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Baldese, Boitumelo

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DO TEACHERS NEED TO BELIEVE IN AN INTERVENTION FOR IT TO BE EFFECTIVE? A MEDIATION ANALYSIS OF THE READING CATCH-UP PROGRAMME IN PINETOWN, KWAZULU-NATAL

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by

Name: Boitumelo Baldese

Student No: 320138

Supervised by Prof Volker Schoer

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Abstract

Literacy, which is the ability to read and write, forms the building blocks to one's learning and inevitably enables active participation in a nation (Bormuth, 1974). The literacy landscape in South Africa is such that, although enrolment levels are high, about 74 percent of learners still cannot read with understanding after six years of schooling (Spaull & Taylor, 2015), rendering the quality of education in the country relatively poor. Consequently, there are studies that investigate interventions that may improve literacy outcomes, some of which focus teacher development and instructional change. This study is based on an initial study of the Reading Catch-Up Programme, a randomised control trial implemented in Pinetown, KwaZulu-Natal. The purpose of the programme was to effect instructional change with the use of scripted lesson plans, high quality reading resources as well as onsite one-on-one coaching in order to improve learner performance on literacy (Fleisch, et al., 2016). The purpose of this study to determine if teachers internalising the instructional change is significant in impacting learner performance, using a causal mediation analysis, where teachers' internalisation is the mediator and learner performance is the outcome. The study found that teachers' internalisation is not significant in impacting learner performance and that most of the teachers in the treatment group did not internalise the instructional change. Alternatively, the study may suggest a sequence of teacher change reflecting the Guskey model, where teachers form a belief in the instructional change only after the improvement on learner performance is evident, which may also encourage persistence and sustainability of the change. However, due to data limitations, the full Guskey sequence cannot be tested, which presents an opportunity for future research.

Introduction

Literacy may be loosely defined as the ability to read and write with understanding, and is considered man's most valued skill (Bormuth, 1974) because it forms the foundation to the building blocks of one's education; it is a gateway to future learning (Cilliers, et al., 2018). The fourth goal of the Sustainable Development Goals (SDGs) is to ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy by 2030 (United Nations Development Programme, 2015). The South African Nation Development Plan aligns with the UNDP's 2030 Agenda by targeting about 90 percent of learners in grades

3, 6 and 9 to achieve 50 percent or more in the annual national assessments in literacy, maths and science (National Planning Commission, South Africa, 2012). The main task for the next decade with respect to the SDGs is reorganise and reprioritise the education system such that learning is achieved in literacy and numeracy once learners have completed primary schooling (Fleisch, et al., 2016). It is widely recognised that a country's ability to educate its youth is measured by being able to impart to students the knowledge, skills, abilities, cultural understandings, and values that are necessary to participate as full members of their society, their polity, and their economy (Spaull & Taylor, 2015).

In South Africa, as with other African countries with a similar context, great priority is placed in increasing the levels of literacy as well as mathematical skills as seen in the National Development Plan (National Planning Commission, South Africa, 2012), as these are paramount for economic prosperity and the social wellbeing in the country. There is an urgent need to reduce literacy achievement gaps because of its impact ethically, to ascertain that learners are exposed to quality education as well as economically to produce the nation's workforce with the essential skills required for the 21st century (Bausmith, 2012) and beyond. Also, even though the potential productivity of people may be the same, differences in factors like social relations, attitudes to work, form of organisation and literacy levels contribute significantly to the realisation of varying productivity levels (Lewis, 1954). That is why addressing the literacy achievement shortcomings needs to be a policy priority.

Unfortunately, in South Africa, about 78 percent of children still cannot read with meaning after four years of schooling (Cilliers, et al., 2018). A critical approach for improving literacy outcomes is effectively teaching reading in the Foundation Phase (school grades R to 3, also known as part of Early Childhood Development) because if children do not acquire the necessary literacy skills in the first few years of primary school, they will struggle to complete the full school series and have a greater probability of dropping out (Piper, et al., 2014). In the long run, this could result in scarce skilled labour and further increase the already high unemployment rate, thus perpetuating inequality and high poverty levels.

A growing body of literature, some of which is unpacked in this paper, suggests that more focus needs to be put on pedagogic approaches in order to improve literacy. Failure to teach learners how to read may be attributed to unstructured and ineffective pedagogy, among other reasons, which perpetuate poor performance among learners. Many of the teachers have relatively low levels of education, infrequent in-service training and are faced with little to no instructional

support from cluster leaders, who spend most of their time on administrative tasks (Piper & Zuilkowski, 2015). The inability to train learners to read well means they do not perform well, which results in the evident low levels of literacy.

For many schools in South Africa, there exists an English language disadvantage as learners have to transition from their respective mother-tongue language as the Language of Learning and Teaching (LOLT) in the Foundation Phase, to English as the LOLT from the Intermediate Phase (Grade 4 to 7). Reducing this disadvantage experienced by many learners requires a better understanding of the mechanisms through which language elements affect learning outcomes and how English as the LOLT will be implemented through instructional approaches (Armstrong, et al., 2011).

In 2011, the Gauteng government rolled out the Gauteng Primary Language and Mathematics Strategy (GPLMS), which used a structured pedagogic programme model with coaching, particularly in low-performing primary schools in Home Language, English as a Second Language and Mathematics (Fleisch & Taylor, 2018). Structured pedagogic programmes are effective at promoting instructional change and student learning in foundation phase outcomes. Studies on the GPLMS strategy contribute to a growing body of research by presenting results on a system-wide, government-led initiative, which show positive learning achievements within a short period of time (Fleisch, et al., 2016). In light of initiating intervention programmes to improve school performance, the Reading Catch-Up Programme (RCUP) was formed. It was an eleven week intervention, which was implemented in 2014, aimed at increasing learner performance in literacy through improving English as a first additional language for Grade 4 – 6 learners (intermediate phase) as well as to help facilitate the transition of the LOLT from Home Language to English, using a structured pedagogic approach with onsite coaching. The RCUP study assessed the impact of the intervention on learner performance through a randomised control trial conducted in Pinetown, KwaZulu-Natal (Fleisch, et al., 2016). While the study found that there was little evidence that the RCUP had a meaningful impact, it found a statistically significant impact on spelling and language but not on comprehension and writing, as the learning domains. This could be attributed to the observed coach differentials, the likelihood that the intervention ran for a short period considering the time it may take for teachers to adopt instructional change, which is a very important factor for the success of the intervention or the role played by the teachers themselves in the intervention process.

This paper utilises the study by Fleisch et al. (2016) to evaluate the impact of the RCUP instructional change programme on learner performance in the Intermediate Phase in Pinetown, KwaZulu-Natal, focusing on the teachers' adoption of the instructional change, as a mediator, on learner performance. Furthermore, it analyses variations of impact on teachers internalising the instructional change, given the treatment and coach effects.

The main research question of this paper is "What is the impact of the teacher, in relation to the instructional change, as the mediator to learner performance?" In unpacking the research question, the underlying questions this paper seeks to answer in further analysing the role of the teacher are "Did the teacher internalise what was taught in the intervention? Was teachers' internalisation a necessary condition for improvement in learner performance through the intervention? And did it result in learners performing better? Another possible observation for further analysis as suggested by the coach effect is, did the coaches effectively teach the new methodology to the teachers? Essentially, does the teacher have to obtain a belief in the new pedagogy in order to implement it such that, it results in improved learner performance? Those are the form of questions that this study seeks to investigate and reach a significant conclusion that will define the role and impact of the teachers in the intervention. This study contributes to current research by determining the necessity of teachers internalising instructional change in order to for interventions to improve learner performance.

The rest of the paper is followed by the literature review, which provides more context to instructional change intervention programmes and outlines how the knowledge gap was identified, the research methodology which explains the RCUP intervention and the characteristics of the various study units. The data analysis begins with the descriptive statistics, the regression and mediation analyses followed by the discussion of the results obtained as well as the study's limitations. The paper is finalised with concluding remarks.

Literature Review

Spaull and Taylor (2015) posit that South Africa has high initial access and very low dropout rates before grade 6, with only 4 percent of learners who enrol but do not complete grade 6. However, there exists low learning for those who do complete grade 6, with 26 percent of learners who complete grade 6 but remain functionally illiterate (Spaull & Taylor, 2015). National and global assessments indicate that over half of South African learners cannot read

and comprehend at a basic level of literacy (Beck & Condy, 2017). This speaks to the poor quality of education in the country and urgent need for South Africa to address the literacy challenges and enable effective teaching practices so that learners read with understanding.

There have been many studies which attempt to devise a suitable approach to improving literacy outcomes. Duflo, Dupas and Kremer (2009) conducted a study on the impact of supplying additional resources versus effecting organizational changes as a quest to improve learner performance in primary schools in Kenya. The study shows that increases in resources (including changes in pupil-teacher ratios) alone may not be sufficient to improve school quality. Rather, what improved learner performance was implementing organisational changes which involved learners being taught by a contract teacher hired by the local community thus increasing parental involvement and monitoring by the school committee. Other studies include analysing the effect of flip chart use on test scores (Glewwe, et al., 2000), providing textbooks to learners (Glewwe, et al., 2009) as well as the use of technology through electronic books (Moody, 2010) and mobile phones (Kemp, 2011). Other methods researched to improve learner performance were tracking, which involves placing students in groups or classes based on their initial performance, as well as aligning teacher incentives that will encourage teacher effort across the performance distribution (Duflo, et al., 2011). The study found that while the direct impact of tracking on high performing pupils is positive, tracking benefited lower performing pupils indirectly by allowing teachers to instruct at their level. The approach of interest in this paper on improving learner performance is interventions through instructional change, placing focus on the role of teachers.

There is an increasing body of literature that places great focus on the role of the teachers as well as the method of instruction as a strategy to improving literacy outcomes in primary schools because teachers who teach and model effective literacy behaviours equip learners with the ability to read independently and help learners who are not exposed to reading and writing skills at their respective homes (Beck & Condy, 2017). In addition, there are recommendations (Fleisch & Taylor, 2018) to intervention programmes making use of instruments such as effective teacher professional development programmes, the use of lesson plans, coaching (onsite or virtual), teacher-coach relations as well as on teaching based on the critical elements of achieving reading proficiency. Specifying the critical elements to reading is important because it guides the pedagogy as well as the process of teachers adopting the instructional change.

Providing scripted lesson plans, along with high-quality reading resources for learners and suitable capacity building including strong system leadership, could shift teaching practice, which, in turn, will improve learning outcomes; as the learning materials provide students with the opportunity to practise new knowledge and skills (Piper, et al., 2014). Furthermore, appropriate capacity building in the form of more intensive group training or one-on-one coaching builds teacher capacity to enact the new set of practices (Fleisch, et al., 2016).

