio.	0.40***	-0.00	-0.09
	(0.11)	(0.11)	(0.16)
O-Class has learning corners.	0.05	0.08	0.07
	(0.07)	(0.06)	(0.07)
Learning material index (blocks, toys, writing utensils) (alpha=0.77)	-0.04	-0.02	-0.01
	(0.04)	(0.04)	(0.03)
Prior learning level	Y	Y	Y
Child/family characteristics		Y	Y
School/teacher characteristics			Y
Observation	1,894	1,789	1,789
Number of schools	78	78	78
R^2	0.30	0.37	0.38

Note: Robust standard errors clustered at school level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A12: Empirical associations between pre-primary class quality and early numeracy: Classroom interactions and approaches to learning (SD) (Related to Table 3.15)

	Model 1	Model 2	Model 3
	Endline | Baseline	Endline | Baseline	Endline | Baseline
MELE domain (3): classroom interactions and approaches to learning			
Child's engagement in the classroom	0.05	0.13*	0.14*
	(0.10)	(0.08)	(0.07)
Child-teacher interaction Index (alpha = 0.80)	-0.12	0.02	0.01
	(0.08)	(0.07)	(0.06)
Prior learning level	Y	Y	Y
Child/family characteristics		Y	Y
School/teacher characteristics			Y
Observation	1,894	1,789	1,789
Number of schools	78	78	78
R^2	0.27	0.37	0.38

Note: Robust standard errors clustered at school level in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7.5 Supplementary Tables II

Table A13: MELQO: MELE survey for school principals and pre-primary teachers

	Survey		
School characteristics	Director survey	Teacher training	Number of trained teachers in past 12 months
		Teacher qualification	Number of teachers with certificate
			Number of teachers with diploma
			Numer of teachers with first degree and above
		School grants	Amount of SG received for O-Class
			Allocation of school grants on materials or resources for O-Class
		PSTA	Participation of O-Class teachers or O-Class parents in PSTA
		School type	Government, community, private or independent company, faith-based organisation, NGO or other
		School duration	Full-day or half-day
		ECE funding	- Share and sources of recurrent funding - Share and sources of capital funding
		School resource	School is cluster resource center.
Classroom/ teacher characteristics	Teacher survey	Age	Teacher age in years
		Gender	Female/male
		Teaching experience	Teacher years of preprimary experience
		Language	- Language speaks at home -Main language of instruction
		Teacher education level (qualification)	- Grade 10 or 12 - Post-G10 certificate - Post-G10 diploma - University degree
		Teacher contract type	- Permanent - Temporary
		Teaching time	- Days per week
		Teacher perception	- Satisfied with job - Adequate support/supervision from school - Personal well-being
		Compensation	- Gross salary - Paid on time - Who pays
		Teaching resources	- O-Class syllabus - O-Class teacher guide
		Professional Development	- Former induction before teaching O-Class - Hours spent in continuous professional development training - Organiser of continuous professional development
		Teacher-parent communication	Share of parents contacting teachers regularly

Table A14: Differences in early numeracy achievement depending on O-class participation

		O-Class			Not in pre-primary School		
Early numeracy		2019/20 Baseline mean percent score (%)	2020/21 Endline mean percent score (%)	Change in score (% points)	2019/20 Baseline mean percent score (%)	2020/21 Endline mean percent score (%)	Change in score (% points)
Gender	Male	45.9	65.6	19.6***	26.5	45.0	18.5***
		(0.8)	(0.8)		(1.1)	(1.3)	
	Female	45.4	63.4	18.0***	24.6	46.1	21.5***
		(0.8)	(0.8)		(1.1)	(1.3)	
	Diff	*0.5*	*2.2*		*1.9*	*1.1*	
Location	Urban	50.6	74.6	24.0***	27.1	53.4	26.3***
		(1.1)	(0.9)		(1.9)	(1.9)	
	Rural	43.5	60.0	16.5***	25.1	43.3	18.1***
		(0.7)	(0.6)		(0.9)	(1.0)	
	Diff	*7.2****	*14.6****		*1.9*	*10.2****	
Wealth tercile	Poorest	42.9	59.9	17.0***	25.5	43.3	17.8***
		(0.9)	(0.9)		(1.2)	(1.4)	
	Middle	44.5	63.4	18.9***	24.7	48.5	23.7***
		(1.0)	(0.9)		(1.4)	(1.6)	
	Richest	48.9	69.3	20.4***	26.9	45.2	18.4***
		(1.0)	(0.9)		(1.6)	(1.9)	
Caregiver's literacy	Literate	45.4	65.5	20.2***	23.2	42.7	19.5***
		(1.0)	(0.9)		(1.4)	(1.8)	
	Illiterate	45.0	62.7	17.7***	26.4	46.6	20.2***
		(0.7)	(0.7)		(0.9)	(1.1)	
	Diff	*0.4*	*2.8*		*-3.2**	*-3.9**	
Region	Addis A.	59.0	81.2	22.2***	-	-	-
		(1.6)	(1.4)		-	-	-
	Amhara	41.8	62.0	20.2***	24.3	42.6	18.3***
		(1.2)	(1.3)		(1.7)	(2.3)	
	B-G	37.4	53.1	15.7***	20.2	29.2	9.0***
		(1.6)	(1.7)		(1.8)	(2.6)	
	Oromia	34.9	55.9	21.0***	22.0	44.1	22.0***
		(1.0)	(0.9)		(1.2)	(1.3)	
	SNNP	58.6	68.5	9.9***	28.2	49.0	20.8***
		(1.0)	(0.9)		(1.6)	(1.6)	
	Somali	47.6	86.5	38.9***	44.8	72.8	28.0***
		(2.7)	(1.4)		(4.3)	(3.3)	

Notes: *** p<0.01, ** p<0.05, * p<0.1

8 Endnotes

[1] In 2018, the government launched a new Education Development Roadmap 2018–2030, which includes an ambitious target for expanding the O-Class to cover 4- to 5-year-olds by 2030 (Teferra et al., 2018).

