



**African Population and  
Health Research Center**



Impact evaluation of a school readiness intervention among pre-primary school learners in Kenya: Tayari Wave 3 Report



**African Population and  
Health Research Center**

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# Abbreviations and Acronyms

<b>APBET</b>	Alternative Provision of Basic Education and Training
<b>APHRC</b>	African Population and Health Research Center
<b>CIFF</b>	Children's Investment Fund Foundation
<b>DICECE</b>	District Center for Early Childhood Education
<b>ECDE</b>	Early Childhood Development and Education
<b>GER</b>	Gross Enrolment Ratio
<b>KICD</b>	Kenya Institute of Curriculum Development
<b>KNEC</b>	Kenya National Examinations Council
<b>MoE</b>	Ministry of Education
<b>PP2</b>	Pre-primary class 2
<b>RCT</b>	Randomized Control Trial
<b>T0</b>	Control group of schools
<b>T1</b>	Treatment 1 group of schools
<b>T2</b>	Treatment 2 group of schools
<b>T3</b>	Treatment 3 group of schools
<b>TSC</b>	Teachers' Service Commission
<b>TSRI</b>	Tayari school readiness index

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1 Tayari is a Kiswahili word meaning 'readiness'.

# 1. Introduction

This report summarizes baseline findings for the third wave (Wave Three) of an external evaluation of the Tayari pre-primary school pilot program. Data collection for the Tayari external evaluation is organized in two phases – Phase One and Phase Two. Phase One had two waves of data collection: Wave One or the ‘first baseline’ conducted from January to February, 2016, and Wave Two from September to October, 2016. Phase Two also has two waves – Wave Three or the ‘second baseline’ and Wave Four, the final follow-up. Wave Three was completed in February, 2017 while Wave Four is planned for September to October, 2017. A total of 298 schools that were involved in data collection in Waves One and Two will be referred to as Phase One schools. Schools that participated for the first time in Wave Three (n = 292) will henceforth be referred to as Phase Two schools. Phase One schools will participate in all four rounds of data collection (in 2016 and 2017) while Phase 2 schools will only be involved in the two rounds of data collection in 2017.

The Tayari pre-primary school pilot program aims to prepare children for primary school. Participation in early childhood development and education (ECDE) programs is associated with better schooling adjustment and higher levels of academic achievement. In Kenya, ECDE currently faces considerable challenges related to poor management of the sector, characterized by insufficient funding and allocation of resources as well as inconsistent curricula and programs in existing pre-primary schools. Consequently, most ECDE programs in Kenya are of questionable quality and are arguably limited in their ability to adequately prepare children for school. In an effort to improve the quality of ECDE programs, the Tayari model is being piloted by the Ministry of Education in partnership with RTI International in both public and low-cost private ECDE centers<sup>2</sup> in four counties: Nairobi, Uasin Gishu, Laikipia and Siaya. The Tayari model will be implemented in more counties across Kenya once the model is fully developed and found to be successful. The African Population and Health Research Center (APHRC) is undertaking an independent external evaluation to measure the impact and cost-effectiveness of the Tayari program. This summary report presents Wave Three results of the Tayari evaluation conducted in January/February 2017 by the APHRC.

2 In Kenya, low cost private schools are also known as Alternative Provision of Basic Education and Training (APBET) institutions

## 2. Methods

This section provides a description of the intervention, sampling procedures, training of enumerators, data collection, study instruments, and analysis techniques used.

### 2.1 Tayari intervention components

The Tayari intervention comprises the following four key components:

- Training for DICECE<sup>3</sup> officers (supporting public centers) and instructional coaches (supporting APBET centers) in the use of tablet-based technology to supervise ECDE teachers;
- Teacher support and training with a focus on increasing active learning and instructional time; development of instructional materials; and, utilization of books and teachers' guides;
- Providing books and teachers' guides to learners and teachers respectively on a 1:1 ratio. The teachers' guides developed through the Tayari program are linked to the learning materials, which contain activities that are matched to the lessons; and,
- Health support provided to ECDE centers by Community Health Assistants/Volunteers (CHAVs) to improve key health aspects such as hand washing and latrine use.

For each category of ECDE centers (public and APBET), the evaluation study adopted a randomized control trial (RCT) design involving three separate treatment arms and a control arm. As shown in Table 2.1, the first treatment arm (T1) receives components (a) and (b) of the intervention; the second treatment arm (T2) receives components (a), (b) and (c) of the intervention, while the third treatment arm (T3) receives all four components of the intervention. The control arm (T0) currently receives no treatment - however the successful treatment will be extended to this group in 2018.

**Table 2.1: Tayari components by study arms**

Component	Study Arm			
	T0	T1	T2	T3
DICECE training		X	X	X
Teacher support & training		X	X	X
Provision of books			X	X
Health support				X

Note: "X" shows Tayari component received

### 2.2 Sampling procedures and sample size

The evaluation study of the Tayari pilot program used a randomly selected subset of the pre-primary schools in the larger Tayari program<sup>4</sup>. The Wave Three study targeted children who were attending public ECDE centers in the four counties (Nairobi, Uasin Gishu, Laikipia and Siaya) as well as those attending APBET ECDE centers in Nairobi County in 2017. The targeted children were those in their final year of pre-primary school class (also referred to as "Pre-primary class 2" or PP2 class in Kenya).

<sup>3</sup> District Center for Early Childhood Education

<sup>4</sup> For the larger Tayari program, all public ECDE centers in the four counties and all APBET ECDE centers in Nairobi were listed and are randomly allocated to treatment or control arms of the study.



For the evaluation study, power calculations were used to determine the number of ECDE centers required to detect a mean effect size of 0.20 standard deviations at the program level, assuming a school attrition rate of 5%. Having involved half the required total sample in 2016, the other half was included in 2017 during the third wave of data collection. This “step-wedge” like design is useful in examining the effects of duration of exposure to the Tayari intervention. Details on the number of schools sampled to participate in each study wave can be found in Appendix 6.1 Details about Tayari study design can be found in the Tayari baseline report by Ngware et al., 2016, available on the APHRC website ([www.aphrc.org](http://www.aphrc.org)).

In each wave of the Tayari evaluation study, 16 PP2 learners from each sampled ECDE center were randomly selected to participate in the study. If a PP2 class had less than 16 learners, all the learners in that class were included in the study. In ECDE centers with more than one PP2 class, one class was randomly selected to participate in the study. PP2 teachers of the selected classes and head teachers of the selected ECDE centers were automatically included in the evaluation study. Details on the number of learners, teachers and schools involved in the third wave can be found in Appendix 6.2.

## 2.3 Survey instruments

The data covered in this report were collected using three main instruments, namely:

- Learner direct assessment test<sup>5</sup>
- ECDE teacher questionnaire
- Questionnaire for the head teacher or teacher-in-charge of the ECDE center

The information sought from the teachers included details of their personal and professional characteristics, classroom resources and learner enrolment. Information on personal and professional characteristics as well as information about their schools was also sought from the teacher-in-charge of the ECDE centers.

## 2.4 Training of field interviewers

The third wave of data collection for the Tayari evaluation was conducted between January and February 2017. Data for Waves One and Two were collected in January/February 2016 and September/October 2016, respectively. A total of 63 enumerators were available to participate in Wave Three from a pool of 90 enumerators who participated in previous Tayari waves. Potential enumerators were interviewed and 48 suitable candidates were recruited to replace the unavailable enumerators and to increase the number of enumerators to cover the additional Wave Three schools. The minimum criteria for selection of candidates were: at least a high school level of education (with a minimum mean grade of C+ in the KCSE<sup>6</sup> examination); residence in the study area; fluency in the local language; and, previous data collection experience, preferably with young children.

The enumerators were carefully trained on how to administer the Tayari study tools, as well as ethical issues to be observed during data collection. The training also involved practice through supervised group work, role-plays and practice runs on tools administration in 16 ECDE centers in Kiambu County. As part of the training, all enumerators observed and rated the same mock interview several times until at least a 95% inter-rater reliability (IRR) score was attained for each study tool. All practical exercises were followed by debriefing sessions to ensure that all the enumerators had a common understanding of the tools and the procedures. By the end of the training, all the enumerators were fluent with the administration methods of the study, well equipped, confident and thoroughly prepared to collect data.

5 Details on how the learner direct assessment test was developed including piloting can be found in the Tayari baseline report (Ngware, et al., 2016).

6 Kenya Certificate of Secondary Education randomly allocated to treatment or control arms of the study.

## 2.5 Data collection and management

Enumerators used electronic devices to administer all the survey instruments. The direct assessment test was administered to the selected PP2 learners in a 15-20 minute face-to-face assessment session with each learner. The sessions began with a brief introduction to build rapport between the learner and the enumerator. During the administration of the test, practice items were used to enhance learners' understanding of the requirements of each item. Enumerators also interviewed the teachers of the selected PP2 learners as well as the head teacher or teacher in charge of the ECDE center on a one-to-one basis.

Several measures were taken to ensure data quality throughout the data collection process. For instance, prior to data collection a data capture software was installed in tablets with quality control measures to disallow out-of-range data, missing values where none were expected, and allow observation of skips where necessary. During data collection, the senior members of the core research team conducted random spot check visits to confirm the accuracy of information collected and adherence to procedures. The data collected were verified on site for accuracy and completeness, after which they were uploaded to a central server. Thereafter, the data were synchronized and cleaned for inconsistency and missing values.

## 2.6 Analyses

In this report, descriptive techniques are used to understand the performance of the treatment groups and the control group on outcome measures of interest. The key outcome of interest in this study is learning achievement measured through the Tayari school readiness index (TSRI<sup>7</sup>). However, the results also include the main learning domains (namely executive function, literacy and numeracy) and sub-domains of interest. Within the learning domains of literacy and numeracy, we analyzed the results of specific areas of competencies such as letter naming, letter sound fluency, quantity discrimination, number identification and shape identification.

In addition to the descriptive techniques, the baseline balance in learning achievement was examined using multiple regression models, taking into account the key potential intervening factors that might not have been perfectly balanced across the groups being compared, and are known or hypothesized to be predictors of learning outcomes among pre-primary school children in Kenya. For each ECDE center category, three separate regression models (to be referred to as "Model 1", "Model 2" and "Model 3") were run to make comparisons between the control group (T0) and each of the three treatment groups – T1, T2 and T3. In Model 1, T0 and T1 groups were compared. In Model 2, T0 and T2 groups were compared, while T0 and T3 groups were compared in Model 3. In each model, controls were made for learner sex, teacher age, teacher level of education, teacher pre-service training, years of experience as an ECDE teacher, teaching documents, and class size. Controls were also made for language of instruction, single-grade teaching (as opposed to multi-grade teaching where learners of different grade-levels are taught in the same class), learner-textbook ratio, and Wave Three schools.