Piper et al. (2014) evaluated the impact of the Primary Maths and Reading Initiative (PRIMR) in improving reading outcomes in Kenya. The intervention was centred around improving teaching methods relating to literacy, moving teaching beyond using the whole-class oral repetition as their main method of instruction towards research-based strategies to improve the use of two languages – English and Kiswahili. The outcome of interest that were outlined from the initiative were fluency of reading, increasing the percentage of learners who read at the benchmark of the Minister of Education (65 correct words per minute (cwpm) for English and 45 cwpm for Kiswahili). The analysis showed that the first year of PRIMR had a positive impact on the three outcomes of interest—oral reading fluency, the percentage of pupils who read at the MOE's benchmark, and reading comprehension—although not on all combinations of language (English and Kiswahili), grade (1 and 2), and school type (public and nonformal) (Piper, et al., 2014). The lesson plans and teaching material from the initiative focused on spelling, phonological awareness, and comprehension which form the building blocks of reading and resonates with what the RCUP intervention has urged as the priorities of teaching reading and was incorporated in the training.

Cillers et al. (2018) conducted a study on improving teaching practices and performed a mediation analysis on the impact of teacher professional development, with the technique called group-guided reading as a mediator on reading proficiency outcomes. First, they experimentally compared two approaches of in-service teacher development for South African public primary school educators; one being training the teachers at a centralized venue and the other was classroom visits by coaches who continually observed teaching and provided feedback, demonstrating correct teaching techniques (Cilliers, et al., 2018). While the training approach provides more time for a deeper conceptual understanding to develop before implementing the new techniques, which might not be sufficient to change behaviour, the coaching approach could facilitate a change in behaviour by encouraging practice, which may in turn lead to learning by doing; and targeted feedback could assure correct application of techniques. Furthermore, it is found that the combination of coaching and lesson plans can

result in a relatively larger shift in effective teaching practice and improving learning, especially for difficult techniques. Subsequently, the study by Cilliers analysed the impact of implementing the 'group-guided reading' technique where students read aloud in small groups, as a mediator to literacy outcomes. Group-guided reading is considered an essential ingredient to learning since it provides opportunities for students to practice reading and receive individual feedback, but it is difficult to implement since it is viewed as a technically challenging technique. Both treatment arms (training and coaching methods) had a higher probability of implementing the 'group-guided reading' technique and learners are more likely to receive individual attention from the teacher when they read. They concluded that more than half of the impact of coaching can be explained by the improvements in group-guided reading. The PRIMR's research has asserted that teachers can be responsive to in-service teacher professional development (ITPD) if it is closely aligned to the lesson plans and other resources used in schools, and if teachers are observed and supported regularly (Piper, et al., 2014). High quality teacher development leads to lasting changes in instructional methods, which effect improvements in learner outcomes (Piper & Zuilkowski, 2015).

The literature by Piper et al. (2014) follows the Guskey model of teacher change in their approach of instructional change. The Guskey model advises on the teachers' attitudes and perceptions as a crucial vehicle through which teacher practices will change. Once teachers have bought into the change and their perceptions have transformed, this enables for the change to persist in schools and the programmes will be sustainable with lasting impact. Also, once the teachers have formed a belief in the change, there is ownership and opportunity for innovation in how they deliver the new pedagogy to the learners. However, teachers' buy-in will only take place if evidence of success is visible to them, using informal measures derived by the teachers themselves (Piper & Zuilkowski, 2015). In the systematic study used to test the model of teacher change, it was found that the changes experienced by the teacher from the instructional change were not based on the quality of teacher development programme they participated in but rather on the improved results attained by their learners (Guskey & Huberman, 1989). Therefore, changes in teachers' attitudes, beliefs and understanding generally followed, rather than preceded, changes in behaviour; they are most likely to implement the new instructional changes only after improvements in student learning outcomes are witnessed (Guskey & Huberman, 1989) because that is when they see the value of the intervention. Over time, the pedagogical change will be sustainable, as teachers base their support for new pedagogical structures from personal experiences of success rather than inputs

and indirect information relating to the instructional change (Fleisch & Taylor, 2018), which also encourages ownership and advocacy for the new and effective teaching practices on the teachers part. For Guskey, the most appropriate sequence for instructional change interventions that aim to improve learner performance and teacher beliefs must begin by enabling the teachers to implement the change first (Fleisch & Taylor, 2018); teachers have to practice the new method in class first and may form a belief in it as a result. This model implies that teachers require regular instructional support during the implementation stage; One-on-one coaching is a key element in providing this direct support through the use of feedback and corrective activities (Guskey & Huberman, 1989). This paper aims to investigate the application of the Guskey model further and possibly assess the alternative consideration that teachers would have to form a belief in the instructional change in order to effectively teach it to the learners. In addition, Guskey recommends that the process must be followed by evaluation of the new practice, either internally or externally, followed by correction and adjustment, and finally, assessment of the impact on learning (Fleisch & Taylor, 2018).

An additional and key component to instructional change interventions is support provided to the teachers throughout the process. Piper and Zuilkowski (2015) examine the impact of instructional support on learning outcomes. They focused on cost-efficient interventions of instructional change with the coaching approach, which is more fitting for low-resourced regions. They observed that coaches with a higher teacher ratio made fewer visits per teacher, and the teacher-coach ratio was negatively associated with student performance. Using causal methods, it was concluded that lower teacher-coach ratios might impact school performance outcomes positively. (Piper & Zuilkowski, 2015). Another common observation in literature is on the teacher support through the Teachers' Advisory Centre (TAC) tutors, also known as cluster leaders, as well as coaches, given that their role is critical in shaping instructional improvement nationally in Kenya. These trainers are viewed as crucial to the program's ongoing success and scalability. In the PRIMR initiative, TAC tutors and coaches received 15 days of training to ensure that they would be capable of guiding teachers as they implemented the program (Piper, et al., 2014). Piper and Zuilkowski provide empirical evidence regarding the most effective coach-to-teacher ratios in Kenyan schools and also discuss how the different ratios affect the duration and quality of coach-teacher interactions (Piper & Zuilkowski, 2015). They observed that a coach-to-teacher ratio of 1:17 was effective and perhaps a lower ratios could be more effective. Also, the evidence of observed lessons as well as detailed case studies indicated that the coaching approach encourages compliance in the programme and more

effective teaching of concepts that considered to be difficult (Fleisch & Taylor, 2018). These findings emphasize the importance of effective instructional support; although coaching is a component of the RCUP intervention, the topic of instructional support will not be central to our discussion.

Our study investigates the impact of the instructional change intervention and its effect on literacy outcomes, focusing on the teachers' internalisation of the change as a mediating factor. We use the critical elements of reading proficiency to form the benchmark of internalisation by the teachers. We also unpack the exposure of the teachers to coaches and its view against internalisation.

Research Methodology

The RCUP was an eleven week intervention which was implemented in 2012, aimed at improving English as a first additional language for learners as they move to the intermediate phase (from grade 4), to help facilitate the transition of LOLT from home language, using a structured pedagogic approach with onsite coaching. The RCUP study assessed the impact of the intervention on learner performance through a randomised control trial conducted in Pinetown, KwaZulu-Natal (Fleisch, et al., 2016). The designers of the programme prescribed a strict and consistent weekly teaching regimen to be followed, according to the same routine every week. The RCUP intervention programme included providing daily scripted lesson plans, six sets of teaching and learning resources, just-in-time training as well as in-class coaching to each teacher by two coaches (Fleisch, et al., 2016).

The RCUP intervention was implemented in 2014 in 100 public primary schools at the Pinetown district in KwaZulu-Natal. Only schools that scored 55% or below on the Grade 4 English (First Additional Language) test in both the 2012 and 2013 national standardised tests in the Pinetown district were eligible for inclusion, and the selected schools had to have entered national standardised tests for between 15 and 120 students in 2013. The sample consisted of 100 schools, from which 40 schools were in the treated group and 60 schools were in the control group. Fleisch et al. (2016) obtained data on baseline tests for 2663 learners from 96 schools. However, only data from 2543 learners who also wrote the endline test was used. This represented a 7.4% attrition rate, which is not significant. The attrition rate was slightly higher in the control group than in the treatment group.

One of the core components of the intervention design were the daily scripted lesson plans which were in accordance with the official curriculum by the Department of Basic Education. The objective of the lesson plans was to introduce and gradually instil a sequence of teaching practices that would improve teachers' time on task and institutionalise daily and weekly routines as well as to provide guided and paced lessons for the teachers to utilise throughout the intervention, ensuring that the official curriculum is covered. They also expand the teachers' repertoire and encourage teachers to incorporate practices of new and effective lesson strategies (Fleisch, et al., 2016). Finally, lesson plans were designed to reduce teachers' planning and administrative workloads by allowing the teachers to concentrate on actual teaching, thus shifting the focus from interpreting the national curriculum to delivery of the curriculum (Fleisch, et al., 2016).

The lesson plans and teaching material from the RCUP intervention put emphasis on what was considered the important elements of teaching reading proficiency - spelling, phonological awareness, and comprehension - which form the building blocks of reading. Cillers et al. (2018) note that in order to acquire reading proficiency, there needs to be a systematic practice of all the different components of reading, at the appropriate sequence and pace; starting from the development of vocabulary, to recognizing sounds and letters (decoding), and moving towards recognizing words and eventually reading extended texts. The ultimate goal of reading with comprehension can only be reached once learners can read fluently. Comprehension is arguably the most important indicator, since the ultimate goal of literacy is reading with comprehension (Cilliers, et al., 2018).

