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1038157 Joanne Taylor

Write like a Scientist. The effects of Systemic Functional Linguistics-informed teaching on Science writing outcomes in Secondary School EAL learners.

A Randomised Trial.

Abstract

The aim of this research was to discover the effects of applying a Systemic Functional Linguistics (SFL) based approach to the teaching of explanatory science writing. The research was conducted in a co-educational, independent secondary school in the UK with 19 EAL learners from China, Hong Kong, Japan, Poland, France, Spain and the Netherlands, who were aged between 13 and 18.

A randomised control trial design was used to explore causal relationships between the SFL teaching approach and writing outcomes: schematic structural stages, use of logical relations, lexical density, and amount of technical vocabulary. A comparison group received 'business as usual' writing instruction. A pre/post-test model was used, and a final delayed post-test was administered five weeks after the end of the treatment to identify any lasting impact.

The means for the SFL and the usual practice groups were analysed through independent samples t-tests in order to look for statistically significant differences between groups. No significant difference was found between groups, but the SFL group made slightly more improvement compared to the usual practice group.

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List of Abbreviations

Abbreviations	Explanation
SFL	Systemic Functional Linguistics
EAL	English as an Additional Language
TLC	Teaching and Learning Cycle
L1	First language
L2	Second language
RCT	Randomised Control Trial

1. Introduction

1.1 Aim

The aim of this study was to investigate whether using a Systemic Functional Linguistics (SFL) approach to teaching explanatory science writing is associated with better outcomes on participant texts than the researcher's usual practice. The focus of the experiment was teaching students to structure a scientific explanation using the appropriate logical relations, and scientific vocabulary to explain processes. The study used an experimental design in order to discover whether there were any statistically significant differences in writing outcomes between the SFL group and the usual practice group.

1.2 Rationale

Currently in the UK there is no National Curriculum guidance on the teaching of writing to EAL pupils. The National Curriculum makes a single mention of EAL learners: that their needs should be appropriately considered (DfE, 2014). A recent inspection framework for state schools published by the government's inspectorate of schools, Ofsted, makes no discrete mention of EAL learners (DfE, 2019). The Independent Schools Inspectorate, ISI, make no mention of specific groups of learners including EAL students in their inspection framework (ISI, 2019). An ISI inspection focuses on pupil outcomes, and EAL learners are considered a sub-group catered for alongside those with Special Educational Needs and Disabilities, and pupils designated as gifted and talented. Therefore, there is a lack of nationally endorsed good practice for EAL teaching which presents a need for research to fill this gap.

Internationally, research has been conducted on writing pedagogy at the secondary level within subject specialisms. This has drawn on various concepts which place writing as a learning activity in and of itself. The most complete and well researched of these at secondary level is Systemic Functional Linguistics (SFL) which has been used as the basis for studies across the globe. It began in the UK with Halliday (1989, 1996 inter alia) conducting research in schools, but due to changes in government education priorities Halliday moved to Australia where he continued his research (Walsh, 2006). The group of academics who have worked alongside Halliday became known as the Sydney school of researchers. In Australia SFL has been used as a basis for writing pedagogy in classrooms. This has also become popular in the USA as an intervention to support English Language Learners in the mainstream classroom. Genre based approaches have also continued to be used in Primary education in the UK. For example, learners should discuss examples of the texts they are expected to write, and apply appropriate features to their own writing (DfE, 2014). Nevertheless, while experiments into SFL have been conducted around the world there is a lack of experimental research based in the UK at Secondary school level.

1.3 Background

The background of this research was the ad hoc nature of English as an Additional Language (EAL) writing support across curriculum subjects at the researcher's school. At the school, EAL learners could choose to bring work to the EAL department from a range of subjects in order to gain extra help and support in improving what they perceive as disappointing outcomes. Alternatively, subject teachers could refer students to the EAL department for support. While whole school training has been delivered on the support of EAL students within subjects, this has not focused narrowly on specific writing support beyond strategy

provision, for example, creating scaffolds. Within EAL classes writing has been taught using a selection of elements from the Process, Product and Genre approaches, which will be detailed in the literature review of this study. There was a need to conduct research to discover which pedagogical approach is most beneficial to teaching writing and whether this might be applied across the school as a whole to support EAL learners. An SFL approach has been selected for investigation as this incorporates research for teaching writing across curriculum subjects. This research was an opportunity to fill the gap in knowledge across the staff, but particularly in the EAL department.

The research was carried out at a co-educational independent UK school with students in the Senior School aged 13 – 18. The students chosen for participation came from the English as an Additional Language register as these were the students the research was most looking to benefit. At the time of the study, the school had 30 students on the EAL register in the 13 – 18 age bracket. These students were from a variety of language backgrounds and proficiencies. Some students had been at the school for several years already, while some started in the UK education system in the same academic year in which the study was conducted. The specific genre chosen for research was based on evidence of need provided by subject teachers, and the needs of the participants.

1.4 Research Questions

The focus of the research was narrowed by conducting a review of literature. This enabled research questions to be designed. The specific research questions to be answered by this research were:

RQ1: Does adopting a genre-based Teaching and Learning Cycle framework have an effect on structure in students' writing?

RQ2: Does adopting a genre-based Teaching and Learning Cycle framework have an effect on register in students' writing?

1.5 Dissertation Outline

The outline of this dissertation is as follows: section two comprises a literature review which will outline SFL theories before detailing how these have been pedagogically applied. Research into teaching writing at secondary level and the use of SFL in experimental designs is presented in order to identify the specific gaps in literature that guided this research. Section three presents the methodological considerations and details the process of the research with justifications. Section four presents results in the form of descriptive and inferential statistics, while Section five discusses these in relation to the literature reviewed in section two. The final section will summarise the research with limitations and offer concluding remarks.

Literature Review

2.1 Introduction

The aim of this review is to familiarise the reader with the theoretical basis of Systemic Functional Linguistics (SFL) before contextualising SFL within wider writing strategies and approaches for both first language (L1) and second language (L2) learners. Empirical research will be critically reviewed. Finally there will be an evaluation of modes of instruction.

2.1.1 Orientation towards writing

Writing in a second language is a complex skill. Not only do writers need to concentrate on expressing their meaning clearly, but also on the correct grammatical and lexical forms of language. When a learner is writing in a language which has a completely different representational system they also need to consider how to form words. For example, a person with English as their first language writing in Chinese would need to consider character formation. In addition, there are certain expectations connected with types of writing that differ according to country and culture. For example, when writing an email of request in English to a person we don't know well, we would use indirect questions.

Writing at secondary school level has specific associated challenges. Currently in the UK curriculum subject knowledge has to be demonstrated almost exclusively through writing in the form of national examinations at the ages of 16 and 18. However, content specialisation often focuses on content knowledge and does not teach students specifically how to write in subject disciplines (Miller, Scott, & McTigue, 2018). This can leave weaker students unable to perform well in assessment which can limit future opportunities (Graham & Perin, 2007).

2.1.2 Pedagogical Approaches

Common pedagogical approaches to writing use aspects from a variety of theoretical approaches. The Process approach centres on the cognitive processes undertaken during writing; the Product approach isolates structures within a text in order for the learner to develop these in their own writing; and the Genre approach analyses texts as a group in order to understand the messages and the structures which communicate these.

Flower and Hayes (1981) developed a Cognitive Process Model of Writing in which they identified recursive cognitive processes that occurred during the writing of a text. This model was developed using think aloud protocols to identify the thoughts of a writer throughout the task of writing. Pedagogically, the Process approach to teaching writing focuses on the individual stages of writing such as planning, drafting, revising and checking. Training writers to work through these stages allows individuals to express ideas through the writing without prescribing what they should write (Galbraith, 2009). The theory aims to empower the writer, but has been criticised for failing to provide second language writers with the language they need to adequately express ideas (Hyland, 2016).

A strict Product approach analyses the linguistic items within a text and teaches students how to practise and use these items in their own writing. The texts are considered to hold a standard meaning in themselves no matter who reads them (Hyland, 2016). However, the approach has been criticised for being too prescriptive and not allowing for genuine communication (Hyland, 2016). Critics suggest that the focus is too tightly placed on form and grammatical structures, rather than meaning.

Finally, the Genre approach, in which SFL is situated, views writing as a communicative act that is situated in specific social contexts (Hyland, 2007). Therefore, there are specific

features of types of writing that can be learnt in a structured way in order for the writer to express themselves within expected social conventions. Section 2.2 will examine SFL and alternative genre based approaches in more detail.

In the language learning classroom it is likely that aspects from these approaches may be selected and used together rather than one approach being strictly adhered to.

2.1.3 Writing Success

Writing outcomes have been measured in numerous ways. Often in school based research writing is measured according to nationally standardised test scores. This is the case in the SFL case studies in the UK and of English Language Learners in the USA (Section 2.3). In experimental research, writing outcomes are measured directly through the analysis of participant texts. This analysis looks for the features of specific generic texts as identified through SFL literature (Section 2.3). While improving test scores is an overall aim of any teaching intervention aimed at school aged pupils, using these as a measure is problematic in experimental conditions. Test scores themselves are not directly based on the specific aspects of experimental intervention and, therefore, the cause of any improvement cannot be directly attributed. Direct measures are used to more finely isolate the cause and effect which is the essence of experimental research (Rose, McKinley & Baffoe-Djan, 2020). This means analysing a student text for the features being taught and scoring these in a systematic way. An example of a direct measure is the use of lexical density as a measure of scientific register in writing. Kim et al (2017) define lexical density as the ratio of content to grammatical words where content words hold meaning and grammatical words support syntax. The researchers used lexical density as a proxy measure of more academic and technical language as opposed to conversational language in a sample of 44 American

middle school students with Spanish as an L1. A pre/post-test design was used to analyse samples of science writing after a teaching intervention as part of a much larger previous study. Lexical density was found to have increased from pre to post-test along with the amount of technical vocabulary used. Raeisi, Dastjerdi and Reaisi (2019) compared 30 psychology research paper abstracts to analyse linguistic differences between 15 native and 15 non-native English speakers. One aspect explored was lexical density which was used as a proxy for information density in a text. No difference was found between the two groups, but an average of 59% content words per text was calculated which suggests a higher than conversational amount. The use of specific textual features to measure the success of writing supports an SFL approach to teaching writing. SFL deconstructs text features to make these observable for student writers to apply to their own writing.

2.2 Theory of Systemic Functional Linguistics

SFL is a body of work originating from the ideas of Halliday (1989, 1993, 1996 inter alia). The concept uses meaning as a starting point and language as a series of choices to build that meaning. The systemic aspect refers to the linguistic choices we can make as we are building our meaning. The functional aspect refers to a metalanguage based on the functions of the lexico-grammar we use rather than the purely theoretical categories of traditional grammar. Halliday (1993) calls SFL an appliable theory as it pertains to language as it is used rather than describing an ideal to be achieved. The importance of this theory in schools is that it does not separate language from knowledge, but suggests that knowledge is built by and from language. The language of specific subject disciplines differs because it is used to fulfil the specific knowledge requirements of that subject. For example, the language of a literature essay differs from the language of a laboratory report because they form very different types of knowledge. Along with other key scholars in the field (Hasan

1977, 1989; Martin, 1998, 2005, 2008; and Rose 2005, 2008), Halliday developed the theoretical side of SFL. However, this literature review is concerned with the application of SFL to particular subject contexts.

2.1.1 Key terms

SFL identifies the lexico-grammatical patterns that make up specific text types so that writers are aware of the choices they have to express meaning. To situate practice in theory it is necessary to define some of the terms that come up later in this literature review.

Writing acts happen in a specific situation and context which SFL terms situational context. There are three aspects of situational context to consider. These are field (what our communication is about), tenor (who our communication is for) and mode (how we are expressing our meaning) (Halliday & Webster, 2009). Field is important to the application to school subjects as this relates to the subject students are working in. This will be addressed later (Section 2.2.2) when learning frameworks are discussed in relation to situating writing in clear generic contexts. Tenor helps give purpose to a student's writing and to understand why they may need to select certain lexico-grammatical features. Mode in the case of this study will always be writing but different written genres will require different lexico-grammatical features.

In addition, there are three functional components of SFL to consider. These are: ideational (language we use to express ideas), interpersonal (language we use to communicate with others) and textual (discourse) (Achgar & Columbi, 2008). This study will focus on ideational and textual functions which are more relevant to writing within school subjects.

2.2.2 Genre

Genre is a specific way of constructing language which can be recognised in social contexts. For example, in the UK a person reading a newspaper article would have certain expectations about the structure, layout and content. Martin (1997:13) suggests that genres are “goal-oriented” meaning that some specific outcome is expected. With the newspaper article example a reader would expect to be informed by reading it. The reader would expect a headline which summarised the story in a few words, and an opening paragraph with all the important information contained in the text. Within the text the reader expects to find objective facts and subjective opinions attributed to sources with context about their relationship to the story. Genres exist within school subjects with each individual subject having its own culture. This culture makes up the *field* or context of the subject (Martin & Rose, 2008; Christie & Derewianka, 2008; Forey, 2020). Gibbons (2002:99) further breaks down the aspects of genre into four characteristics from which to study written genre and learning:

- "occurs within a culture
- has a specific social purpose
- has a particular overall organizational structure
- is characterized by specific linguistic features".

Linguists of the Sydney School (Derewianka, Maritin, Rose, Christie) categorise school genres thus:

- Recounts
- Narratives
- Information

- Reports
- Procedures
- Arguments
- Discussions
- Explanations.

Within genres there are two levels: elemental genres and macro genres (Martin, 1994). For example, an elemental genre could be procedural writing, meaning any text in which a procedure is described. A macro genre within this is a specific type of procedural text, such as a laboratory report. Within genres, texts follow specific structural patterns which allow them to be recognised as part of their generic family. Hasan (1977) recognised that there were variations and choices possible within these structures but there must be an adherence to a set of stages in order to locate a particular aspect of discourse within its genre. Veel (1997) details four types of science writing genre and analyses the stages of texts from those genres. For example, for a simple procedural text to be recognised as such the writer must include an aim, the materials needed, and steps to follow (Veel, 1997).

2.2.3 Teaching and Learning Cycle

Texts routinely used in the classroom fit into genres as described above. For example, in a History class students frequently produce recount texts, while in an English class students construct narrative texts. Therefore, each school subject requires students to write in specific genres (Christie & Martin, 1997).

At the heart of an SFL based pedagogical approach is the Teaching and Learning Cycle (TLC) comprising the stages of joint teacher-learner contextualisation, teacher-led deconstruction of text, teacher supported co-construction of a text and finally learners working

independently to create their own text (Polias and Forey, 2016). The scaffolding through the TLC is the teacher and therefore this differs from Vygotskian notions of social learning in the form of peer scaffolding (Wells, 1994). The TLC has been detailed with slight variations across the literature but the basis is very similar. For example, Derewianka's (1990) model suggests four stages:

1. Introduce the field (the context)
2. Deconstruct
3. Joint reconstruct
4. Independent writing

Martin and Rose (2005: 252) use the model below (Fig 2.1) which demonstrates the importance of learners understanding the context of the type of writing they are being asked to produce. This conscious awareness of the field continues throughout the cycle. The deconstruction phase begins with reading a text and examining its constituent parts. For example, in a magazine article noticing the direct address of the audience, the use of sarcasm or hyperbole, and the subtitles, call outs, and images positioned in the layout. The next stage of the cycle leads to a joint or co-construction of texts using the parts examined. Learners will be scaffolded in this by the teacher and receive feedback before attempting an independent construction of the text type for themselves. The cycle continues as feedback is given on the features of the text first identified in the deconstruction stage.



2.1 Chapter 2 Figure 1: Model of the Teaching and Learning Cycle (Martin & Rose, 2005:252)

Polias and Forey (2016) model the TLC as iterative process with each stage of the cycle having its own mini-cycle. This is important to consider as each stage may require mini-cycles of its own in order to build up understanding and confidence in the expectations of the text under construction. As Hermasson et al (2019:484) suggest the TLC is not 'static' and can be adapted to the needs of the learners and complexity of the writing task.