7 A description of how the TSRI was derived can be found in the Tayari baseline report (Ngware et al., 2016).

# 3. Characteristics of learners, teachers and their schools

This chapter provides information on the characteristics of the Wave Three participants and schools.

## 3.1 Learners’ sex by ECDE center category

For both categories of ECDE centers, the number of boys (or girls) in the control group did not differ much from the number of boys (or girls) in each of the three respective treatment groups (results in Figure 3.1). In addition, there were few differences in the number of boys and girls within each treatment group or across the ECDE categories.

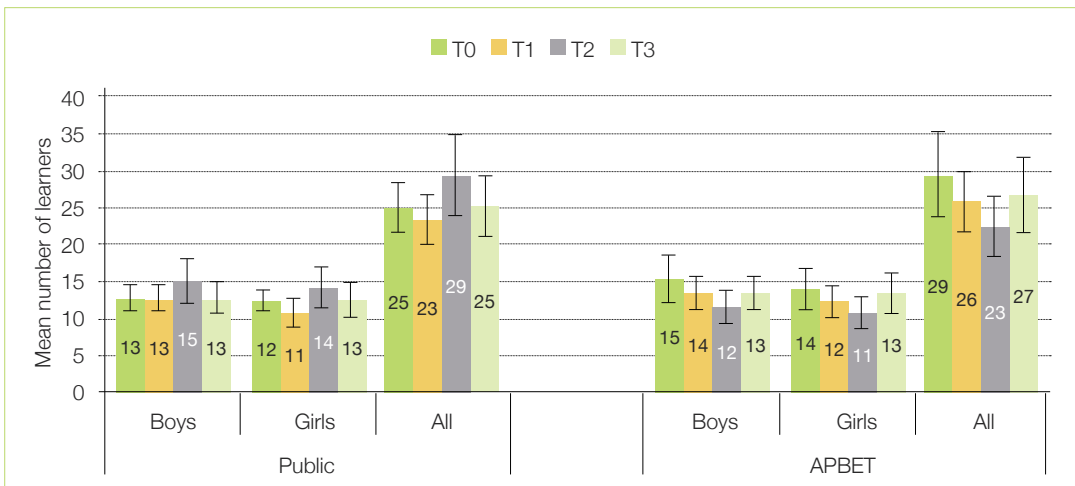
## 3.2 Characteristics of ECDE teachers and their classrooms

### (a) Teacher age, years of experience, education and pre-service training

Results of teacher age, teacher years of experience teaching in ECDE institutions, teacher highest level of education attained, and teacher pre-service qualifications are depicted in the graphs in Figure 3.2 for the Wave Three dataset. The main points to note regarding these results are summarized in the following paragraphs:

Teacher age: For each ECDE center category (public and APBET), results show that the mean age of the teachers in the control group was nearly the same as that of teachers in each of the three treatment groups. However, teachers serving in public ECDE centers were notably older than their colleagues who were serving in APBET centers.

**Figure 3.1: Mean number of boys and girls in the Wave 3 dataset by ECDE center category and treatment group**



Teacher years of experience: Within each ECDE center category, results show that the mean years of experience of the teachers in control and treatment schools were about the same. Results further show

that teachers in public centers had nearly twice the years of experience (11-13 years) as their counterparts in APBET centers (6-7 years). This last finding was expected because teachers in APBET schools are generally employed on temporary contracts unlike those in public centers who are normally employed on permanent terms.

Teacher highest level of education: Regardless of ECDE center category or treatment group, results show that the vast majority of teachers have at least college education (63-76% for public and 68-80% for APBET). However, in terms of baseline balance, results for public centers show that there was a noticeably lower proportion of teachers with at least college education in the control group (63%) than in the T2 group (76%) or T3 (73%) groups.

Teacher pre-service qualification: Results reveal that the majority of teachers in public and APBET centers had certificates or diplomas in pre-primary education – meaning that only a few teachers were untrained. Nevertheless, for public centers, the percentage of untrained teachers in the control group (20%) was markedly higher than the corresponding percentage in the T2 group (9%).

### *(b) Teacher possession of teaching and health records*

Information on the proportion of teachers who had key teaching documents (learner progress record, schemes of work, record of work and lesson plans) and learner health records is displayed in Figure 3.3. Apart from health records in APBET centers which were noticeably more in the T3 group (68%) than in the control group (28%), the distributions of these records were about the same across control and treatments group for both categories of ECDE centers. Analysis of public center data by phase revealed that health records were also noticeably more in the T3 groups (76%) than in the control group (49%) in Phase One schools. This finding is consistent with expectations since by the time the current data were collected, Tayari health activities, through which teachers are encouraged to keep learner health records, had been going on in T3 centers for at least one year.

### *(c) Language of instruction and learner-textbook ratios*

The first panel of Figure 3.4 displays the percentages of teachers who reported the use of mother tongue, Kiswahili or English as their main language of instruction in the classroom, while the second panel displays the learner-textbook ratios for numeracy and literacy.

Regardless of treatment group, around 61-65% of the teachers in public centers reported the use of Kiswahili with the remainder reporting the use of mother tongue or English as the language of instruction. The use of Kiswahili was also common among teachers in APBET centers especially among teachers in the T2 group (76%), and so was the use of English, especially among teachers in the control group (51%). However, in APBET centers, no teacher reported using mother tongue. This is consistent with expectations given that APBET teachers handle learners from different ethnic groups meaning that the learners have different first languages (or mother tongues).

At this second baseline, learner-textbook ratios were generally very low for both ECDE center categories and across treatment groups – illustrating the scarcity of books for use by learners in these institutions (results in the second panel of Figure 3.4). For public ECDE centers, the ratios for control group did not differ much from the ratios for each treatment group. Further analysis splitting public centers data by phase revealed that the ratios for Phase One and Phase Two schools were about the same. This finding was rather strange because one would have expected higher ratios in T2 and T3 groups of Phase One schools, as Tayari implementation had been going on in those schools for at least one year by the time the current data were collected. It could be that the Phase One learners in public centers were allowed to leave with the books provided by Tayari upon graduating from pre-primary school.

However, for APBET centers, the learner-book ratios for control group were about the same as those for T1 group but significantly lower than those for T2 and T3 groups, which was consistent with the expectations.

Figure 3.2: Teacher age, experience, highest level of education and pre-service training

