Learning gains from engagement with the WCED Maths Curriculum Online Programme

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Mathematics Education in South African continues to face complex, multifaceted challenges, but as data from this study shows, there is reason for much hope. The Western Cape Education Department (WCED) recently implemented a province-wide Maths Curriculum Online (MCO) programme to 500 primary schools to improve Maths education. Very often the benefits from projects that involve technology, are unevenly distributed between resource-rich and resource-poor schools. The current study forms part of a larger longitudinal project to understand the nuanced impact of the WCED MCO project in diverse contexts across the province.

The MCO project consists of various online tools that can be ubiquitously accessed by all stakeholders. These include weekly Brain Quests (BQs) and Quick Quests (QQs), MCO School-Based Assessments (MCOSBAs), GS Insights and GS Teach. BQs are sets of online exercises mapped to the curriculum and aligned to the education department's support material. Ideally, learners complete each week's BQ in tandem with the work they do in class. After submitting BQs, learners receive immediate feedback which they can use to return to the questions they had incorrect to try and solve them again. MCOSBAs are completed termly and may be accompanied by projects and additional activities. One teacher explains the benefits of MCO:

> "*Learners are exposed to relevant concepts aligned with CAPS, platform is colourful, learner friendly and encourages learners to attempt solving problems. I also pair stronger learners with ones who struggle to read because the focus is on the maths. Green shoots added more value to teaching, exploring methods and boosting my learners confidence, they are more eager to try to solve problems and they enjoy the feedback they get if answers are incorrect.*"[1]

The results of the BQs and MCOSBAs become immediately available to the class teacher who can track in real-time where problem areas arise in learners' responses to address these in the same session. During BQs teachers are also strongly encouraged to engage with learners and to address challenges or misconceptions as they notice these. These results also feed through to the school's senior management team (SMT), and to the district office where officials can identify trends from the data and gain insight into potential challenges. The data is also available to the WCED directorate at head office to track usage of the program throughout the province, and more importantly, to identify areas from the data where learners are generally struggling. With the data insights guiding them, the leaders throughout the system can make data-informed decisions regarding

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[1] Quotes are included as in the original.

teaching and learning, how to improve this, and which areas in the curriculum to target for interventions. The WCED are custodians of the data produced by the learners in the province, therefore strict ethical guidelines and rules govern access to this data.

Research Context

This study seeks to understand the learning gains of learners, parents and teachers as they engage in the Green Shoots Maths Curriculum Online (MCO) programme currently underway in 500 WCED primary schools. Rogaten, Rienties and colleagues' (2018) ABC classification of affective, behavioural and cognitive learning gain is used to analyse the learning gain for learners, parents and teachers who participate in the MCO programme. The study is framed by an Education Design Research methodology (Mckenney and Reeves, 2019), which is also referred as Design-Based Research.

The research takes place in the Western Cape province of South Africa, and involves 190 076 learners, 7270 teachers and 500 primary schools, representing:

- 53 Quintile 1 (11%)
- 87 Quintile 2 (17%)
- 77 Quintile 3 (15%)
- 151 Quintile 4 (30%)
- 132 Quintile 5 (26%)

The number of active learners in each district per quintile is illustrated in Figure 1.