2.2 Chapter 2 Figure 2: Model of the Teaching and Learning Cycle (Polias & Forey, 2016:115)

2.2.4 Register

Register "refers to the choices made by a…writer in context with respect to the field" (Forey, 2020: 3). For example, when writing an explanation of a geographical phenomenon it would be expected that precise geographical terminology would be used.

A Spanish study compared register use by students writing in their L1 to those writing in their L2. Two groups of Spanish speaking students wrote texts: one group wrote in Spanish while their peers wrote in English (Llinares ,2013). Analysing the students' writing against expected conventions of the genres, the researchers found more examples of academic lexico-grammar in the Spanish writing and more spoken lexico-grammar in the English examples. This suggests that L2 writers in particular need explicit instruction on register use.

2.2.5 Benefits

SFL pedagogy is based on learning theory such as scaffolding with the teacher in the position of expert able to support learners to achieve better writing outcomes. The Teaching and Learning Cycle provides teachers with a model to use to scaffold learning effectively (Hyland, 2007). The cycle provides students with opportunities for noticing gaps between their work and the model text. The cycle also allows teachers to assess formatively and provide feedback to ensure students develop. Scaffolding is scaled back throughout the cycle to give learners autonomy in the later stages.

A further benefit of teaching writing using an SFL approach is the concept of schematic structures in texts. As texts belonging to one genre contain a specific structural pattern, this

can be used as a basis for scaffolding learner's writing for that particular genre (Schleppegrell, 2010).

The explicit teaching of register in SFL can help learners to understand the expectations of classroom genres. Forey's (2020) case-study of the implementation of SFL principles to teaching subject specific writing in a British secondary school notes how valuable students found the metalanguage of register. The routine cross-curricular noticing of how word choice affects register enabled learners to suggest tangible improvements to their own writing. The research notes enthusiastic comments from students who understand the importance of using a scientific register to demonstrate their knowledge when writing up experiments.

2.2.6 Criticisms

SFL pedagogy has been criticised for being too prescriptive (Freadman, 1994). The idea that writing can be distilled into elements that can then be rebuilt with slightly different information can appear restrictive. This overlooks the knowledge construction element where the conventions of a genre are used by the writer to build knowledge through the writing process. Bruce (2008) has also criticised SFL for being too narrow in the way that it perceives genres. Bruce argues that there are other ways to construct knowledge that are not social and suggests that SFL overlooks the role of individual cognition in knowledge creation. This does not appear to fully consider the body of work by Christie and Derewianka (2008) which connects the individual with genre in classroom contexts. They developed a framework of linguistic development across texts from pre-school to adolescence. It is acknowledged from the outset that these phases are not prescriptive and that the individual must not be ignored. In this work Christie and Derewianka (2008) are

providing an insight into the needs and expectations of writing at different stages of schooling in order to better support individual students in building knowledge and linguistic skill.

The TLC has many different versions according to different authors, for example, Derewianka (1990), Martin and Rose (2005), and Hyland (2007). Therefore, it can be difficult to refer to it as one specific concept. Nevertheless, different TLCs are all grounded in the SFL theory of contextualisation within the genre (reading lots of examples and deconstructing the common key features), followed by creating elements of the genre with support from the teacher before trying to construct a text independently. There are feedback elements in some cycles, and Hyland's (2007) cycle has a final step of comparing the genre being studied with other related genres. The idea is not for the TLC to be prescriptive, but for teachers to adapt according to their own learners and the complexity of the task. As Hyland (2007:160) comments it is a cycle that is 'intended to be used flexibly'.

Alternative models of genre based writing instruction such as Academic Literacies (Section 2.2.7) criticise SFL for not questioning the existing conventions of writing which represent a claim to power in societies. However, Christie and Martin (1997) said that SFL was a direct challenge to power in that it opened up writing conventions to a broader range of people. Nevertheless, SFL is focused on linguistics while Academic Literacies places identity at the core of its research.

2.2.7 Alternatives

As noted above, there are other genre based arms of L2 writing research such as Academic Literacies and English for Specific Purposes. Academic Literacies is also engaged in understanding the social and cultural areas of language choice; however, this is more

ethnographically based in that it focuses on the writer and issues of identity and voice (Coffin & Donohue, 2012). The expectations of certain cultures is problematized as not being accessible to all. However, the idea of learner writers critically engaging with writing in this way does not fit in with actual learner wants and needs. For example, Wingate (2012) found that first year undergraduate students preferred to adapt themselves to the expected conventions of academic writing rather than critique them. Academic Literacies differs from SFL as SFL is invested in breaking down the linguistic choices of cultures, or genres, in order to allow more people access (Christie & Martin, 1997).

English for Specific Purpose (ESP) and SFL both use the concept of genre to talk about specific discourse acts. Both ESP and SFL have strong leaders at their heart: Halliday in the case of SFL and Swales (1990) in the case of ESP. Both are concerned with understanding the workings of specific pieces of discourse but the approaches to this are quite different particularly where knowledge is concerned. While Halliday (1993) does not consider knowledge as separate from language, Swales is more cognitively concerned with using prior world and textual knowledge to build new understandings of how to write in a particular discourse community (Bruce, 2008). This has resulted in ESP being targeted towards very specific technical texts at a higher level than secondary school.

It's clear that for secondary school pupils the concept of changing the texts they are expected to write to better fit their identity and voice is not possible within the constraints of current exam focused syllabi, and the texts they are working towards are not considered *highly* specialised. Therefore from these three branches of study only SFL fits the needs of supporting students to write within generic conventions of secondary school subjects.

Learning to write in accepted conventions empowers learners to access other institutions of knowledge, an idea which is supported by Gibbons (2002).

2.3 SFL Research

2.3.1 Systematic reviews and Meta-analyses

Several systematic reviews and meta-analyses have been conducted into best practice in the secondary writing classroom. Additionally, a review of specific SFL based teaching in the USA is included here. There are pertinent findings in analyses of experimental classroom research which cross over into aspects of SFL pedagogy.

Bangert-Drowns, Hurley, and Wilkinson (2004) conducted a meta-analysis of school and college based 'writing to learn' interventions. Writing to learn is a British school of thought suggesting that the act of writing within curriculum subjects can improve content knowledge. Inclusion criteria for the meta-analysis narrowed the field to studies which compared an experimental 'writing to learn' intervention with a conventional instruction comparison in an academic context. The search included any research conducted up until 1999, but 75% of the selected studies were published between 1985 and 1995 providing studies from a narrow time period. The selected studies (N= 48) were coded for type of writing with 46 classified as instructional writing, for example procedures and reports. Therefore, there are pertinent applications to my research, but overall findings are not representative across a range of writing tasks. Researchers coded for studies which included feedback and those which included metacognitive writing prompts, meaning participants were asked to reflect on their own learning. Furthermore, context, methodology and publication type were all coded for. Effect sizes were measured using Cohen's *d*. Studies were analysed as unweighted and weighted in order to compare any differences in the two

methods, unweighted effect sizes are given here to reflect a true impression from the studies included (Bangert-Drowns, Hurley, and Wilkinson, 2004). Effect size seemed to correlate with treatment length; longer treatments showed greater effect sizes with treatments lasting a single semester or longer (d = 0.45) compared to those lasting for less than a semester (d = 0.14). Conversely, longer writing tasks were correlated to lower effect sizes: writing for under ten minutes had a higher effect size (d = 0.52) than writing for more than fifteen minutes (d = -0.10). However, the information on length of writing was not available for all studies included so this finding is drawn from fewer studies. Writing tasks that supported students in connecting their own understanding to the writing had a larger effect size (d = 0.44) than studies which included teacher feedback (d = 0.32). The findings suggest that time spent on teaching writing supports students' knowledge development rather than the act of individual writing practice itself. Learners need to reflect on their own learning in relation to writing in order for better outcomes. These aspects can be supported through the SFL Teaching and Learning Cycle with student writers supported by the teacher and able to compare their own writing to examples of the genre. However, the use of a variety of different outcome measures within the studies makes it unlikely that the meta-analysis gives a full picture. As the authors themselves caution, different outcome measures could better show effects of writing interventions. As such, measures that specifically target the features of successful writing can give a more nuanced understanding of how teaching approaches affect writing outcomes.

Graham and Perin (2007) conducted a meta-analysis of types of writing instruction for adolescent students. Inclusion criteria narrowed the field to studies involving participants in grades 4 – 12 in mainstream education, which focused solely on writing outcomes using an experimental or quasi-experimental design. Studies also had to show robust outcome

measures with inter-rater reliability calculated at .60 or above. Studies were placed into a treatment category, for example, process approach or strategy instruction. Only treatment categories with four or more effect sizes were continued into the analysis stage. 123 studies were eligible and were coded for genre, grade of participants, population sample, type of student and publication type. While care was taken to explain the coding in detail decisions about categorisation of treatment type are open to subjectivity. Furthermore, the use of different outcome measures across studies mean that caution should be taken in drawing conclusions. Weighted effect sizes for quality of writing outcome were calculated using Cohen's *d*. Process writing was shown to have a moderate effect only when teachers had undertaken specific training in that approach. Strategy instruction was found to have the largest effect size (*d* = 0.82). Furthermore, the use of peer assistance and or group planning and assigning specific goals to the writing based on expected features had medium effect sizes (*d* = 0.75 and 0.70 respectively). Studying model texts was found to have a smaller effect (*d* = 0.25). Aspects of these categories feature in the SFL based Teaching and Learning Cycle, for example, specific product features and elements of individual and group planning. Finally, the teaching of specific text structures was analysed but no clear overall effect size could be calculated due to the wide statistical variety (*d* = 0.75 - 1.27). This suggests further research is needed into the teaching of text structure.

In reply to the meta-analyses above Miller, Scott and McTigue (2018) conducted a systematic review aimed at uncovering the reasons for the efficacy, or otherwise, of the approaches included. In their rationale, Miller, Scott and McTigue (2018) argue that there is a need for more integrated subject literacy and that language is a vehicle for becoming specialists in academic subjects. This echoes SFL pedagogy that language and knowledge are

not separate entities but that one constructs the other. To meet inclusion criteria, studies had to include production of complete and coherent writing and to have been conducted between 2000 and 2016. Therefore, the systematic review started its search window where Graham and Perin (2007) finished. Only empirical research focused on learners, as opposed to teachers, was included. The aims of the systematic review were to identify themes in writing for content areas, how writing can benefit content knowledge, and what evidence based approaches enable integration of writing and content knowledge. Coding was based on quality indicators such as theoretical base of the study, validity and reliability, and consistency of findings. A screening process occurred before the quality coding which resulted in N= 43 studies being included in the review. An inductive paradigmatic analysis was taken where multiple researchers read studies and coded them by dominant theme(s) in order to recognise common themes across different studies. Three categories were identified: context or conditions of the writing task (n= 22), cognition or the thinking evident in the writing (n= 11) and content or the subject specific nature of the writing (n= 10) while a sub-category of content called achievement was apparent across all categories (n= 24). The most commonly investigated writing strategy (n= 13) identified in the context category was the use of models and templates prior to writing. The cognition category drew together themes of how best to help learners become aware of their own thinking practices in order to apply these to different learning situations. The content category contained very varied literature, but demonstrated the need for learners to be taught how to write in the specific ways that they will be assessed. The differences across literature in the content category and the relatively small number of studies included demonstrate a need for further research into subject genres. SFL classroom genres are a useful for bridging the gap in understanding about specific requirements of a particular writing culture.

Santiago Schwarz and Hamman-Ortiz (2020) reviewed SFL literature based in USA elementary classrooms. The inclusion criteria narrowed the field to empirical studies, published in peer reviewed journals, focusing on English Language Learners in U.S elementary classrooms which applied SFL. Literature had to address student writing outcomes or other disciplinary outcomes and be published in English between 2009 and June 2019. Studies (N= 28) were screened and then coded twice to draw out central themes. These key themes found that SFL pedagogy supported production of genre specific texts, language and literacy development, content learning, and critical language awareness. Again, the variety of outcome measures results in a general rather than specific understanding of the utility of SFL in the classroom. Nevertheless, the situation of SFL in the USA context is helpful as it has been developed to support English Language Learners within mainstream classrooms reflecting the EAL setting of this research.

2.3.2 Classroom based studies

Experimentally designed studies into elements of SFL have tended to focus on the use of the Teaching and Learning Cycle and explicit teaching of register. These have taken place in a variety of settings from EFL to first language classrooms across primary, secondary, and tertiary settings.

Within the UK, case studies into the use of SFL pedagogy with both L1 and L2 learners across the curriculum provide an insight into the effects of using the TLC in a secondary school, and explicitly teaching register to all students.

2.3.2.1 Experimental studies

Two studies from Iran used a pre/post-test design to compare the effects of teaching register using the Teaching and Learning Cycle. Osguee, Aidinlou, & Zoghi (2019) compared the use of the TLC and explicit register instruction against traditional writing instruction comprised of a structural focus with 100 Iranian EFL learners. Participants were randomly assigned to experimental and control groups at two different levels: intermediate and advanced resulting in 25 participants in each group. The study used essay questions from a large scale proficiency test called TOEFL iBIT for pre and post-testing, and model TOEFL examination answers in the teaching stages. The experimental group were explicitly taught about register, and followed the TLC. The comparison group were taught with a focus on grammar and vocabulary. Writing was marked according to the public criteria available for the TOEFL examinations. The use of published materials and criteria provides a well validated instrument for the research. The TOEFL PBT skills test was also used to measure proficiency and this allowed the researchers to control for any proficiency advantages before the intervention in their final statistical analysis. They found a significant difference ($p < .0001$) in the post-test scores of the two experimental groups suggesting that register teaching and the use of the Teaching and Learning Cycle was more effective than the traditional grammar focused approach. This is a tightly focused experiment on one genre: discursive writing for the TOEFL iBIT test. However, the strong sample size, lack of attrition, validated outcome measures and robust statistical practices are strengths of this research.

Aidinlou (2008) tested the TLC with N= 54 Iranian university students. The experimental group were taught about cohesive devices and register in five different genres: exposition, exploration, report, description, and discussion while the control group in this study practised writing paragraphs and essays. For the pre and post-tests the participants were

asked to read a passage from the IELTS Academic proficiency test reading section and write an essay on the same topic. This was then rated by two independent raters with a good reliability score of r = >.7. Writing was scored 1 – 5 for schematic structure and 1 - 5 for register. The scoring rubric was based on the schematic structure of the exposition genre: thesis, arguments, and conclusion. The texts were also scored for register on elements such as argument, topic, logical relationships between ideas and impersonal statements. There was a positive statistically significant difference between the experimental and control groups in the post-test writing measures ($p < .001$). In addition, there was a significant difference between the experimental groups' scores between pre and post-test ($p < .005$) but not in the control groups' scores ($p = .06$). This experiment adjusted published materials in order to adhere more closely to the tenants of SFL by scoring generic features of the texts as outcome measure. This could have unfairly advantaged the SFL group if they were taught the specific features measured in the test, while the comparison group were not.

Hermansson et al. (2019) conducted an experiment across three grades in a Swedish primary school to measure the effect of the joint construction phase of the Teaching and Learning Cycle on writing outcomes. The participants (N= 90) were aged 9 – 12 and taught in six intact classes with one experimental and one control class in each grade. The experiment measured narrative writing in the students' native Swedish. Both classes were taught using the Teaching and Learning Cycle but the control groups missed out the joint construction phase of the cycle. Writing outcomes were measured using generic features with a score of 0-3 given for each aspect, for example, a character's expression of plans. In addition, complexity was measured using specific lexico-grammatical items such as coordinating conjunctions and adverbs each scored on a 0 – 3 scale.

There was no statistically significant difference in quality or length of writing between the intervention and control groups over time (ps > .06). This suggested that the joint construction phase is not a critically important phase of the teaching and learning cycle. However, the comparison group spent some time dramatizing a narrative in place of joint construction. This act in itself could be construed as a collaborative scaffold for narrative construction similar to joint construction. This is an interesting finding but one that supports the overall use of the stages of the TLC.