The dominant norms of teaching practice in South Africa involve an overreliance on teacher-directed strategies and whole-class activities, such as "chorusing", where the teachers and students all read together, or repeat after a teacher. With these activities, there is a risk that students do not attempt to read themselves and merely mimic what the teacher is reading, hence whole class reading is not recommended when effectively teaching reading. This is different to group-guided reading, where each student reads aloud in smaller groups and teachers are able to give more individual attention and provide immediate feedback (Cilliers, et al., 2018). Group-guided reading is highly recommended, although it is classed as highly technical and is often complicated for teachers to implement. Fleisch et al. (2016) also discuss the elements that are used to teach literacy, which are comprehension, spelling, read aloud in class, phonics and letter blends, critical thinking and whole language (grammar). From there, the elements

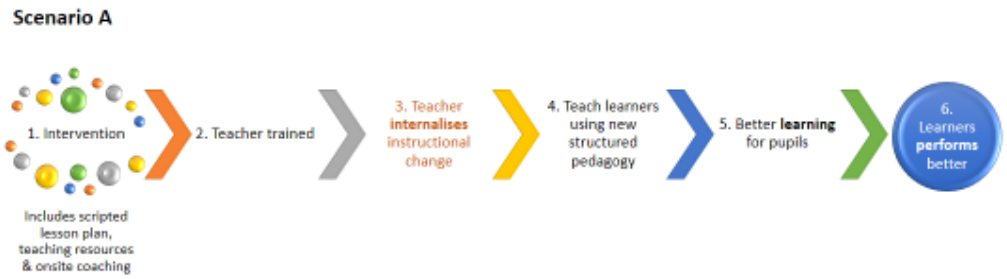
which are considered a priority to teaching literacy, particularly from the Foundation Phase, are spelling, comprehension as well as phonics and letter blends. The transparency of a language refers to the mapping of letters (spelling) and sounds (phonology), and when the focus is on these specific elements, learners are able to connect spelling to meaning, discuss different levels of representation in written words thus acquiring skills of vocabulary learning and reading comprehension (Devonshire, et al., 2013). Critical thinking and whole language is not a priority in the Foundation and Intermediate Phases given its level of difficulty, which could perpetuate underperformance if taught prematurely. Whole class reading is ineffective because the confident readers read louder while the unconfident ones murmur, further widening the disparity between the good and poor readers. The elements for teaching literacy are included in the endline questionnaire of the RCUP study for teachers. Both the control group and treatment group teachers were asked to identify the three most important elements of teaching literacy. This paper aims to assess whether teachers in the treatment group had a higher probability of reporting the correct elements of reading proficiency, thus adopting them in their teaching practice, as a result of the instructional change intervention. For the purposes of this study, teacher internalisation is defined as teachers having received training from the intervention, successfully adopting the three elements of reading proficiency and gaining a belief and perception towards the new pedagogy that may result in a positive impact on learning outcomes. Because it was the treatment group that was exposed to the intervention and were evaluated for the change, we expect the treatment group to report the appropriate elements with a higher probability. However, this term does not apply to the control group; although they may have identified the elements of reading proficiency, they were not exposed to the RCUP training. For ease of reference, internalisation is the term that will be used in this paper bearing the definition outlined in mind for clearer context.

The RCUP intervention used the coaching approach in facilitating the instructional change to teaching reading in primary schools. Two coaches were allocated to the programme, providing just-in-time training and ongoing in-class coaching to each teacher. The coaches provided training to the teachers in small groups and visited each of these classes to model correct teaching practice. The coaches also monitored and tracked teachers' participation (Fleisch, et al., 2016). Coaching aims to provide an additional set of mechanisms to ensure that new methods are being attempted, facilitate an evaluation of how new practices are being implemented and encourage re-implementation in a better way through both guidance and even modelling best practice themselves (Cilliers, et al., 2018). The approach promotes adherence

to the programme and better use of the more difficult teaching methodologies (Fleisch & Taylor, 2018). The RCUP intervention made use of two coaches (labelled Coach A and B) to facilitate the intervention. Each coach was allocated 20 schools and the impact of each coach on the programme could be determined. The evidence in the initial study showed no significant impact for Coach B for any of the outcomes, however, there were statistically significant effects for Coach A on spelling and language. This may suggest that the success of an intervention largely depends on the coaching characteristics. We will analyse teachers' internalisation under each Coach (A and B) to assess whether the coach differentials evident in the initial study also reflect in the teachers' internalisation of the instructional change as it does in learner performance.

Figure 1 below illustrates three possible scenarios for the theory of teacher change as the instructional change intervention is implemented and our analysis tests these scenarios to determine which one better reflects the process of teacher change as well as its relation to the RCUP study by Fleisch et al. (2016). The first scenario (Scenario A) starts with the RCUP intervention implemented at the selected treatment schools, along with the package that consists of daily scripted lesson plans, high quality reading material as well as onsite coaching (also known as the triple cocktail). The outcome of the initiation of the intervention is that teachers are now trained. Once the teachers are trained, they then internalise the instructional change by developing a belief in the new form of methodology and applying it in their teaching practices to the learners. This results in better learning for the learners, from which the outcome is improved learner performance. The previous study by Fleisch et al. (2016) concentrated only on the impact of step 1, the intervention on step 6 as the final outcome. However, the results of the final outcome (step 6) may be attributed to the intermediate factors within the process, thus prompting for further investigation on the impact of step 3 being the teachers' internalisation, which is highlighted below, and its impact on the learning outcome (step 6). However, there lies a possibility that the process of teacher change follows a different sequence, hence, we outline two other possible sequences which will be tested later on as we proceed with the analysis. The second scenario (Scenario B) suggests that once the teachers are trained, they internalise through practice, simultaneously as they teach the learners using the new pedagogy. This then results in better learning for the pupils and improved literacy performance. The third and final scenario (Scenario C) emulates the Guskey model of teacher change. Once the teachers are trained, they teach the learners reading using the new pedagogy. The learners are then assessed and if their performance improves, the teachers then internalise the new

structured pedagogy from seeing evidence that the instructional change is effective. Once they've internalised the change, they can then form a better understanding and teach reading more effectively. This paper further analyses the study to determine which of the below sequences is a more accurate reflection of teacher change and achieving improved learner performance. The importance of understanding and testing the differences in the three sequences below is to learn the stage at which instructional change will have the most impact in the process as well as to recognise where the teachers best effect learner performance. This may guide future research to align instructional change interventions on which aspects in the appropriate sequence. However, a limitation to note regarding this study is that it would prove to be difficult to test the sequence as per the Guskey model of teacher change (Scenario C), which posits that internalisation follows learner performance which forms the evidence that would alter the teachers' attitude and perception. However, data on teacher internalisation after learner performance was not collected through a follow-up teacher questionnaire, disabling the study from conclusively testing the Guskey sequence.



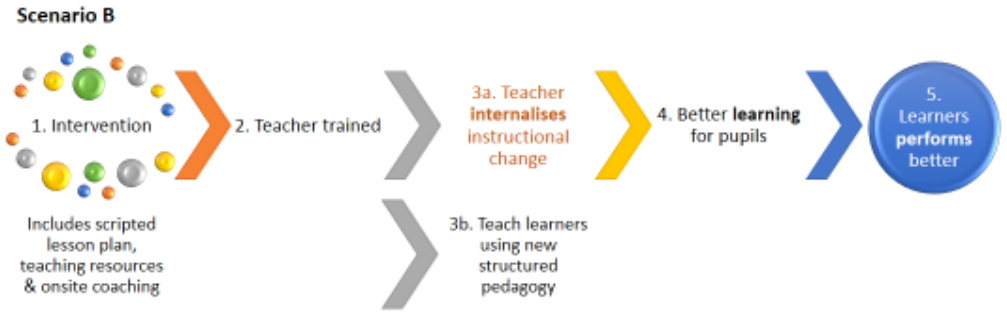




Figure 1: Scenarios on theories of the RCUP Instructional Change

Given the aim of the RCUP as well as the subsequent evaluation outlined in this paper, we would expect the outcome to reflect the sequence illustrated in Scenario A or Scenario B. The structure of the instructional change intervention included resources like scripted lesson plans and onsite coaching for 11 weeks, which would enable the teachers to internalise the instructional change, whether prior (Scenario A) and simultaneously (Scenario B) to teaching the learners and would ultimately impact learner performance. However, the Guskey sequence remains a possibility as teacher may want to view evidence from the intervention before committing to the change, so we perform an analysis below to test for most fitting theory of teacher change.

The initial study found that there was little evidence that the RCUP had a meaningful impact on the learners' overall performance. However, the RCUP study concluded that, with high levels of statistical significance, the intervention positively impacted spelling and language outcomes for learners in the treatment group by 1.27% points and 3.96% points respectively, relative to the control group. The estimated impact for comprehension and writing outcomes was not statistically significant from zero (Fleisch, et al., 2016). As such, most of the analysis in our study will focus on spelling and language, as they were the two domains with significant impact.

The RCUP evaluation was a randomised control trial. In the initial RCUP study (Fleisch, et al., 2016), the focus was on the actual treatment which is the intervention and its impact on the outcome, being the learner performance. In this paper, more focus is put on the effect of the teacher as the mediator on the outcome being learner performance, therefore, a causal mediation analysis is the appropriate method that will be used in this study. "Causal mediation analysis allows the examination whether the treatment causally affects the outcome and helps

identify the intermediate variables that lie in the causal pathway as the treatment indirectly influences the outcome through the mediator" (Imai, et al., 2010, p309). It has been identified that the treatment is the RCUP intervention, the teachers (their internalisation of the instructional change) are the mediator and the outcome is learners' performance. Over and above analysing the impact of teachers' internalisation on learner performance, we further unpack the teachers' internalisation as the mediator by studying the impact of the coach-to-teacher relationship and observe if teachers exposed to Coach A had a higher probability of internalising the intervention than those coached by Coach B. In our study, we perform a mediation analysis to determine the role of the teacher internalising the instructional change as the mediator in improving learner performance. From the output derived, we will also determine direct and total effects through the mediation analysis. The effects as outlined by Pearl (2014), applying the definition to our case, are as follows:

- Total Effects (TE): measures the complete effect of the treatment and mediator on the outcome
- Natural Direct Effect (NDE): measures the direct effect of the mediator on the outcome
- The Average Causal Mediation Effects (ACME): measures the average mediation effect of the mediator on the outcome.

Thereafter, we perform a sensitivity analysis to check for robustness. "The sensitivity analysis investigates how robust the results are to the violation of the sequential ignorability assumption." (Hicks & Tingley, 2011, p5) Sensitivity analysis is based on the correlation between the error term of the mediator and that of the outcome.

Descriptive Statistics

A sample size of 100 schools, from which 40 schools are in the treated group, was used. The sample contained 2663 learners but only 2543 learners were included in the analysis, as they wrote both the baseline and endline test. The class size ranged from 23 to 67 students per class. The sample also contained 106 teachers. The summary statistics table and correlation matrix of the variables used in our analyses are shown in the Appendix below.

Two waves of questionnaires were taken by teachers, conducted at different times in the intervention period. The first wave was taken before the commencement of the RCUP

intervention and is considered the baseline questionnaire for the teachers, the second wave at the end of the programme and is considered the endline questionnaire for the teachers. The questions asked related to teacher demographics, qualifications and teaching experience, characteristics of the school and learners' environment as well as teachers' method of teaching reading. The question relating to internalisation in the endline questionnaire was posed as follows:

In your opinion, which of the following are the most important three priorities when teaching reading?

- *Critical thinking*
- *Spelling*
- *Whole class reading aloud*
- *Phonics and letter blends*
- *Whole language*
- *Comprehension*

The three elements that are considered important for teaching reading are spelling, phonics and letter blends as well as comprehension.

In analysing internalisation, we see from the figure (Figure 2) below that only 7.6% of treated group and 3.6% of the control group captured all the elements correctly. This indicates that more of the teachers from the treatment group have reported all three elements of teaching literacy correctly, relative to the control group. Although this may be the case, most of the teachers overall did not internalise the instructional change (about 92% of the treatment group failed to identify the critical elements for teaching reading), which shows very little evidence of internalisation.