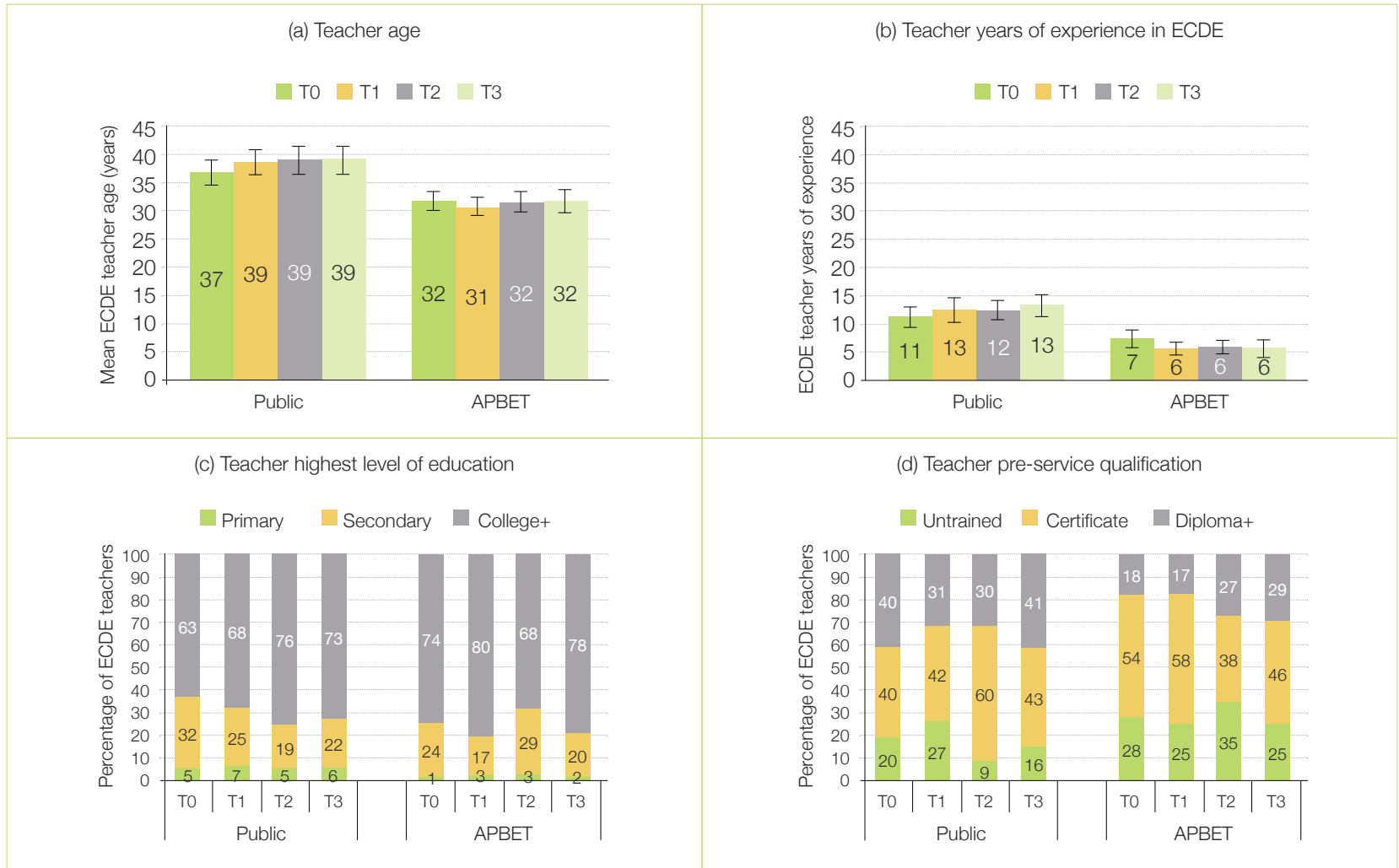


Figure 3.3: Teacher possession of teaching and health records

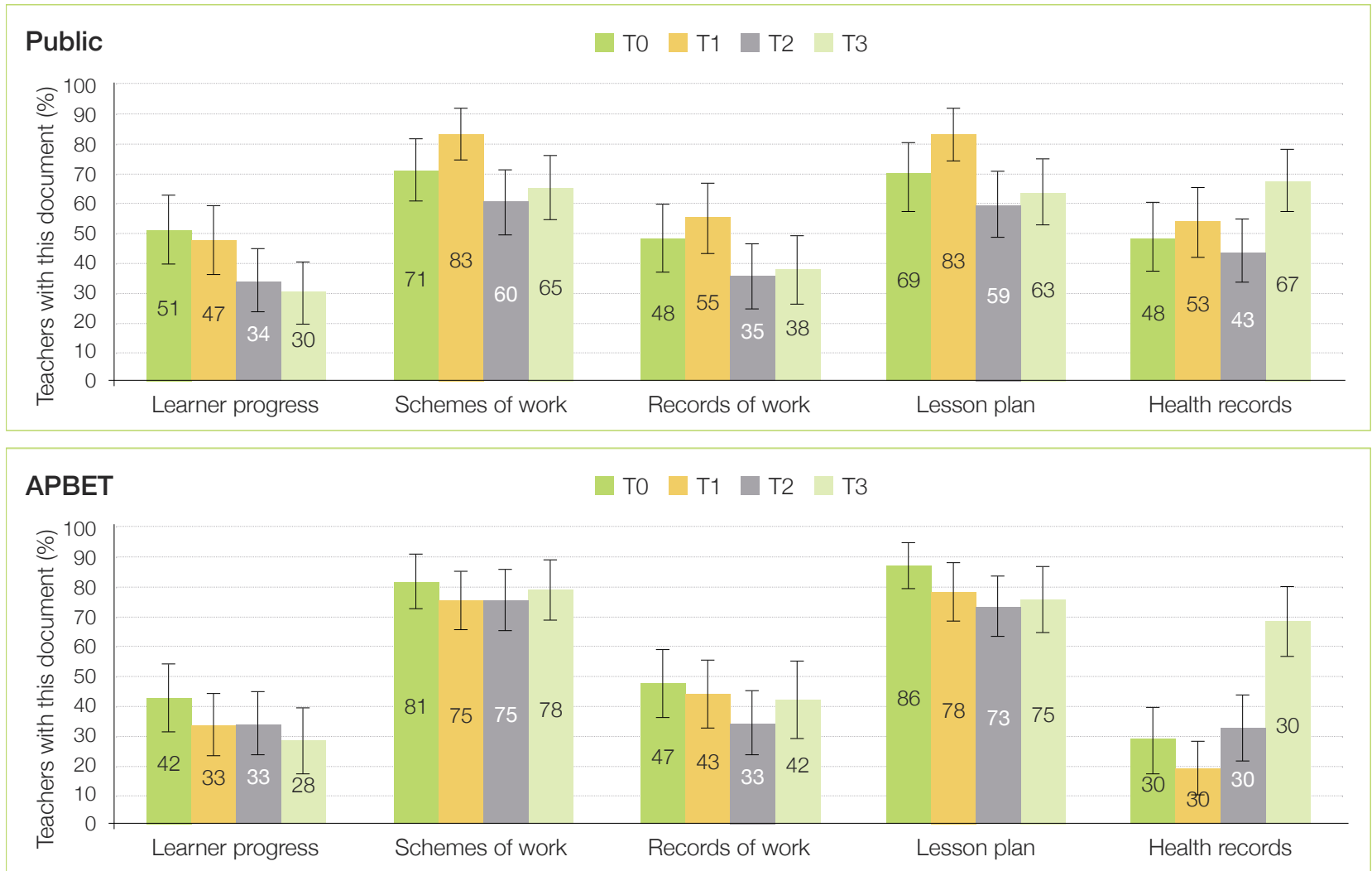
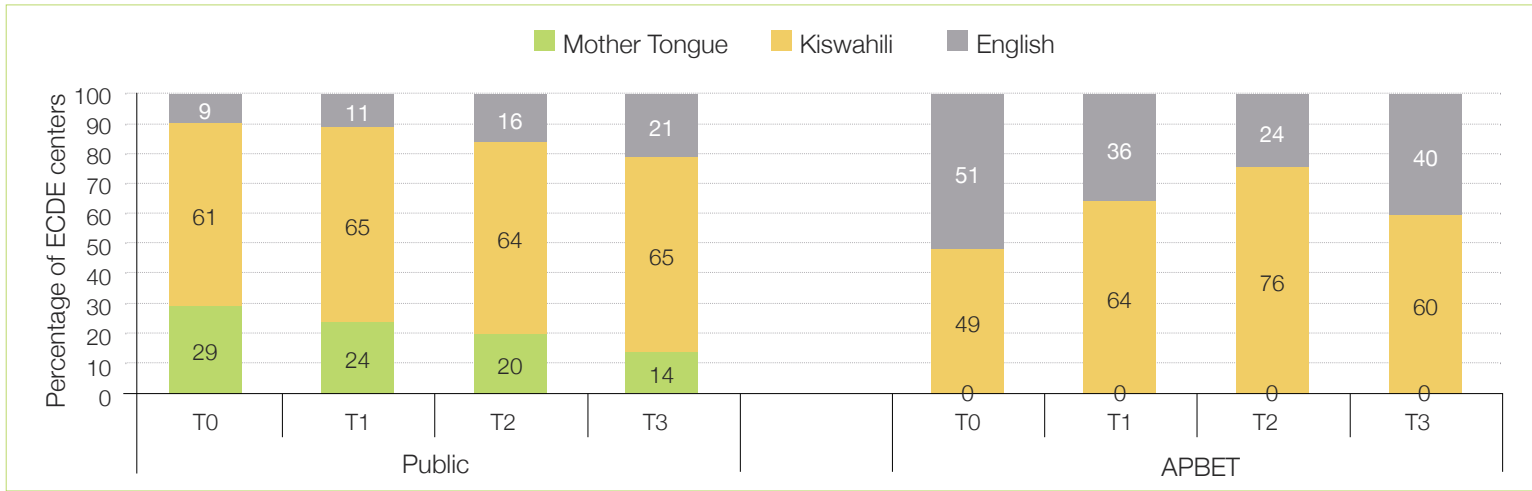
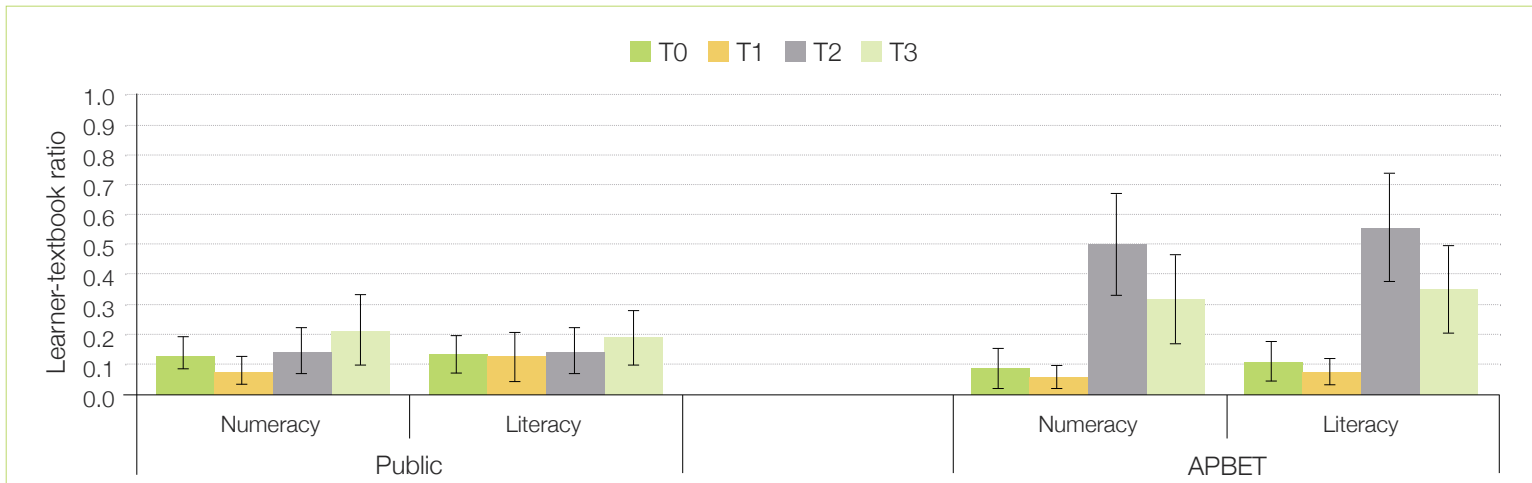


Figure 3.4: Language of instruction and learner-textbook ratios

(a) Language of instruction



(b) Learner-textbook ratios



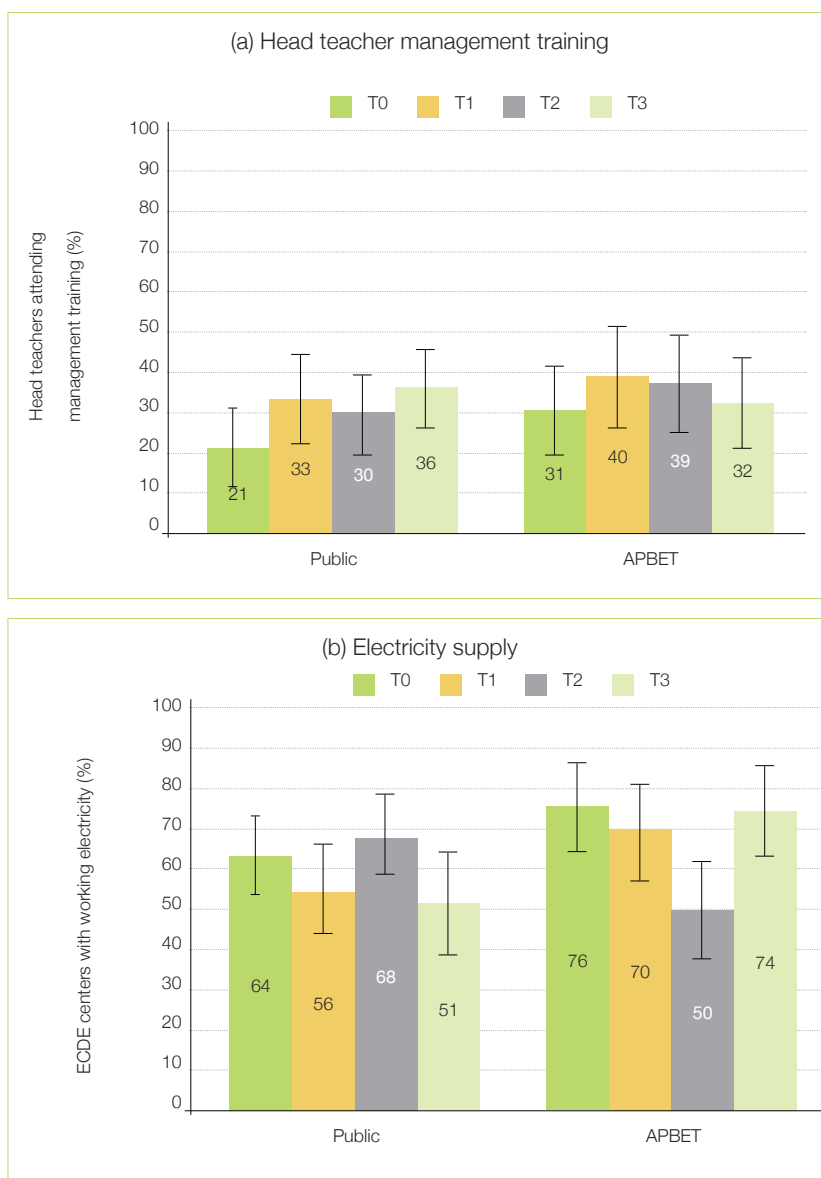
### 3.3 Characteristics of ECDE head teachers and their ECDE centers