In a quasi-experiment of N= 84 Norwegian upper secondary school pupils in two schools Horverak (2016) examined the use of SFL based instruction on discursive essay writing. The Teaching and Learning Cycle was implemented across four General Studies classes and students were pre and post tested on their ability to write an essay with reference to supporting material. The essay prompts and materials differed in wording but the topic remained the same. The order of the tests was changed across the groups. Writing outcomes were scored 1 – 6 on three aspects: structure, language and content and an overall score was given by two teachers and the researcher. Inter-rater reliability reported at .76 at pre-test and .84 at post-test. Students improved significantly from pre to post-test with an overall effect size calculated at .77 ($p < .01$). However, the lack of control group is a limitation as writing instruction of any kind could have caused the improvement seen. In addition the pre and post-tests were similar in topic and structure which alone could have caused an improvement.

2.3.2.2 UK case studies

SFL has a long and rather contentious history in the British school system. Halliday's initial work was centred on a government commissioned report into teaching methodology, but

the politics of the time moved on between commission and implementation (Walsh, 2006). So while integral research from Halliday and Hasan was based in UK schools in the 1960s this fell out of fashion. There are elements of SFL to be found in the National Curriculum throughout different levels, but these have been somewhat watered down and lack some of the more fundamental concepts of SFL applied theory such as the broad concept of register (Walsh, 2006).

The gap in the research and use of SFL in the UK has been picked up by Forey (2020) in her longitudinal whole-school case-study with 1100 students 52.3% of whom were classed as having English as an Additional Language. A Design-Based Research approach was taken to the study which collected data from teachers and students alongside analysing GCSE results. The study was able to consider many features of SFL and to train subject teachers in how to apply these. Perhaps most pertinent was the use of a register continuum across disciplines with which students were asked to critically engage. GCSE results improve substantially across all learners at the end of the academic year in which the intervention occurred: 5 A* - C grades for all students improved from 56% in 2015 to 62% in 2016.

The study recognises the limitations incurred in the self-selection of teachers who embraced SFL: those who were resistant to it did not volunteer to take part in the study. It would be interesting to see a breakdown of GCSE results across subjects and teachers according to who adopted SFL and who declined to. Although as a whole school approach which can be applied across the curriculum, the intervention would have had an effect on students even in classes which did not explicitly apply the intervention. This is an exciting study and the

impressive improvement in GCSE results makes it compelling, but these are not a direct measurement of the intervention.

Forey & Cheung, (2019) produced a case study focused on PE teaching at the same school following just four lessons: three theory and one practical. This enabled a closer look at the specific aspects of SFL through coding of teacher interviews, field-notes, student focus groups and document collection for genre, register, cause-complex, nominalisation and theme. The comments from interviews and focus groups demonstrate the practical tools that SFL had provided teachers and students to move their focus onto using language to construct learning. Students particularly found the use of register and tracking of theme and rheme helpful. The detailed qualitative data provided suggests that SFL can be used as a powerful tool for writing in specific school subjects.

While there have been some robustly conducted experiments into SFL pedagogy these have not taken place in a UK secondary school setting. Therefore, research with an experimental design taking place in a UK secondary school with EAL learners is needed.

2.4 Method of delivery

The practical vehicle for theoretical approaches need to be carefully considered in order to ensure the most effective methods are selected. Considering that this experiment took place during a pandemic, online teaching needed to be considered as the most accessible mode of delivery. Research into using the Teaching and Learning Cycle (Derewianka, 1990; Gibbons; 2002; Forey, 2020, Polias and Forey, 2016; Schleppegrell, 2020) demonstrates the

importance of scaffolding being delivered by the teacher to ensure that learners have all the tools needed to build their knowledge through appropriate disciplinary language.

2.4.1 Online learning

This research took place at a time of global crisis with a WHO declared pandemic in circulation. This resulted in world-wide disruption to schooling, including UK schools. The effect was a sudden migration to online teaching. This happened through necessity and without time to carefully consider the requirements of successful online teaching and learning. Therefore, in order to safeguard my research it was essential to consider how to successfully deliver the teaching interventions online.

Teaching online in a carefully planned course and teaching online as a result of an emergency are very different situations. Typically online courses require 6 – 9 months preparation time and are carefully designed with distanced learners in mind (Hodges et al., 2020). Teaching that needs to move online due to a crisis is not online learning but Emergency Remote Teaching where teachers are using whatever resources they have to offer as much learning as is possible in the situation (Hodges et al., 2020). Once the crisis abates the intention is to return to the physical classroom. Nevertheless, the large-scale necessity for Emergency Remote Teaching has produced some reflective findings that are insightful for future online provision. The most common and perhaps least surprising of these findings is the wish by students for live teacher interaction (Pu, 2020, Cragg, 2020, Dodgerson, 2020, Hodeges et al, 2020).

In their review of award-winning online teaching provision at university level Martin et al. (2019) interviewed eight teachers across a range of subjects. They targeted their research to three areas: course design, course assessment and evaluation, and course facilitation.

Despite not triangulating research and conducting just single interviews the findings give clarity to the process of establishing a successful online learning environment. Participants discussed the importance of aligning learning outcomes to activities and marking rubrics being given ahead of time. They also supported the importance of teacher interaction and availability. These are useful considerations when planning the intervention as there are many possible iterations of an online course. Means, Bakia and Murphy (2014) detail nine areas of consideration when building an online course. Some of these are predetermined by the research context such as class size but others are essential choices to be made such as pacing, feedback and assessment type. Yet other choices are linked to the SFL underpinning such as teacher and student roles and pedagogy. Finally, some choices may be determined by outside events such as whether a course will be fully online or mixed with some face to face learning and whether it can run synchronously or may have to be asynchronous.

2.5 Summary

There are three key aspects to SFL that will be of most use to the participants of this research as they are initially introduced to the approach. The first two are the recognition of schematic structures in texts, and use of register as this explicitly differentiates correct usage of language for specific classroom genres. The third element is the use of the Teaching and Learning Cycle as this will allow students to develop their independence in writing effectively. It is the nature of a body of work as deeply developed as SFL that there are elements that have not been examined for this research.

SFL has had an arrested journey in the British education system and despite initially being conceived of in the UK has had far greater success and development in countries such as Australia and the USA. Forey's work with her colleagues (2016, 2019, 2020) has gone some

way to demonstrate benefits to teachers and learners of applying SFL to curriculum learning. However, there's a lack of experimentally designed research demonstrating the specific effects of SFL based teaching. This research aims to discover if using the SFL based Teacher and Learning Cycle has better outcomes on the writing of specific genres in comparison to usual practice. This will be measured through frequency of generic features in the writing.

3. Methodology

This chapter will explain and justify the chosen design for this study: Randomised Controlled Trial (RCT). Participants and context are illustrated followed by a detailed explanation of instruments and procedure. The method of data analysis is introduced and a final explication of ethical considerations given. The aim of this research was to explore whether an SFL approach to teaching explanatory science writing has an effect on writing outcomes when compared with the researcher's usual practice. The hypothesis is that using the Teaching and Learning Cycle to deconstruct texts and scaffold student writing supports better use of the features of explanatory science writing. The focus of this research is on schematic structure and register and as such outcomes were measured according to schematic stages present, logical relations used, lexical density of texts and technical vocabulary used. The specific research questions were:

	Research Question	**Measurement**
RQ1	Does adopting a genre-based Teaching and Learning Cycle framework have an effect on structure in students' writing?	Structural stages Conjunction type
RQ2	Does adopting a genre-based Teaching and Learning Cycle framework have an effect on register in students' writing?	Lexical density Technical vocabulary

3.1 Design

An RCT is a form of experimental research design which aims to discover "the effect of something on something else" (Gass, 2015: 101). This is achieved by constructing conditions which allow for the measurement of a carefully controlled independent variable on a measurable dependent variable. In this RCT, the dependent variable is the extent to which the writing output conforms to the generic features of the writing task, measured by counting indicators of features. When investigating issues of causality, as Hutchinson and Styles (2010) emphasize, the use of an RCT should be the first choice method in educational research unless there are major barriers. This is because RCTs are better at allowing causal conclusions due to the fairer distribution of possible confounding characteristics across groups. To know whether the independent variable is causally related to the outcome, it is necessary to have a group to compare with, known as the control group. It's common to use 'usual practice' as a comparison method, and this is the most practical option to use in this study where the researcher is the classroom teacher. The intervention group will be taught using the SFL Teaching and Learning Cycle, comprised of contextualisation, deconstruction of a text, supported reconstruction and finally independent construction of individual texts. The control group will look directly at a task rubric and be guided through planning the structure and language needed to write an appropriate response to the task.

Hutchinson and Styles (2010) suggest specific conditions that must be met to consider using an RCT:

- Specific population
- Improvements in outcomes are measurable
- The effect on the outcomes is measurable.

These were met in my research through the use of the EAL population of students in my school, the use of generic features to measure outcomes and the use of statistical analysis to measure effect.

3.2 Participants and setting

3.2.1 Participant overview

Participants were international students at an independent English boarding school (N= 19) in which the researcher taught. The numbers of girls and boys are unequal with n= 15 female and n= 4 male. Students are from Hong Kong (n= 4), Mainland China (n= 7), Poland (n= 3), Spain (n= 2), France (n= 1), the Netherlands (n=1) and Japan (n= 1). All participants were taught wholly in English with varying amounts of EAL support available outside the classroom. They made up a range of ages (14 - 18) and as a result some study a full complement of curriculum subjects while some are already specialising in three or four A level subjects. All students were found to study at least one science subject. Biology, Chemistry and/or Physics (n= 15); Psychology (n= 4). In order to teach all students weekly it was necessary to use an online learning platform for ease of access in a busy timetable. It was also built in as a safeguard against any return to emergency remote teaching caused by the ongoing Covid-19 pandemic (see 2.4). The study began with (N= 26) potential participants but there was attrition both in the beginning and end stages of the study with a loss of seven participants either before or immediately after pre-test and a further three lost prior to the delayed post-test stage, leaving a total of N = 19 for pre/post-test analysis and N= 16 for pre/post and delayed post-test analysis.

3.2.2 Participant characteristics

Participants were Year 9 – 13 students enrolled in English as an Additional Language lessons at an independent boarding school in the UK. All participants studied either Biology, Chemistry, Physics or Psychology, or a combination of these. The table below gives details of the age, first language and gender of participants across the SFL and usual practice groups in the study. Following randomisation seven students dropped out of the study before the pre-test resulting in unequal sized groups. Of those who left the study four had been assigned to the usual practice group, and three to the SFL group. These participants are not included in the table below as they did not take part in the research.

3.1 Chapter 3 Table 1: descriptive statistics for participants across groups

Characteristics	**Total**	**R0 (Usual practice group)**	**R1 (SFL group)**
Total	N = 19	n= 8	n= 11
Age	14 n= 2 15 n= 6 16 n= 3 17 n= 6 18 n= 2	14 n= 1 15 n= 3 16 n= 2 17 n= 2 18 n= 0	14 n= 1 15 n= 3 16 n= 1 17 n= 4 18 n= 2
First language (L1)	Mandarin n= 7 Cantonese n= 4 Polish n= 3 Spanish n= 2 French n= 1 Dutch n = 1 Japanese n = 1	Mandarin n= 2 Cantonese n= 2 Spanish n= 2 Polish n= 1 Dutch n= 1	Mandarin n= 5 Cantonese n= 2 Polish n= 2 French n= 1 Japanese n= 1
Gender	Female n= 15 Male n= 4	Female n= 6 Male n=2	Female n= 9 Male n= 2

Following the immediate post-test stage of the study a further three participants dropped out of the study. These were all in the usual practice group reducing the number in this group to 5 at the delayed post-test stage. Approximately half of the participants in each group spoke a Chinese language as their L1. The balance between older and younger learners favours younger learners in the usual practice group. Ages were more or less equally represented in the SFL group. (A consort diagram is available in appendix i).

3.3 Instruments

In order to measure the effect of using a Systemic Functional Linguistics approach on scientific explanations I delivered a series of lessons which comprised the stages of the Teaching and Learning Cycle (Section 2.2.3). I used a pre and post-test of writing in order to measure generic elements of structure and register. In order to discover whether the intervention had a lasting effect I also delivered a delayed post-test 5 weeks later. The use of the experimental design only allows for measuring the effect of the intervention, for purposes of depth I triangulated the data with my own research journal to notice any further findings such as any obvious differences in understanding in formative assessment throughout the study.

3.3.1 Pre-research

I engaged Heads of Department in a whole curriculum genre mapping exercise in order to pinpoint genres that would be most beneficial for my students in this intervention (appendix ii). This was achieved through a questionnaire designed to capture which genres teachers felt they taught in their subjects. It was clear that explanation and report texts would have the broadest practical benefit across the age groups of my students. In order to be useful to

the broadest range of students I selected science as the subject taught to the greatest number of participants (Section 3.2). To ensure that the intervention and control lessons supported the specific needs of my population I conducted a sample analysis of GCSE and A level question papers, mark schemes and examiner reports for the three main science subjects of Biology, Chemistry and Physics. My sample year was 2018 and the focus was on questions that required any amount of written response as opposed to presenting knowledge in the form of calculations, diagrams, graphs or by selecting multiple choice options. I noted the command words in the questions; command words are those which tell the candidate what type of response is required to the question, for example, *describe, give reasons for*, or *evaluate*. The most common command word identified across and within science subjects was *explain*. This informed the selection of explanation texts as the focus of my research from the two most commonly referenced genres in my survey of Heads of Department. The other notable finding from the analysis of exam materials was that the mark schemes and examiner reports often made reference to logical sequencing of ideas and explicit links in written responses. This is directly applicable to the assessment of the appropriate schematic stages of participants' writing. Veel (1997) explains that sequencing and linking are key elements of causal explanations due to the fact that the phenomenon being explained is usually not directly observable.

3.3.3 Writing prompts

Students in both groups were given the same writing prompts at each stage of testing; however, the prompts were changed for all participants at each stage to avoid any improvement that would result from having practised the same task before. Writing prompts were selected to give students some technical vocabulary and enough visual

information about the process which they needed to explain to replace the need for specific knowledge. The first prompt I found online without copyright for teaching purposes, but it was not as easy to find appropriate prompts with such generous copyright for the next two tests, therefore I created my own using a graphics software package called Adobe Spark. The prompts can be seen in appendix iii.

3.3.4 Reflective journal

I kept a contemporaneous reflective journal as the research progressed. Although this is a subjective record of events, it enabled potential problems to be noted and solutions found in a timely manner. It was also an invaluable tool in accurately constructing this methodology chapter.

3.4 Procedure

3.4.1 Randomisation

Random allocation to comparison groups is used to ensure that participants' individual characteristics, both known and unknown, are fairly distributed across groups. If students are allocated randomly to the intervention or control group this ensures that differences in average characteristics between groups is a result of the play of chance, and not due to a systematic difference, or bias. I randomly assigned participants to their group by flipping a coin. Heads was the treatment group and Tails the control group. The identities of the participants were concealed from the allocator by first using a random number generator to assign four digit numbers to each participant, then using these numbers instead of

participant names when conducting the random allocation. A coin was then flipped for each number to allocate the participant to a group.

3.4.2 Blinding

Blinding is the act of concealing which treatment is being received during an experiment. It is used in order to prevent behaviour change in participants caused by knowing which treatment they are receiving (Moustgaard et al., 2020). For example, participants in experimental groups may behave in ways to improve their performance in a conscious or unconscious effort to show that the experimental treatment 'works'. It is not possible for a teacher to be blind to the treatment and control groups, but participants themselves need not know which group they are in. In this study participants knew only that different types of writing instruction were being researched, but had no information about the pedagogy involved or which group they were in. The blinding of participants may reduce the "Research Participation Effect" (Mccambridge, Kypri, & Elbourne, 2014), where participants in a study behave differently because they know that they are taking part in research. While this effect may occur across my study it should not cause any strong difference between the two groups. It is important to use an experimental design to test the effects of SFL based teaching on writing outcomes as this is missing from the SFL literature in British school contexts

3.4.3 Intervention

Eligible participants were randomly allocated to either SFL or usual practice groups (see appendix i for CONSORT flow diagram). All participants were tested using the same pre-test the week before teaching began. For the SFL group, teaching followed the SFL Teaching and

Learning Cycle. Specific aspects such as schematic structure, technical vocabulary and temporal and causational linking devices were studied from the deconstruction stage onwards. The usual practice group followed writing instruction for the same genre but did not focus on deconstruction or explicit concepts such as register. A table of the intervention lessons is in appendix iv. In order to practically reach all EAL students all lessons were available as short interactive PowerPoint lessons uploaded to Microsoft Teams (see appendix v). Students focused on one aspect of writing per week for four weeks. In the sixth week they all completed the same post-test. Finally, a delayed post-test was administered five weeks later.

