RESEARCH REPORT 2020

Edulution Programme

Zambian Grade 7 National Exams 2020

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ABSTRACT

Edulution offers an after-school learning programme that supports primary school learners in disadvantaged areas in Zambia, Namibia, and South Africa. Learners use tablet PCs to engage with content and interactive exercises, with their self-paced learning being guided and facilitated by trained coaches. This research report analyses the impact of Edulution's programme on the mathematics performance in Zambia's Grade 7 exam.

In the analysis, learners in the Edulution programme were compared to the entire cohort of learners from the regions in which Edulution operates (n=136,830) regarding the 2020 Grade 7 exam. The Grade 7 exam is a national assessment at the end of primary school and is a useful way to compare different learners' cohorts.

The comparison was based on a percentile calculation that classifies learners within a scale of 100: the best learners are at the 99th percentile, and the poorest learners are at the first percentile. In the mathematics exam, the analysis shows that Edulution learners scored pronouncedly higher than the entire cohort: Considering all active learners from the Edulution programme (who studied 120 hours or more, n=1544), the median Edulution learner was at the 72nd percentile. This means that they performed better than 72% of the entire cohort. In comparison, the median learner of the entire student cohort was at the 50th percentile. The difference between the 50th and the 72nd percentile means a substantial advance of 22 percentile ranks of the median Edulution learner. Even if all Edulution learners are considered, including those, who studied less than 120 hours in the Edulution programme, the advance of the median Edulution learner remains substantial with 17 percentile ranks.

Moreover, increasing engagement with the Edulution programme, such as working on exercises, was linked to higher percentile scores. Taken together, the findings permit the conclusion that participation in the Edulution programme is associated with markedly higher mathematics scores in the Grade 7 exam.

In the Management Summary, the key findings of the analysis are outlined. In the Technical Report, the detailed statistical results are reported to make the approaches and conclusions traceable according to established research standards.

MANAGEMENT SUMMARY

Background and programme
Edulution is a social enterprise that offers an after-school learning programme to support primary school learners in townships and rural areas in Zambia, Namibia, and South Africa. Learners use tablet PCs to engage with content and interactive exercises, with their self-paced learning being guided and facilitated by trained coaches.

Research questions
This analysis aimed to evaluate the potential impact of the Edulution programme on learners' numeracy skills. The specific research questions are:

- **Research question 1**: Does the performance of learners from the Edulution programme in the national Grade 7 mathematics exam differ from the performance of the entire learner cohort, and if so, to what extent?

- **Research question 2**: Is the specific engagement of learners with the Edulution programme, such as working on exercises or time spent with the programme, linked to improvements in their Grade 7 mathematics performance?

Approach, method and sample
The statistical analysis methods included a percentile comparison and statistical significance tests for research question 1 and regression analyses for research question 2. The analysis was based on two different data sets, which Edulution provided to the research team. The first data set contained information about learners (variables such as facility, exam number, gender, date of birth) and their performance in the national Grade 7 exams in the three provinces in which Edulution operates (n=159'783). Data for this set was provided by the respective district school inspectors. In addition, the Edulution coaches confirmed and verified this information of the Edulution learners in Grade 7. The second data set was obtained from the digital Edulution learning platform, which tracks learner activities. This set provided more detailed information of the Edulution learners (n=2084), containing information on the learners (age, gender) and their context (province, cluster, school type, facility, environment etc.), their use of the Edulution programme (number of exercises, number of hours engaged) and their results in the 2020 Grade 7 exams.

Both data sets were joined at first, then cleaned and explored. From the entire data set (n=159'783) provided by the school inspectors, 1509 observations were excluded because the learners' age was reported as being below 10 or above 22, likely indicating errors in the data entry process. To be included as an active Edulution learner for the percentile comparison, an engagement of at least 120 hours with the programme was required. One hundred twenty hours was derived from the projected number of hours a learner should be on the programme, assuming consistent attendance over a given year. Learners can drop in and out of the programme for various reasons, such as changes in class schedules and class enrolment or altered family situations. This criterion excluded 481 learners (23%) from the Edulution data set for the main percentile comparison. The

sample, cleaned as described above, resulted in a set with 157'793 learners. Of these, 136'830 participated in the Grade 7 exam and were thus included in the final sample.

Entire sample: In the final sample (n = 157'793), 53% of the participants were female and 47% male, who were, on average, 14.8 years old. 28% were from the Eastern province, 18% from the Western province and 54% from Lusaka.

Edulution learners: From the Edulution cohort, which was compared to the entire student cohort, 1544 participated in the Grade 7 exam. The learners were on average 14.8 years old, 52% of whom were female and 48% male. 55% were from rural areas and 45% from urban environments. 27% came from the Eastern province, 63% from Lusaka and 10% from the Western province.