The percentages of ECDE head teachers who reported having attended school management training are displayed in the first panel of Figure 3.5 while the percentage of ECDE centers with working electricity (either main or solar) are displayed in the second panel. The key points to note regarding these results are summarized in the paragraphs below.

**Head teacher management training:** The percentages of ECDE head teachers who reported that they had received school management training in the control group and the treatment groups did not differ much, especially for APBET centers.

**Electricity:** Results reveal existence of baseline balance in electricity provision across control and treatment groups for public as well as APBET centers. In general, provision of electricity was slightly higher among APBET centers than among public centers.

**Figure 3.5: Head teacher management training and electricity supply**





## 4. Learners' achievement

This chapter focuses on the learners' achievement scores on the direct assessment test at Wave Three, which also serves as the second baseline of the Tayari evaluation.

For each category of ECDE center, the results presented in this chapter cover learners' scores on: the overall TSRI score; the three main domains of interest in this study (i.e. executive function, literacy and numeracy); the five literacy sub-domains (i.e. rhymes, letter naming, letter sounds, initial sound discrimination, and listening comprehension); and the four numeracy sub-domains (i.e. shape identification, quantity discrimination, addition and subtraction, and measurement vocabulary). For each ECDE center category, comparisons are made between the control group (T0) and each of the three respective treatment groups – T1, T2 and T3. The main purpose of these comparisons is to examine baseline balance between the treatment groups and the control group.

For the purposes of examining baseline balance across the different sets of ECDE centers involved in the Wave Three study, reporting in this chapter focuses on three datasets. The first dataset involves all the ECDE centers that participated in the Wave Three study – that is, Phase One and Phase Two schools combined (n=303 and n=288 for public and APBET centers, respectively). The second set involves Phase One schools<sup>8</sup> only. These are the centers that were included in the study for the first time in 2016. The third set involves Phase Two schools<sup>9</sup> only, which are the centers that were included in the study for the first time in 2017.

### 4.1 TSRI scores for each ECDE center category

The mean TSRI scores (together with the associated standard errors) for the learners in the Wave Three dataset by treatment group and ECDE category are shown in Table 4.1. Within each ECDE center and dataset under consideration, the asterisks in this table denote significant differences in the comparisons made between the control group and each respective treatment group.

8 Phase 1 schools: n=154 for public centers and n=145 for APBET centers.

9 Phase 2 schools: n=149 for public centers and n=143 for APBET centers.

**Table 4.1: TSRI scores by treatment groups and ECDE center category for each dataset**

a) Public centers

	ALL: Phase 1&2 schools combined					Phase 1 schools					Phase 2 schools				
Group	n	Mean (A)	SE	DIFF (Ti-T0)	p-value	n	Mean (B)	SE	DIFF (Ti-T0)	p-value	n	Mean (C)	SE	DIFF (Ti-T0)	p-value
T0	75	33.70	0.97			39	36.94	1.40	-		36	32.62	1.22	-	
T1	75	32.08	0.87	-1.62	0.215	38	33.82	1.45	-3.12	0.124	37	32.79	0.98	0.17	0.914
T2	78	33.18	0.98	-0.52	0.705	39	33.93	1.09	-3.01*	0.092	39	35.07	1.68	2.45	0.241
T3	75	30.49	0.85	-3.21**	0.013	38	32.78	1.19	-4.16**	0.025	37	31.07	1.23	-1.55	0.372

NB: In Ti, i=1, 2, 3.

b) APBET centers

	ALL: Phase 1&2 schools combined					Phase 1 schools					Phase 2 schools				
Group	n	Mean (A)	SE	DIFF (Ti-T0)	p-value	n	Mean (B)	SE	DIFF (Ti-T0)	p-value	n	Mean (C)	SE	DIFF (Ti-T0)	p-value
T0	74	33.31	0.87			36	35.23	1.49	-		38	34.21	0.99	-	
T1	76	33.46	0.78	0.14	0.902	38	34.65	1.29	-0.58	0.770	38	34.63	0.92	0.42	0.754
T2	73	34.69	0.85	1.38	0.258	37	37.67	1.01	2.44	0.178	36	34.36	1.28	0.15	0.924
T3	65	36.45	1.01	3.13**	0.019	34	37.17	1.25	1.95	0.319	31	37.96	1.65	3.76*	0.053

**KEY**

**DIFF (Ti-T0)** Difference between treatment group and control group i.e. T1-T0; T2-T0; T3-T0

**Mean (A)** Overall mean of 2017 Phase 1 and Phase 2 schools combined

**Mean (B)** Mean of 2017 Phase 1 schools only

**Mean (C)** Mean of 2017 Phase 2 schools only

\*p-value < 0.10, \*\*p-value < 0.05

When considering the combined dataset for public centers, the results in Table 4.1 show that the mean TSRI score for the learners in the control group was generally higher than those of the learners in each of the three treatment groups. On the other hand, the corresponding results for APBET centers show the opposite – that is, the mean TSRI score of learners in control group was generally lower than that of their counterparts in each treatment group.

When looking at the statistical significance of the differences in the combined dataset for public centers, the mean score for learners in the control group did not differ greatly from those of learners in the T1 and T2 groups – indicating existence of baseline balance between each of these two treatment groups and the control group. On the contrary, for the same combined data set, learners in the T3 group obtained significantly lower mean scores than those in the control group - indicating baseline imbalance between the T3 and the control groups.

From the same Table 4.1, further analyses splitting data for public centers by study phases revealed that the baseline imbalance between the T3 and control groups was generally driven by the Phase One schools. This last finding, though consistent with what was found in the Wave One study, is still somewhat peculiar because Tayari implementation activities had been going on in Phase One schools for at least one year by the time the current data (Wave Three) were collected. Therefore, one would have expected the performance of the learners in each of the Phase One treatment schools to be at least at the same level as that of their counterparts in the control groups, if not higher. However, it is likely that the imbalance occurred by chance alone. Whatever the explanation, it will be important to control for observed imbalances when evaluating the impact of Tayari during the end-term study.

For the APBET centers, in reference to statistical significance, results of the combined schools show baseline balance between T1 and T2 group and control group on the TSRI scores. However, the TSRI scores for learners in the T3 group were significantly higher than those of the learners in the control group – implying baseline imbalance between the T3 and control groups. Results splitting data by phase were generally consistent with those of the combined data, and more so when considering the Phase Two dataset.

Regardless of the ECDE category, results in Table 4.1 also show that the average TSRI scores for the various datasets were generally low (e.g. for the combined dataset, around 31-34 % for public and 33-37% for APBET) meaning that the learners did not possess most of the skills evaluated in the direct assessment test. These results are generally consistent with what was found in the Wave One study. As was pointed out in the Wave One report, arguably, “these are desirable results at baseline because any learning gains made by the learners between baseline and subsequent data collection rounds can be captured using this test with minimal risks of running into ceiling effects” (Ngware et al., 2016).

## 4.2 Main domain scores for each ECDE center category

Figures 4.1 and 4.2 depict learners’ mean scores on the three main domains of interest in this study (executive function, literacy and numeracy) by treatment groups for public and APBET ECDE centers, respectively. It is clear that the learners performed quite poorly in all the three main domains – meaning that there is sufficient room for learners to improve their performance in each of these three domains at the next wave of data collection in October 2017. Across the two ECDE center categories as well as across the four study groups (T0 to T3); learners’ performance was relatively better in numeracy and literacy than in executive function. Nevertheless, learners in APBET centers generally outperformed their counterparts in public centers across these three main domains. These findings are consistent with what was found in the Wave 1 study.

In terms of baseline balance, it can be seen from the results in Figures 4.1 and 4.2 that scores for learners in the control group did not differ much from those of learners in each of the three treatment groups, especially for APBET centers. Nevertheless, for public centers, it is worth noting that the scores for learners

in the T3 group were generally lower than those of the learners in the control group especially for the Phase One schools. In addition, when considering data for Phase One public schools, the numeracy scores of learners in the T2 group were noticeably lower (32%) than those of the learners in the control group (40%).

### 4.3 Sub-domain scores for each ECDE center category

Figures 4.3 and 4.4 depict the mean scores (based on the Wave Three data) for literacy sub-domains for public and APBET centers, respectively, while Figures 4.5 and 4.6 depict the mean scores for numeracy sub-domains for the two categories of ECDE centers. The data that were used to plot these figures can be found in Appendix 6.3. The main points to note regarding baseline performance of the learners in each literacy sub-domain are outlined in Appendix 6.4.

From these results, it is evident that, with only a few exceptions – which are listed in Appendix 6.4 – the sub-domain scores of learners in the control group did not differ a lot from those of learners in each treatment group for each ECDE center category.