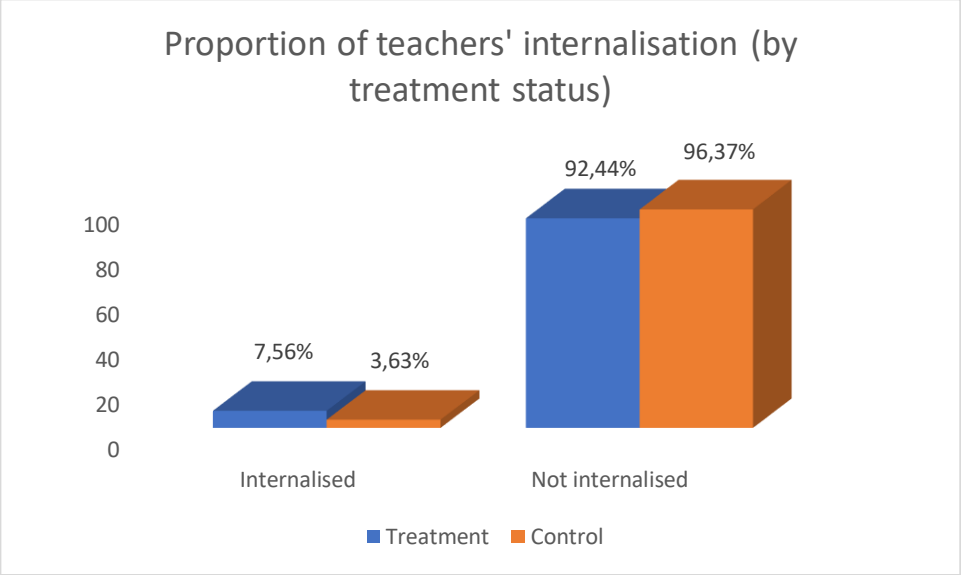


Figure 2: Teachers' internalisation (treatment vs control group)

The graph below (Figure 3) shows the reported elements of reading proficiency by teachers, individually, by treatment status. It is shown that most teachers overall identified spelling, followed by phonics, then comprehension, which are the elements of reading proficiency. The least amount of teachers identified whole class reading and whole language as prioritized components in teaching reading, these elements do not align with the teaching practices facilitated in the intervention programme. Furthermore, the teachers in the treatment group mostly report spelling and phonics as the most important elements of teaching reading. When zooming in a bit further into the treatment group, reporting these elements by coaches shown on figure 4 below, it is seen that of the three correct elements, spelling was mostly selected by teachers trained by Coach B, comprehension by Coach A and phonics is almost equal between the two coaches, with a leniency towards Coach A. It is also interesting to note that those who selected whole class reading as an element for teaching reading all belonged to Coach A, who happened to have a significant treatment effect in the initial study, and none from Coach B. This makes it surprising to see that despite the fact that those who selected whole class reading aloud all belonged to Coach A, they still managed to impact a greater treatment effect.

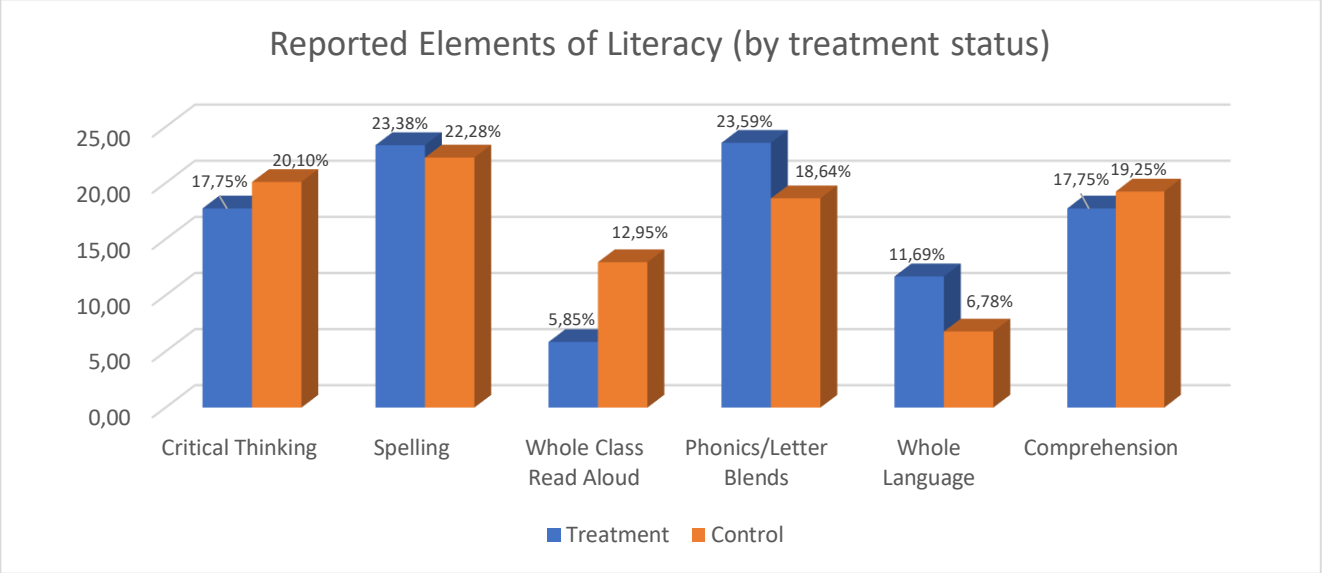


Figure 3: Teachers responses on endline questionnaire per category

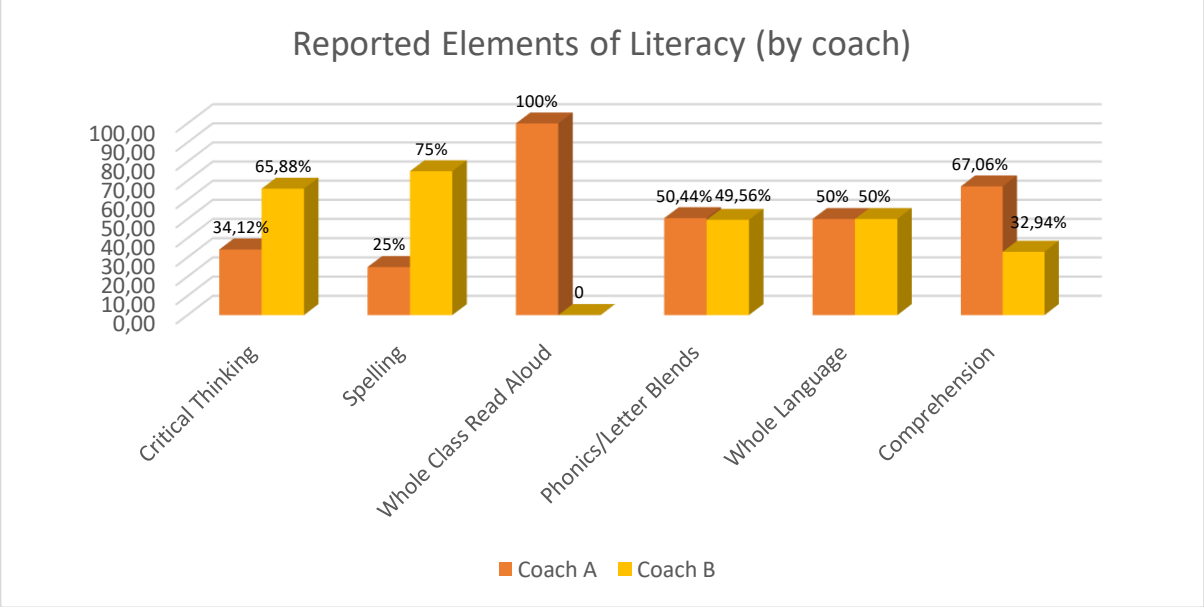


Figure 4: Teachers (treatment) responses of elements by Coaches

Learners completed an assessment in the form of a literacy test. The baseline test assessed the learners' initial and actual reading levels and skills and the endline test evaluated the difference as a result of the intervention. The estimated treatment effect observed on the overall literacy score is 0.49% points gained relative to the control group (Fleisch, et al., 2016). The endline scores by category on Figure 5 below show that, on average, learners from the treatment group scored more for spelling, language and writing, relative to the learners in the control group. It

is also seen that, overall, learners scored higher scores, on average, for comprehension, followed by spelling and language. This aligns with the important outcome of the RCUP intervention, in terms of the elements to learning reading.

This shows that, by individual category, teachers are aware of the important elements of reading as relayed by the RCUP intervention and are able to transfer the knowledge to learners. However, whether the full combination of elements is collectively internalised or not will be analysed below.

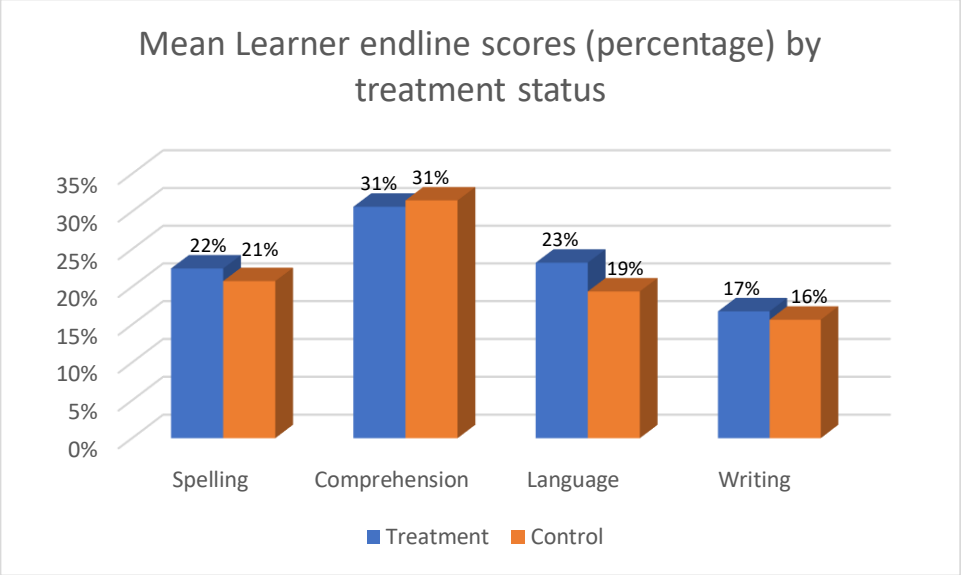


Figure 5: Learners' endline scores per category, by treatment status

This study will also explore the data relating to coaches. In the initial RCUP analysis, it is shown that the impact for Coach A is relatively larger compared to Coach B. Even though the training material used by the coaches is the same, there is a possibility that they delivered the pedagogical structure such that the teachers understood it differently. We further investigate if the impact of the coaches can explain learner performance, through the teachers as the mediator, in the RCUP intervention. When zooming in further on the learners endline test scores by the coaches as shown on Figure 6 below. It is noted that, on average, learners who were taught by teachers trained by Coach A score higher marks compared to learners taught by teachers who were trained by Coach B. Although the difference is minimal, this affirms the coach effect on learner performance by Coach A outlined in the RCUP study.

