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Unpacking the efficacy of Reading to Learn using Cognitive Load Theory

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This paper synthesises the key findings of two past separate studies conducted by the same authors, which sought to assess the efficacy of the Reading to Learn (RtL) literacy intervention on students' academic writing performance. Both previous studies of RtL were implemented in response to growing concerns about the academic under-preparedness of undergraduate students at universities across South Africa. The first study aimed to support mostly first-generation, first-year English Additional Language (EAL) learners in their transition to higher education. The second study aimed to support EAL students' academic writing development at a senior secondary school level prior to the school-to-university transition. In both studies, the cohorts of students examined originated from low socioeconomic communities, where linguistic marginalisation arguably imposes significant barriers to successful university completion. The novel contribution of this paper is to use a Cognitive Load Theoretical lens to explicate why RtL might improve the academic writing skills of under-prepared students making the transition to university.

Key Words: academic literacy, scaffolding, Cognitive Load Theory, instructional design, equity.

1. Introduction

Access to higher education in South Africa has risen sharply within the last 10 years post-Apartheid, resulting in students from a diverse range of backgrounds enrolling for tertiary studies. For example, the number of students matriculating with the requisite university enrolment requirements rose from 14% in 2000 to 24.8% in 2016 (Millin & Millin, 2018). With the increase in the number of students graduating from their final year of school with a bachelors pass (a pass that enables access to university) comes the tacit assumption for students that their academic literacy skills developed within the basic education sector (primary and secondary schooling) are adequate for the academic literacy rigours of higher education. However, a plethora of studies have highlighted that often, undergraduate students, but particularly first-generation English Additional Language (EAL) students entering first-year studies, lack advanced academic reading and writing skills to function autonomously at university (Penrose, 2002; Greene & Forster, 2003; Nakata, Nakata, & Chin, 2008; Van Schalkwyk, 2008; Allardice, 2013). In other words, these students lack the skills needed to learn from prescribed class readings on their own without intensive academic support. This sentiment is marked when considering the university entrance academic literacy benchmark tests that most South African universities require of students prior to official university enrolment.

Due to a growing level of uneasiness from tertiary institutions across South Africa concerning the academic preparedness of students transitioning into higher education, many tertiary providers now require a literacy benchmark test. This test is used to assess the entry-level academic skills

of students in academic literacy; quantitative literacy, and mathematics literacy. Table 1 below gives an overview of the South African national benchmark tests project (NBTP) results for the academic literacy component of the university entrance tests.

Table 1. University entrance academic literacy national benchmark tests (NBTP National Report, 2009, 2015, 2016, 2017, 2018).

Year	Basic proficiency (BP)	Intermediate proficiency (IP)	Proficient	Total number of students in need of academic literacy support (BP + IP)
2018	16%	64%	20%	80%
2017	15%	63%	22%	78%
2016	14%	56%	30%	70%
2015	15%	56%	29%	71%
2009	7%	46%	47%	53%

The academic literacy benchmark tests presented in Table 1 are offered in two languages only – English and Afrikaans – as these two languages represent the medium of instruction for most tertiary institutions in South Africa. This is despite the fact that a large majority of university students are non-native speakers of English or Afrikaans. According to the NBTP National Report (2018), the academic literacy test assesses candidates' ability to: read texts for meaning (reading to learn); understand vocabulary in cognitively demanding, and context reduced situations (relying on cognitive academic language proficiency); identify claims being made in texts; evaluate evidence used to support arguments; draw inferences from information presented as evidence within texts; identify the main supporting idea from a number of different texts; understand the specific organisation of academic texts, and understand the different types of text types and their communicative purpose with associated language usage. Benchmark descriptors for the academic literacy tests provide tertiary institutions an indication of students' academic literacy proficiency, or preparedness. For example, *basic proficiency* states that serious learning challenges are identified and students will *not cope* with independent university studies. Students who fall within the *intermediate proficiency* category will have serious academic challenges and will *most likely struggle* with academic progress. If admitted into university, extended, or augmented academic literacy programmes are needed with intensive, longitudinal academic literacy support. Students who fall within the *proficient* category are not likely to suffer negatively with academic progress, and are expected to track through their academic studies independently without the need for focussed academic literacy support (NBTP National Report, 2018).