Figure 4.1: Main domain scores by treatment groups for public ECDE centers

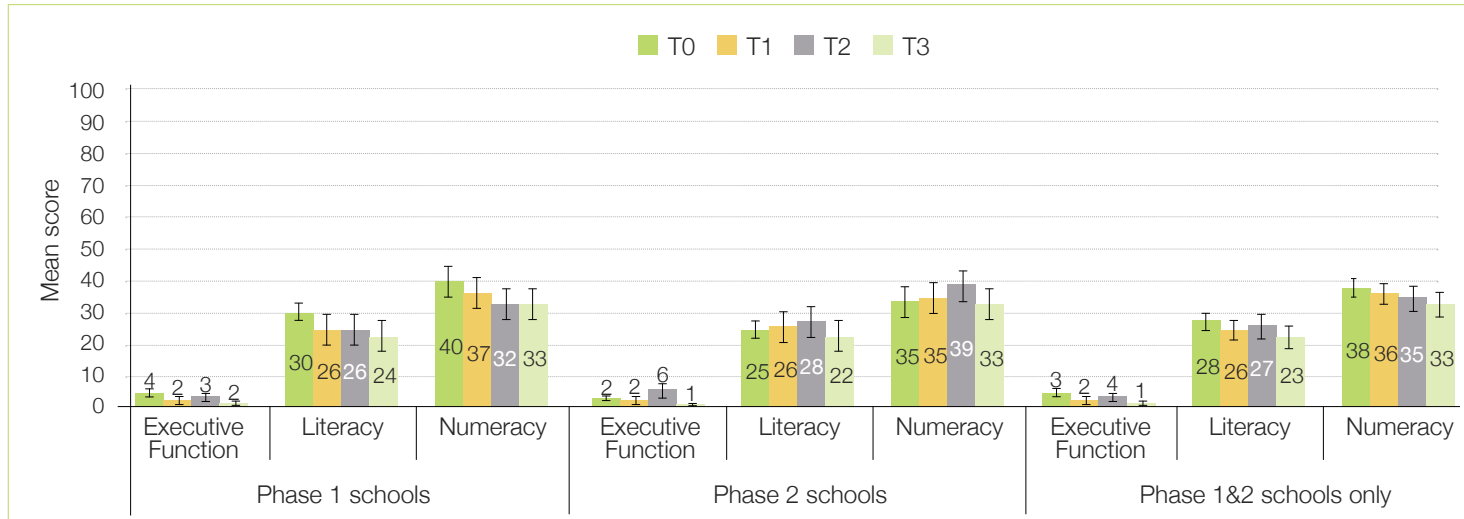


Figure 4.2: Main domain scores by treatment groups for APBET ECDE centers

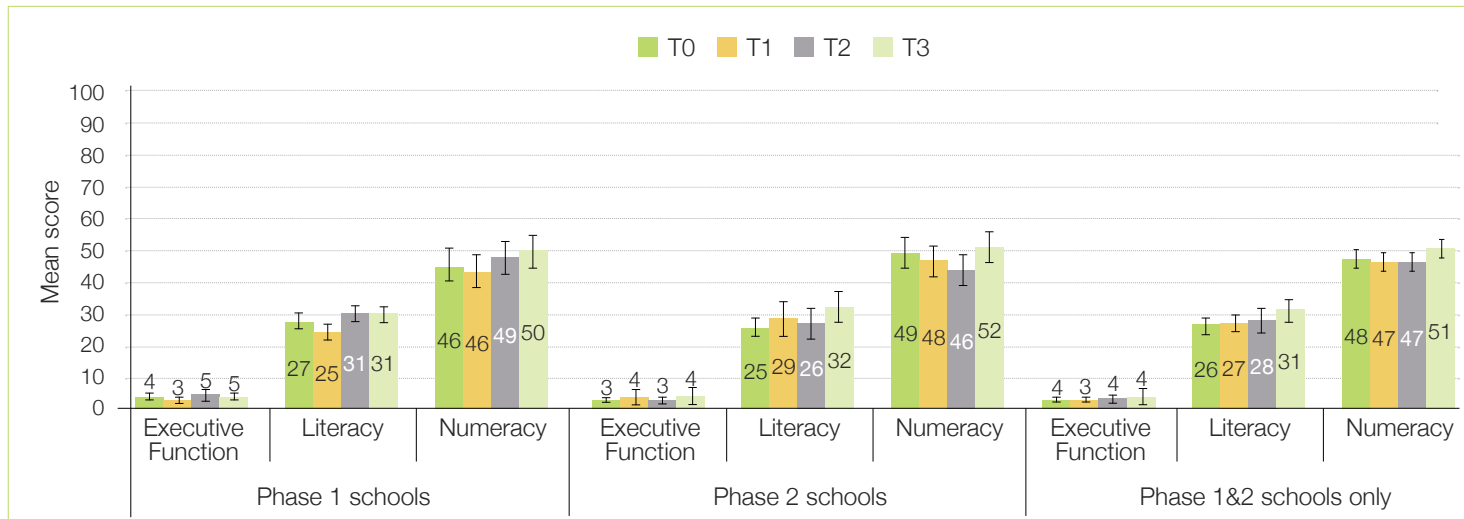


Figure 4.3: Literacy sub-domain scores for Wave 3 dataset for public schools

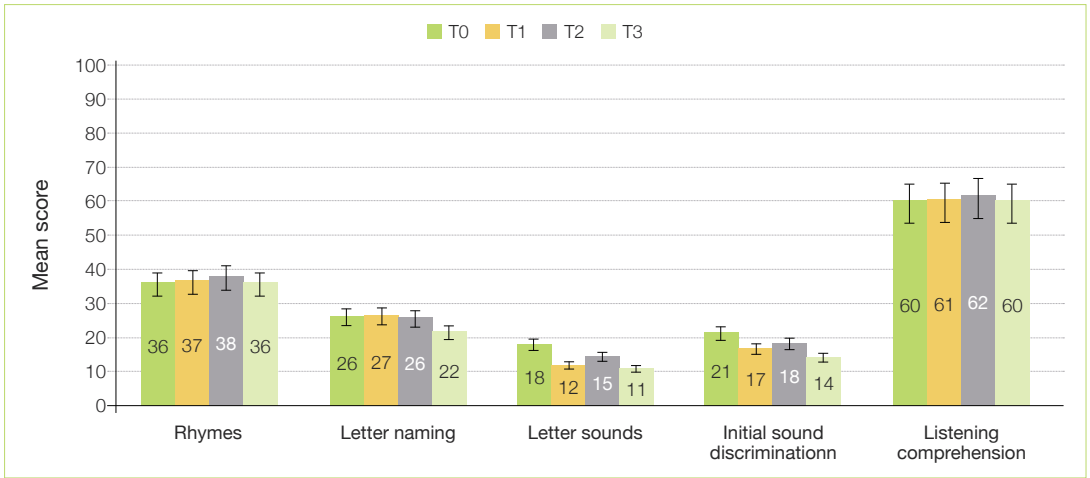


Figure 4.4: Literacy sub-domain scores for Wave 3 dataset for APBET schools

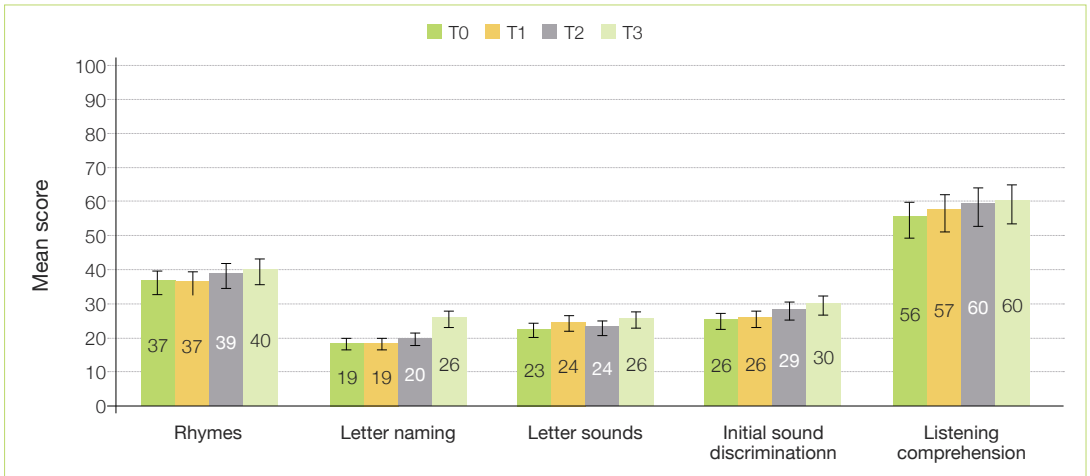
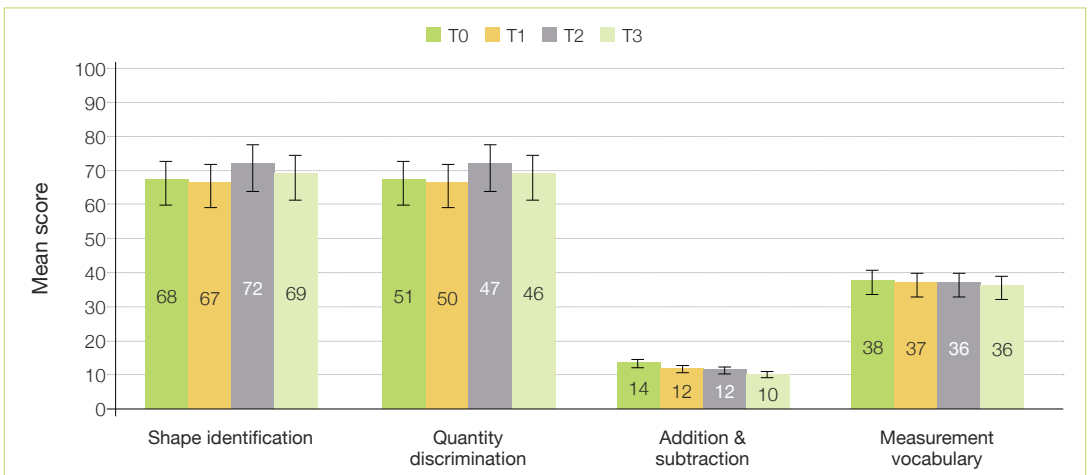
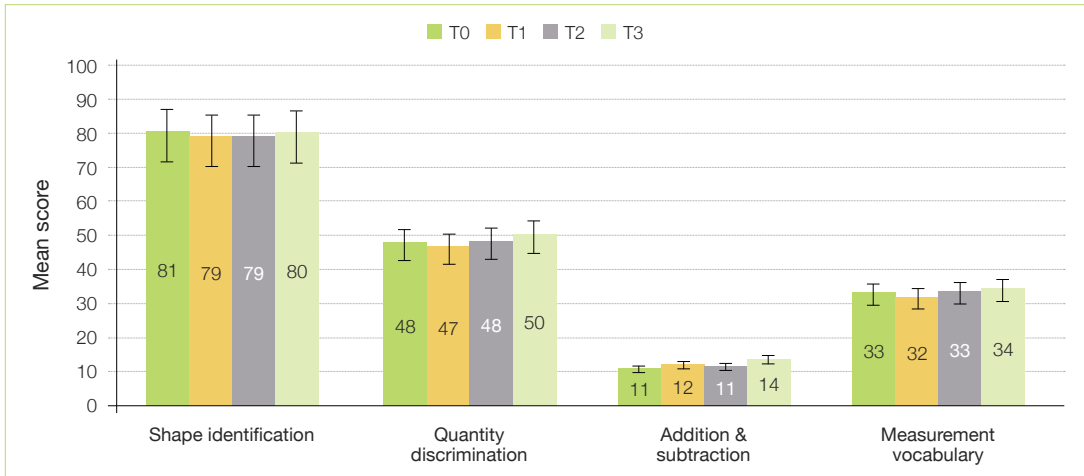