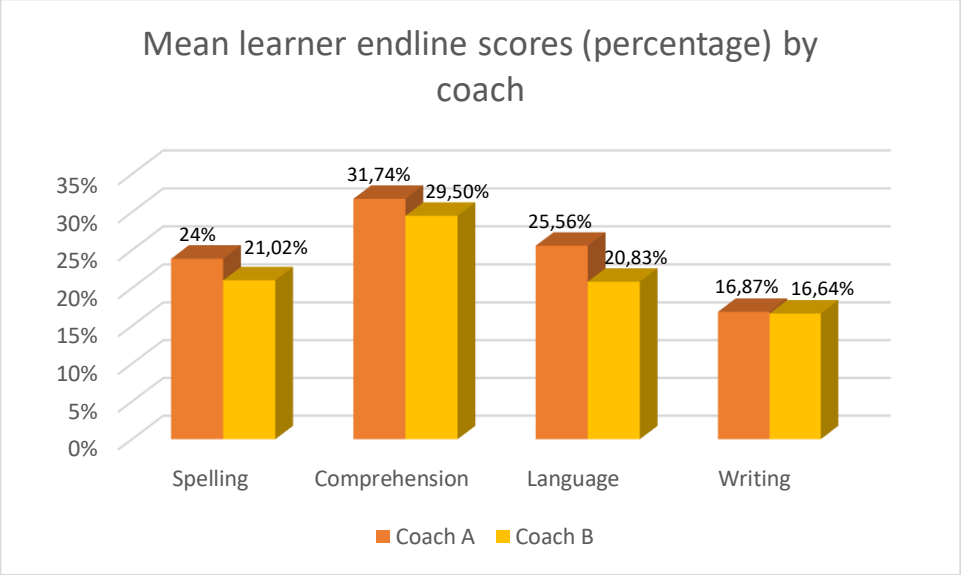
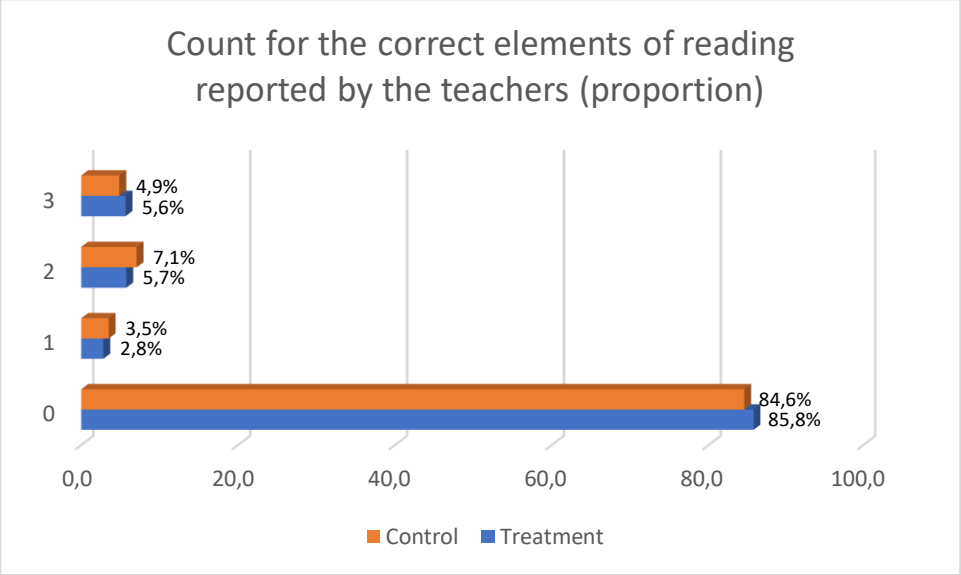


Figure 6: Mean learners' endline test scores (percentage) by coach

Figure 7 below shows the proportion of teachers' responses of the correct elements of teaching reading by treatment status as well as by coach. About 5.6% of the teachers in the treatment group reported all three elements correctly, compared to the 4.6% of teachers in the control group. The rest of the proportion in the respective groups reported less than the three important elements and over 80% of teachers in each group failed to identify any of the elements. When sorting the treatment group by coach, the representation of the results look similar. The proportion of teachers who reported the three correct elements are similar between Coach A and B, with teachers trained by Coach B slightly higher at 5.7%. The proportion of teachers reporting two correct elements is also similar, with those under Coach A slightly higher at 5.8%. Both graphs show that most of the teachers failed to report any of the correct elements of teaching reading.



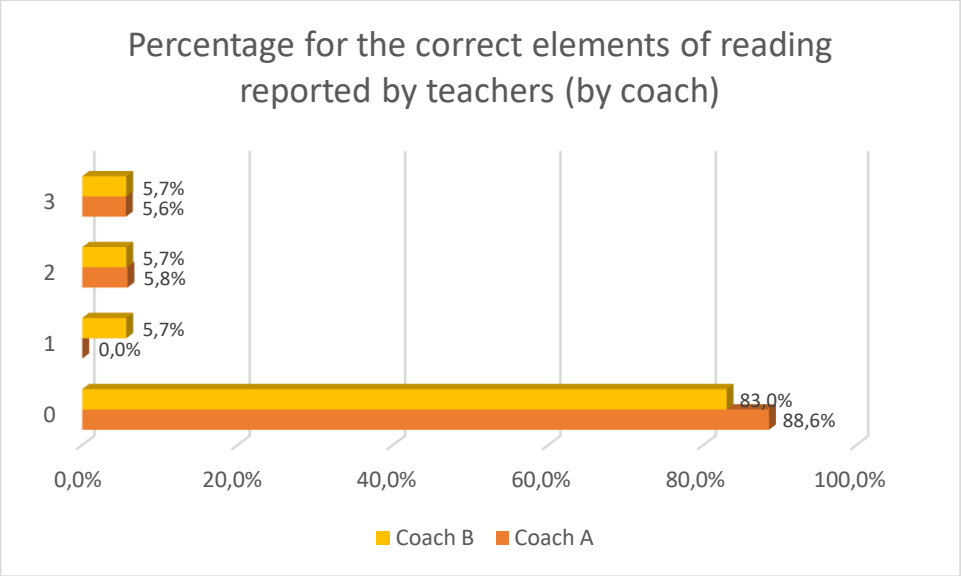


Figure 7: Count of correct elements of literacy reported by the teachers (proportion)

To investigate further, we run a regression analysis to observe the relationship between teacher internalisation and the respective coaches. The descriptions of the variables are available in the appendix. The output is shown below:

Probit Regression

				Number of obs	=	2536
				LR chi2(2)	=	0,76
Log likelihood = -515,34953				Prob>chi2	=	0,6843
				Pseudo R2	=	0,0007

Teachers' internalisation	Coef.	Std. Err.	z	P>|z|	Conf.	Interval]
Coach A	0,071551	0,106129	0,67	0,5	-0,13646	0,27956
Coach B	0,075561	0,106244	0,71	0,477	-0,13267	0,283795
c	-1,65883	0,054286	-30,56	0,000	-1,76523	-1,55243

Table 1: Regression of teachers' internalisation and coaches

The analysis above shows that there is no significant relationship between either Coach A or B and teachers' internalisation, which indicates that the coach characteristics and coach differentials identified in the initial study did contribute to impacting internalisation.

We lastly follow by running a regression analysis on internalisation of each of the elements against the coaches to determine whether the treatment effect by each was on one of the elements required to effectively teach reading. We begin with spelling, followed by phonics then comprehension. The output for the three elements is shown below:

Probit Regression

				Number of obs	=	2536
				LR chi2(2)	=	33,61
Log likelihood = -897,00909				Prob>chi2	=	0,000
				Pseudo R2	=	0,0184

Teachers' internalisation (spelling)	Coef.	Std. Err.	z	P>|z|	Conf.	Interval]
Coach A	-0,40814	0,10016	-4,07	0,000	-0,60445	-0,21183
Coach B	0,225136	0,078585	2,86	0,004	0,071113	0,379159
c	-1,17914	0,04142	-28,47	0,000	-1,26032	-1,09796

Table 2: Regression of teachers' internalisation and coaches (spelling)

Probit Regression

				Number of obs	=	2536
				LR chi2(2)	=	1,28
Log likelihood = -852,82574				Prob>chi2	=	0,527
				Pseudo R2	=	0,0008

Teachers' internalisation (phonics)	Coef.	Std. Err.	z	P>|z|	Conf.	Interval]
Coach A	0,079872	0,085638	0,93	0,351	-0,08798	0,247721
Coach B	0,07418	0,086066	0,86	0,389	-0,09451	0,242865
c	-1,28303	0,043536	-29,47	0,000	-1,36836	-1,1977

Table 3: Regression of teachers' internalisation and coaches (phonics)

Probit Regression

				Number of obs	=	2536
				LR chi2(2)	=	12,87
Log likelihood = -796,67631				Prob>chi2	=	0,002
				Pseudo R2	=	0,008

Teachers' internalisation (comprehension)	Coef.	Std. Err.	z	P>|z|	Conf.	Interval]
Coach A	0,0616	0,085439	0,72	0,471	-0,10586	0,229056
Coach B	-0,31851	0,101005	-3,15	0,002	-0,51648	-0,12055
c	-1,26476	0,043141	-29,32	0,000	-1,34931	-1,1802

Table 4: Regression on teachers' internalisation and coaches (comprehension)

The output shows that for internalising spelling, Coach A and B are significant at a 5% level, however, for internalising phonics, both Coach A and B are not significant. For internalising comprehension, Coach A is not significant but Coach B is significant at a 5% level with a negative coefficient showing that teachers trained by Coach B have a lower probability of reporting comprehension as an element of reading proficiency. This aligns with the illustration on Figure 4. This means that Coach A and B have a treatment effect on the teachers internalising spelling, Coach B on comprehension and none of the coaches on phonics.

Regression Analysis

From the analysis shown in the descriptive statistics above, we have seen that when analysing the data by treatment status, the teachers from the treatment group seemed to have adopted the instructional change slightly better, relative to the control groups understanding of effective teaching of reading. When focusing on the treated group and analysing by coach, the output is ambiguous making it challenging to provide a clear stance with regards to the coach effect, as with the initial RCUP. We now run regression and mediation analyses to determine the role of teachers' internalisation as the mediator.

We create a binary variable for the mediator that indicates 1 if the teacher identified spelling, phonics and comprehension (all three elements) as the key elements to teaching reading and 0 if otherwise. This represents the teachers' who have reported the correct elements which are then implemented in their teaching practice. To determine the mediation effect, we will subtract the effect of the mediator on learner performance from the effect of the intervention directly on learner performance.