3.4.3.1 Lesson 1

Once the intervention began students in both groups received a lesson on the structure of a cause and effect text in science writing. Both groups had the same learning objective and received the same introduction slide which introduced the topic of global warming. The usual practice group then looked at a visual diagram, before being introduced to the headings and bullet pointed contents of each structural stage. At no point were they introduced to a complete model text, which differed considerably from the SFL group, who were given a model text to read first before the structure was deconstructed for them. Both groups were then asked to check their understanding of the structure by answering questions on a Microsoft Form. The usual practice group had to select the correct options from multiple choice questions while the SFL group had to order the correct elements themselves according to the SFL principle of reconstruction. To note, at this stage in the experiment three stages of schematic structure were presented as per Veel's (1997)

analysis. It later became clear that it was only possible to mark two stages in the outcome writing as per Martin and Rose's (2008) analysis.

3.4.3.2 Lesson Two

In the second lesson, again with a shared learning objective focusing on structure, the usual practice group were reminded of the diagram from the previous week and asked to think about the structure presented to them for scientific explanations. They were given a new diagram on the same topic and a guided planning sheet to use to create the contents of a plan for explaining the process shown in the diagram. The SFL group were reminded of the structural stages of the model text and could again view the text with headings to show the stages. They were then asked to place the stages as headings on a second text, again using the same topic, to allow for guided reconstruction. (In both the first and second lessons the texts and diagrams used were connected but students in each group saw either the diagram only or the text only).

3.4.3.3 Lesson Three

In lesson three both groups focused on vocabulary. For the logical relations part of the lesson both groups shared a language related learning objective. The usual practice group was asked to sort a list of linking words into three categories during the lesson, and later, asked to recall three linking words related to cause and effect as a formative assessment task. The SFL group was introduced to the concept of register using a continuum. They were shown the same explanation model text from lesson one this time with linking words highlighted in blue. They were asked to notice these and then to highlight any cause and effect linking words in the second text introduced to them in week two.

For the technical vocabulary part of the lesson the usual practice group looked again at the original diagram from lesson one and were asked to notice the specific topic vocabulary. In their formative assessment task they were asked to list three examples of topic specific vocabulary they could use to explain the diagram. The SFL group remained focused on the idea of register and were asked to notice specific scientific terms highlighted in yellow in the model task from week one. They were then asked to highlight scientific terms in the text from week two.

3.4.3.4 Lesson Four

In lesson four the learning objectives were worded slightly differently for each group. In the usual practice group the learning objective was to plan language choices following on from the structure planning in lesson two. In the SFL group the objective was to make a full plan for a scientific explanation text. The usual practice group were reminded of the learning so far and presented with the same diagram from lesson two which they had used to create a potential structure for explaining. They were asked to consider what vocabulary they might use for each stage of the explanation with one column for topic specific vocabulary and another for linking words. The SFL group were also reminded of their learning so far using specific terms such as register, process and structure, and asked to plan an answer to the question: Explain the causes of global warming. They were given a table with directions on how to fill each box, for example: which scientific terms will you use? This was the final task, in which learners combined all learning from the previous three lessons.

3.5 Outcome measure

Discourse Analysis is used to analyse the effect of particular linguistic choices on meaning (Paltridge & Wang, 2015). It has been used in this study to analyse participants' writing for

features of scientific explanations genre. This forms a sub-area of Discourse Analysis called Genre Analysis which was initially developed within SFL by Halliday and Hasan (1989). Later, SFL research focused on generic texts and the features of these that can be learnt (Martin & Rose, 2008) (Section 2.2). By analysing participant texts for the chosen features of scientific explanations I can measure outcomes directly.

Overall, I created four categories in which to numerically score writing competence in scientific explanation texts: two measures for each of the research questions. I holistically measured the structural stages using those explained by Veel (1997) and Martin and Rose (2008). As a further measure I coded the linking devices, using the conjunction (Veel, 1997) and consequential relations (Martin and Rose, 2008) lists along with my own synonymous additions (appendix vi). The use of published criteria for analysing discourse supports validity of the measure. It meets the criteria of authenticity, interactivity and practicality, and by using it to analyse sample texts in my pre-research I was able to check reliability, construct validity and impact (Rose et al, 2020).

In order to measure register I used a lexical density analysis and a subjective assessment of technical vocabulary as judged by two raters. Lexical density is a proxy measurement of complexity in written language comprised of the ratio of lexical to grammatical words (Halliday, 1985). Lexical words are those containing meaning while grammatical words create the structure of syntax. Classifying words into lexical and grammatical groups is not an exact science and so Halliday (1985) emphasises the importance of a consistent approach. Therefore, I chose to use analysis software, Lextutor (Cobb, 2021), to ensure internal consistency. Lexical density has been used to measure how much a written text

reflects scientific and academic domains in studies employing an SFL approach to textual analysis (Section 2.1.3). A key area of school science writing identified by Halliday and Martin (1996) is the use of technical terms. In order to improve the validity of the measure I also performed a manual count of technical terms used and had these technical terms judged by a second rater to improve reliability.

3.5.1 Text analysis procedure

In order to remain blind to which student had produced which text, I copied and pasted all writing into a single document for each data collection point and identified each text only by participant number. This was important as it ensured that I could not identify participants during the analysis stage therefore limiting the effects of bias. In order to be able to analyse the data using lexical analysis software, I spell checked the document before using lextutor (Cobb, 2021) to get a measure of lexical density for each individual piece of writing. I then selected the technical words provided in the prompt and searched the combined document for these to highlight. Again using lextutor, I performed a lexical frequency analysis on each full data collection document and selected technical vocabulary from the resulting list. This was to ensure fairness across all student writing. These were then searched for and highlighted in the text document. To guard against subjectivity and improve reliability a second rater also selected technical vocabulary from the list. Cohen's κ was run to find agreement between raters with good to very good agreement found at .807, .898 and .936 $p < .001$ for each data collection text respectively (Altman, 1999). In the event we disagreed on the inclusion of a word we discussed it and were able to agree on whether to include or reject it in 100% of cases (appendix vii). In order to measure the use of logical relations for

sequencing and demonstrating cause and effect two independent lists were used: Veel (1997) and Martin and Rose (2008). These were then searched for and highlighted in a different colour. In the event of finding synonymous logical relations I added these to the list and performed a search of the document to ensure all students were recognised for the same usage. All highlighted choices across research questions were checked by eye to ensure a match to meaning and not just form. Finally, I used Veel (1997) and Martin and Rose (2008) to determine the specific structure of a sequential explanation text, awarding one point for each aspect of the structure found in a text by highlighting in different colours. Both Veel (1997) and Martin and Rose (2008) agree that a phenomenon identification should begin the text followed by a logical explanation stage. While Veel (1997) suggests that cause and effect should be made explicit, Martin and Rose (2008) argue that an implicit cause and effect relationship exists in these texts. I attempted a sample analysis of participant texts and found evidence for implicit cause and effect relationships and so chose to look for only the two stages: phenomenon identification and explanation sequence. This enabled me to count up scores for each aspect to create numerical data for analysis (see appendix viii). In order to check the outcome measures post hoc, I completed some sample explication analysis on high and low scoring samples of writing. These are used to demonstrate the functional aspects of a text (Martin and Rose, 2008) (appendix ix). These were useful as they demonstrated that higher scoring samples were easier to categorise according to the expectations of the genre than lower scoring samples.

3.6 Data analysis

A mean score was calculated for each group in each outcome measurement these could then be examined for any group differences across testing stage. SPSS was used to analyse

the mean group scores from the three collection points using Chi- square tests and independent samples t-tests, or non-parametric equivalents where necessary, on each category of the writing scores: lexical density, schematic structure, technical vocabulary and logical relations. This provided both descriptive and inferential statistics. Inferential statistics were used to check for statistical significance in outcomes.

3.7 Ethics

An application was submitted to, and approved by, The University of Oxford's Central University Research Ethics Committee. In addition, permission to run the experiment was sought from the Head teacher and the Deputy Head Academic at the school. In order to ensure that students were not overwhelmed by the extra work no EAL homework was set during the period of the intervention so that participants did not experience extra demands on their time. Participants were made aware of their position in the research and engaged in the aims of the study. Randomisation was not considered unethical as the benefit of the intervention was not known at the beginning of the study and all participants received some form of extra writing instruction. See appendix x for proposal submitted to the ethics committee, and subsequent approval given.

4. Results

This chapter presents the results of the experiment to assess the relative effects of writing instruction using an SFL approach compared with a usual practice control. The chapter begins with an overview of results, and then goes on to address each research question in turn.

4.1 Overview of results

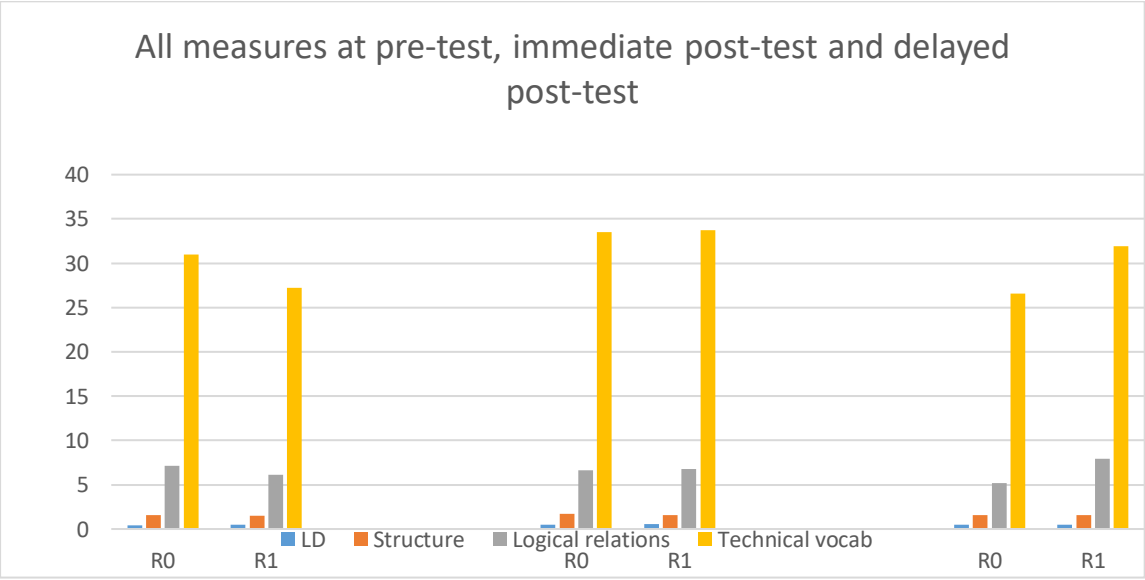
Each participant's writing samples were analysed across four categories: schematic structure, logical relations, technical vocabulary and lexical density by counting the use of these features. In the case of lexical density, analysis was made using computer software. Participants were tested pre and immediately post treatment, and again five weeks later.

4.1.1 Descriptive statistics

Descriptive statistics show the group means for each writing outcome measure at the three data collection points. These show that there was very little change in outcomes in either group across the three stages of testing.

4.1 Chapter 4 Table 1: Mean writing scores on all measures for each group at each testing point

		Pre-test		Immediate post-test		Delayed post-test	
Measure	Total Potential score	Usual practice group	SFL group	Usual Practice group	SFL group	Usual practice group	SFL group
Lexical density	1.0	**0.4** *SD = 0.02*	**0.5** *SD = 0.03*	**0.5** *SD = 0.04*	**0.5** *SD = 0.05*	**0.5** *SD = 0.03*	**0.5** *SD = 0.03*
Schematic structure	2	**1.6** *SD = 0.48*	**1.5** *SD = 0.49*	**1.7** *SD = 0.43*	**1.6** *SD = 0.48*	**1.6** *SD = 0.48*	**1.6** *SD = 0.48*
Logical relations	unlimited	**7.1** *SD = 2.36*	**6.1** *SD = 2.89*	**6.6** *SD = 2.23*	**6.8** *SD = 4.55*	**5.2** *SD = 1.93*	**7.9** *SD = 2.35*
Technical vocabulary	unlimited	**31** *SD = 9.89*	**27.2** *SD = 6.49*	**33.5** *SD = 6.5*	**33.7** *SD = 8.26*	**26.6** *SD = 5.67*	**31.9** *SD = 8.55*



4.2 Chapter 4 Figure 1: Mean writing scores on all measures for each group at each testing point

Differences were calculated between mean group score from pre-test to delayed post-test for each group. These show slight gains overall for three of the four measures in the SFL group with only lexical density making no improvement. In the usual practice group, only lexical density showed slight improvement while schematic structure remained static, and logical relations and technical vocabulary showed lower scores compared to pre-test. However, the results must be taken with caution given the attrition of participants in the usual practice group. Table 4.2 shows the differences in mean scores for each outcome measure in each group from pre-test to delayed post-test.

4.2 Chapter 4 Table 2: Differences in mean scores for each group between pre-test and delayed post-test.

		Pre-test		**Delayed post-test**		**Differences between scores**	
Measure	Total Potential score	Usual practice group	SFL group	Usual Practice group	SFL group	Usual practice group	SFL group
Lexical density	1.0	**0.4** *SD = 0.02*	**0.5** *SD = 0.03*	**0.5** *SD = 0.03*	**0.5** *SD = 0.03*	*0.01*	*0.00*
Schematic structure	2	**1.6** *SD = 0.48*	**1.5** *SD = 0.49*	**1.6** *SD = 0.48*	**1.6** *SD = 0.48*	0.00	0.01
Logical relations	unlimited	**7.1** *SD = 2.36*	**6.1** *SD = 2.89*	**5.2** *SD = 1.93*	**7.9** *SD = 2.35*	-1.9	1.8
Technical vocabulary	unlimited	**31** *SD = 9.89*	**27.2** *SD = 6.49*	**26.6** *SD = 5.67*	**31.9** *SD = 8.55*	*-4.4*	*4.7*

4.2.2 Inferential statistics

Inferential statistics are presented for the post-tests and delayed post-tests which show no significant differences between groups for any of the writing measures. Independent samples t-tests were run where correct assumptions were met. A Bonferroni correction was applied to protect against type I errors, where spurious results can occur due to multiple comparisons (Hayes, 2020). To make the Bonferroni correction in this study the significance was set at $p < 0.0125$. This was calculated by dividing the normal acceptable significance value of $p<0.5$ by four to reflect the four comparisons being made. In the case of the structure measure a Chi square test was required due to the type of data collected. In the delayed post-test the data for technical vocabulary did not meet the assumptions and so a non-parametric Mann Whitney U test was conducted in place of a t-test. The statistical comparison of means across the usual practice and SFL groups showed no significant difference at either immediate or delayed post-test. The results will be considered in greater detail in the next sections. Table 4.3 shows the statistical test results for each measure at immediate and delayed post-test stages. $P > 0.0125$ demonstrates the non-significance of these results.