From Table 1, it becomes increasingly clearer why South African tertiary institutions are becoming more concerned about the academic literacy preparedness of undergraduate students transitioning into university. Drawing on data from Table 1, between 2015 and 2018, on average, 15% of students who sat the university entrance academic literacy tests were deemed underprepared to successfully enter higher education despite matriculating with a university pass. Even more alarmingly, between 2015 and 2018, on average, 60% of university enrolments who took the university entrance test were categorised as learners in need of intensive, long-term academic literacy support if they were to successfully navigate higher education studies. Thus, if taking into account the two categories that show students needing support (basic proficiency and intermediate proficiency), according to Table 1, it is clear that between 2015 (71%) and 2018 (80%) a large majority of students applying for undergraduate studies were deemed under-prepared for higher education studies, and in need of intensive literacy support.

According to Groenewald (2005), 1 in 3 undergraduate students in South Africa face the risk of dropping out of tertiary studies before completion due to academic under-preparedness. Several factors contribute to this attrition rate. According to Elliott et al. (2018), there is firstly, often a difference in teaching and learning methods between school and university. For example, school teachers tend to offer highly intensive scaffolding that assists students with individual task completion. This may even include both intensive and extensive text modelling of assessment tasks. Further, administrative support is usually higher at school with teachers reminding students when assignments are due, offering students the opportunity to submit multiple rewrites, and offering deadline extensions if students' extra curricula is too onerous. Secondly, the academic literacy skills developed at school tend to not match the academic literacy skills required for autonomous learning at university (Elliott et al., 2018). At school, often little attention is given to skills development to support extended academic material searches on library catalogues because many schools lack access to these types of search engines. Instead, students are encouraged to search what is freely available on Google. Teachers also provide summaries of important information for exams, and tend to provide 'model answers' for examination purposes (teaching to the test). This is contrary to university examination preparation whereby responsibility for exam revision lies solely with the student. Often, model answers for past examination papers are also not readily available. Thirdly, and most importantly for the purpose of this paper, student perceptions of what good academic writing is versus what university tutors expect are frequently very different. With limited opportunities for the writing of extended texts similar in genre and purpose to university texts at school, first-year students tend to find the discourse practices of university far removed from that of secondary school. In other words, first-year students might lack an understanding of the academic writing conventions of higher education (Borg & Deane, 2011). This often leads to a loss in academic writing confidence, and increased feelings of being overwhelmed by the academic rigours of higher education (Hamilton, 2016).

Given the above, it makes sense that multiple school to university transition factors create barriers for many students, particularly EAL students when language comprehension is an added barrier. This may result in a significant struggle with the transition to university. Using Sandford's Challenge and Support Theory (1966) below, first-year undergraduate studies do offer students an opportunity to grow from various challenges, particularly with regards to academic literacy development. Sandford (1966) believed that for growth and development to occur, students *need* to face challenges. However, according to Figure 1, there needs to be a balance between the nature of the academic challenge, and the level of support given to students based on individual student need's analyses (Ward, Trautvetter & Braskamp, 2005; Matesic, 2020). EAL students tend to need a higher level of academic literacy support to avoid frustration, anxiety and higher levels of attrition.
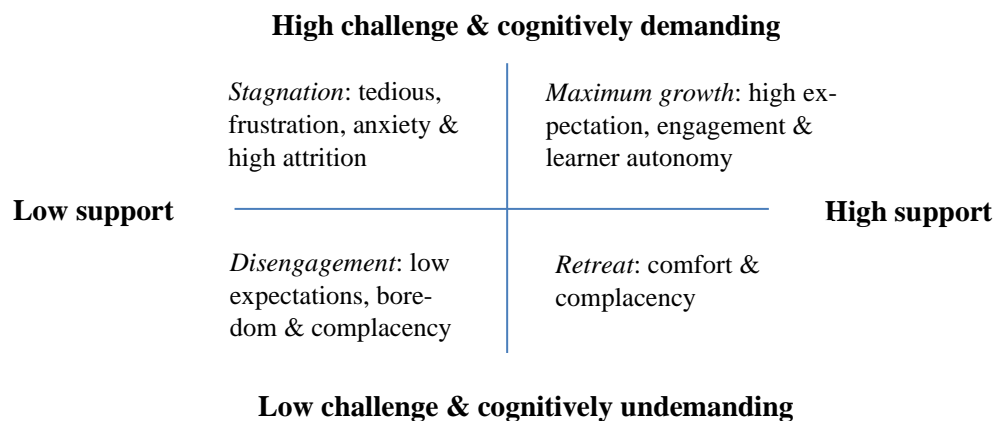
High challenge & cognitively demanding