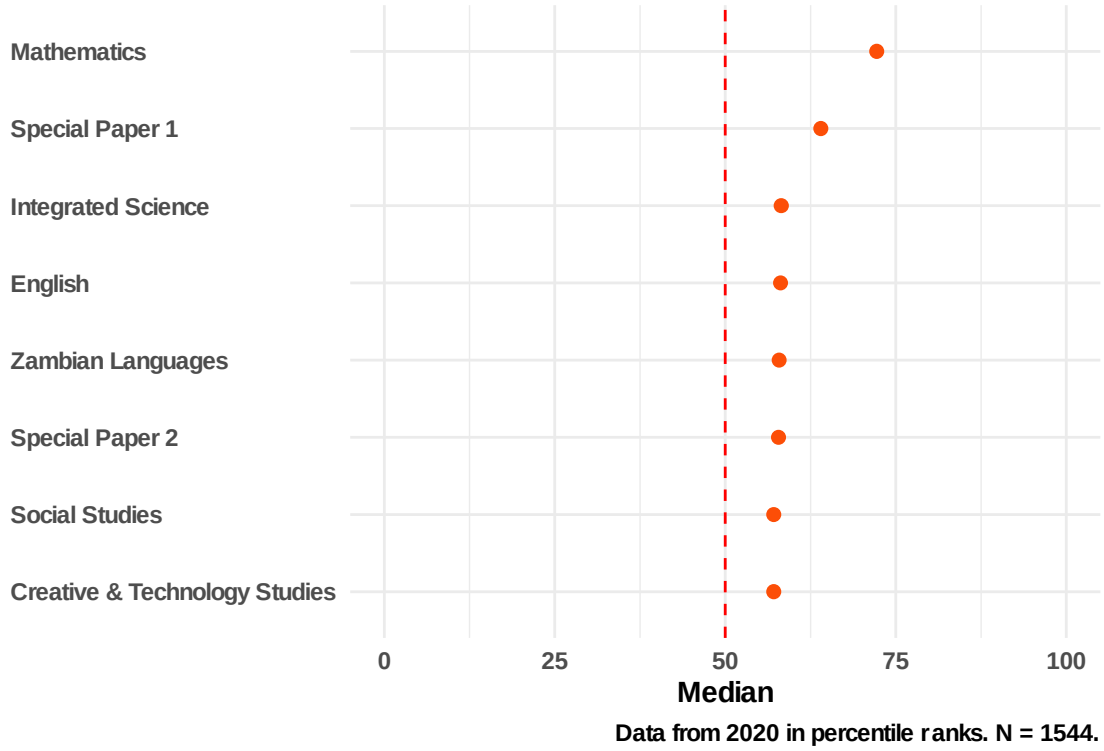
Results: Impact of Edulution programme on mathematics score

Concerning research question one, the results show that learners from the Edulution programme scored pronouncedly higher in the Grade 7 mathematics exam than learners from the entire regional cohort. This difference was statistically significant $t(1516) = 22.219$, $p < .001$, $d = 0.57$ 95% CI [0.51, 0.63]. In detail, the median learner in the Edulution programme was at the 72nd percentile compared to the median learner of the entire learner population, who was at the 50th percentile.

Percentiles are learners' ranks expressed on a scale of 100, with the best learners being at the 99th percentile and the worst at the 1st percentile. The 72nd percentile of the median Edulution learner means that their performance was superior to 72% of the entire learner cohort. This is an advance of 22 percentile ranks compared to the median learner of the entire learner population (at the 50th percentile; Figure 1).

Even if all Edulution learners are taken into account, including those who engaged in less than 120 hours in the programme, the difference between the median learners remains substantial, with an advance of 17 percentile ranks of the median Edulution learner.

Figure 1: Edulution learners' median (red points) vs median of entire cohort (dashed vertical line)



Compared to the other subjects, the advance of Edulution learners relative to the entire cohort was most pronounced in mathematics, which underpins the positive impact of the Edulution programme (see Figure 1). The median Edulution learner was also at significantly higher percentiles regarding the other subjects, i.e., Special Paper 1 and 2, Integrated Science, English, Zambian Languages, Social Studies, and Creative & Technology Studies, although to a considerably lesser extent.

Transfer effects might explain why Edulution learners scored higher than the entire cohort in subjects other than mathematics: gains in mathematics might relate directly to improvements in other logic-based subjects, especially regarding the Special Papers. Indirectly, learners' participation in the Edulution programme may also have increased their motivation to learn more thoroughly in other subjects. Moreover, Edulution's focus on disadvantaged areas would speak against the alternative hypothesis– that the organisation's learners were privileged in the first place. However, the research design does not permit causal interpretation. Only a randomised controlled trial could provide insight into the cause-and-effect relationship between the programme participation and improvements in other subjects.