4.3 Chapter 4 Table 3: Inferential statistics for each outcome measure at immediate and delayed post-test stages.

Research Question	Measure	Immediate post-test	Delayed post-test
Does adopting a genre-based TLC framework have an effect on structure in students' writing?	Schematic structure	Fisher's exact test, p = 1.00	Fisher's exact test, p = 1.00
	Logical relations	t(17) = -.092, p = .928.	U = 39.5. Z = 1.37, p = 1.68.
Does adopting a genre-based TLC framework to lessons have an effect on register in students' writing?	Lexical density	t(17) = -.659, p = .518.	t(14) = -1.13, p = .277.
	Technical vocabulary	t(11) = -1.07, p = .304.	U = 38.0. Z = 1.19, p = 2.33.

4.3 Research question one: Does adopting a genre-based Teaching and Learning framework have an effect on structure in students' writing?

4.3.1 Immediate post-test

As the score for schematic structure was recorded as either 1 or 2, a Chi square test for association was selected. A Chi square test can be used when two categorical responses are being examined for association (Shih and Fay, 2017). The Chi square test showed no significant difference between schematic structure scores between the SFL and usual practice groups, p = 1.00.

An independent samples t-test was conducted to look for any significant relationship between teaching group and outcome in the measure of logical relations. No outliers were found on inspection of a box plot, and engagement scores were normally distributed according to Shapiro-Wilk's test ($p > .05$). Homogeneity of variance was met by Levene's test ($p = 1.47$). The usual practice mean score was -.170, 95% CI [-4.71 – 4.36] lower than the SFL group. There was no significant difference between groups $t(17) = -.092$, $p = .928$.

4.3.3 Delayed post-test

At the time of delayed post-test the SFL group had overtaken the usual practice group on both structure measures. The validity of these results is caveated as the usual practice group had lost three participants at this stage, resulting in a much smaller sample for comparison. A Chi square test for association showed no significant difference between schematic structure scores between the usual practice and SFL groups, $p = 1.00$.

The logical relations data did not meet assumptions for parametric tests, the data showed outliers in both groups on inspection of a boxplot, therefore a non-parametric test was selected. Mann – Whitney U can be used in place of t-test in the event of non-normal data. On visual inspection of distribution pyramid scores were not evenly distributed. As there is the possibility of ties in the data the asymptotic significance level is reported showing no significance between the usual practice group (Mean rank = 6.10) and SFL group (Mean rank = 9.59) logical relations scores, $U = 39.5$. $Z = 1.37$, $p = 1.68$.

The SFL group did improve slightly in measures of schematic structure and use of appropriate logical relations, suggesting that the use of the Teaching and Learning Cycle had a positive effect on structure in students' writing.

4.4 Research question two: Does adopting a genre-based Teaching and Learning Cycle framework have an effect on register in students' writing?

4.4.1 Immediate post – test

At post-test the SFL group mean for both register measures was slightly higher than the usual practice group.

Technical vocabulary scores showed no outliers on inspection of a boxplot. Scores for both groups were normally distributed according to Shapiro-Wilk's test ($p > 0.5$). Levene's tests showed homogeneity of variance between the two groups ($p = .105$). The mean difference was -1.26, 95% CI [3.85 to 1.32] higher for the SFL group than the usual practice group. There was no significant difference between the two groups' scores at immediate post-test $t(11) = -1.07$, $p = .304$.

Lexical density scores showed no outliers on inspection of a boxplot. Scores for both groups were normally distributed according to Shapiro-Wilk's test ($p > 0.5$). Levene's tests showed homogeneity of variance between the two groups ($p = .493$). The mean difference was -.017, 95% CI [-.072 to .037] higher for the SFL group than the usual practice group. There was no significant difference between the usual practice SFL group scores at immediate post-test $t(17) = -.659$, $p = .518$.

4.4.3 Delayed post-test

At delayed post-test the SFL group mean for technical vocabulary remained higher while the lexical density score was equal between the two groups.

Technical vocabulary data demonstrated an outlier on inspection of a boxplot and so again a Mann – Whitney U test was performed. On visual inspection of distribution pyramid scores

were not evenly distributed. As there is the possibility of ties in my data the asymptotic significance level is reported showing no significance between the usual practice group (Mean rank = 6.40) and SFL group (Mean rank = 9.45) logical relations scores, U = 38.0. Z = 1.19, p = 2.33.

When testing lexical density scores for significance, no outliers were found on inspection of a boxplot. Scores for both groups were normally distributed according to Shapiro-Wilk's test (p >0.5). Levene's tests showed homogeneity of variance between the two groups (p = .546). The mean difference was -.022, 95% CI [-.065 to .020] lower for the usual practice group than the SFL group. There was no significant difference between the usual practice and SFL group scores at delayed post-test t(14) = -1.13, p = .277.

The SFL group improved in the measure of technical vocabulary, although not lexical density. This shows that the Teaching and Learning Cycle did have a positive effect on register in students' writing.

4.6 Research Journal Triangulation

A research journal was kept throughout the whole process in order to provide depth to the research. During the process I noticed some differences between the groups' reactions to different tasks. For example, the initial exposure to schematic structure was more challenging for the SFL group as evidenced in formative assessment tasks for the lesson. Comparatively, allowing the usual practice group to create a structure was more successful. The selection of appropriate logical relations by the SFL group was also initially more challenging but appeared to provide better results in the post-tests. The journal has also been useful in understanding the reasons for attrition. The first stage of attrition occurred at the start of the research. At the start of the research Coronavirus infections were very high

in the UK which triggered a national lockdown. This resulted in the closure of schools and the requirement for remote learning. For some students the situation caused difficulties ranging from lack of motivation to anxiety to feelings of stress at having to complete work more independently. Some students were working in different time zones and felt the loss of structure, while others were in the boarding house coping with a prolonged absence from their families, without the usual distractions of school life. Therefore, it was not ethical to extensively persuade participants into research tasks at the expense of their mental wellbeing. The second stage of attrition happened between the post-test and delayed post-test. Conversely, the attrition of two participants was caused by the re-opening of schools in early March. Both of these participants were in exam years and the re-opening of school came with a renewed focus on collecting subject work to evidence exam grades. Therefore, students felt that they did not have time to focus on additional work such as the research task. A final student was unable to complete the delayed post-test until much later in the term due to illness. As this task was completed weeks after the collection point, it was considered unfair to include it in the analysis due to the extra time that had passed between learning and undertaking the task.

4.7 Summary

Inferential statistics found no significant differences between the SFL group and the usual practice group. The descriptive statistics demonstrate only small differences in mean scores across the three data collection points. The data does show better gains between pre-test and delayed post-test for the SFL experimental group. The caveat to this finding is the loss of participants in the usual practice group between immediate and delayed post-test stages in an already small scale experiment.

5. Discussion

5.1 Aims

The aims of this research were to discover if using an SFL approach to teaching explanatory science writing would result in better writing outcomes than the usual practice. The specific SFL features measured in participant texts were schematic structure and register. Writing outcomes were measured through counting the stages of schematic structure present, use of appropriate logical relations, number of topic specific technical vocabulary items, and lexical density of the texts as measured by lextutor software (Cobb, 2021) which calculates the percentage of content words contained in a text.

The research questions were:

Does adopting a genre-based Teaching and Learning Cycle framework have an effect on structure in students' writing?

Does adopting a genre-based Teaching and Learning Cycle framework to lessons have an effect on register in students' writing?

5.2 Writing scientific explanations

This research followed the SFL principal of empowering students to write in genres necessary for future academic success (Martin, 1997, Schleppegrell, 2010). Therefore a pre-research audit of curriculum genres with Heads of Department led to the selection of explanation writing which is a characteristic of science writing according to Martin and Rose (2008). This ensured that the experiment would support genuine learning needs of the participants involved. As SFL research aims to develop the linguistic resources likely to be needed by students (Christie and Derewianka, 2008), I conducted some analysis of the

writing expectations at national exam level for both 16 year olds (GCSE exams) and 18 year olds (A level exams). This confirmed that explaining phenomena was the most common question prompt. Conducting these steps of pre-research was an essential component of designing an experiment that would be of value to students.

5.3 Teaching and Learning Cycle

The results of this study showed better overall gains for the SFL group, although these did not reach statistical significance. As Osugee, Aidinlou and Zoghi (2019) found, the use of the Teaching and Learning Cycle with the SFL group supported learners to recognise the expectations of the genre as they could see the intended outcome in model texts. This was reflected in Horverak's (2016) findings where students significantly improved discursive writing after following the stages of the TLC. Familiarity with the genre through the TLC, appeared to develop confidence in both structure and register choices in the delayed post-test for the SFL group in my study. This may be because the learners were more closely inducted into the features of the writing that would be assessed, which is considered a guiding principal of writing instruction (Miller, Scott and McTigue, 2019). As noted by Martin and Rose (2005) and Polias and Forey (2016), it was important to have teacher guidance throughout this process. For example, when deconstructing technical vocabulary and logical relations a small number of students tried to analyse the text at sentence rather than word level which was quickly resolved with teacher intervention. The usual practice group did not have the immersion into the genre in the same manner and were expected to use visual diagrams as a tool from which to structure their explanations. Although the diagram formed a starting point for writing, the usual practice group lacked the support of effective scaffolding (Hyland, 2007). The stage of deconstruction within the TLC also supported the

SFL participants in creating their own knowledge maps of texts which may help learners to better understand and apply features in their own writing across different topics.

5.4 Structure

The measure of schematic structure (counting which of the expected stages were present in the writing) showed a slight improvement for the SFL group while the usual practice group average remained the same. This echoes findings by Miller, Scott and McTigue (2018) who found exposure to models prior to writing to have a positive effect in their review of writing pedagogy. The specific structure of a text forms an essential element of defining genres for the classroom (Gibbons, 2002). Therefore this was the first element that the SFL group were introduced to. Participants were able to deconstruct a text in order to find the elements of schematic structure present which supports Schleppegrell (2010) in her belief that schematic structure can form a scaffold in classroom genres. In the case of scientific explanations it is necessary to identify the phenomenon being explained before creating an explanation sequence (Veel, 1997, Martin and Rose, 2008). This proved challenging for some students across groups who omitted the identification stage at times. While both groups were informed about introducing the topic at the start of the text, only the SFL group saw how to do this in a model text. It is possible that a longer intervention would see more significant outcomes. Aidinlou (2008) used schematic structural elements to measure outcomes in experimental SFL research. Significant results were found with a greater number of participants and more time spent teaching this element.

The measure of logical relations (counting appropriate uses) pertains to the organisation of schematic structure. This measure showed a non-significant increase for the SFL group from pre to delayed post-test, while the usual practice group's result was shown to worsen between the pre and delayed post-test. The use of logical relations as a generic feature is a

differentiating factor in SFL approaches to writing. Even with younger learners Hermansson et al (2019) found conjunction use to be a marker of successful narrative creation. Aidinlou (2008) developed the use of logical relations across five different genres and found significant positive results for this approach. The SFL group had the opportunity to observe the structural function of the logical relations within the model texts embedding them within the specific linguistic choices of the genre (Gibbons: 2002). The usual practice group may have suffered from seeing logical relations as a separate linguistic addition as appeared to be the case in Osugee, Aidinlou and Zoghi's (2019) research.

5.5 Register

The use of technical vocabulary in the SFL group was slightly better at delayed post-test than the usual practice group. Previous studies have shown that use of inappropriate register is more common in second language writing and as such explicit register teaching is required (Llinares and Whittaker, 2010). As EAL learners are better supported by understanding the concept of register, the SFL group may have felt more confident employing technical vocabulary in their writing. Further support for this outcome is found in Forey and Cheung (2019) who showed that both L1 and L2 students found explicit register instruction to be empowering to their understanding of writing conventions. The SFL group in my experiment were introduced to the concept of register on a continuum which supports students in understanding how their linguistic choices need to differ according to the purpose of their communication (Forey, 2020). The SFL group could view technical vocabulary as an essential element in creating scientific explanations. While the usual practice group were encouraged to consider scientific terms in their writing, this was an additional element and not embedded into the construction of the text from the beginning. Again, further time spent on teaching register could have supported more significant

findings as Osugee, Aidinlou and Zoghi (2019) found significant outcomes for their SFL group from explicit register teaching over time.

The measure of lexical density was the only one to improve for the usual practice group. There was little change in group means across testing points which may suggest a ceiling in the ratio of this text type. This is similar to the findings by Raeisi, Dastjerdi and Reaisi (2019) who found no difference in Psychology research abstracts written by native and non-native English writers. Here the lexical density averages of 0.59 is similar to the 0.5 in my research suggesting participants were reaching an upper limit of content word ratio.

5.6 Method of delivery

The method of delivery is likely to have had an impact on the results of this experiment. The requirement to teach fully online was necessitated by the Covid-19 pandemic induced lockdown. Learning objectives and tasks were carefully aligned, and marking rubrics were made explicit in each online lesson in line with good practice found by Martin et al (2019). The requirements for clarity in this situation resulted in the contents of the course being slightly reduced. In recognition of previous research into student preferences (Pu, 2020, Cragg, 2020, Dodgerson, 2020, Hodeges et al, 2020), the teacher was available by video and chat function online for live interaction. However, some students were working in different time zones and so feedback could not always be immediate.

5.7 Implications for future research and classroom practice

The use of an SFL based genre approach to the teaching of writing within specific secondary school subjects requires further experimental research. My findings demonstrate a small benefit to the group that was taught using SFL pedagogy which suggests that a larger study is needed to better identify any effects, should they exist. There is scope to develop SFL

research further by designing research into the effects of both writing outcomes and content knowledge development through a more integrated knowledge writing paradigm (Graham & Perin, 2007). Collaborative research with subject specialists would deepen the understanding and potential use of this framework in the future. The concept of explicit register teaching has the potential to make a lasting effect across curriculums but needs further carefully designed research to discover the specific benefits to writing outcomes (Forey, 2020). The idea of schematic structures in texts provides a compelling scaffold in the minds of language teachers but how this is realised and also received by both students and subject specialists also warrants investigation (Schleppegrell, 2010). The timing of my research coincides with a period of disrupted learning which will have an effect on students undertaking future national examinations. This necessitates a research focus on how to better support students to write for specific subject examinations in order to maximise opportunities for future generations.

Classroom implications of this research demonstrate the benefits of deconstructing models in order for learners to better understand the features of specific text types. The appearance of logical relations within the text illustrate how a writer can create the schematic structure of a text (Hermansson et al, 2019, Aidinlou, 2008). This appears to be more beneficial to writing outcomes long term than focusing on logical relations separately as a vocabulary choice. The explicit teaching of register may support students when selecting subject specific terminology to use, as this is integrated into the conventions of the text rather than a separate display of knowledge (Forey, 2020). The use of the Teaching and Learning Cycle, whichever version you choose, provides a clear structure for the teaching of writing that is principled and consistent for the learner. While larger scale research could

identify more nuanced outcomes, the positive implications for classroom teaching are visible from this study.

The selection of this research topic was grounded in the needs for my particular teaching context. Therefore the findings will be useful in supporting EAL students in secondary classrooms following a British curriculum. It is important that educational research reflects the needs and priorities of learners and teachers. Future research priorities need to be set with the aim of answering questions that are being asked by teachers and learners.

6. Conclusion

6.1 Research Question Outcomes

The outcomes of the research did not reach any statistically significant answers. Nevertheless, the SFL group did demonstrate better gains in measures from pre-test to delayed post-test than the usual practice group. This suggests that there is benefit in using aspects of SFL theory, specifically schematic structure and register to teach explanatory science writing

6.1.1 Does adopting a genre-based Teaching and Learning Cycle framework have an effect on structure in students' writing?

The focus on specific logical relations to construct the appropriate structure appeared beneficial over viewing linking words as a vocabulary choice. The nature of the Teaching and Learning Cycle means that students see how logical relations build structure in the model texts, and so may better understand how to apply these in their own writing. The understanding of schematic structure may need exposure to a greater amount of texts in order for students to see how the structure applies across topics.

6.2.2 Does adopting a genre-based Teaching and Learning Cycle framework have an effect on register in students' writing?

The use of model texts in the Teaching and Learning Cycle, again, may have supported learners to see the importance of technical vocabulary in their own writing. The explicit teaching of the concept of register may also have prompted participants to consider vocabulary choice more carefully resulting in a higher number of technical vocabulary items being used by the SFL group.