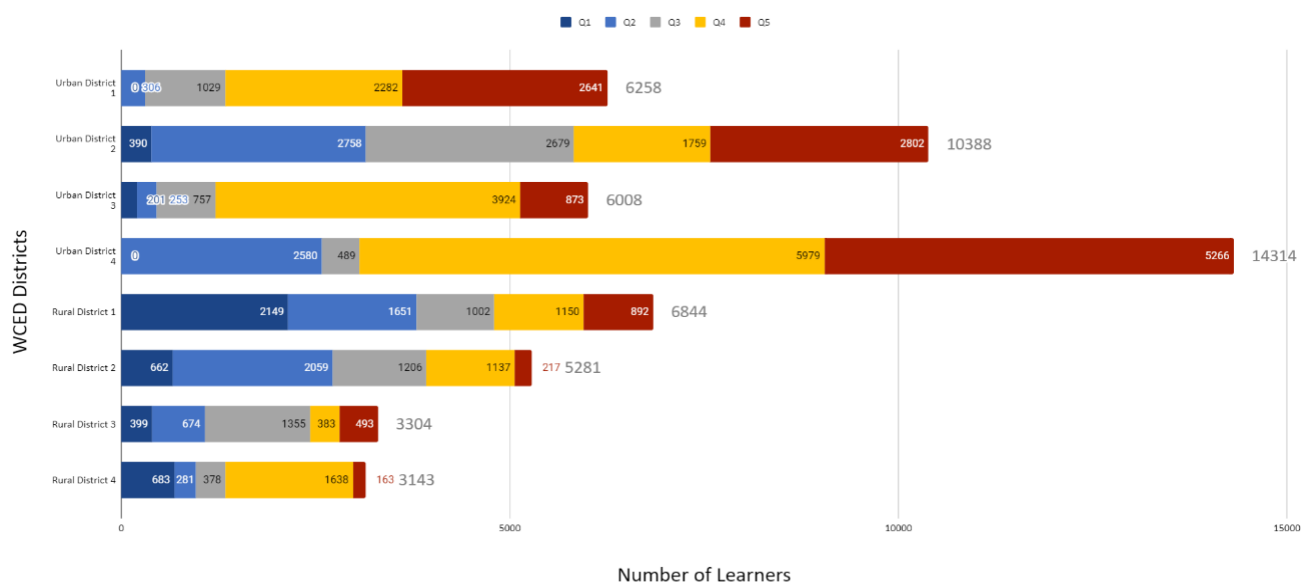The Distribution of Grade 6 Active Learners in each District per Quintile

Figure 1 The distribution of Grade 6 active learners in each district per Quintile

Data was produced through self-reported surveys involving 3270 learners and 286 teachers; project documents and reports; MCO usage data; and the Grade 6 results for termly MCO

assessments from Term 1 – 3 of 2022. The study was conducted with permission from the WCED and applied the strictest ethical standards to safeguard all participants' identities.

Learning gain was measured for learners, parents and teachers participating in the project. Data was analysed to identify the learning gains for each party and synthesized in Table 1.

Table 1 Summary of Learning Gains for Learners, Parents and Teachers who participated in the WCED MCO project

	Affective Learning Gains	Behavioural Learning Gains	Cognitive Learning Gains
Description	Change in affect for example confidence, motivation, or attitudes	Development of skills rather than knowledge, including for instance engagement and collaboration	Improvement or development in knowledge, understanding or cognitive or metacognitive abilities
Learners	Positive Maths perception Improved confidence enough to help / teach a friend, write a test or try new concepts / questions Greater ownership	Greater engagement and attempting more sums on MCO (compared to class) More engagement in collaborative learning, peer support & healthy competition Self-regulated behaviours: • Goal-directed behaviour • Check progress • Motivated and positive self-efficacy beliefs	Higher grades for MCOSBAs with lower quintile schools experiencing a higher improvement from Term 1 – 3, 2022 Increased concentration Greater Maths literacy and use of Maths vocabulary
Parents / Caregivers	Feeling empowered Able to understand learners' progress Able to support their children More positive belief about Maths	Greater engagement with teachers More parents access MCO	How to use MCO Understand learners' progress Can use MCO and get results from the website
Teachers	Increased confidence Lowered anxiety about Maths teaching / teaching generally Greater enthusiasm, interest, and enjoyment for teaching Maths	Greater variety of teaching methods used Higher use of GS Insights & MCO activity data to understand / analyse learners' data Greater school-wide use of Insights to make data-	Increased pedagogical and content knowledge Increased knowledge of assessment, cognitive levels and question types, and how to use these to support differentiation Increased understanding of differentiation and how to differentiate

		informed decisions (though not habitual use) Greater differentiation in the class through use of MCO	using data = data-informed decisions

Findings indicate that the MCO project impacted individuals and then multiplied to benefit different levels of the system. Learners gained Mathematical knowledge, practices and cognitive and metacognitive skills. Their parents gained a greater sense of empowerment and ability to understand their children's progress and provide support. Teachers gained greater confidence and lowered anxiety levels, more enjoyment and enthusiasm; their knowledge increased about Maths in general, teaching strategies and specifically differentiated methods to use; and how to make data-informed decisions and use data to differentiate their teaching. Such individual learning gains multiply within school ecosystems to benefit and further build the culture of teaching and learning. Teachers for instance who want to use the computers for MCO, need to stick to a timetable, necessitating the development and use of a timetable in the school. Similarly, the greater collaboration between colleagues to discuss data from GS Insights creates habits and skills that may impact other subjects within the school. Parents learning to understand one child's progress and how to support them, creates opportunities for siblings to receive similar support. Learners' gaining metacognitive skills to set goals and monitor their progress in Maths, opens opportunities for such skills to impact other subject areas as well. Hence, individual learning gain is multiplied to increase learning gain in the system.