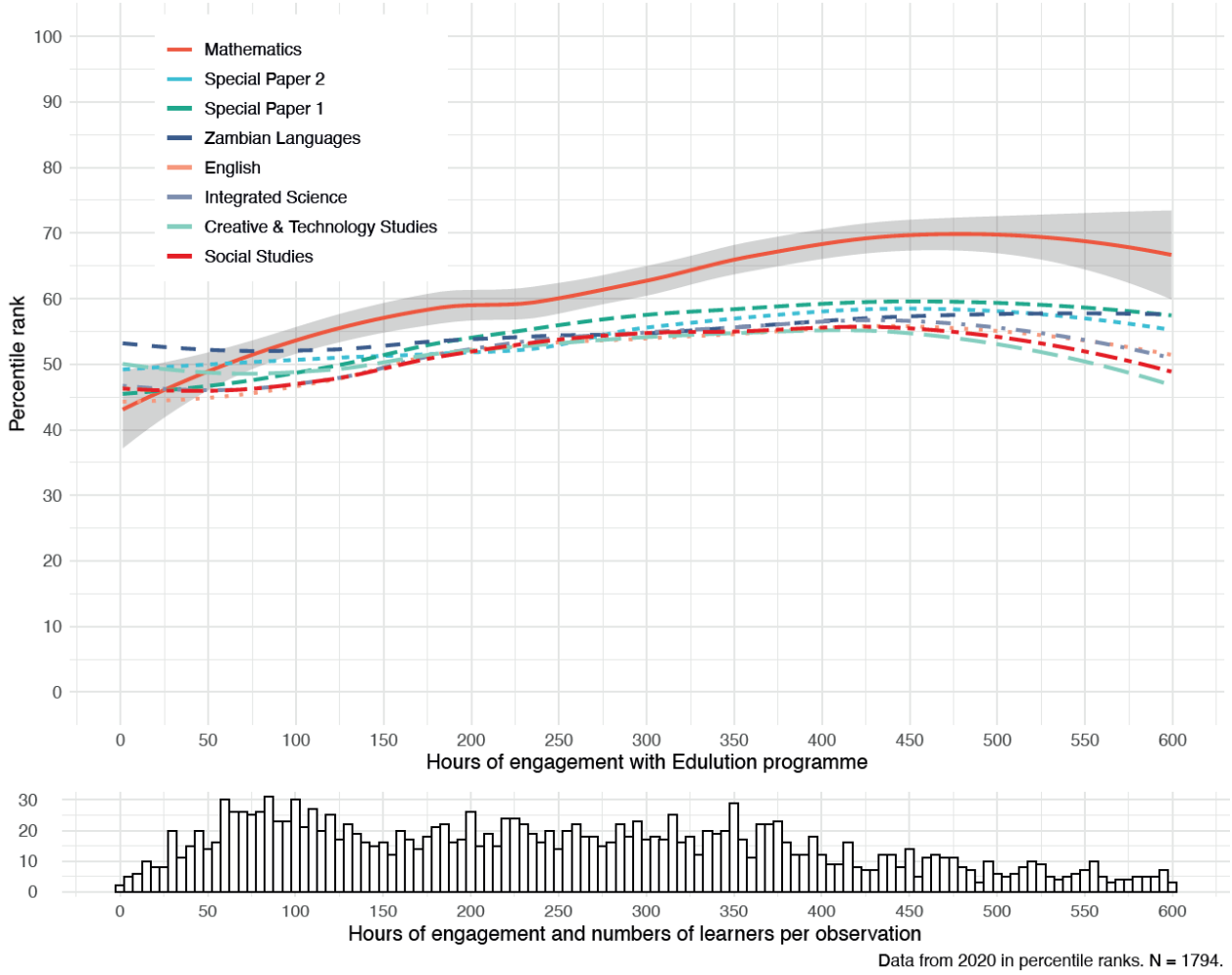
Regarding research question 2, regression analyses suggest that the specific engagement of learners with the Edulution programme is linked to concrete improvements in their Grade 7 mathematics score. The strongest relative predictor of learners' mathematics performance of all variables was the number of exercises.

In detail, the engagement with about 36 to 37 exercises in the Edulution programme was associated with an improvement of one percentile rank (drawing on robust linear regression and lasso regression, respectively). The other programme-related engagement variables, i.e. the number of logins, number of months active, and number of hours of engagement also predicted learners' success in the mathematics exams. Moreover, socio-demographic and contextual factors were associated with mathematics performance, including gender, age, and cluster. In detail, being younger or male was associated with higher scores, as were learners from the clusters in and around the city of Lusaka and the town of Lundazi.