Stagnation: tedious, frustration, anxiety & high attrition	*Maximum growth*: high expectation, engagement & learner autonomy

Low support ———————————————— **High support**

Disengagement: low expectations, boredom & complacency	*Retreat*: comfort & complacency

Low challenge & cognitively undemanding

Figure 1. Challenge and growth matrix (Sandford, 1966).

The overarching aim of this paper is to report on two separate literacy projects in South Africa that sought to test the efficacy of the Reading to Learn (RtL) literacy intervention in both supporting and scaffolding EAL students with more advanced forms of academic writing in two separate project contexts to reduce high levels of attrition at university. The first project sought to support EAL undergraduate, first-generation students in their transition from school to university (first-year undergraduate students). The second project tested the efficacy of incorporating RtL within the senior secondary school context to prepare EAL students for the academic literacy rigours of higher education *before* transitioning to university. RtL was embedded within the existing English curriculum. Both studies incorporated a genre pedagogy and systemic functional linguistics approach to an intensive academic writing initiative that made use of the process approach to writing. In both studies, text modelling was used to scaffold more advanced forms of academic writing. Students were tasked with weekly writing portfolios that were marked and detailed feedback given to help students advance their writing skills. This paper does not focus on the results of the two studies in detail as these results have already been published in separate journal papers (Millin & Millin, 2014, 2018) with a detailed discussion of RtL pedagogy. However, what these paper's lacked was a link to theory such as Cognitive Load Theory that could better explain why RtL pedagogy successfully bridges student knowledge about formal writing conventions and university formal writing expectations. Therefore, this paper offers a discussion of RtL efficacy by drawing on a Cognitive Load Theoretical lens. The introduction offers a rationale for the need for literacy interventions in South Africa. The literature review gives a very brief overview of RtL followed by a discussion of Cognitive Load Theory. The methods section presents a summary of the two projects under discussion with a snapshot overview of student progress when enrolled in an RtL programme. The paper concludes with a discussion of Cognitive Load Theory and its link to RtL efficacy.

2. Literature review

2.1. Reading to Learn – An overview

RtL is a literacy remediation initiative originally designed to address declining literacy outcomes of Aboriginal students in Australia, and later, to address growing literacy inequality between students from higher socioeconomic circumstances, and those from lower socioeconomic contexts globally. Developed through collaborative efforts between primary and secondary school teachers, and literacy experts, the key objective of RtL pedagogy is to ensure reading and writing skills are explicitly taught across the curriculum to scaffold reading and writing development for students with high literacy needs (Rose, 2004; Rose & Martin, 2012). Growing in momentum globally, RtL is currently being used in over 14 countries. Studies have reported on the efficacy of RtL at improving academic literacy skills of students, with weaker students being afforded a greater opportunity to perform on par with academically stronger students, thus democratising (equal opportunities of success) the classroom (McRae et al., 2000; Culican, 2006; Rose & Acevedo, 2006; Rose et al., 2008; Acevedo, 2010; Rose, 2010, 2011; Carusi-Lees, 2017; Shum et al., 2018).

Several core principles of RtL have reference to our work. Firstly, RtL posits that reading is the primary mode of learning. Thus, students need to develop the necessary reading skills to augment university classroom teaching by engaging in independent, extensive reading of academic material to advance their own learning. In a traditional academic cycle adopted at university, it is assumed students can read independently to further develop their knowledge base outside of the lecture (see Figure 2). However, if students are unable to read independently before lectures, they are unable to grasp academic concepts before class, or tutorials, and struggle to keep up with the academic cycle. In attempting to remedy the failings of the traditional academic cycle, RtL pedagogy explicitly models language patterns found in subject-specific texts, which assists students in understanding how to access meaning within them (access to discourse patterns). This occurs during the 'preparing for reading' phase (see Figure 2). This is followed up with explicit teaching

of writing conventions to ensure students are able to articulate knowledge and ideas acquired through independent reading.