Figure 4.5: Numeracy sub-domain scores for Wave 3 dataset for public schools



**Figure 4.6: Numeracy sub-domain scores for Wave 3 dataset for APBET schools**



For the literacy sub-domains, it is evident from the results in Figures 4.3 and 4.4 that learners’ performance in letter naming, letter sound, initial sound discrimination, and rhymes (11-38% for public, and 19-40% for APBET) was very poor. The learners’ performance was much better on the listening comprehension task (60-62% for public, and 56-60% for APBET).

Likewise, for numeracy sub-domains, it is clear that learners performed very poorly on the addition and subtraction tasks (10-14% for both public and APBET), poorly in measurement vocabulary (36-38% for public, and 32-34% for APBET), moderately well in quantity discrimination (46-51% for public, and 48-50% for APBET), and much better in shape identification (67-72% for public, and 80-81% for APBET) – results in Figures 4.5 and 4.6. These Wave Three findings for literacy and numeracy sub-domains are generally consistent with Wave One results.

For the sub-domains on which the learners performed poorly (e.g. addition and subtraction), the direct assessment test can be used to measure learning gains in these areas without running into the risks associated with ceiling effects. In the sub-domains that the learners performed well on (e.g. shape identification) the opposite is the case – there is a potential risk of a ceiling effect, especially for items on shape identification.

#### 4.4 Regression models for the TSRI scores

This sub-section reports on the regression analyses that were carried out to examine baseline balance of the overall TSRI score in the Wave Three dataset, taking into account the key potential intervening factors.

The results for the regression analyses are displayed in Tables 4.2 and 4.3 for public and APBET centers, respectively. For public centers, results show that after taking into account the key factors hypothesized to influence TSRI scores in this study (including a dummy for the phase in which the school was first involved in the study), the mean TSRI score of the learners in the control group did not differ significantly from that of the learners in the T1 or T2 groups. However, the mean TSRI score of the learners in the control group was significantly higher than that of the learners in the T3 group – indicating baseline imbalance between the learners in the control group and in the T3 group. For APBET centers, regression results show that the mean TSRI scores of learners in the control group did not differ significantly from those of the learners in each of the three treatment groups. In general, these regression results confirm what was found using descriptive analyses reported earlier in this chapter.

**Table 4.2: Regression model for TSRI scores for Public ECDE centers based on the Wave 3 dataset**

	Model 1: T0 vs T1				Model 2: T0 vs T2				Model 3: T0 vs T3			
	Coeff.	p-value	95% CI		Coeff.	p-value	95% CI		Coeff.	p-value	95% CI	
Female learner	0.07	0.89	-0.96	1.10	0.69	0.15	-0.25	1.63	0.28	0.62	-0.84	1.41
Teacher highest level of education (ref=Primary)												
Secondary	-5.63	0.17	-13.75	2.49	-3.59	0.41	-12.22	5.03	-4.47	0.26	-12.30	3.36
College/University	-3.06	0.54	-12.87	6.74	-4.69	0.34	-14.33	4.95	-3.61	0.39	-11.85	4.63
Teacher pre-service training (ref=Untrained)												
Certificate	-0.96	0.71	-6.00	4.08	0.75	0.79	-4.76	6.26	1.64	0.49	-3.05	6.33
Diploma/Degree	-0.59	0.83	-5.94	4.75	2.78	0.35	-3.05	8.61	1.02	0.68	-3.82	5.87
Teacher years of experience	-0.19	0.16	-0.46	0.08	-0.03	0.86	-0.35	0.29	-0.11	0.48	-0.43	0.20
Possession of teaching documents#	0.24	0.51	-0.47	0.94	-0.14	0.68	-0.82	0.53	0.07	0.85	-0.65	0.80
Teacher age	0.15	0.18	-0.07	0.37	0.07	0.65	-0.22	0.35	0.12	0.43	-0.18	0.42
Language of instruction (ref=MT)												
Kiswahili	-5.13**	0.00	-8.44	-1.81	-1.27	0.53	-5.21	2.67	-3.98**	0.03	-7.61	-0.35
English	1.69	0.51	-3.32	6.70	5.88*	0.05	-0.04	11.80	0.51	0.83	-4.27	5.29
Phase 2 schools	-2.39*	0.06	-4.85	0.08	-0.75	0.57	-3.37	1.86	-2.47*	0.05	-4.96	0.01
Single-grade teaching	0.98	0.52	-2.03	4.00	-1.38	0.41	-4.63	1.88	1.44	0.36	-1.67	4.54
Class size	-0.04	0.43	-0.13	0.06	0.05	0.16	-0.02	0.11	0.00	0.97	-0.09	0.09
Learner-textbook ratio	-1.55	0.41	-5.22	2.13	0.10	0.97	-5.76	5.96	-0.33	0.82	-3.13	2.46
Classroom resources index	-0.02	0.98	-1.14	1.11	-0.39	0.36	-1.20	0.43	-0.06	0.88	-0.90	0.78
County (ref=Laikipia)												
Nairobi	-0.17	0.93	-3.81	3.47	-3.72	0.27	-10.33	2.88	0.55	0.81	-3.90	5.00
Uasin Gishu	2.41	0.21	-1.34	6.16	0.45	0.84	-3.87	4.78	0.71	0.72	-3.10	4.52
Siaya	-1.95	0.32	-5.77	1.86	-3.21	0.14	-7.51	1.08	-0.94	0.62	-4.63	2.75
Treatment (ref=T0)	-1.96	0.14	-4.55	0.63	-0.17	0.90	-2.94	2.60	-3.06**	0.02	-5.68	-0.44
Constant	38.48**	0.00	27.00	49.97	35.79**	0.00	21.23	50.35	35.56**	0.00	23.24	47.87
Random part												
Number of learners	2073				2180				2051			
Number of schools	150				153				150			
Level 2 variance	7.00				7.94				7.03			
Level 1 variance	11.99				12.04				12.19			
ICC	25%				30%				25%			

**Notes:** Coeff. = Regression coefficient; #Four basic teaching documents were considered - namely lesson plan, schemes of work, record of work, and learner progress records; MT=Mother tongue; ICC=Intraclass correlation.



**Table 4.3: Regression model for TSRI scores for APBET ECDE centers based on the Wave 3 dataset**

	Model 1: T0 vs T1				Model 2: T0 vs T2				Model 3: T0 vs T3			
	Coeff.	p-value	95% CI		Coeff.	p-value	95% CI		Coeff.	p-value	95% CI	
Female learner	-0.19	0.75	-1.34	0.96	-0.58	0.34	-1.77	0.61	-0.26	0.63	-1.32	0.80
Teacher highest level of education (ref=Primary)												
Secondary	0.69	0.93	-14.86	16.24	-10.89**	0.00	-15.34	-6.45	-8.73*	0.05	-17.37	-0.08
College/University	1.62	0.84	-14.27	17.50	-9.16**	0.00	-14.25	-4.07	-7.37*	0.09	-16.00	1.25
Teacher pre-service training (ref=Untrained)												
Certificate	0.20	0.93	-4.21	4.61	0.79	0.67	-2.83	4.42	3.54	0.10	-0.65	7.73
Diploma/Degree	-0.82	0.75	-5.90	4.26	1.38	0.55	-3.16	5.91	3.81	0.13	-1.07	8.69
Teacher years of experience	-0.14	0.36	-0.43	0.16	-0.10	0.45	-0.35	0.16	-0.20	0.10	-0.45	0.04
Possession of teaching documents#	0.45	0.19	-0.23	1.13	0.49	0.17	-0.21	1.19	0.66*	0.09	-0.11	1.43
Teacher age	0.03	0.81	-0.23	0.29	0.06	0.56	-0.15	0.28	0.01	0.88	-0.17	0.20
Language of instruction (ref=Kiswahili)	0.73	0.54	-1.58	3.05	1.86	0.15	-0.67	4.38	1.99*	0.09	-0.29	4.27
Phase 2 schools	-0.25	0.82	-2.35	1.85	-0.51	0.64	-2.69	1.66	-0.21	0.86	-2.42	2.00
Single-grade teaching	1.83	0.30	-1.62	5.28	0.95	0.48	-1.68	3.58	-2.08	0.15	-4.90	0.74
Class size	-0.02	0.56	-0.07	0.04	-0.03	0.42	-0.09	0.04	-0.05*	0.05	-0.10	0.00
Learner-textbook ratio	-0.07	0.91	-1.22	1.08	4.02**	0.00	1.69	6.36	0.60	0.60	-1.63	2.82
Classroom resources index	0.35	0.25	-0.25	0.94	0.39	0.20	-0.20	0.99	0.07	0.82	-0.56	0.71
Treatment (ref=T0)	-0.31	0.79	-2.63	2.01	0.26	0.84	-2.25	2.78	1.76	0.18	-0.80	4.32
Constant	29.83**	0.00	12.02	47.63	39.05**	0.00	31.16	46.93	39.98**	0.00	29.79	50.18
Random part												
Number of learners	2019				1894				1885			
Number of schools	150				147				139			
Level 2 variance	5.48				5.59				5.54			
Level 1 variance	12.08				12.14				12.02			
ICC	17%				18%				18%			

**Notes:** Coeff. = Regression coefficient; #Four basic teaching documents were considered - namely lesson plan, schemes of work, record of work, and learner progress records; ICC=Intraclass correlation

## 5. Summary and concluding remarks

This report summarizes the main results of the second baseline (or Wave Three) study of the external evaluation of the Tayari pre-primary school program. Data for this report were collected in January/February 2017 among final year pre-primary (PP2) school children attending public and APBET ECDE centers in four Kenyan counties: Nairobi, Uasin Gishu, Laikipia and Siaya. The evaluation study adopted a randomized control trial design, involving three treatment arms and one control arm. Schools in the first treatment group (T1) receive a package with two components – namely teacher training and support, and DICECE/Coaches training. Schools in T2 receive the two components in the first package, plus learners' books and teachers' guides. Schools in T3 receive all the components in the second package plus a health support component.