Figure 2 visualises the relationship between hours of engagement with the Edulution programme and the development of learners' percentiles, shown through the red line. A relatively steep curve indicates a substantial increase in mathematic scores between zero and 200 study hours spent in the Edulution programme. The curve continues to trend upwards, and learners' engagement of 200 hours and more is linked to a further improvement of percentile ranks - up to about 500 hours. Studying more than 500 hours does not seem to be associated with further improvements, and the red line in Figure 2 indicates even a slight decline. However, this needs to be interpreted with caution, as only a few learners studied more than 500 hours, which diminishes the accuracy of the calculation. This variation is also expressed through a 95% confidence interval, the (widening) grey area underlying the red line. What can be inferred from this figure is that there is no added value of studying more than 500 hours in the programme for the vast majority of learners.

Moreover, Figure 2 shows that the percentiles for some other subjects also increase with the hours of engagement in the Edulution programme, most notably Special Paper 1; yet not as strong as mathematics. In contrast, the percentile development of Zambian languages is unrelated to the engagement with the Edulution programme.

Figure 2: Percentiles matched with hours engaged in the Edulution Programme



Comparison of key results between 2019 and 2020 cohorts and interpretation

The cohorts of 2019 and 2020 were almost identical in terms of age and gender distribution. There was, however, a difference in the learners' environment (urban vs rural), as the share of rural (vs urban learners) increased from 45% in the 2019 cohort to 55% in the 2020 cohort. This shift was caused by changes in participating schools, which also meant that the 2020 sample consisted of more students from community schools (from 23% to 29%) and fewer students from government schools (from 60% to 50%).

The percentile rank comparison revealed similar tendencies in the 2019 and 2020 cohorts. The results from the 2020 cohort concerning the mathematics percentile comparison were even better, with the median Edulution learner being at the 70th percentile in 2019 and at the 72nd percentile in 2020. In addition to changes in the cohorts, one interpretation is that this shift could be caused by enhancements of the Edulution programme. This included the migration to a new platform (Kolibri). The new platform offers additional content which is also better structured to flow with the pace of learning and it aligns more closely with the national curriculum. This platform migration required learners to redo exercises they had completed on the old platform, which resulted in a double count of some exercises.

Thus, the comparison of the association between completed exercises and mathematics performance between 2019 and 2020 is not meaningful.

Limitations

Firstly, the comparison of Edulution learners with the entire cohort of learners from the provinces where Edulution operates was not the result of a randomised sampling process of learners or schools. Instead, it drew on the existing Edulution cohort, which restricts causal interpretation. In other words, it cannot be statistically excluded that schools which work with Edulution are generally more privileged than others. Thus, the Edulution learners' higher ranks cannot exclusively be attributed to their participation in the programme. However, the fact that Edulution explicitly targets schools and learners in disadvantaged settings suggests the comparability of the two cohorts. Secondly, in the regression analyses that calculated the extent to which the engagement with the Edulution programme was linked to higher percentile ranks, we controlled for some but not all possible influencing factors. For example, we did not account for parental support, the socio-economic status of the learners' families, or individual learners' cognitive capabilities. For example, learners with higher levels of parental support, typically from families with a higher socio-economic status, could have possibly been motivated by their parents to engage in exercises and, additionally, supported by their parents in the learning process. This means that, potentially, part of the learning gains might be attributed to other factors, such as parental support, and not exclusively to the Edulution programme. Again, the fact that Edulution deliberately targets schools and learners in disadvantaged and rural settings where parents are from a lower socio-economic standing and less educated would suggest that they were limited levels of parental support given to the learners.

Conclusion

The mathematics performance of the median Edulution learner (who worked for at least 120 hours in the programme) differs significantly from the performance of the median learner of the entire cohort, with an advance of 22 percentile ranks. This is an indicator of the Edulution programme's *efficacy*. Even if all Edulution learners are taken into account, including those who studied less than 120 hours in the programme, the difference between the median learners remains substantial, with an advance of 17 percentile ranks of the median Edulution learner. This difference indicates the *effectiveness* of the Edulution programme. Moreover, increasing engagement with the Edulution programme, such as with exercises and hours, was linked to higher percentile scores. Despite limitations inherent in the particular research methods, taken together, the findings permit the conclusion that learners' participation in the Edulution programme is associated with markedly higher mathematics scores in the Grade 7 exam.

Disclosure

Edulution mandated the authors to conduct this analysis. The data analysis and the development of this report were carried out independently.