Secondly, RtL moves away from an incrementalist approach to teaching and learning by enabling academic literacy tutors (or classroom teachers) to set classroom activities based on individual student's needs whilst still engaging in whole-class teaching. When academic writing tasks are not accessible to weaker performing students, and the skills needed to complete academic tasks successfully are not scaffolded appropriately, weaker performing students may be at risk of struggling until they drop out of university. Thus, to remedy this situation, RtL pedagogy provides the same level of teaching to all students, but differentiates assessment feedback to individual students to meet students where they are at within their own learning journey. In other words, students with weaker literacy skills will require more focussed feedback than students with less literacy struggles. The classroom input may be similar but the scaffolded support with writing drafts differs according to individual student needs, meaning RtL pedagogy is more likely to support most students within their own zones of proximal development.
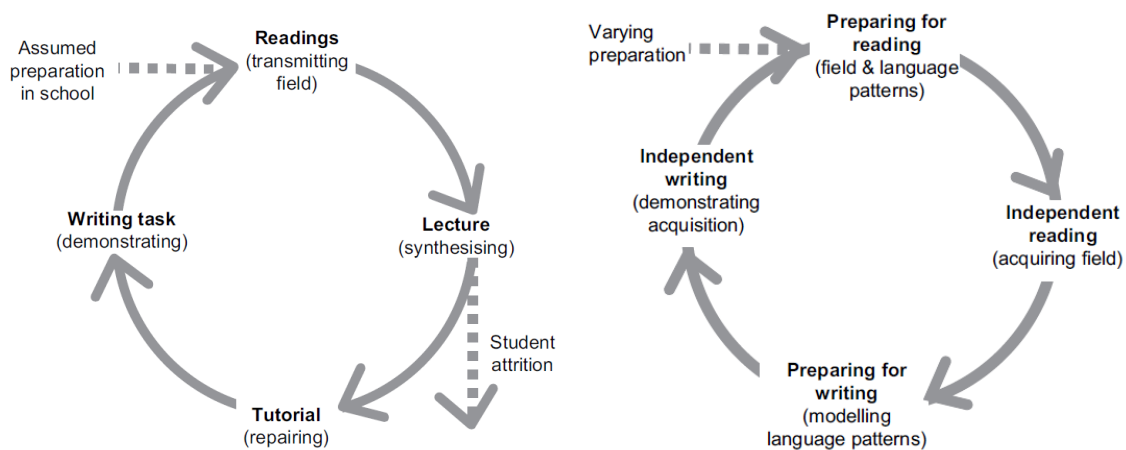

Figure 2. The traditional academic cycle (left) versus scaffolded academic cycle (right) (Rose et al., 2008[1]).

2.2. Cognitive Load Theory

Cognitive Load Theory stems from recognition of the implications arising from the relationship between working and long-term memory (Sweller, 1988; Schunk, 2012; Sweller, Van Merrienboer, & Paas, 2019). Novel information is received and temporarily held in working memory while the brain accesses related information from long-term memory, and then integrates new and old knowledge into a schema (Schunk, 2012). Whereas working memory requires conscious effort, long-term memory stores practised information that can be automatically retrieved when needed (Sweller, Van Merrienboer, & Paas, 1998). Working memory, although not necessarily fixed in either capacity or duration, can be depleted when a complex task requires an excess of cognitive effort (Chen, Castro-Alonso, & Paas, 2018; Sweller et al., 2019). This is particularly true when there is a need to apply multiple reasoning processes to combinations of unfamiliar elements. This can lead to the learner being unable to manipulate simultaneous task requirements and to use their cognitive resources to generalise and transfer new knowledge (Sweller et al., 2019). This tends to be the case when students are expected to master academic literacy skills, new to the students' literacy repertoire whilst simultaneously having to draw on growing content

knowledge. Cognitive Load Theory is based on the assumption that the goal of classroom instruction is to foster the acquisition of domain-specific knowledge and the organisation of its individual elements into a schema, which can be stored and accessed as one element in long-term memory (Sweller et al., 1998). This frees working memory to solve a more immediate problem, or learn new information. An effective means to promote schema acquisition is through instructional design, which reduces cognitive load.