We start by regressing teachers' internalisation by treatment assignment using the following equation:

$$M_i = \alpha_1 + \beta_1 T_i + \varepsilon_{1i} \qquad (2)$$

Where

M_i = mediator effect, being the teachers' internalisation binary variable for teacher *i.*

T_i = binary treatment variable

ε_{1i} = residual term

We obtain the following results:

Source	*SS*	*df*	*MS*	*Number of obs*	=	2536
Model	0,037469	1	0,037469	F(1,2534)	=	0,76
Residual	124,19558	2534	0,049012	Prob>F	=	0,382
Total	124,23304	2535	0,049007	R-squared	=	0,0003
				Adj R-squared	=	-0,0001
				Root MSE	=	0,22139

Teachers' Internalisation	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Treatment Group	0,007877	0,009008	0,87	0,382	-0,009788	0,025541
c	0,048575	0,005634	8,62	0,000	0,0375272	0,059623

Table 5: Regression of teachers' internalisation in treatment group

The above results show that there is a positive correlation between teachers' internalisation and the treated group but the coefficient is not significant. This indicates that teachers' internalisation of the treatment group is not significant in the mediation analysis. This gives us an indication that teachers' internalisation may not be that significant in impacting learner performance, but we continue with the analysis to ascertain if this is really the case.

The regression used to estimate the mediator effect is as follows:

We follow by setting the regression equation to estimate overall learner performance, with teachers' internalisation as the mediator is as follows:

$$Y_{zi} = \alpha_2 + \beta_2 T_i + \gamma_2 M_i + \theta_2 Xi + \varepsilon_{2i} \quad (3)$$

Where

Y_i = endline score for learner i, $z=s$ for spelling and $z=l$ for language

X_i = overall baseline score for learner i

ε_{2i} = residual

B_2, γ_2 and θ_2 represent the structural parameters which need to be estimated from the data.

The null hypothesis states that $\gamma_2 = 0$, meaning that learner performance is not attributed to teachers' internalisation as a mediator effect.

Source	*SS*	*df*	*MS*	*Number of obs*	=	2536
Model	44780,8765	3	14926,96	F(1,2532)	=	2005,62
Residual	18844,56480	2532	7,442561	Prob>F	=	0,0000
Total	63625,44120	2535	25,09879	R-squared	=	0,7038
				Adj R-squared	=	0,7035
				Root MSE	=	2,7281

Endline Score (Spelling)	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Treatment Group	0,2837833	0,111031	2,56	0,011	0,0660634	0,501503
Teachers' Internalisation	0,1828994	0,2448	0,75	0,455	-0,2971285	0,662927
Baseline Score (Spelling)	1,06637	0,013761	77,49	0,000	1,039385	1,093354
c	0,7584525	0,08581	8,84	0,000	0,5901886	0,926716

Table 6: Regression for spelling and teachers' internalisation

This regression shows that learner performance in spelling is positively correlated with the treated group, and is significant at a 5% level of significance. However, teachers' internalisation is positively correlated with the learner performance in spelling but is not significant.

Source	*SS*	*df*	*MS*	*Number of obs*	=	2536
Model	5223,49731	3	1741,16577	F(1,2532)	=	551,86
Residual	7988,71721	2532	3,15510158	Prob>F	=	0,0000
Total	13212,21450	2535	5,21191894	R-squared	=	0,3954
				Adj R-squared	=	0,3946
				Root MSE	=	1,7763

Endline Score (Language)	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Treatment Group	0,3569830	0,072292	4,94	0,000	0,2152264	0,49874
Teachers' Internalisation	-0,1383318	0,15958	-0,87	0,386	-0,4512527	0,174589
Baseline Score (Language)	0,7096123	0,017633	40,24	0,000	0,6750365	0,744188
c	0,7853651	0,054379	14,44	0,000	0,6787343	0,891996

Table 7: Regression for language and teachers' internalisation

For language, the output shows that the impact teachers' internalisation on learner performance in language is relatively less than in the control group but is not statistically significant. The above output collectively indicates that teachers' internalisation, as a mediator, does not impact learner performance from the instructional change by the RCUP.

We follow by performing the mediation analyses using the variables of focus previously specified. The output for spelling is as follows:

Probit Regression

	Number of obs	=	2536
	LR chi2(2)	=	0,76
Log likelihood = -515,35001	Prob>chi2	=	0,3841
	Pseudo R2	=	0,0007

Teachers' internalisation	Coef.	Std. Err.	z	P>|z|	5% Conf. Interval]	
Treatment Group	0,0735512	0,084328	0,87	0,383	-0,0917287	0,238831
c	-1,658829	0,054286	-30,56	0,000	-1,765228	-1,55243

Source	*SS*	*df*	*MS*	*Number of obs*	=	2536
Model	90,1445518	2	45,0722759	F(2,2533)	=	1,80
Residual	63535,2967	2533	25,0830228	Prob>F	=	0,1660
Total	63625,4412	2535	25,0987934	R-squared	=	0,0014
				Adj R-squared	=	0,0006
				Root MSE	=	5,0083

Endline Score (Spelling)	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Treatment Group	0,3675352	0,2038218	1,8	0,071	-0,0321392	0,7672095
Teachers' Internalisation	0,248798	0,4494039	0,55	0,580	-0,6324386	1,130035
c	4,55592	0,1293137	35,23	0,000	4,3023480	4,809491

Effect	Mean	[95% Conf. Interval]	
ACME	0,0032259	-0,0080192	0,0207922
Direct Effect	0,3676502	-0,03812	0,7680407
Total Effect	0,3708761	-0,0344333	0,7802461
% of Tot Eff mediated	0,008225	-0,0371511	0,0516783

Table 8: Mediation analysis (spelling)

The output from the mediation analysis for spelling shows that teachers' internalisation is not significant. The mediation effects essentially indicate that 0.0082% of learner performance can be effected by the mediator (teacher internalisation) as a result of the RCUP intervention, which is quite immaterial. We run the mediation analysis again, focusing on learner performance in language. The output is as follows:

Probit Regression

	Number of obs	=	2536
	LR chi2(2)	=	0,76
Log likelihood = -515,35001	Prob>chi2	=	0,3841
	Pseudo R2	=	0,0007

Teachers' internalisation	Coef.	Std. Err.	z	P>|z|	95% Conf. Interval]	
Treatment Group	0,0735512	0,084328	0,87	0,383	-0,0917287	0,238831
c	-1,658829	0,054286	-30,56	0,000	-1,765228	-1,55243

Source	*SS*	*df*	*MS*	*Number of obs*	=	2536
Model	113,47621	2	56,738105	F(2,2533)	=	10,97
Residual	13098,7383	2533	5,17123502	Prob>F	=	0,0000
Total	13212,2145	2535	5,21191894	R-squared	=	0,0086
				Adj R-squared	=	0,0078
				Root MSE	=	2,274

Endline Score (Language)	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Treatment Group	0,3850213	0,092546	4,16	0,000	0,2035477	0,566495
Teachers' Internalisation	-0,4540061	0,2040535	-2,22	0,026	-0,8541348	-0,05388
c	1,961173	0,0587153	33,4	0,000	1,8460380	2,076308

Effect	Mean	[95% Conf. Interval]	
ACME	-0,0051187	-0,0161143	0,0024886
Direct Effect	0,3850736	0,2008321	0,5668723
Total Effect	0,3799548	0,195722	0,5649839
% of Tot Eff mediated	-0,0134703	-0,026153	-0,00906

Table 9: Mediation analysis (language)

From the regression, we see that teachers' internalisation is significant at a 5% level of significance but is negatively correlated with learners' performance in language. The mediation effects indicate that the percentage of the treatment effect that is attributable by the mediator on the outcome is -0.0135%, which indicates that the importance of the teachers' internalisation in improving learner performance in language is higher than that of spelling, but remains immaterial. These mediation analyses affirm that the role of teachers' internalising that instructional change is insignificant in terms of improving learner performance which essentially means that teacher internalisation does not matter as far as learner performance is concerned.

As seen in the descriptive statistics, the treated group mostly reported spelling and phonics as the elements of reading proficiency, we now analyse further by performing mediation analyses on the three elements of literacy individually to determine whether teachers' internalisation

may have had a mediation effect on the significance of spelling and language outcomes. The output is shown below:

Probit Regression

				Number of obs	=	2536
				LR chi2(1)	=	0,23
Log likelihood = -913,69901				Prob>chi2	=	0,6308
				Pseudo R2	=	0,0001

Teachers' internalisation (spelling)	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Treatment Group	-0,032091	0,066833	-0,48	0,631	-0,1630812	0,0988993
c	-1,179141	0,0414203	-28,47	0,000	-1,260323	-1,097959

Source	*SS*	*df*	*MS*			
Model	132,59417	2	66,2970852	Number of obs	=	2536
Residual	63492,8471	2533	25,0662641	F(2,2533)	=	2,64
Total	63625,4412	2535	25,0987934	Prob>F	=	0,0712
				R-squared	=	0,0021
				Adj R-squared	=	0,0013
				Root MSE	=	5,0066

Endline Score (Spelling)	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Treatment Group	0,3722397	0,2037322	1,83	0,068	-0,027259	0,7717383
Teachers' Internalisation (Spelling)	0,4379306	0,3096487	1,41	0,157	-0,1692599	1,045121
c	4,515817	0,1326511	34,04	0,000	4,2557010	4,775932

Effect	Mean	[95% Conf.	Interval]
ACME	-0,0049199	-0,0272969	0,0108642
Direct Effect	0,3723547	-0,0332372	0,7725691
Total Effect	0,3674347	-0,032118	0,7691436
% of Tot Eff mediated	-0,0127637	-0,1125141	0,0478004

Table 10: Mediation analysis on spelling (learner outcome) and spelling (teachers' internalisation)

Probit Regression

	Number of obs	=	2536
	LR chi2(1)	=	1,28
Log likelihood = -852,82722	Prob>chi2	=	0,2584
	Pseudo R2	=	0,0007

Teachers' internalisation	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Treatment Group	0,07704423	0,0680651	1,13	0,258	-0,0563627	0,2104474
c	-1,283029	0,0435358	-29,47	0,000	-1,368358	-1,197701

Source	*SS*	*df*	*MS*			
Model	140,191422	2	70,0957111	Number of obs	=	2536
Residual	63485,2498	2533	25,0632648	F(2,2533)	=	2,8
Total	63625,4412	2535	25,0987934	Prob>F	=	0,0612
				R-squared	=	0,0022
				Adj R-squared	=	0,0014
				Root MSE	=	5,0063

Endline Score (Spelling)	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Treatment Group	0,3764629	0,2037625	1,85	0,065	-0,0230952	0,7760209
Teachers' Internalisation (Phonics)	-0,491734	0,3239894	-1,52	0,129	-1,1270450	0,143772
c	4,617051	0,1314418	35,13	0,000	4,3593070	4,874796