The WCED MCO project impacted learners, parents and teachers from diverse backgrounds. While 306 587 learners are registered on the system, only 192 076 were active. The Grade 6 learners' data was used as a sample, and particularly the number of weekly BQs that they complete every term. The Activity Rate (AR) for Grade 6 learners in the province was calculated using this formula:

$$Activity\ Rate\ (AR)\ for\ each\ school = \frac{\text{Sum of BQs completed per term} \div \text{weeks in the term}}{\text{\#Grade 6 active learners per school}}$$

The resulting AR for each of the four Urban Districts (UD) and Rural Districts (RD) was then compared per quintile, as indicated in Table 2.

Table 2 Quintile and District Activity Rate for Grade 6 MCO learners in Term 3, 2022

Quintile	Urban Districts				Rural Districts				Quintile Activity Rate
	UD1	UD2	UD3	UD4	RD1	RD2	RD3	RD4	
Q1	0	2.4	0	0	**21**	2.6	2.6	1.4	29.9
Q2	2.5	**11.6**	0.2	9.1	7.5	6.8	6.8	0.6	45.1
Q3	5.7	8.1	3.4	1.4	**9.1**	2.9	4.8	1.2	36.5

Q4	13.6	7.1	10.7	**22.7**	8.7	4	0.5	2.2	69.6
Q5	20.3	10	3.6	**34.4**	4.7	2.7	3.9	2.2	81.8
District Activity Rate	42.1	39.2	18	67.6	50.9	19	18.6	7.6	262.8

The data from Table 2 suggests that learners in Quintile 5 (Q5) schools, especially in UD4, were the most active while Quintile 1 (Q1) schools' learners were least active. The greater AR in Q5 schools is often due to their greater access to devices and reliable connectivity. However, a closer look at the data reveals that rural schools particularly in RD1 achieved commendable ARs. RD1 has 52.9% fewer active learners (6844) than UD4 (14214), more Q1 schools (31) than any other district, and most Q1-3 schools in the district are situated outside urban settlements. Rural schools often function in more challenging circumstances, with frequent interruptions to electricity and internet connectivity. As the data in Table 2 shows, RD1s Q1 & Q3 schools scored significantly higher ARs than any of the other districts which is to be celebrated.

Understanding the different activity rates for the sample Grade 6 learners confirms that learners across quintiles are accessing and using the program, suggesting that the entire system is supporting change in schools. Teachers are committed to getting learners to the computer labs or on devices to complete the BQs. School leaders create a positive ecosystem that allow learners to access and use MCO. Schools work with the eLearning advisors to ensure that the technology infrastructure is available to support access to MCO, while also timetabling use of MCO in the school. Similarly, the eLearning advisors work with the eLearning Directorate to ensure that connectivity is made available whenever problems arise. Circuit managers work directly with principals and school leaders to make sure learners are active on the system by monitoring activity from the Green Shoots reports and GS Insights. Districts' Maths subject advisors work with teachers to support and guide their curriculum delivery and pacing, and the head office curriculum directorate strategically creates and maintains an enabling ecosystem to make all this possible. This systemic growth will be probed further in the next phase of the study, but at this point these findings demonstrate how a large-scale project such as the WCED MCO project, can benefit different stakeholders from diverse education contexts if the project is not framed as a stand-alone technology implementation, but as a part of a growing, evolving ecosystem.

More work is required to understand some gaps revealed from the research. Teachers' use of the MCO programme and how they can use this to plan, pace and deliver the curriculum is a focus for the next stage of the project. As is the use of GS Insight data within schools to understand how such organisations can make data-informed decisions a part of their culture and habits. In future, learners MCOSBA data can also be compared to systemic Grade 6 results that are typically published in March each year, to further interrogate the data and strengthen generalizable findings.

The next part of the study looks at ways in which learning gain is experienced by non-teaching educators at district offices and beyond, and to create a means to quantify the

increased learning gain in the system as a whole. These preliminary findings from the greater project, however, make it clear that hope for improved Maths education is being realized in the WCED MCO project.

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