There are three types of cognitive load. The first is *intrinsic load*, representing the inherent difficulty of the material itself or the level of interactivity between simultaneous elements required to achieve the learning goal (Sweller, 1988, 2010; Sweller et al., 2011). The second is *extraneous load*, created when the way information is presented or the type of learning activities assigned, place unnecessary demands on working memory (Sweller, 1988, 2010; Sweller et al., 2019). Sweller (2010) defines a third type, *germane cognitive load*, as the working memory resources needed to form a schema. If the intrinsic and/or extrinsic cognitive load is too great, a learner is likely to have insufficient capacity to create the schema required for mastery (Sweller, 1988; Sweller et al., 2019).

Academic literacy skills development tends to carry a heavy intrinsic load. It is not knowledge that learners are biologically evolved to automatically acquire; rather, it may be slow to develop unless explicitly taught (Sweller, 2016). In other words, academic literacy skills used at university are not native to anyone, and require time and effort to internalise. Moreover, there is a high level of interactivity between academic literacy components (Sweller, 2010). Readers and writers must access and apply multiple levels of discourse in order to achieve comprehension, and to transform new knowledge for useful application – such as a demonstration of knowledge acquisition in essay or test assignments.

Cognitive Load Theory asserts that good instructional design can reduce high levels of cognitive load (Sweller, 1988; Sweller et al., 2019) through the use of explicit, guided and integrated instruction with a variability of practice opportunities and a gradual fading of support (Van Merrienboer, Kirschner, & Kester, 2003). In traditional problem-solving tasks, learners are frequently asked to independently use a means-end strategy to arrive at a pre-determined solution or end goal. This requires them to expend a large cognitive effort to work backwards simultaneously juggling consideration of the details to identify the problem(s) needing to be solved, to understand the end goal, and to select and apply the appropriate strategies, and how to apply those (Sweller, 1988). This is often what the traditional academic cycle expects of students (see Figure 2). In contrast, instruction informed by Cognitive Load Theory uses simple-to-complex sequencing to manage intrinsic load and scaffolded whole-task practice to manage extrinsic load (Moreno & Park, 2010; Van Merrienboer, Kirschner, & Kester, 2003). The RtL scaffolded academic cycle indicated in Figure 2 exemplifies this.

Intrinsic load is influenced by individual learner knowledge and aptitude (Sweller et al., 2011). Research into the categorisation and quantification of cognitive load suggests that the instruction effective to reduce unnecessary load should be differentiated to align with the level of prior domain knowledge possessed by the individual learner (Kalyuga & Singh, 2015; 2016). This is consistent with scaffolding theory (Bruner 1978; Vygotsky, 1978) and with instructional design, which targets various cognitive load effects. For instance, novice learners may benefit from the use of goal-free problems and worked examples (Sweller, 2010). When the aim of finding the one end-goal solution is removed, learners are better able to focus their cognitive effort on recognising problem components and various operators which could be applied to definite variables, working forward to a solution (Ayres, 1993; Sweller, 2010; Sweller, Ayres, & Kalyuga, 2011). Similarly, using worked examples, such as studying the features of model texts, or reading and thinking aloud to model high-level decoding and comprehension skills, reduces the intrinsic complexity of reading and writing tasks (Sweller, 2010; Sweller et al., 2019). The overall cognitive load dimin-

ishes because the interactivity of the multiple task elements involved in decoding, comprehending, synthesising and composing is reduced. Learners instead devote working memory to recognising text features and how to use them.

Within Cognitive Load Theory, scaffolding such as modelling, cues and feedback must be integrated to support learners within the task (Van Merrienboer, Kirschner, & Kester, 2003). In academic literacy instruction, complexity can be reduced by providing real-time text cues, which draw sentence-by-sentence, or whole paragraph attention to text features related to discourse. By discussing sentence-level, or paragraph-level features in the context of the whole-text genre or discourse level (Kucer, 1985), the complexity of the multiple layers of genre structure, content, language choices, grammar and spelling is reduced without losing sight of how each of the sub-elements relates to meaning. Further, by embedding the text guidance within the task structure, the learner is focussed on application, and the effect of splitting attention between reconciling the information needed and the strategy to be used from multiple sources is avoided (Kalyuga, 2010; Sweller, 2010).