Effect	Mean	[95% Conf.	Interval]
ACME	-0,0051672	-0,0251181	0,0096364
Direct Effect	0,3765779	-0,0290743	0,7768519
Total Effect	0,3714106	-0,0363956	0,7774225
% of Tot Eff mediated	-0,0131368	-0,0772539	0,0675319

Table 11: Mediation analysis on spelling (learner outcome) and phonics (teachers' internalisation)

Probit Regression

				Number of obs	=	2536
				LR chi2(1)	=	2,1
Log likelihood = -802,06063				Prob>chi2	=	0,1469
				Pseudo R2	=	0,0013

Teachers' internalisation (Comprehension)	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Treatment Group	-0,1030552	0,0713	-1,45	0,148	-0,2428007	0,0366904
c	-1,264757	0,0431413	-29,32	0,000	-1,349312	-1,180201

Source	*SS*	*df*	*MS*			
Model	117,601732	2	58,8008661	Number of obs	=	2536
Residual	63507,8395	2533	25,072183	F(2,2533)	=	2,35
Total	63625,4412	2535	25,0987934	Prob>F	=	0,0960
				R-squared	=	0,0018
				Adj R-squared	=	0,0011
				Root MSE	=	5,0072

Endline Score (Spelling)	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Treatment Group	0,3764015	0,2038305	1,85	0,065	-0,0232899	0,7760929
Teachers' Internalisation (Comprehension)	0,3993758	0,3373234	1,18	0,237	0,2620819	1,060834
c	4,526878	0,1320801	34,27	0,000	4,267882	4,785874

Effect	Mean	[95% Conf.	Interval]
ACME	-0,0091928	-0,0336323	0,005337
Direct Effect	0,3765166	-0,029271	0,7769242
Total Effect	0,3673228	-0,0346844	0,7637328
% of Tot Eff mediated	-0,0238045	-0,1752897	0,0924967

Table 12: Mediation analysis on spelling (learner outcome) and comprehension (teachers' internalisation)

Probit Regression

				Number of obs	=	2536
				LR chi2(1)	=	0,23
Log likelihood = -913,69901				Prob>chi2	=	0,6308
				Pseudo R2	=	0,0001

Teachers' internalisation (Spelling)	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Treatment Group	-0,032091	0,066833	-0,48	0,631	-0,1630812	0,0988993
c	-1,179141	0,0414203	-28,47	0,000	-1,260323	-1,097959

Source	*SS*	*df*	*MS*			
Model	102,43931	2	51,2196551	Number of ob	=	2536
Residual	13109,7752	2533	5,17559226	F(2,2533)	=	9,90
Total	13212,2145	2535	5,21191894	Prob>F	=	0,0001
				R-squared	=	0,0078
				Adj R-square	=	0,007
				Root MSE	=	2,275

Endline Score (Language)	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Treatment Group	0,3799661	0,0925752	4,10	0,000	0,1984352	0,5614969
Teachers' Internalisation (Spelling)	-0,2360164	0,1407034	-1,68	0,094	-0,5119218	0,039889
c	1,967245	0,0602762	32,64	0,000	1,849050	2,085441

Effect	Mean	[95% Conf.	Interval]
ACME	0,0022636	-0,0041993	0,0117455
Direct Effect	0,3800182	0,1957187	0,5618745
Total Effect	3822819	0,2006068	0,5629961
% of Tot Eff mediated	0,005941	0,0040206	0,0112836

Table 13: Mediation analysis on language (learner outcome) and spelling (teachers' internalisation)

Probit Regression

	Number of obs	=	2536
	LR chi2(1)	=	1,28
Log likelihood = -852,82722	Prob>chi2	=	0,2584
	Pseudo R2	=	0,0007

Teachers' Internalisation	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Treatment Group	0,0770423	0,0680651	1,13	0,258	-0,0563627	0,2104474
c	-1,283029	0,0435358	-29,47	0,000	-1,368358	-1,197701

Source	*SS*	*df*	*MS*			
Model	203,074907	2	101,537453	Number of obs	=	2536
Residual	1300,1396	2533	5,13586246	F(2,2533)	=	19,77
Total	13212,2145	2535	5,21191894	Prob>F	=	0,0000
				R-squared	=	0,0154
				Adj R-squared	=	0,0146
				Root MSE	=	2,2662

Endline Score (Language)	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Treatment Group	0,3912881	0,0922385	4,24	0,000	0,2104176	0,5721586
Teachers' Internalisation (Phonics)	-0,6945998	0,1466624	-4,74	0,000	-0,9821902	-0,4070094
c	2,008399	0,0595006	33,75	0,000	1,891724	2,125074

Effect	Mean	[95% Conf. Interval]	
ACME	-0,0074889	-0,025746	0,0108805
Direct Effect	0,3913401	0,207711	0,5725347
Total Effect	0,3838512	0,1969993	0,5664856
% of Tot Eff mediated	-0,0195188	-0,038105	-0,0132199

Table 14: Mediation analysis on language (learner outcome) and phonics (teachers' internalisation)

Probit Regression

				Number of obs	=	2536
				LR chi2(1)	=	2,1
Log likelihood = -802,06063				Prob>chi2	=	0,1469
				Pseudo R2	=	0,0013

Teachers' Internalisation (Comprehension)	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
Treatment Group	-0,1030552	0,0713	-1,45	0,148	-0,2428007	0,0366904
c	-1,264757	0,043141	-29,32	0,000	-1,349312	-1,180201

Source	*SS*	*df*	*MS*			
Model	106,215876	2	53,1079379	Number of obs	=	2536
Residual	13105,9986	2533	5,17410132	F(2,2533)	=	10,26
Total	13212,2145	2535	5,21191894	Prob>F	=	0,0000
				R-squared	=	0,008
				Adj R-squared	=	0,0073
				Root MSE	=	2,2747

Endline Score (Language)	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Treatment Group	0,3764562	0,092596	4,07	0,000	0,1948853	0,558027
Teachers' Internalisation (Comprehension)	-0,2884953	0,153239	-1,88	0,060	-0,5889808	0,0119901
c	1,968828	0,060001	32,81	0,000	1,851172	2,086484

Effect	Mean	[95% Conf.	Interval]
ACME	0,0057888	-0,00109	0,0167982
Direct Effect	0,3765084	0,192168	0,5584047
Total Effect	0,3822972	0,201174	0,5629801
% of Tot Eff mediated	0,0151387	0,010282	0,0287751

Table 15: Mediation analysis on language (learner outcome) and comprehension (teachers' internalisation)

From the output above, it can be seen that for learner performance in spelling, none of the elements of reading for teachers to internalise are significant and the mediation effects remain minimal. However, for learner performance in language, internalising spelling is significant at a 10% level of significance with a negative coefficient; this could be due to the effect of Coach A (the coach with significant treatment effect) reporting spelling with a lower probability relative to Coach B. Internalising phonics is significant at a 5% level of significance and internalising comprehension is significant at a 10% level of significance. The mediation effects remain minimal. This means that internalisation had no impact on the improvement of spelling

scores but had a significant impact on the improvement of language scores for all three elements, even though the mediation effect was relatively small.

We follow the mediation analysis by performing the sensitivity analysis to check for robustness. The output is as follows is shown in the appendix. The results show that sensitivity analyses for both spelling and language are not available. This is because the results from the mediation analysis were immaterial and insignificant. An alternative analysis shows that, when comparing the mediation analyses as well as the sensitivity analyses, the signs of the coefficients for both spelling and language, as well as the results remain insignificant for spelling and significant for language (at a 10% level of significance). This means that, even with small violations the results remain the same, indicating that they are reliable and not sensitive.

Discussion of Results

From the descriptive statistics we see, from the minimal differences, that the analysis echoes the outcome from the initial RCUP study which indicated that there is very little evidence showing impact of the intervention on learner performance. The graphs indicated that more teachers from the treated group internalised the instructional change by reporting all three elements of teaching reading effectively, relative to control group, although the difference is minimal. When breaking down the elements that were outlined in the endline questionnaire, it is seen that the teachers in the treatment group mostly reported spelling and phonics as the most important elements of teaching reading. However, most teachers failed to report any of the correct elements of teaching reading.

When analysing the data by coach, the ambiguous results obtained make it challenging to form a cohesive and clear stance on the coach effect with regards to teacher internalisation. Of the three correct elements, spelling was mostly selected by teachers trained by Coach B, comprehension by Coach A and phonics is almost equal between the two coaches, with a leniency towards Coach A. It is also interesting to note that those who selected whole class reading as an element for teaching reading were all allocated to Coach A and none from Coach B yet from the initial RCUP study, Coach A has a significant treatment effect relative to Coach B. We have also observed that Coach A and B have a treatment effect on the teachers internalising spelling, Coach B on comprehension and none of the coaches on phonics.

The endline learner assessments indicate that learners from the treatment group scored relatively higher average scores, particularly for spelling, language and writing relative to learners in the control group. Additionally, on average, learners who were taught by teachers trained by Coach A scored higher marks compared to learners taught by teachers who were trained by Coach B.

The regression and mediation analyses focused on the determining the impact of teachers' internalisation as the mediator to learner performance. This assesses whether it is necessary for teachers to believe in and internalise the instructional change in order to effectively teach literacy to learners. The regression analyses indicates that teachers' internalisation of the treatment group is not significant. The regression output for spelling and language collectively indicate that teachers' internalisation, as a mediator, does not impact learner performance from the instructional change by the RCUP. Simply put, the regression analyses show that teachers believing in the instructional change is not a necessary condition for learners to improve in performance from the instructional change. Furthermore, the mediation analyses affirms that the role of teachers' internalising that instructional change is insignificant in terms of improving learner performance which essentially means that teacher internalisation does not matter as far as learner performance is concerned. However, when performing mediation analyses for the elements of reading separately, we find that teachers' internalisation for learner performance in language is significant, although the mediation effect is small. This further asserts the low significance of teachers' internalisation in impacting literacy outcomes in the RCUP intervention. The analyses performed indicate that even after 11 weeks of rigorous training and onsite support, most teachers failed to identify the elements of reading and internalise the instructional change yet learners did benefit from the programme and improved in their literacy scores. This could suggest that teachers merely and absent-mindedly implementing the change, with the use of resources provided, still improves learner performance. So just by effecting the instructional change intervention, the learning experience for learners improve. In other words, it is shown that the change in teacher practice could improve learner performance, which is different to teachers' internalisation, which relates to teachers forming a belief in (internalising) and potentially innovating the approach to teaching literacy.