6.2 Limitations

There are some limitations to the research particularly associated with low participant numbers and attrition throughout the experiment. Initially, I had wanted to employ a matched randomisation method where participants were stratified by age and then assigned to groups, but after attempting this with my first two participants I recognised that the participant numbers I was working with were too small to be able to do this. After the first two participants I randomly assigned everyone one else regardless of age. The participant numbers initially started at 26 but there was some attrition before the research began, and again between the post and delayed post-test. This was due to the Covid-19 situation in the UK and the decision to close schools just as my data collection began. This decision was reversed a few weeks before collecting delayed post-test data which again affected the learning situation of some participants.

In addition to the effect on participation, conducting research during a school closure meant that all the teaching had to take place online. Some of the participants were based abroad in very different time zones while some were in the UK. In order to ensure fairness of access to learning materials, I carefully designed lessons that could be accessed asynchronously by all participants. This limited the depth in which I could teach certain aspects such as structure and register. It also limited opportunities for joint construction, although I overcame this through carefully scaffolding resources to enable learners to build up to their own independent construction of a text. Nevertheless, it is fair to say that these were less than ideal circumstances for conducting a controlled experiment. Further limits were caused by the extremely high workload on colleagues in the term preceding the data collection. This limited the amount of collaborative interaction on the research project in the preliminary

phases. In order to better understand the explanation genre within curriculum subjects at my school, I intended to perform a review of the features of successful examples of this genre across the Science curriculum. Unfortunately, this did not happen due to absences, workload and stresses caused by the pandemic.

A final limitation became apparent in the analysis of texts. While the first two writing tasks featured a natural phenomenon, the final task detailed a man-made process. This difference in the tasks may have made it more challenging for participants to apply their learning especially five weeks after the treatment had finished. In future experiments the tasks should be better aligned to reduce any difficulties relating to topic.

6.3 Conclusions

The research has underlined the importance of identifying features that situate a text within a specific genre, and that these can be taught to student writers. The structure of a text can be identified and uses as a scaffold for student writers. The steps of the Teaching and Learning Cycle can support this in a consistent way. In my own teaching practice I will continue to deconstruct texts with learners in order to demystify the writing process.

The explicit instruction of register has potential to make students aware of their language choices in writing specific texts. Grounding these choices in the exposure to model texts can enable students to make an abstract idea more concrete. Over continued exposure students may be able to notice the register of their own texts and how they fit into the genre in which they are writing. Again, this is something I will continue to offer in my own teaching. Finally, SFL provides a principled scaffold for teaching writing which offers students

information about how to write, but also provides space for writer choice. This appears to be a useful tool in teaching writing and one that deserves further research.

16,975 words (Word, 2013 + figures)

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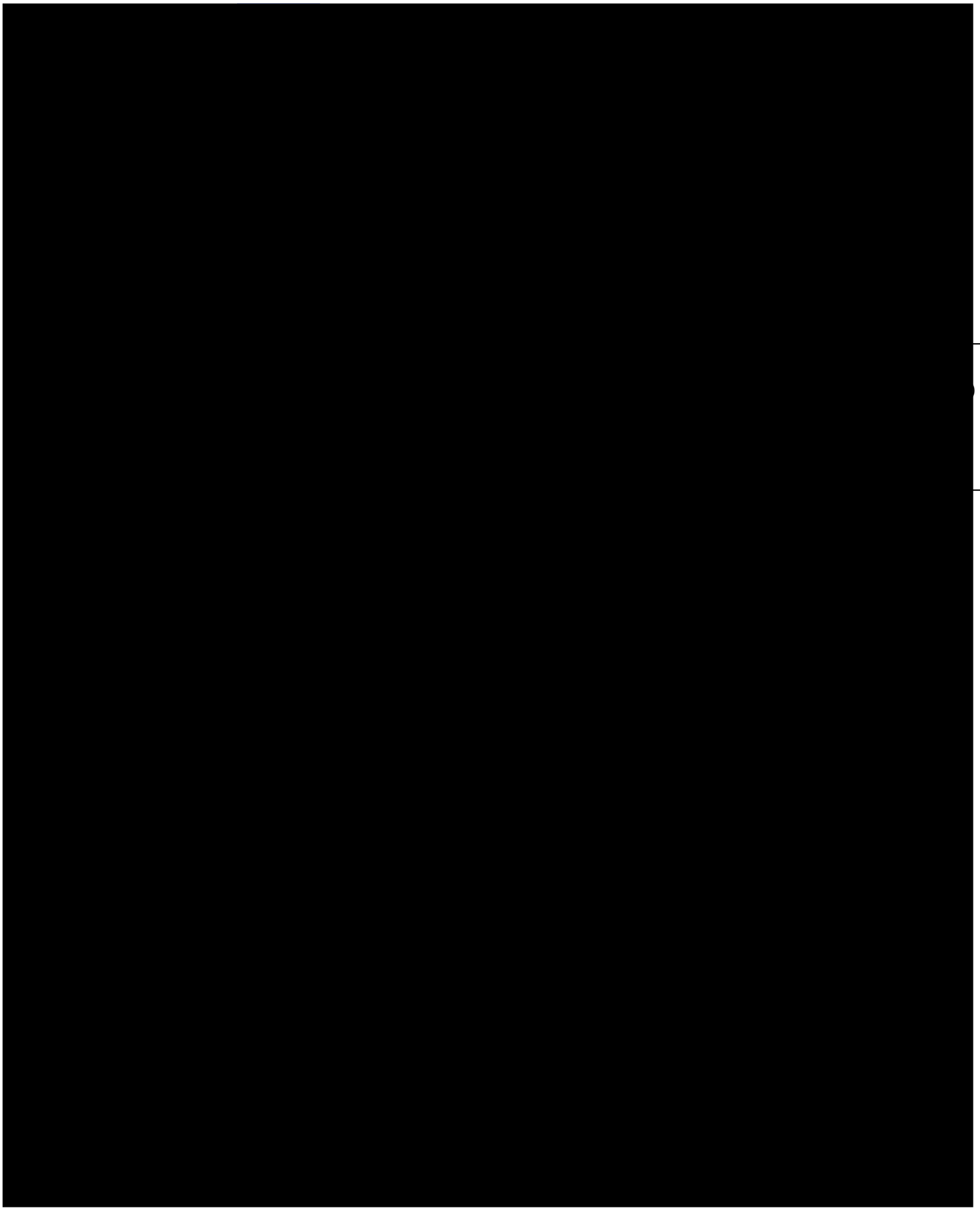
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Appendices

Appendix i: CONSORT flow diagram



Appendix ii: Curriculum mapping exercise



Appendix iii: Writing prompts

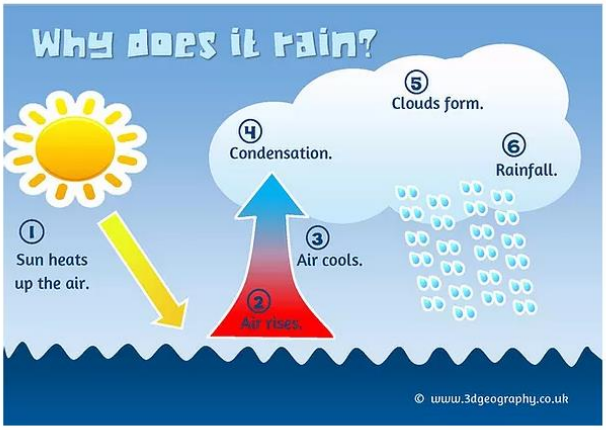
Pre-test

L/O: To write an explanation text.

Task: write a short text 100 – 150 words to answer the question.

Question: Why does it rain?

Use the diagram to help you write your answer. Try your best **but** do **not** spend more than 25 minutes writing this. Type your answer here and press Hand in.



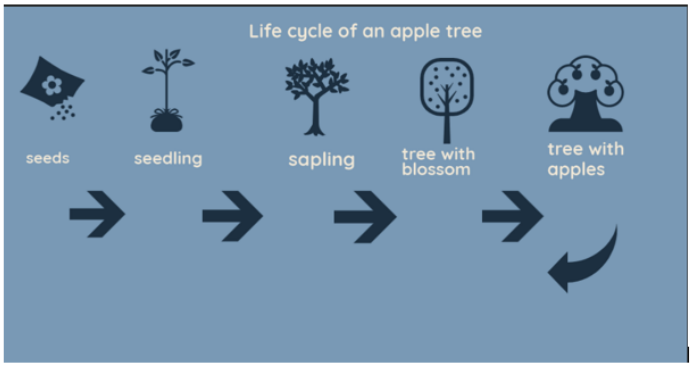
Post-test

L/O: To write an explanation text.

Task: write a short text 100 – 150 words to answer the question.

Question: Explain the life cycle of an apple tree.

Use the diagram to help you write your answer. Try your best **but** do **not** spend more than 25 minutes writing this. Type your answer here and press Hand in.



Delayed post-test

L/O: To write an explanation text.

Task: write a short text 100 – 150 words to answer the question.

Question: Explain how aluminium cans are recycled.

Use the diagram to help you write your answer. Try your best **but** do **not** spend more than 25 minutes writing this. Type your answer here and press Hand in.

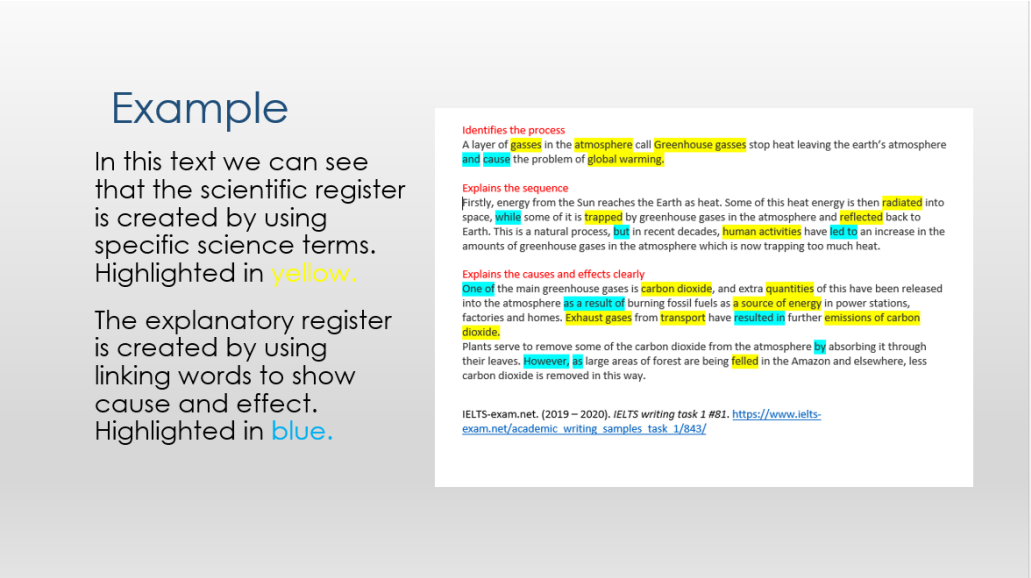


Appendix iv: Intervention schedule

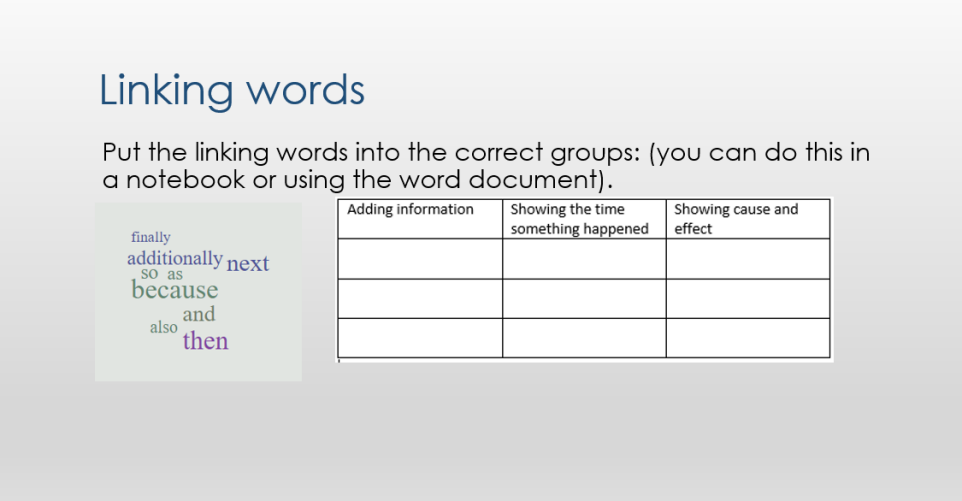
Week	Intervention	Control
1 11/01/21	Pre-test	Pre- test
2 18/01/21	Deconstruction stage - structure	Planning the structure
3 25/01/21	Scaffolded creation of structure	Creating own structure
4 01/02/21	Deconstruction stage - register	Planning language choices
5 08/02/21	Scaffoled creation of language choices	Selection of own language choices
6 22/02/21	Post-test	Post-test
11 22/03/21	Delayed post-test	Delayed post-test

Appendix v: Example of slides from intervention and control lessons in week 4

Intervention lesson



Control lesson

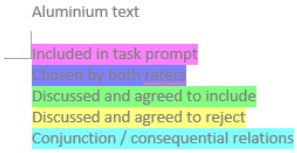


Appendix vi: Outcome measures

Research question 1: schematic structure including linking devices *(italics are author's own additions)*

Generic stage (Veel, 1997: 179) Martin and Rose (2008: 150)	**Conjunction type (Veel, 1997: 186)**	**Consequential relations and common conjunctions (Martin and Rose, 2008: 150).**
Phenomenon identification	Additive: addition/alternation And/ or	Cause: Expectant/ concessive Because, so, therefore/ Although, even though, but, however *due to/ yet*
Logical explanation sequence	Comparative: similarity/contrast Likewise/ but	Condition: Expectant/ concessive If, then, provided that, as long as/ Even if, even then *Once*
Cause and effect relationship made explicit – **Note: Martin and Rose (2008) say it is not necessary to be explicit so only using two stages.**	Temporal: simultaneous/ successive While, as/ then, after *During/ Until, till, when, next, firstly, secondly, thirdly, finally, eventually, lastly, later*	Means: Expectant/ concessive By, thus/ Even by, but
	Consequential: purpose/ condition/ consequence/ concession/ manner So that/ if, unless. Because, since/ although/ thereby	*Implicit: which*

Appendix vii: Example of frequency list coded for raters' reactions



1. 76_aluminium
2. 60_cans
3. 41_new
4. 35_centre
5. 35_recycling
6. 23_drinks
7. 22_can
8. 18_machine
9. 16_collection
10. 14_roll
11. 13_drink
12. 12_process
13. 11_recycled
14. 10_melt
15. 9_data
16. 8_rolls
17. 8_used
18. 6_back – included as relates to process
19. 6_going – rejected as too general
20. 6_melted

Appendix viii: Example of highlighted text ready for scoring

Words in prompt

Technical words as selected by 2 raters

Linking devices

Phenomenon identification and logical explanation sequence

Why does it rain? The first step is that the sun heats the water until then water evaporates. After the water evaporates it raise. When it raises the air cools until it condensates and make a cloud when inside the cloud the cold air starts to heat and they start becoming bigger and bigger till they become drops after they spent enough time in the cloud, they fall in the form of rain, after the drops falls, they go back to the sea. After that happens the sun reheats the water then the water cycle begins again and it finishes and it starts again.

Appendix ix - Explication of sample participant text as per Martin and Rose (2008)

Successful text: Structure: 2/2. Logical relations 10. LD 0.47. Technical vocabulary 36.

Phenomenon: Rain is the most common thing happen around the world, not only filtering the soil also improve the environment. But how does this happen. With this diagram allow us to understand more about it.

Explanation sequence: First, the sun heats up the air on the ground.
Cause: That causes the air rises because of low density.

Appendix x – CUREC Approval and application (please note any identifying information has been redacted for the purpose of anonymization).