Cognitive Load research further supports the differentiation of instruction through guidance fading (Kalyuga & Singh, 2015; 2016). Once learners have acquired and practised a schema, they no longer need the scaffolded instruction (Sweller, 2010; Sweller et al., 2019). Effective pedagogy may present learners with a cycle of worked examples, completion problems and then full problems. As understanding and familiarity increases, smaller intrinsic elements should become part of the long-term memory and thus extraneous (Sweller, 2010). At that point, scaffolding may distract working memory from progressing schema application to more difficult problems. A shift to independent problem solving may then become the more efficient instructional approach to achieve a greater progression (Kalyuga & Singh, 2015; 2016).

Finally, instructional design must support an increase in germane cognitive load (Van Merrienboer et al., 2003). The reduction of intrinsic or extraneous cognitive load is not the aim. Rather, in conjunction with repeated variable practice for recurrent task aspects, such as the inclusion of genre elements within different topical contexts, supports the acquisition of literacy schemata into long-term memory to enable a generalisation and transfer of learning (Van Merrienboer et al., 2003; Sweller et al., 2019). When the extrinsic load of a task is reduced, learners are able to use their working memory capacity for germane cognitive load and concentrate on the acquisition of schemata. In turn, as more schemata are acquired, automaticity and task fluency are achieved to lessen the intrinsic difficulty of the literacy task. Overall, this promotes learning and can foster a progression in literacy development (Paas, Renkl, & Sweller, 2003).

3. A methodological overview of two empirical studies of Reading to Learn

3.1. Background

This section gives a brief overview of two (empirical) studies that two of the present authors undertook (see Millin & Millin, 2014, 2018), examining the efficacy of RtL in two different educational contexts (senior secondary and first-year tertiary) in South Africa. The studies were chosen for the following six reasons: both studies were concerned with academic literacy development; they implemented/applied the RtL intervention in a more or less similar fashion; they focussed on the academic or argumentative genre of writing as a way to provide academic literacy support; they considered cohorts of students 'straddling' either side of the transition from high school to university education; albeit samples of students from different parts of the educational spectrum, the two cohorts of students had broadly similar characteristics, as will be pointed out next; and both studies used the same quantitative method for analysis purposes (i.e., Wilcoxon signed-rank test for pairwise comparison of related or dependent or matched or repeated samples).

3.2. Participants

Two separate studies of RtL, both ostensibly comprising small-scale longitudinal study designs, were undertaken in 2010 (an inquiry about first-year students at a prominent public university) and 2014 (an inquiry about senior secondary school students at a low socioeconomic status school in a peri-urban area of the Western Cape province).[2] The tertiary study comprised a maximum (valid) sample size of 51 first-year Social Science/Humanities students, who were largely first-generation, Black African, with English as a second or even third language; who were from low socioeconomic status, previously disadvantaged, predominantly rural and peri-urban communities. The secondary study comprised a maximum (valid) sample size of 32 penultimate year English curriculum students, entirely Black African, with English as a second or even third language, who were from low socioeconomic status, previously disadvantaged[3], predominantly from peri-urban and rural communities. This cohort of students was a 'top-grade' (top performing cohort) class, with a number of them having aspirations at the time to pursue their studies at university in the near future. Therefore, from a purely descriptive point of view, the secondary and tertiary students had many characteristics in common.

3.3. Data collection

Although Millin & Millin (2018) advocate for process-based inquiry of RtL efficacy, for our purposes here, we focus on the pre- and post-intervention results in providing a summary of the key findings with respect to these two empirical studies. In both studies, a pre-intervention (baseline or diagnostic) task was administered to gauge each student's level of academic development. Writing skills were the focus because they were assumed to proxy a student's level of academic literacy skills. A topic was set, and students were asked to write a short argumentative essay (no more than 1000 words) to demonstrate the skills they had acquired to date. Although the intervention made use of a series of interim tasks (process approach to writing) to gauge students' ongoing academic writing development (or not), the post-intervention (summative) task comprised similar requirements to the baseline, but with respect to a new topic, and no support. The pre- and post-intervention results are reported in Table 2.