When referring back to the scenarios of the theories of teacher change (Figure 1), we can now see that Scenario A and B do not apply because it is found in this paper that teachers' internalisation does not hold any significance in the process of the intervention leading up

learners performing better. However, Scenario C could be a possibility, which implies that once the learners have improved literacy outcomes, it may form the evidence required for teachers to change their perceptions and attitudes towards the instructional change thus internalising the new pedagogy and potentially finding more innovative methods to deliver the learning outcomes required to effectively teach reading. The challenge with the scenario is that data beyond learner performance does not exist in our study in order to fully test the complete Guskey process. So it could be that the Guskey model is proven to be the appropriate sequence for our study or that teacher internalisation simply does not matter.

Limitations

Initiatives like the GPLMS and RCUP have put in great efforts in a quest to improve literacy outcomes in South Africa. It was determined in the initial RCUP study that the intervention had little impact on learner performance. Additionally, this subsequent RCUP study has observed that the teachers' internalisation of the instructional change is not significant in impacting learner performance. Though these may be the outcomes, this does not necessarily suggest that the programme and interventions alike do not work. There may be limitations and challenges worth considering that can explain why the programme had little impact and can contribute to making related future studies and interventions more effective.

The first limitation could be that the RCUP programme is that it may have run for a relatively short period. The intervention ran for 11 weeks, which is almost three months of using scripted lesson plans and related resources with onsite coaching. However, given the baseline results of the learners before the implementation of the programme, the RCUP intervention may have needed to run longer to be more effective. This could also give teachers time to be more acquainted with the new pedagogy and better adopt the appropriate elements for teaching reading effectively. The programme may have been too short for students to benefit from and teachers to be well acquainted with the new practice, future instructional change programmes would need to last at least one or two years (Fleisch, et al., 2016).

In this paper, we allude to the possibility that, given the results obtained, it is possible that the appropriate sequence of teacher change could reflect the Guskey model (Scenario C). The challenge is that the data collected does not support fully testing the sequence. Teacher data could also have been collected a certain period after the completion of the programme to assess

the perception and attitude of the teachers once the performance of the learners impacted by RCUP has become evident, potentially reflecting the Guskey model. The longitudinal data could also inform on whether the new structured pedagogy persists or did they abandon the instructional change and revert to their old teaching practices.

Lastly, there may exist a limitation on the measurement of internalisation, which does not adequately capture if the teachers really improve their knowledge on how to teach reading. In addition, we do not have baseline information on their perception of teaching reading, making challenging to ascertain the likelihood that teachers from the treatment group would report the critical elements of reading proficiency.

Conclusion

This paper is based on the study by Fleisch et al. (2016), where the RCUP intervention was implemented in Pinetown, KwaZulu-Natal to improve literacy outcomes as learners move to the intermediate phase and transition from Home Language to English as the LOLT. The aim of this study was to determine the impact of the teacher internalising the instructional change, as a mediator, on learner performance as the outcome.

There is an increasing body of literature that focuses on approaches to improving literacy in South Africa. The literature provides a view of the different types of intervention programmes available; some being on the professional development of teachers as well as improving teaching practices so learners are effectively taught reading proficiency from primary school. In addition, the improved teaching practices may come in the form of a structured pedagogy including lesson plans and coaching. The literature also place emphasis on elements which are considered critical to teaching reading proficiency, which guide the pedagogy with the accompaniment of lesson plans and related resources.

The RCUP design contains many of the features outlined in the literature review. The gap identified, which is the centre of this paper's study, is if teachers' internalising the instructional change can impact learner performance.

The analysis shows that more teachers from the treatment group identified all elements of reading proficiency, relative to the control group but overall, most teachers failed to identify at least one critical element for effectively teaching reading. The coach effect on teachers'

internalisation is ambiguous when viewing total or partial internalisation, however, on average, learners who were taught by teachers trained by Coach A scored higher marks compared to learners taught by teachers who were trained by Coach B.

The regression and mediation analyses show that teachers' internalisation is not significant in the treatment group and its mediation effect on learner performance is immaterial. This suggests that either teachers' internalisation is not important with regards to the intervention impact learner performance, or it could be that teachers' internalisation occurs once the evidence on learner performance is witnessed by teacher, reflecting the Guskey model. The challenge with Guskey scenario in relation to the RCUP study is that there isn't sufficient data (collected in the form of teacher questionnaires) to assess internalisation beyond learner performance. Other limitations on the study relating to data and time period have been identified, which could improve the efficacy of the study and interventions alike.

The findings indicate that internalisation has not been crucial to the improvement in learner performance. Given that this was the case, particularly in the short term that the intervention was implemented, the implications of no internalisation may have lasting effects; teachers may dismiss the instructional change and revert to their old teaching methods, affecting learner performance such that the state of literacy in the schools reverts to the status quo once the intervention is complete. This would make the intervention programme futile, unless alterations to the programme are effected such that there is a long term impact, particularly for the learners. This is also why internalisation is important and the Guskey sequence is considered, because it enables the change to have a sustainable impact, whose life span will exceed that of the instructional change intervention.

An area for future research can be on testing the complete Guskey sequence and conducting a longer term study to evaluate the persistence of the instructional change and testing for the significance of teachers' internalisation on learner performance and assess if there are changes. Additionally, there lies an opportunity to align future instructional change intervention programmes to the most appropriate sequence, perhaps the Guskey, to enable maximum impact and possibly increasing learner performance. The findings from this paper suggest that, over and above extending the length of the intervention programmes, it calls for frequent interactions with teachers beyond the period of the programme. This is so as to encourage the persistence and sustainability of the instructional change, as well as to ensure that the teachers

perceive the change such that they are able to attribute the impact on literacy outcomes to the change itself and not so much themselves.

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Appendix

Sensitivity analyses

Probit Regression

	Number of obs	=	2536
	LR chi2(1)	=	0,76
Log likelihood = -515,35001	Prob>chi2	=	0,3841
	Pseudo R2	=	0,0007

Teachers' Internalisation	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Treatment Group	0,0735512	0,084328	0,87	0,383	-0,0917287	0,238831
c	-1,658829	0,054286	-30,56	0,000	-1,765228	-1,55243

Source	*SS*	*df*	*MS*			
Model	90,1445518	2	45,0722759	Number of obs	=	2536
Residual	63535,2967	2533	25,0830228	F(2,2533)	=	1,80
Total	63235,4412	2535	25,0987934	Prob>F	=	0,1660
				R-squared	=	0,0014
				Adj R-squared	=	0,0006
				Root MSE	=	5,0083

Endline Score (Spelling)	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Teachers' Internalisation	0,2487980	0,4494039	0,55	0,580	-0,6324386	1,130035
Treatment Group	0,3675352	0,2038218	1,8	0,071	0,0321392	0,7672095
c	4,55592	0,1293137	35,23	0,000	4,302348	4,809491

Table 16: Sensitivity analysis (spelling)

Probit Regression

				Number of obs	=	2536
				LR chi2(1)	=	0,76
Log likelihood = -515,35001				Prob>chi2	=	0,3841
				Pseudo R2	=	0,0007

Teachers' Internalisation	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Treatment Group	0,0735512	0,084328	0,87	0,383	-0,0917287	0,238831
c	-1,658829	0,054286	-30,56	0,000	-1,765228	-1,55243

Source	*SS*	*df*	*MS*			
Model	113,47621	2	56,738105	Number of obs	=	2536
Residual	13098,7383	2533	5,17123502	F(2,2533)	=	10,97
Total	13212,2145	2535	5,21191894	Prob>F	=	0,0000
				R-squared	=	0,0086
				Adj R-squared	=	0,0078
				Root MSE	=	2,274

Endline Score (Language)	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Teachers' Internalisation	-0,4540061	0,2040535	-2,22	0,026	-0,8541348	-0,0538774
Treatment Group	3850213	0,092546	4,16	0,000	0,2035477	0,5664949
c	1,961173	0,0587153	33,4	0,000	1,846038	2,076308

Table 17: Sensitivity analysis (language)

Summary Statistics Table

Variable	Obs	Mean	Std. Dev.	Min	Max
Teachers' Internalisation	2,536	0,051656	0,221376	0	1
Coach A	2,536	0,196372	0,397332	0	1
Coach B	2,536	0,194795	0,396121	0	1
Teachers' Internalisation (Spelling)	2,536	0,116719	0,321149	0	1
Teachers' Internalisation (Comprehension)	2,536	0,105284	0,306979	0	1
Teachers' Internalisation (Phonics)	2,536	0,096215	0,294943	0	1
Learners' Endline Score (Language)	2,536	2,088328	2,282963	0	10
Learners' Baseline Score (Language)	2,536	1,649448	2,003287	0	10
Learners' Endline Score (Spelling)	2,536	4,712539	5,00987	0	22
Learners' Baseline Score (Spelling)	2,536	3,595032	3,937635	0	20

Correlation Matrix

	Teachers' Internalisation	Coach A	Coach B	Teachers' Internalisation (Spelling)	Teachers' Internalisation (Comprehension)	Teachers' Internalisation (Phonics)	Learners' Endline Score (Language)	Learners' Baseline Score (Language)	Learners' Endline Score (Spelling)	Learners' Baseline Score (Spelling)
Teachers' Internalisation	1.0000									
Coach A	0.0102	1.0000								
Coach B	0.0112	-0.2431	1.0000							
Teachers' Internalisation (Spelling)	0.6420	-0.0931	0.0817	1.0000						
Teachers' Internalisation (Comprehension)	0.6804	0.0148	0.0129	0.7236	1.0000					
Teachers' Internalisation (Phonics)	0.7153	0.0306	-0.0659	0.6602	0.5852	1.0000				
Learners' Endline Score (Language)	-0.0426	0.1013	-0.0011	-0.0340	-0.0915	-0.0396	1.0000			
Learners' Baseline Score (Language)	-0.0490	0.0712	-0.0606	-0.0375	-0.0497	-0.0284	0.6240	1.0000		
Learners' Endline Score (Spelling)	0.0116	0.0529	-0.0087	0.0277	-0.0293	0.0225	0.7037	0.5528	1.0000	
Learners' Baseline Score (Spelling)	0.0036	0.0284	-0.0164	0.0312	-0.0225	0.0220	0.6186	0.6036	0.8384	1.0000

Description of variables in output

Variable Name	Description	Range
teacher_intern/teacher_in~n	Teachers' internalisation	0 = two or less of elements identified 1 = all three elements identified
CoachA	Coach A	
CoachB	Coach B	
teacher_intern_sp/teacher_i~sp	Teachers' internalisation for spelling	1 = spelling identified, else, 0
teacher_int_phon/teacher_i~on	Teachers' internalisation for phonics	1 = phonics identified, else, 0
teacher_int_comp/teacher_i~mp	Teachers' internalisation for comprehension	1 = comprehension identified, else, 0
treat_group	Treatment binary variable	0 = control group 1 = treatment group
EL_score_spelling/EL_score_spe~g	Endline learner scores for spelling	
BL_score_spelling	Baseline learner scores for spelling	
EL_score_lang	Endline learner scores for language	
BL_score_lang	Baseline learner scores for language	