Tayari was intentionally designed so that half the number of schools needed to detect the required effect size were included in Phase One of the study in 2016, with inclusion of the other half in Phase Two of the study in 2017. The current report is based on data that were collected in 2017 – which means that it includes data from schools in the two phases.

Results also revealed existence of baseline balance between control and treatment groups in distribution of the key background characteristics considered in this study, namely: learner sex, teacher age, teacher experience, teacher education, teacher pre-service qualification, and teacher possession of teaching documents. In addition, there was baseline balance in respect of the language of instruction, head teacher management training and provision of electricity to the ECDE centers. However, for both categories of ECDE centers, the availability of health records generally tended to be more commonly reported among teachers in the T3 groups than among teachers in control group, which was expected because Tayari health activities in T3 schools were ongoing. In addition, learner-book ratios in APBET centers, were significantly lower in the control group than in the T2 and T3 groups – again consistent with the expectations.

With regards to learning achievement, results from the combined Wave Three dataset revealed that, for public ECDE centers, the mean TSRI score for learners in the control group was generally higher than that of the learners in the T1 and T2 groups though not of statistical importance. However, the mean score for learners in the public centers' control group was significantly higher than that of the learners in T3 group – indicating some baseline imbalance. For APBET centers, results revealed existence of baseline balance between the control group and the T1 and T2 groups but imbalances were found between the control group and the T3 group.

Results further revealed that, for both ECDE categories, the mean TSRI Wave Three scores for Phase One and Phase Two schools were generally low, meaning that the learners did not possess most of the skills assessed by the direct assessment test – which is consistent with Wave One results. This also means that any learning gains made by the learners between this baseline and end-term can be captured using this test with minimal risks of running into ceiling effects (Ngware et al., 2016).

In terms of the main domains and sub-domains tested, results for both categories of ECDE centers revealed that learners' performance was poorest in the executive function domain, literacy sub-domains of letter naming, letter sound, initial sound discrimination, and in the numeracy sub-domains of addition and subtraction.

## 6. Appendices

### Appendix 6.1: Summary of sampled ECDE centers for evaluation

		ECDE centers to be involved in Phase 1	ECDE centers to be added in Phase 2	Total ECDE centers to be involved in Phase 2
Public ECDE Centers by Treatment	Treatment 1	38	37	75
	Treatment 2	39	39	78
	Treatment 3	38	37	75
	Control	39	36	75
	<b>Total</b>	<b>154</b>	<b>149</b>	<b>303</b>
		ECDE centers to be involved in Phase 1	ECDE centers to be added in Phase 2	Total ECDE centers to be involved in Phase 2
Public ECDE Centers by County	Laikipia	50	42	92
	Nairobi Public	27	24	51
	Siaya	36	47	83
	Uasin Gishu	41	36	77
	<b>Total</b>	<b>154</b>	<b>149</b>	<b>303</b>
		ECDE centers to be involved in Phase 1	ECDE centers to be added in Phase 2	Total ECDE centers to be involved in Phase 2
APBET ECDE Centers by Treatment	Treatment 1	38	38	76
	Treatment 2	38	37	75
	Treatment 3	35	34	69
	Control	36	39	75
	<b>Total</b>	<b>147</b>	<b>148</b>	<b>295</b>
<b>Total (Public + APBET)</b>		<b>301</b>	<b>297</b>	<b>598</b>

Note: Phase 1 = 2016; Phase 2 = 2017

## Appendix 6.2: Number of learners, teachers and schools involved in the Tayari Wave 3 study

County	Target/outputs	Schools	Learners	Teachers	In-charge /HT	Remarks to explain the variance (if any)
Laikipia	# Targeted	92	1472	92	92	Half of the schools (46) had enrollments below the targeted number of 16
	% Reached	100	78.7	100	100	
Nairobi	# Targeted	346	5536	346	346	<b>7 schools could not be replaced because the replacing schools had all been sampled. 125 schools had enrollments below the targeted 16.</b>
	% Reached	98	81	98	98	
Siaya	# Targeted	83	1328	83	84	20 schools had enrollment below the targeted number of 16. In one school, there was a new head teacher with very little information on Tayari. The previous head teacher had more information about Tayari, but had assumed a new role. The situation forced us to interview both.
	% Reached	100	92.6	100	101.2	
Uasin Gishu	# Targeted	77	1232	77	77	<b>22 schools had enrollments below the targeted number of 16 learners</b>
	% Reached	100	92.5	100	100	
Total	Targeted	598	9568	598	598	213 schools had enrollments below the targeted number of 16 learners. 7 schools could not be assessed and could not be replaced either as the replacing schools had all been sampled.
	%Reached	99.5	86.2	99.5	99.5	

## Appendix 6.3: Learners' main and sub-domain scores by treatment groups based on Wave 3 dataset

Public ECDE Centers

i) PHASE 1 SCHOOLS ONLY														
	T0		T1		T2		T3		T1-T0		T2-T0		T3-T0	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	DIFF	p-value	DIFF	p-value	DIFF	p-value
Main domains														
Executive function	4.29	0.71	2.37	0.67	2.90	0.76	1.54	0.44	-1.93	0.048	-1.40	0.177	-2.75	0.001
Literacy	29.63	2.06	25.99	1.54	26.09	1.58	24.42	1.51	-3.64	0.155	-3.54	0.171	-5.22	0.041
Numeracy	40.29	1.83	37.28	2.27	32.45	1.76	32.73	1.90	-3.01	0.299	-7.85	0.002	-7.56	0.004
Literacy sub-domains														
Rhymes	36.45	1.30	36.39	1.78	38.24	1.09	37.38	1.32	-0.06	0.979	1.80	0.287	0.94	0.610
Letter naming	27.48	3.06	25.99	2.97	26.04	3.03	23.39	2.82	-1.49	0.724	-1.44	0.735	-4.10	0.322
Letter sounds	21.48	2.58	12.24	1.87	11.84	1.86	12.18	1.75	-9.24	0.004	-9.64	0.003	-9.30	0.003
Initial sound discrimination	23.52	3.10	18.29	2.70	17.39	2.65	16.34	2.24	-5.23	0.201	-6.13	0.131	-7.18	0.059
Listening comprehension	64.12	3.03	61.40	3.36	62.50	2.98	57.64	2.78	-2.72	0.544	-1.62	0.700	-6.48	0.113
Numeracy sub-domains														
Shape identification	71.05	2.83	65.45	3.36	73.05	3.01	74.57	2.43	-5.61	0.200	2.00	0.626	3.52	0.343
Quantity discrimination	51.11	2.07	50.13	2.39	45.77	1.83	43.74	2.37	-0.98	0.756	-5.34	0.053	-7.37	0.019
Addition & subtraction	14.52	1.33	12.40	1.86	10.94	1.41	11.30	1.26	-2.12	0.350	-3.58	0.063	-3.22	0.078
Measurement vocabulary	40.74	2.41	39.67	2.46	36.28	1.91	38.34	2.58	-1.07	0.755	-4.45	0.146	-2.40	0.494

**Note:** DIFF=Difference between treatment group and control group

## Appendix 6.3(contd)

### Public ECDE Centers

ii) PHASE 2 SCHOOLS ONLY														
	T0		T1		T2		T3		T1-T0		T2-T0		T3-T0	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	DIFF	p-value	DIFF	p-value	DIFF	p-value
Main domains														
Executive function	2.48	0.75	1.71	0.42	5.56	1.08	0.95	0.32	-0.77	0.368	3.08	0.019	-1.54	0.059
Literacy	25.38	1.61	25.79	1.53	27.62	2.45	22.05	1.71	0.41	0.852	2.24	0.441	-3.33	0.154
Numeracy	34.98	2.02	35.37	1.82	39.15	2.42	32.67	2.04	0.39	0.886	4.17	0.183	-2.31	0.418
Literacy sub-domains														
Rhymes	36.39	1.39	36.73	1.30	37.53	1.40	35.03	1.75	0.34	0.856	1.14	0.561	-1.36	0.540
Letter naming	24.52	2.90	27.45	3.88	25.99	3.37	20.59	3.06	2.93	0.543	1.47	0.740	-3.94	0.347
Letter sounds	13.75	2.08	11.70	1.71	18.44	2.94	9.40	1.69	-2.05	0.443	4.69	0.191	-4.35	0.102
Initial sound discrimination	18.86	2.65	15.32	2.36	19.77	3.02	12.54	2.53	-3.53	0.317	0.92	0.818	-6.31	0.084
Listening comprehension	55.77	3.38	59.75	3.05	61.05	3.02	62.00	3.37	3.98	0.379	5.28	0.241	6.22	0.190
Numeracy sub-domains														
Shape identification	63.89	2.20	68.53	2.46	71.51	2.64	64.75	3.00	4.64	0.157	7.62	0.027	0.86	0.815
Quantity discrimination	50.58	2.37	49.68	2.14	49.39	2.42	47.11	2.43	-0.90	0.776	-1.19	0.724	-3.47	0.303
Addition & subtraction	12.82	1.63	11.20	1.14	12.75	1.39	8.66	1.38	-1.62	0.412	-0.07	0.973	-4.16	0.051
Measurement vocabulary	34.47	2.15	34.54	2.32	36.73	2.29	34.57	2.39	0.07	0.982	2.26	0.469	0.10	0.975