(Contact details redacted)

Thu 19/11/2020 15:25

To: **(Contact details redacted)**

Student CUREC;

Dear candidate and supervisor
An experimental study of science writing outcomes using a Systemic Functional Linguistics teaching approach - approval reference ED-CIA-21-036

The above application has been considered on behalf of the Departmental Research Ethics Committee (DREC) in accordance with the procedures laid down by the University for ethical approval of all research involving human participants.

I am pleased to inform you that, on the basis of the information provided to DREC, the proposed research has been judged as meeting appropriate ethical standards, and accordingly, approval has been granted.

Should there be any subsequent changes to the project which raise ethical issues not covered in the original application you should submit details to research.office@education.ox.ac.uk for consideration.

Good luck with your research study.
With kind regards,
(name redacted)
Department of Education
University of Oxford

CENTRAL UNIVERSITY RESEARCH ETHICS COMMITTEE (CUREC)

Form CUREC 1A Checklist for the Social Sciences and Humanities

The University of Oxford places a high value on the knowledge, expertise, and integrity of its members and their ability to conduct research to high standards of scholarship and ethics. The research ethics clearance procedures have been established to ensure the University is meeting its obligations as a responsible institution. They start from the presumption that all members of the University take their responsibilities and obligations seriously and will ensure that their research involving human participants is conducted according to the established principles and good practice in their fields and in accordance, where appropriate, with legal requirements. Since the requirements of research ethics review will vary from field to field and from project to project, the University accepts that different guidelines and procedures will be appropriate.

- Please check **"Where and how to apply for ethical review"** and the **CUREC flowchart** first to see if you need ethics approval.
- Please complete this form using a word processor and email it, together with your supporting documents, to your **Departmental Research Ethics Committee (DREC)** (**if applicable**). If you don't have a DREC please email this form to **ethics@socsci.ox.ac.uk** using your official **ox.ac.uk email** address. **Only type-written, emailed applications will be accepted.**

SECTION A: Filter for CUREC 2 application

This section determines whether your study raises more complex issues requiring the completion of a full application for ethical review, known as the CUREC 2 application. **(Please mark 'X' in the Yes/No column.)**

1.	Are research participants classed as **people whose ability to give free and informed consent is in question**? (This may include under 18s (although see "competent youths"), prisoners, or adults "at risk".) Your attention is drawn to the University's **Safeguarding Code of Practice** and its implications for researchers involving children or adults at risk. This includes the need for the work to be risk assessed and for researchers to undertake related training. (**Note**: If any of your participants are aged 16 or under, answer 'Yes' here **and** also answer question 5 below.)	Yes ☒	No ☐
2.	By taking part in the research, will participants be at risk of criminal prosecution (e.g. by providing information on drug abuse or child abuse)?	Yes ☐	No ☒
3.	Does the research involve the **deception** of participants?	Yes ☐	No ☒
4.	Does your research raise issues relevant to the **Counter-Terrorism and Security Act (the Prevent duty)**, which seeks to prevent people from being drawn into terrorism? Please see advice on this on our **Best Practice Guidance web page**.	Yes ☐	No ☒

If you answered 'No' to all the questions above, go to **Section B**. If you answered 'Yes' to any question above, continue to question 5 below.

5.	Is your project covered by a CUREC **Approved Procedure** (formerly known as "CUREC Protocols")?	Yes ☒	No ☐
	If yes, give the specific Approved Procedure number(s): AP25		

If you answered '**Yes'** to **ANY** of questions **1-4**, **and** answered '**No'** to question **5**, **stop completing this checklist and do not submit it for ethical review**. Instead, complete the CUREC 2 application form from the CUREC website, then submit that for ethical review.
If you answered '**Yes'** to ANY of questions 1-3, **and** answered '**Yes'** to question 5, go on to **Section B**.

SECTION B: Contact details and project description

Contact details:

1. **Principal investigator** OR supervisor (if student research) (give title and full name)	**(name redacted)**
2. Name of student (if student research)	**(name redacted)**
3. Degree programme (if student research), e.g. BA, BSc, MSc, MPhil, DPhil	MSc ALLT
4. Department or Institute name	Education
5. Address for correspondence (if different from above)	Department of Education University of Oxford 15 Norham Gardens OX2 6PY
6. University (**not** private) e-mail address and telephone number	**(contact details redacted)**
7. Name and status of others taking part in the project (e.g. third year undergraduate; postdoctoral research assistant)	N/A

Project description:	
8. Title of research project	An experimental study of science writing outcomes using a Systemic Functional Linguistics teaching approach.
9. List of location(s) where project will be conducted	**(School details redacted)**
10. If your research involves overseas fieldwork or travel and your department requires a travel risk assessment, will you have completed and returned a risk assessment form beforehand? (This must be approved by your department before you travel. If you are travelling overseas, you are strongly advised to take out University travel insurance.) Please also address any physical or psychological risks for Oxford researchers and local fieldworkers in Section 16 below and discuss with your safety officer.	Yes ☐ No ☐ Not required in this instance ☒
11. Anticipated duration of overall research project	9 months or years (maximum 5)
12. a) Anticipated start and end dates of the part of the research project involving human participants and/or personal data	From: (04/01/21) To: (31/07/21) **Note**: You will need ethics approval **before** you start your research. CUREC 1As may take up to 30 days to

	process. **Retrospective ethics approval cannot be granted.**
12. b) In the case of international or collaborative research, will you submit or have you submitted this project for ethical review or consideration elsewhere (e.g. collaborator's/local ethics committee, or other local approval)?	Yes ☐ No ☒ If 'Yes', please attach ethics or other approvals and give more details below. If 'No', please explain your reasons below. Please also refer to the Best Practice Guidance on Ethical Review of social-sciences based research conducted outside the UK (BPG 16), which includes an Ethics Issues Checklist for International Research (Appendix A)
Please supply further details in response to question 12 b here *No international or collaborative work will be undertaken in this project, therefore this question is not applicable.*	
13. **External** organisation funding the research (if applicable)	N/A

14. a) Title and brief description of **research** (about 150 words) in lay language.
When describing the research, include your methodology, how you are applying professional guidelines, and the use to which results/data will be put. **Please also declare any conflicts of interest here.**

An experimental study of science writing outcomes using a Systemic Functional Linguistics teaching approach. I intend to run an experiment in which I offer 5 online sessions to support students to write explanatory reports for science subjects. Half of my students will be taught using an SFL framework and the other half using my usual practice for teaching writing. After stratifying for age I will randomly allocate students to the two conditions. All data will be anonymous and I will utilise blind marking. I will measure outcomes using a pretest/post-test model with a second delayed post-test. Information about the study will be carefully shared both orally and in writing and students and parents will be offered a clear opportunity to opt out of the study. No identifiable personal data will be collected. Data (test scores for pre and post tests) will be stored in a password protected file on my laptop and backed up to a password protected cloud file using the University's OneDrive for Business, and destroyed using a file shredding programme (fileshredder.org) once the study is complete. I will be following the ethics guidelines of the British Educational Research Association.

14.b) Description of participants and how you will **obtain informed consent** to take part in the research (about 200 words in total)

1. Description of participants **and** your criteria for inclusion/exclusion

   Participants are English as an Additional Language (EAL) students at the school in which I work. All students on the EAL register will be asked to participate. Students included on the EAL register usually have a background of being educated primarily in a language that is not English or primarily speak a language that is not English in the home.

2. Your method(s) of recruitment

I will speak to all EAL students within their Covid secure bubbles to explain the research to them. I will tell them that the aim of the research is to find out if there is a better way to teach how to write for science subjects. I will explain that students do not have to participate in the research, that their grades will not be affected by the research and that the research will not require extra work from them. I will also send the information sheet and opt-out forms to parents via agents (who provide a service to support communication between British schools and internationally based parents and are able to translate information into the appropriate language where necessary).

3

Both parents and students will have the opportunity to opt out of the research if they choose. Students will be told that they have the right to end participation at any point without repercussion. It will be made clear that the outcome of any work submitted for this research will not be linked to their reported grades. Approved Procedure 25 states that opt-out consent may be used when conducting non-invasive research on students in an institutional setting using computer based tasks. In order to adhere to AP-25 conditions opt-out letters and forms will be named and sent specifically to the relevant parents/guardians. Students themselves will also have the choice to opt out. A follow up email will be sent before the deadline and reminders given to students to allow appropriate opportunity for opting out. The research will only use students aged 13 and above in accordance with the AP-25 guidelines. As parents of EAL students are based overseas they will return the form via email.

Opt-out forms have been prepared and are attached to this submission.
Support and permission for this research has already been obtained from both the Head and Deputy Head (Teaching and Learning) of the school in which it will take place.

our processes for obtaining consent from participants

Please

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ttach separate supporting documents (in Word) if appropriate for your research (English language only). Tick those you are submitting below. If appropriate supporting documents are not submitted, be asked to provide these separately, which may delay the ethical review process.

Recruitment and advertisement material (e.g. a poster, social media recruitment text, or brief invitation letter/ email)

Information for participants to read (or hear) before they agree to take part (e.g. written information or, if applicable, an outline oral information script).

A document to record informed consent. Templates for written consent forms and/or oral information scripts (in case of an oral consent process) are available from the CUREC website

Questions to be asked of participants (e.g. interview questions, or a preliminary scope of questions, or a sample questionnaire)

(If relevant) debriefing document after participants have taken part

If you feel the above approaches are not appropriate for your study, provide details on how you will obtain consent from participants

Please complete section 15 if you cannot obtain informed consent

15. If you cannot obtain informed consent from participants according to CUREC guidelines and good practice in your discipline, please give a brief explanation and justification of this decision below.

16. What are the ethical issues connected with your research and what steps have you taken to address them? **Please do not answer 'none'.** We need to see evidence that you have identified potential ethical issues with respect to your research and have taken steps to address them. If applicable, please address:

- Participant burdens and/or risks

In order not to overburden students with work the research lessons will be set in place of homework for their EAL lessons. This will develop skills and regardless of which group students are in should benefit them. The outcome of the teaching intervention is not known so, a priori, there are no known negative effects to students of being in either the intervention or control groups. However, if one method of teaching proves to be superior in terms of benefiting students this teaching will be made available to the other group after the experiment has ended. The teaching will take place over video to ensure that students are not needing to mix with those outside their usual 'bubbles' and therefore adheres to school Covid-19 risk assessment policies.

- Your own physical and psychological safety as a researcher or of fieldworkers you may employ (see the University's and Social Science Division's Safety in Fieldwork guidance)

There are no risks to me as researcher as this takes place in my normal work environment.

- Data protection/ confidentiality (also see Section 18).

I will keep a list of names during the study in order to be accurate about aspects of running the study such as ensuring students are in the correct group. However, these will be anonymised for the write up. I will keep a key matching student ID numbers to their names for the purposes of managing the study while it is happening, and will keep this key in a separate password protected folder that I will destroy once the data collection and anonymization has taken place. All data collected will be stored in a password protected file and backed up to password protected cloud storage owned by the University on its OneDrive for Business. Data will be destroyed using a fileshredder.org once the research has been submitted.

For more guidance on ethical issues, please see
http://researchsupport.admin.ox.ac.uk/governance/ethics/resources

Discuss other ethical issues here		
17. Will your research involve discussing sensitive issues? This could be information relating to race or ethnic origin, political opinions, religious beliefs, physical/mental health, trade union membership, sexual life or criminal activities.	Yes ☐	No ☒
If you answered 'Yes', make sure you include some supporting information (as directed in Section 14 b.) above, showing the range of questions covering these issues.		

18. Management and handling of personal and other research data

All information provided by participants is considered **research data** for the purpose of this form. Any research data from which participants can be identified is known as **personal data**; any personal data which is sensitive is considered **special category data**.

Management of personal data, either directly or via a third party, must comply with the requirements of the General Data Protection Regulation (GDPR) and the Data Protection Act 2018, as set out in the University's Guidance on Data Protection and Research. In answering the questions below, please also consider the points raised in the Data Protection Checklist and whether, for higher-risk data processing, a separate Data Protection Impact Assessment (DPIA) may also be required for the research. Advice on research data management and security is available from Research Data Oxford and your local IT department. Advice on data protection is available from information.compliance@admin.ox.ac.uk.

a.) **Please mark 'X' against the data you will collect for your research**

Consent records (written consent forms, audio-recorded consent, assent forms (for research minors) including participant name	☐ involving
Online consent (may be anonymous)	☐
Opt-out forms	☒
Contact details for research purposes only (destroyed when no longer needed for this research)	☐
Contact details kept for future studies	☐
Audio recordings (preferably using PIN-protected audio recorder and stored on device's hard	☐ drive)
Video recordings	☐

Transcript of audio/video recordings	☐
Photographs	☐
Task results (e.g. paper/online tasks, diary completion)	☒
Questionnaire answers	☐
Field notes	☐
Other (please specify below)	☐

I will keep a process diary but this will not contain any personal data about any participant.

b.) For **each** of the types of data selected above, state how this will be physically transferred from where it is collected to a local secure storage site (and backed up as necessary). This includes paper records and data captured electronically.

No physical data will be captured .All digital data will be kept in a password protected file and backed up to password protected cloud storage, using the University's OneDrive for Business. My process diary will be written digitally and stored in the same password protected files as other data.

c.) How and where will **each type of data** be stored during the research (until the end of all participant involvement)? Describe the arrangements for ensuring confidentiality, i.e. location of storage (e.g. Nexus 365 OneDrive for Business, SharePoint), security arrangements and de-identification of such data. Do not store unencrypted data in freely available cloud services or unprotected USB drives.

All data will be stored on the University's OneDrive for Business in password protected file.

NEXUS 365 password protected file through Oxford University.

d.) Will you use a unique participant number on research data instead of a participant name?

If **yes,** state whether or not you will retain a list of participant names against numbers (i.e. pseudonymisation via a linkage list). Where will the list be stored, and when will it be destroyed?

I will use unique participant numbers on research data and will retain a list of names until the research is complete in order to ensure correct running of the experiment. Name lists will not be used in the published research and will be destroyed at the end of the experiment using fileshredder.org. I will keep a list of the participant numbers against demographic data such as age, gender and L1 but this will not include names. This will be stored on the University's OneDrive for Business and destroyed at the end of the research period using fileshredder.org. Participants will be given their unique number on a physical piece of paper which I will ask them to immediately photograph in order that they have a digital record in case they misplace the hard copy. They will need to use this for the first pre-test and so will also have a record by looking back at this piece of work.

e.) Who will have access to the research data?

(Candidate name) and (supervisor name). Possible blind second markers will have access to anonymised task scripts. The data may be made available to responsible members of the university as the data controller in this project, for auditing and oversight purposes, if requested.

f.) If research data is to be shared with another organisation, how will it be transferred / disclosed securely?

Not shared.

g.) When and how will identifiable data (including audio/video recordings & photos) be destroyed or deleted? **Note:** Records of consent should be retained for a **minimum of three years after publication or public release**. Some funders may require longer periods (see http://www.dcc.ac.uk/resources/policy-andlegal/overview-funders-data-policies). If you wish to retain contact details in order to re-approach participants about future studies, you must detail this in information provided to them and obtain specific consent for this.		
Data will be permanently destroyed through the file shredder programme at fileshredder.org. Opt-out forms will be kept for 3 years stored digitally on the University's OneDrive for Business, but name lists will be destroyed at the end of the experiment 31/07/21.		
h.) Please confirm that you will store **other research data** safely for at least 3 years after final publication or public release and adhere to any additional research funder policies. For more information about the University policies, please see the University's web pages on research data management.	Yes ☒	No ☐
If '**Yes'**, please give details of who will store the data and on storage format, location and security. Note that open science is encouraged. If **'No',** please provide further details below.		
Data will be stored in password protected cloud storage on the University's OneDrive for Business. Copies of the dissertation will be retained by the university.		
i.) Does your research involve the use of secondary (i.e. previously collected) data? Common sources of secondary data include censuses, information collected by government departments, organisational records and data that was originally collected for other research purposes (If "**No**", please go to section **19**.)	Yes ☐	No ☒
j.) Do you have data access agreements for the use of this secondary data? (If so, please attach these.)	Yes ☐	No ☐
k.) Is your use of this secondary data compatible with what data subjects/participants agreed that their data should be used for?	Yes ☐	No ☐
l.) Could this data be linked back to an individual or individuals? If yes, address how securely any personally identifiable data will be transferred to you, and where and for how long it will be stored during or after the research. Who will have access to it?	Yes ☐	No ☐
19. Publication and dissemination of research data		
How will you disseminate and feedback project outcomes at the end of the research?	Data will be written up and submitted in the form of my MSc ALLT dissertation. Data will also be presented to the Senior Leadership Team at the school and may possibly be disseminated to all teaching staff depending on the outcomes. It is possible that this research may be presented at confrence or published as a research paper.	