[2] NEAEA is a semi-autonomous governmental body of the Ministry of Education in Ethiopia.

[3] All domains are designed as child direct assessments (i.e., 1:1 testing between a child and a fieldworker), but a measurement for socio-emotional development used scales reported by pre-primary teachers. Hence, socio-emotional development measurements were administered only for those enrolled in pre-primary education in this study.

[4] For the GEQIP-E Phase 1 school selection in 2019/20 (about 5% of primary schools nationwide), the MoE and the World Bank applied three purposive criteria followed by randomisation as follows: schools should be located in woredas where there are at least 10 primary schools; schools should offer O-Class as well as all primary school grades (i.e., to grades 7 and 8); and schools should be situated in localities where the test instrument had been adapted to local mother tongues (Hoddinott et al., 2019). Our report focused on GEQIP-E Phase 1 schools given they were expected to receive additional interventions during the period of the ELP study in 2019/20 (The overall GEQIP-E reform programme rolled out to Phase 2 and 3 schools in 2020/21 onwards).

[5] In Ethiopia, 97% of primary schools are public, government schools. O-Class is attached to these schools, and the government intended to expand O-Class as a means to increase access to pre-primary education nationwide.

[6] The Sidama region was formed on 18 June 2020 from the Southern Nations, Nationalities, and Peoples' Region (SNNPR) after the vote in the 2019 Sidama referendum. ELP Phase 2 baseline data collection was conducted in November/December 2020 before the Sidama zone became the independent region; thus, we used the division of the regional states at the time we collected the data.

[7] The fieldworkers conducted school visits first for the random selection of sample children. Once they select the children, they went to the village to inform the parents and ask their consent both for their own participation as well as for their children to participate. The fieldworker used to conduct a household survey first, then carried out child direct assessment in the schools on the day after the household survey. For children not enrolled in school, the fieldworkers received a list of children not enrolled in O-Class from the local guides; then they randomly select the children from the list based on the location (e.g., east, south) of the selected village.

[8] Policy reference number: CAVAS/V2.0/28072014

[9] The average age of the children is close to the O-Class target age of 6 in our sample. Underage enrolment appears to be less of a concern than raised in ELP Phase 1 diagnostic report (Rossiter et al., 2018). This could be explained in part by difficulties in getting the accurate age of children in Ethiopia. The age data in EMIS (ELP Phase 1 report) were reported by teachers or principals, but age data in the current report were reported by their caregivers, thus the data presented here could be expected to be more accurate. Also, there could be an increase of on-age enrolment in O-Class during the period between 2016/17 and 2019/20, although it is not likely to be the main reason.

[10] The household wealth index is a composite score based on consumer durables (e.g., phone, car, radio, etc.), access to basic service (e.g., electricity, water, road, etc.), and housing quality (e.g., wall, roof, floor materials).

[11] We used the Washington Group/UNICEF Module on Child Functioning to assess whether a child has any functional difficulties e.g., seeing, hearing, or moving. However, we did not include this measure in our regression analysis due to reliability issues. To illustrate, the Child Functioning module was administered by the field workers who conducted one-to-one child direct assessment for 20-30 minutes. Given there was a short period of observation and a lack of investigation in inter-rater reliability, we found it was not possible to interpret the findings when we ran models including this information. As a result, we decided not to report these findings.

[12] Variables related to parental education (whether primary caregiver has ever been to school, or specific education level completed by primary caregiver) were also tested in the model but not appeared to be significant. To avoid an issue of multicollinearity, we include caregiver's literacy only.

[13] Given the high correlation between geographical location and household wealth, there could be a multicollinearity issue between rural location and household wealth ($r = 0.40$, $p < 0.01$).

[14] Data are not available to explain why some of our sample schools did not receive school grants for O-Class, while all the schools did receive school grants for primary grade. However, given the school grants for O-Class only takes into account the number of 6-year-old children enrolled, if schools only have 4- to 5-year-old children, these would not be eligible to receive school grants for O-Class.

[15] For example, learning corners include language corners (books, letters, or word charts), maths corners (number charts, counting materials like rocks or beads), constructive play corners (blocks, balls, puzzles), dramatic/pretend/free play corners (toys, dolls, cooking tools), and science corner (chart with personal hygiene, nutrition, and health).

[16] We also ran models with each item instead of using an index for learning materials and child-teacher interaction, but there is no significant change in the relationship. Given the potential for multicollinearity among items, we present the models using the index.

[17] We also ran the combined model with all variables from school/teacher characteristics and the three MELE domains, and the results remain the same (Results available upon request).

[18] The "policy community" comprises government and non-governmental actors concerned with a policy issue, including international donors and NGOs that are engaged in a given domestic policy context (p. 6, Neuman and Powers, 2021).

[19] The survey was supported by the Education Development Trust as part of the Technical Assistance to Reinforce General Education Quality Improvement Program for Equity (TARGET).

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