3.4. Findings

Given the small-scale nature of both inquiries and because the researchers did not want to impose any assumptions of normality about the underlying population of students in question, nonparametric (distribution-free) descriptive statistics and inferential statistics were used for analysis purposes, where the latter were used to show whether statistically significant improvements in students' demonstration of their academic literacy writing scores were exhibited, before and after the RtL intervention was applied. Table 2 reports the applicable results. From a descriptive perspective, both studies showed a noticeable difference in students' median performance with a more or less equal to or smaller variation (inter-quartile range) after RtL was implemented. From an inferential perspective, both studies revealed a statistically significant improvement in students' academic writing skills when comparing pre- and post-intervention writing scores, with 34

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[2] The senior secondary school study comprised a class cohort of Year 12 students, because these were the most senior group of students the researchers were allowed to work with, given most principals' and teachers' reluctance to allow final-year high school students to participate in research projects owing to time and national curriculum constraints. The method of sampling is best described as non-random, convenience sampling (i.e., the tertiary study made use of a cohort of students one of the researchers had access to) or purposive sampling (i.e., the secondary school study purposefully sought out school contexts that exhibited socioeconomic variation). The 2010 and 2014 empirical inquiries are denoted 'tertiary study' and 'secondary study' respectively, for short.

[3] This is a term given to African individuals in South Africa to denote the legacy of Apartheid. Although these students are not necessarily all 'deemed disadvantaged now', from a governance point of view, the legacy of Apartheid is intergenerational and has long lasting ramifications for education.

out of 46 students in the tertiary study (all 29 students in the secondary study) showing an overall gain in their academic writing skills, when comparing the number of positive and negative ranks. These findings are encouraging insofar as RtL being applied to two different cohorts of students from either side of the 'transition to tertiary studies' is concerned. In summary, although we do not present a new analysis in this paper – instead, we present an overview (a synthesis) of the applicable empirical results from two similar studies of RtL in South Africa – we do provide a different theoretical insight to help explain these results. Cognitive Load Theory offers a different theoretical lens for interpreting the previously documented empirical patterns. In the next section, we provide a discussion about how Cognitive Load Theory can usefully inform practice as related to the RtL intervention.

Table 2. Summary of results from two empirical studies of RtL.

| | Tertiary study (2010) | | Secondary study (2014) | |
	Pre (before) A1	Post (after) A4	Pre (before) A0	Post (after) A4
Median	74	80	19	36
IQR	12	8	2.5	3
Minimum	58	62	12	26
Maximum	92	90	24	38
n (Valid)	47	51	32	29
	Pairwise comparison A1-A4		Pairwise comparison A0-A4	
Z-statistic	-3.868		4.715	
p-value[a]	0.000		0.000	
Positive ranks	34		29	
Negative ranks	8		0	
Ties	4		0	
n (Valid)	46		29	

a. Two-sided Wilcoxon signed-rank test.

4. Discussion

As discussed in the literature review, Cognitive Load Theory looks at the relationship between working memory and long-term memory. New information that students receive daily pertaining to academic skills development and subject-specific content knowledge acquisition are stored within the working memory, whilst the brain simultaneously sifts through knowledge already stored within the long-term memory in an effort to integrate new information with old information (Schunk, 2012). Drawing on Piaget's Cognitive Development Theory (Kibler, 2011), where new information integrates easily with old information, a state of equilibrium is encountered. On the contrary, where new information is not easily assimilated into current schema, students have to modify existing schema to accommodate new information. This creates a situation of disequilibrium, which then requires *considerable* mental energy to adapt existing schema. This is often more problematic for EAL students from lower socioeconomic backgrounds, as per the participants from the two studies discussed in this paper. These students' academic discourse practices are typically at odds with discourse practices of the university. Consequently, more cognitive effort might have to be directed towards academic skills development for these students instead

of (or, in addition to) the subject-specific content knowledge they also have to acquire. Articulated differently, the participants spoken about in the two research studies verbalised that more time and energy was often spent on trying to read for meaning, and grapple with academic literacy issues instead of focussing on the required subject-specific knowledge acquisition. In this case, both intrinsic and extrinsic (cognitive) load were high.

Over and above significant mental energy required to reach a state of equilibrium, working memory also requires a huge cognitive effort. Therefore, when students transition to university, and are suddenly having to deal with a lot more *new* information about subject-specific content, in addition to new knowledge about university academic Discourse/discourse[4] practices (being largely first-generation university students), working memory can be more easily and quickly depleted. If students find themselves operating within a traditional academic cycle, where academic reading and writing challenges are high, yet limited support is available, academic anxiety is raised (Sandford, 1966). Prolonged academic anxiety can often lead to higher attrition rates. In both the tertiary and secondary studies, diagnostic or baseline assessments indicated relatively low academic writing skills. Without intensive academic literacy development support, higher levels of stress are likely to prevail, requiring considerable working memory to accommodate new knowledge about academic writing into students' current schema. This would leave little working memory to focus on subject-specific knowledge development. In other words, Cognitive Load Theory provides a very useful theoretical framework for understanding why high rates of attrition occur at South African universities for select student populations who have not been adequately prepared for the literacy rigours of higher education.