SECTION C: Methods and procedures to be used	
Method used: Please ensure you have addressed any potential ethical issues related to these methods in Section 14 and in your Participant Information Sheet	**Please mark 'X'**
1. Analysis of existing records	☐
2. Snowball sampling (recruiting through contacts of existing participants)	☐
3. Use of casual or local workers e.g. interpreters	☐
4. Participant observation	☐
5. Covert observation	☐
6. Observation of specific organisational practices	☐
7. Participant completes questionnaire in hard copy	☐
8. Participant completes online questionnaire or other online task	☒
9. Using social media	☐
10. Participant performs paper and pencil task	☐
11. Participant performs verbal or aural task (e.g. for linguistic study)	☐
12. Focus group	☐
13. Interview	☐
14. Audio recording of participant (you will generally need specific consent from participants for this)	☐
15. Video recording of participant (you will generally need specific consent from participants for this)	☐
16. Photography of participant (you will generally need specific consent from participants for this)	☐
17. Others (please specify below)	☒

Researcher keeping a process diary.

SECTION D: Professional guidelines and training		
1. In this section, please mark 'X' against at least one of the following professional guidelines you aim to adhere to. You should use the principles listed in your chosen guideline(s) in conducting your own research. **Note**: this is not an exhaustive list.		**Please mark 'X'**
Research specialism/ methodology	**Association and guidance document**	
Anthropology	Association of Social Anthropologists of the UK and Commonwealth	☐
Computer Sciences	ACM Code of Ethics and Professional Conduct	☐
Criminology	http://www.britsoccrim.org/ethics/	☐
Education	British Educational Research Association Ethical Guidelines for Educational Research	☒
Geography	Association of American Geographers Statement on Professional Ethics	☐
History	Oral History Society of the UK Ethical Guidelines	☐
Internet-based Research	British Psychological Society: Conducting Research on the Internet Association of Internet Researchers Ethics Guide ACM Code of Ethics and Professional Conduct Association of Internet Researchers (AoIR) Also see our Best Practice Guidance on internet-based research	☐
Law (Socio-Legal)	Socio-Legal Studies Association: Statement of Principles of Ethical Research	☐
Management	Academy of Management's Professional Code of Ethics	☐
Political Science	American Political Science Association (APSA) Guide to Professional Ethics in Political Science	☐
Politics	Political Studies Association. Guidelines for Good Professional Conduct	☐
Psychology	British Psychological Society Code of Ethics and Conduct	☐
Social Research	Social Research Association: Ethical Guidelines	☐
Sociology	The British Sociological Association: Statement of Ethical Practice	☐
Visual Research	ESRC National Centre for Research Methods Review Paper: Visual Ethics: Ethical Issues in Visual Research	☐
Other professional guidelines. Please specify the other guidelines used here*:*		☐
2. Please indicate what training in research ethics (or research methodology) the researchers involved with this study have received, e.g. the title of the course and date completed (online training available at		

http://researchsupport.admin.ox.ac.uk/support/training/ethics), or discussions between researchers and supervisors, if applicable.
MSc ALLT: Research Methods Module, Oxford university research ethics online training, supervision meetings with (supervisor name) from April 2020 ongoing.

SECTION E: Signatures or email endorsements (The SSH IDREC Secretariat accepts either option below. If you have a DREC, check which signature option it prefers.)

- **Option 1:** Email confirmations from a University of Oxford email address can be accepted. Separate emails should come from each of the relevant signatories as outlined below, indicating acceptance of the relevant responsibilities. **Pasted images of signatures cannot be accepted.**
- **Option 2:** Handwritten (wet-ink) signatures. Please scan them and the rest of the checklist pages to create a single PDF document and email to us.

Please ensure this checklist is signed by:

For staff research:	**For student research**:
1. **Principal investigator**	1. **Principal investigator (project supervisor)**
2. **Head of Department (or nominee)**	2. **Head of Department (or nominee)**
	3. **Student researcher**

1. **Principal Investigator signature/supervisor signature (if student research)**

I understand my responsibilities as **principal investigator** as outlined in the CUREC glossary and guidance on the CUREC website.

I declare that the answers above accurately describe the research as presently designed, and that a new checklist will be submitted should the research design change in a way which would alter any of the above responses so as to require completion of CUREC 2 (involving full scrutiny by an IDREC). I will inform the relevant IDREC if I cease to be the principal investigator on this project and supply the name and contact details of my successor if appropriate.

Signature (or email endorsement using the above declaration): ……..

Print name (block capitals): …….. **Date**: ……...

2. **Departmental endorsement signature**

I have read the research project application named above. On the basis of the information available to me, I:

(i) consider the principal investigator to be aware of her/his ethical responsibilities in regard to this research;
(ii) consider that any ethical issues raised have been satisfactorily resolved or are covered by relevant professional guidelinesand/or CUREC approved procedures, and that it is appropriate for the research to proceed (noting the principal investigator's obligation to report should the design of the research change in a way which would alter any of the above responses so as to require completion of a CUREC 2 full application);
(iii) am satisfied that: the proposed project design and scientific methodology is sound; the project has been/will be subject toappropriate **peer review**; and is likely to contribute to existing knowledge and/or to the education and training of the researcher(s) and that it is in the **public interest**.

Signed by Head of Department or nominee *(example nominees for student research include the Director of Graduate Studies/ Director of Undergraduate Studies)*:

Signature (or email endorsement using the above declaration): ……
Print name (block capitals): …….. **Date**: ……...

3. **Student signature (if student research)**

I understand the questions and answers that have been entered above describing the research, and I will ensure that my practice in this research complies with these answers, subject to any modifications made by the principal investigator properly authorised by the CUREC system.

Signature by student (or email endorsement using the above declaration): ……..

Print name (block capitals): …… …….. **Date**: ……06/11/2020……...

Appendices

Appendix i Student and parent information sheet

Appendix ii Opt-out form

Appendix iii PowerPoint slides for sample intervention

Appendix iv Sample pre/post test task

DEPARTMENT OF EDUCATION
(contact details redacted)

An experimental study of science writing outcomes using a Systemic Functional Linguistics teaching approach.

INFORMATION SHEET FOR YOUNG PEOPLE AGED 11 TO 15 YEARS

Ethics Approval Reference: [Insert]

We are inviting you to join in a research study. Our names are (candidate name) and (supervisor name) and we work at the University of Oxford in the Department of Education. Before you decide if you would like to join in, it's important to understand what the study is about, why we're doing it and what it would involve for you. Please read and think about this leaflet carefully. Please feel free to talk to your family, friends, or the researchers about it if you want.
If anything isn't clear or you have more questions you can ask your parent/guardian to give phone or email us and we can discuss it with you and your parent/guardian.

Why are we doing this research?

The aim of this research is to find out if there is a better way to teach science writing to EAL students.

Why have I been invited to take part?

We are inviting you to take part because you are an EAL student who needs to do some science writing for your school studies.
We are inviting all EAL students at (School name) to take part.

Do I have to take part?

No - It is up to you. If you do not want to take part you or your parents can sign an opt out form which means that you will not be part of the study. We will give you a copy of this information sheet to keep. You are free to stop taking part at any time during the research without giving a reason, by telling (teacher name). If you decide to stop, we will not use the information we have already collected from you.

What will happen to me if I take part?

- You will complete some writing activities in your usual EAL homework time. If you do not have EAL lessons but choose to take part in the study then this will be a small amount of extra self-study each week.
- The research will last for most of the Spring term (January – March).
- The work will take you between 20 – 30 minutes to complete each week.
- Your work will be kept on Teams. Any of your writing that I collect for research will not have your name on it. No-one will know that it is your writing (not even me). **What happens to the results of the study?**

The information you provide during the study is the **research data**. Any research data from which you can be identified is known as **personal data**.

Personal data will not be stored.

Other research data will be stored for 3 years after publication or public release of the work of the research.

The research will be written up as part of (teacher name)'s university work. We also aim to publish our findings in scientific journals, but this may be two to three years from the end of the study

What are the advantages / disadvantages of taking part?

The advantages of taking part are that you will be able to learn about and practise your science writing.

The disadvantages of taking part may be that it will take an extra 15 – 30 minutes of your time a week if you do not already have EAL lessons. If you do have EAL lessons this will not be extra work as it will follow your usually homework timetable.

Will anyone else know I'm doing this?

We will keep your information private. This means we will only tell those who have a need or right to know, such as the research team and your parent/guardian. We will only share information that has your name removed.

What if I don't want to take part in the research anymore?

Just tell your parent/guardian and the people carrying out the research that you don't want to take part. You don't have to give a reason and no one will be annoyed with you. It is YOUR choice.

Who is organising the research?

The research is organised by (teacher name) under strict guidance of Oxford University (MSc ALLT candidate).

AP25_v1.4 Child Information Sheet 11-15 years – 06/11/2020

Who has reviewed the study?

Before any research involving people can start, it has to be checked by a Research Ethics Committee to make sure that it is OK for the research to go ahead. This study has been approved by the University of Oxford Central University Research Ethics Committee.

What if there is a problem or something goes wrong?

Please tell us if you are worried about any part of this study, by contacting (teacher name). You may also talk to your teacher/parent/guardian who will let the researcher know. If you are still unhappy or wish to make a complaint, either you or your teacher/parent/guardian can contact the chair of the Research Ethics Committee at the University of Oxford: **(contact details redacted)**

Data Protection

The University of Oxford is the data controller with respect to your personal data and, as such, will determine how your personal data is used in the study.
The University will process your personal data for the purpose of the research outlined above. Research is a task that we perform in the public interest.
Further information about your rights with respect to your personal data is available from https://compliance.web.ox.ac.uk/individual-rights.

Contact details

If you would like to discuss the research with someone beforehand (or if you have questions afterwards), please contact:

(contact details redacted)

Thank you for reading this – please ask any questions if you need to.

Department of Education

(contact details redacted)

An experimental study of science writing outcomes using a Systemic Functional Linguistics teaching approach.

OPT-OUT FORM

Ethics Approval Reference: [Insert]

If you **DO NOT** want your child to participate in the above-named research study please fill out the form below and return it to the school by 03/01/2021.

If we do not receive an opt-out form from you by 03/01/2021, your child may be invited to take part in this study, as described in the accompanying information sheet.

I, the undersigned, hereby DO NOT give permission for my child to take part in the study titled An experimental study of writing outcomes using a Systemic Functional Linguistics teaching approach.

Name of child: _____

Name of parent/guardian:

_____

Signature: _____ Date: _____

Name of researcher: (**name redacted)**

1038157 Joanne Taylor

AP25_v4.0 Opt-out form

Sample control lesson

EAL

January 2021

Before the lesson starts

- Prepare your space.
- Review your homework notes.
- **Learning Objective: I can plan the structure of an explanation text.**
- **Date: 11/01/2021**

Structure

We have looked at different processes and suggested the parts we might need to explain.

Last lesson we saw that there were different parts of the process. This lesson we are going to plan the order in which we would write about these.

Explaining a diagram

With this diagram last week we talked about the causes of global warming.

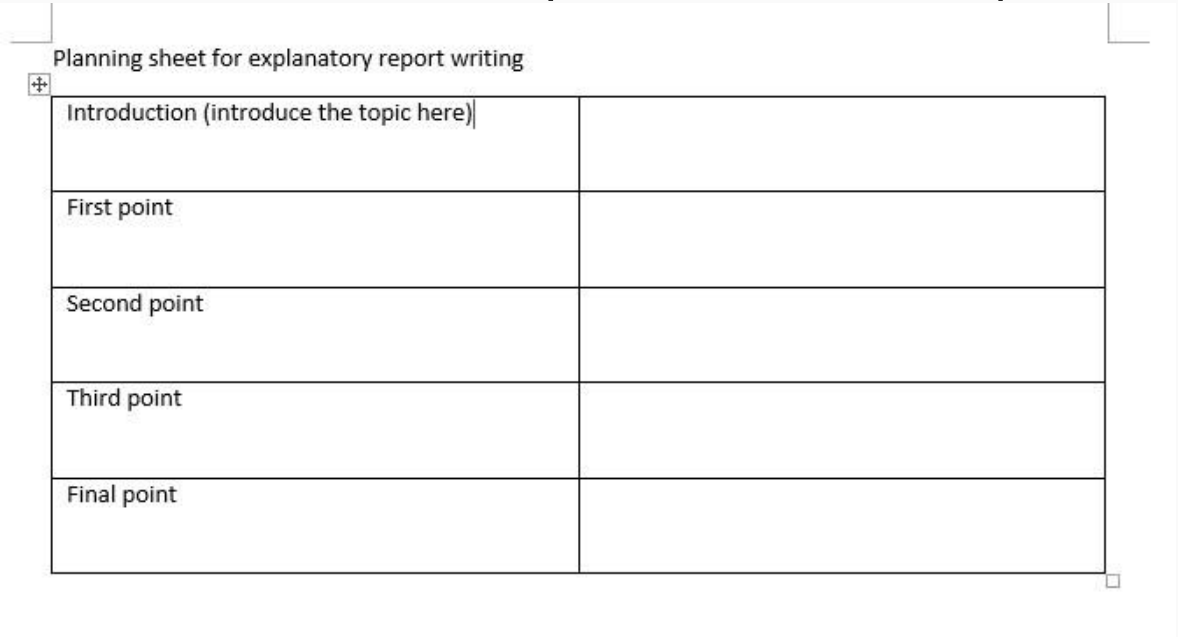


IELTS-exam.net. (2019 – 2020). *IELTS writing task 1 #81*
https://www.ielts-exam.net/academic_writing_samples_task_1/699/

Try it yourself

Complete the planning sheet to decide what order you would write about each part of the process. You may have to put some parts of the process together.

Open the planning sheet in the Word document and press the Hand in button when you have completed it.



Planning sheet for explanatory report writing

Introduction (introduce the topic here)	
First point	
Second point	
Third point	
Final point	

Sample intervention lesson

EAL

January 2021

Before the lesson starts

- Prepare your space.
- Review your homework notes.
- **Learning Objective: I can see the stages of an explanation text.**
- **Date: 11/01/2021**

Structure

Now we have read some explanatory science writing we are going to think more about the way that they are structured.

Last lesson we noticed the stages of structure in the different texts we had read.

Example

In this text from last week we can see that there is a part of the text which identifies the process followed by factors each explaining one part of the process.



Try it yourself

Can you match each stage to the correct place in the text?

Open up the Word document to make paragraphs and write your headings in red (like in the example) and then press the Hand in button.



Indicative task: An experimental study of science writing outcomes using a Systemic Functional Linguistics teaching approach.

In line with findings from my pre-research on the most common genres of text taught at my school I am using the genre of explanations specifically sequential explanations (Veel, 1997). These types of explanations share similarities with diagram types of Task 1 of the academic IELTS paper. See an indicative task below.

In addition Powerpoint decks are included to give an indication of one lesson for the intervention group and one lesson for the control group.



References

IELTS-exam.net. (2019 – 2020). *IELTS writing task 1 #117*. https://www.ieltsexam.net/academic_writing_samples_task_1/843/

Veel, R. (1997). Learning how to mean scientifically speaking: apprenticeship into scientific discourse in the secondary school. In Christie, F., and Martin, J. R. (Eds.), *Genre and Institutions: Social processes in the workplace and in school* (pp 160 -195). London: Continuum