## Appendix 6.3(contd)

### Public ECDE Centers

iii) PHASES 1&2 SCHOOLS (Wave 3)														
	T0		T1		T2		T3		T1-T0		T2-T0		T3-T0	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	DIFF	p-value	DIFF	p-value	DIFF	p-value
Main domains														
Executive function	3.42	0.52	2.05	0.40	4.08	0.66	1.23	0.27	-1.37	0.037	0.66	0.432	-2.20	0.0001
Literacy	27.59	1.34	25.89	1.08	26.77	1.42	23.16	1.15	-1.70	0.322	-0.82	0.670	-4.43	0.012
Numeracy	37.74	1.38	36.36	1.46	35.42	1.51	32.70	1.39	-1.38	0.491	-2.32	0.253	-5.04	0.010
Literacy sub-domains														
Rhymes	36.42	0.94	36.55	1.11	37.93	0.87	36.13	1.10	0.13	0.927	1.51	0.238	-0.28	0.8460
Letter naming	26.06	2.11	26.69	2.41	26.02	2.24	21.90	2.08	0.63	0.844	-0.05	0.988	-4.16	0.160
Letter sounds	17.77	1.72	11.98	1.27	14.77	1.73	10.71	1.22	-5.79	0.007	-3.00	0.213	-7.06	0.001
Initial sound discrimination	21.28	2.06	16.87	1.80	18.45	1.98	14.32	1.69	-4.41	0.106	-2.83	0.319	-6.96	0.009
Listening comprehension	60.11	2.30	60.61	2.26	61.86	2.11	59.95	2.19	0.49	0.878	1.74	0.575	-0.16	0.959
Numeracy sub-domains														
Shape identification	67.61	1.85	66.93	2.09	72.37	2.01	69.36	2.01	-0.69	0.806	4.75	0.083	1.75	0.522
Quantity discrimination	50.85	1.56	49.91	1.60	47.38	1.50	45.52	1.70	-0.94	0.673	-3.48	0.106	-5.33	0.021
Addition & subtraction	13.70	1.04	11.83	1.10	11.74	0.99	9.90	0.94	-1.88	0.215	-1.96	0.172	-3.80	0.007
Measurement vocabulary	37.73	1.65	37.21	1.71	36.48	1.47	36.34	1.76	-0.52	0.826	-1.25	0.570	-1.39	0.563

## Appendix 6.3(contd)

### APBET ECDE Centers

i) PHASE 1 SCHOOLS ONLY														
	T0		T1		T2		T3		T1-T0		T2-T0		T3-T0	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	DIFF	p-value	DIFF	p-value	DIFF	p-value
Main domains														
Executive function	4.07	1.05	3.22	0.78	4.99	1.02	4.55	0.84	-0.85	0.511	0.92	0.526	0.48	0.717
Literacy	27.26	1.73	24.96	1.83	30.51	1.61	30.58	1.98	-2.30	0.357	3.25	0.167	3.32	0.203
Numeracy	45.95	2.47	45.54	1.96	48.52	1.81	50.06	2.05	-0.41	0.896	2.57	0.397	4.11	0.197
Literacy sub-domains														
Rhymes	37.67	1.68	36.93	1.73	39.91	1.17	41.70	1.75	-0.75	0.755	2.24	0.272	4.02	0.096
Letter naming	19.05	2.48	15.95	2.80	24.32	2.91	24.70	2.95	-3.10	0.404	5.27	0.166	5.65	0.140
Letter sounds	24.60	2.89	22.14	2.15	25.54	1.86	24.91	2.48	-2.46	0.491	0.93	0.784	0.30	0.936
Initial sound discrimination	27.18	3.62	23.36	3.11	28.75	2.71	28.22	3.09	-3.82	0.420	1.57	0.727	1.04	0.825
Listening comprehension	56.91	2.38	60.09	2.43	61.88	2.13	60.54	2.49	3.18	0.346	4.97	0.118	3.63	0.288
Numeracy sub-domains														
Shape identification	79.69	2.20	81.54	2.35	82.50	1.98	78.91	2.15	1.85	0.561	2.81	0.339	-0.78	0.799
Quantity discrimination	46.94	2.59	48.78	2.57	48.84	1.81	50.20	2.59	1.85	0.610	1.90	0.544	3.26	0.369
Addition & subtraction	12.69	2.52	14.46	1.87	12.08	1.48	13.48	1.40	1.77	0.570	-0.61	0.832	0.79	0.782
Measurement vocabulary	32.28	2.80	31.13	2.28	36.43	2.27	33.99	2.50	-1.15	0.748	4.15	0.247	1.71	0.646



## Appendix 6.3(contd)

### APBET ECDE Centers

ii) PHASE 2 SCHOOLS ONLY														
	T0		T1		T2		T3		T1-T0		T2-T0		T3-T0	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	DIFF	p-value	DIFF	p-value	DIFF	p-value
Main domains														
Executive function	3.19	0.65	3.77	0.60	3.45	0.81	4.40	1.22	0.58	0.509	0.27	0.796	1.22	0.375
Literacy	25.15	1.63	28.52	1.48	26.18	1.72	32.26	2.63	3.37	0.125	1.03	0.661	7.11	0.021
Numeracy	49.17	1.65	48.38	1.71	45.89	2.05	51.72	2.39	-0.79	0.737	-3.29	0.210	2.55	0.376
Literacy sub-domains														
Rhymes	36.34	1.30	36.67	1.51	38.15	1.62	37.58	1.72	0.33	0.868	1.80	0.382	1.24	0.563
Letter naming	18.03	3.02	21.50	3.22	16.78	2.70	27.40	4.48	3.47	0.429	-1.26	0.755	9.36	0.082
Letter sounds	20.92	2.11	26.84	2.02	21.95	2.45	26.87	2.55	5.92	0.042	1.03	0.748	5.95	0.071
Initial sound discrimination	24.17	2.99	28.12	2.58	28.35	3.07	32.68	4.08	3.95	0.314	4.18	0.326	8.51	0.091
Listening comprehension	54.18	2.36	54.51	2.61	57.45	3.01	59.73	2.98	0.33	0.925	3.26	0.390	5.54	0.142
Numeracy sub-domains														
Shape identification	81.55	2.58	76.57	2.56	76.49	2.15	82.14	1.81	-4.98	0.168	-5.06	0.130	0.59	0.851
Quantity discrimination	48.62	2.12	44.83	1.87	48.07	2.69	50.48	2.18	-3.79	0.179	-0.55	0.872	1.86	0.537
Addition & subtraction	8.93	1.13	9.45	1.39	10.67	1.65	13.60	2.67	0.52	0.771	1.74	0.384	4.67	0.105
Measurement vocabulary	33.70	2.11	32.82	2.11	30.97	2.72	34.45	3.07	-0.88	0.766	-2.74	0.423	0.75	0.840

APBET ECDE Centers

iii) PHASE 1&2 SCHOOLS														
	T0		T1		T2		T3		T1-T0		T2-T0		T3-T0	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	DIFF	p-value	DIFF	p-value	DIFF	p-value
Main domains														
Executive function	3.62	0.61	3.49	0.49	4.17	0.65	4.48	0.72	-0.13	0.869	0.55	0.533	0.87	0.358
Literacy	26.18	1.19	26.72	1.19	28.19	1.20	31.38	1.62	0.55	0.743	2.01	0.233	5.20	0.009
Numeracy	47.60	1.47	46.95	1.30	47.11	1.37	50.85	1.55	-0.65	0.738	-0.50	0.804	3.25	0.128
Literacy sub-domains														
Rhymes	36.99	1.05	36.80	1.14	38.96	1.01	39.73	1.25	-0.19	0.903	1.97	0.177	2.74	0.092
Letter naming	18.53	1.95	18.71	2.14	20.27	2.02	25.99	2.62	0.18	0.951	1.74	0.533	7.46	0.022
Letter sounds	22.71	1.78	24.47	1.49	23.61	1.55	25.85	1.77	1.76	0.446	0.90	0.703	3.13	0.21
Initial sound discrimination	25.63	2.33	25.72	2.03	28.53	2.04	30.35	2.52	0.09	0.977	2.90	0.349	4.71	0.169
Listening comprehension	55.51	1.67	57.32	1.80	59.50	1.87	60.15	1.91	1.81	0.458	3.99	0.114	4.64	0.067
Numeracy sub-domains														
Shape identification	80.65	1.69	79.08	1.75	79.27	1.50	80.45	1.42	-1.57	0.517	-1.37	0.543	-0.19	0.93
Quantity discrimination	47.80	1.66	46.82	1.60	48.43	1.63	50.33	1.69	-0.98	0.670	0.63	0.789	2.53	0.283
Addition & subtraction	10.76	1.36	11.98	1.19	11.32	1.11	13.54	1.46	1.21	0.502	0.56	0.750	2.78	0.162
Measurement vocabulary	33.01	1.73	31.97	1.54	33.50	1.80	34.21	1.95	-1.04	0.652	0.49	0.845	1.20	0.644

## Appendix 6.4: Points to note regarding Wave 3 performance in the literacy and numeracy sub-domains

**Box 4.1: Points to note regarding Wave 3 performance in the literacy sub-domains**

Sub-domain	Public	APBET
Rhyme	Performance of learners in the control group (36%) was about the same as that of learners in the three treatment groups (36-38%)	Performance of learners in the control group (37%) was about the same as that of learners in the three treatment groups (37-40%)
Letter naming	Performance of learners in the control group (26%) was about the same as that of learners in the three treatment groups (22-27%)	Learners in the T3 group (26%) performed noticeably better than their counterparts in the control group (19%)
Letter sounds	Learners in the T1 (12%) and T3 (11%) groups performed significantly worse than their counterparts in the control group (18%)	Performance of learners in the control group (23%) was about the same as that of learners in the three treatment groups (24-26%)
Initial sound discrimination	Learners in the T3 (14%) group had significantly lower scores than those in the control group (21%)	Performance of learners in the control group (26%) was about the same as that of learners in the three treatment groups (26-30%)
Listening comprehension	Performance of learners in the control group (60%) was about the same as that of learners in the three treatment groups (60-62%)	Though not statistically significant, performance of learners in the control group (56%) was slightly lower than of learners in T2 and T3 groups (60% for each)

**Box 4.2: Points to note regarding Wave 3 performance in the numeracy sub-domains**

Sub-domain	Public	APBET
Shape identification	Performance of learners in the control group (68%) was about the same as that of learners in three treatment groups (67-69%)	Performance of learners in the control group (81%) was about the same as that of learners in the three treatment groups (79-80%). There is a risk of ceiling effect, at end-term.
Quantity discrimination	Learners in the T3 group (46%) had noticeably lower scores than those in the control group (51%)	Performance of learners in the control group (48%) was about the same as that of learners in the three treatment groups (47-80%)
Addition & subtraction	Learners in the T3 group (10%) had noticeably lower scores than learners in the control group (14%)	Performance of learners in the control group (11%) was about the same as that of learners in the three treatment groups (11-14%)
Measurement vocabulary	Performance of learners in the control group (38%) was about the same as that of learners in the three treatment groups (36-37%)	Performance of learners in the control group (33%) was about the same as that of learners in the three treatment groups (32-34%)