To bridge the academic literacy knowledge gap, and avoid overburdening academically weaker students' working memory, and to enable them to focus more on content knowledge acquisition, an RtL approach can support academic literacy development because it is highly scaffolded and differentiated in its input and assessment feedback. For instance, text modelling, peer facilitation (joint writing activities to start with to support students in collaborative writing efforts and shared knowledge generation) and intensive feedback (which is differentiated based on student needs) are the basis of RtL. A strength of RtL is its incorporation of subject discipline texts into the scaffolding of more advanced reading and writing skills, which means students are supported in a way that breaks down complex, highly challenging, subject-specific academic literacy tasks, into smaller, more manageable micro tasks. These smaller tasks are less cognitively demanding, and show students how meaning is constructed in the texts they will typically encounter in their discipline-specific studies.

Table 2 shows a general improvement in the academic writing skills of two cohorts of students when using RtL pedagogy. What is not evident from Table 2 is that students made the biggest improvements in their ability to structure more appropriate academic texts according to their respective subject disciplines. This meant that students improved their ability to create more cohesive and coherent texts, allowing for clearer articulation of thoughts and ideas, and better discipline-specific arguments. This provides some evidence to say that RtL, in supporting academic reading and writing development, may allow cognitive energy to be released for students to increasingly focus more on subject-specific knowledge acquisition, as they learn to become more articulate and autonomous academic writers.

5. Conclusion

The empirical evidence from both studies suggested a positive upward trend in students' academic writing skills. From a descriptive perspective, both cohorts of students demonstrated a noticeable improvement in the median performance before and after RtL was implemented. From an infer-

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[4] The use of D/d assists to denote attention to both writing practices and cultural practices.

ential perspective, both studies revealed a statistically significant improvement in students' academic writing skills when comparing pre- and post-intervention writing scores, with 34 out of 46 students in the tertiary study, and all 29 in the secondary study showing an overall gain in their academic writing skills, when comparing the number of positive and negative ranks. As discussed in Millin & Millin (2019), these studies provide evidence supporting the efficacy of RtL in scaffolding more advanced forms of academic literacy development in students whilst simultaneously helping them to develop discipline-specific content knowledge, implying a reduction in cognitive load.

From these two studies it is fair to say that RtL may reduce cognitive load in four ways. First, it reduces cognitive load by making instruction of academic writing explicit through text modelling. Examples of good writing guide students in developing more advanced forms of academic essays. Second, individual student needs guide the level of student support required. For instance, students receive differentiated input and feedback on each separate piece of writing submitted. Using a process approach to writing means students receive detailed feedback on multiple smaller tasks completed. These individual writing drafts scaffold students at a micro level, while building students' writing skills repertoire for a final extended writing task. Third, academic writing support integrated with subject-specific academic materials ensures scaffolding of discipline-specific writing practices. Fourth, the level of support is slowly reduced until students have autonomy to complete their final writing task.

Literacy interventions like RtL, which embrace instructional design, and are consistent with Cognitive Load Theory, have the potential to allow for a diverse range of learners to participate and achieve in the same rich, complex, real-world learning tasks. In other words, rather than perpetuating the gaps in learner development by utilising multiple non-equivalent tasks geared toward differing student abilities, the instructional approaches of sequencing equivalent tasks and supporting whole-task complexity, offer democratic learning opportunities. The target shifts from means-end cognitive effort to developing the schemata required to effectively and independently apply learning to solve a wide range of problems beyond the immediate curriculum. Simply put, RtL reduces cognitive load by making the discourse of academic writing more explicit, thus promoting the acquisition of new material and ideas. If students are provided with differentiated feedback and scaffolding throughout the process of learning to write academically, all students – regardless of their starting level of academic writing ability – are best afforded the opportunity to achieve high levels of autonomous academic writing outcomes.

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