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The Impact of Teacher and Peer Dialogue on Online Collaborative Writing in an Authentic Science Literacy Learning Environment

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Abstract

This research is concerned with authentic science writing, and in particular, investigating collaborative science writing at secondary school level, using an online collaborative-writing environment. Specifically, it investigates how measures of successful authenticity relate to (i) how close to the text-structure of a prototypical library report genre are collaboratively-written student papers (i.e., how close to the model students were taught) (ii) to what extent do the papers use the language of science as expected at this level of schooling, for example, use of nominalization, and finally, (iii) what is the degree of participation and contribution by students in a collaborative writing task? The research also examined how students' collaboratively written texts evolved, or changed, over time in terms of their textual structure and of their key linguistic features. The research provides some insight into how text changes and evolution could be explained in relation to online dialogue and feedback. Finally, the thesis identifies the implications of the above for pedagogy and policy, i.e., for (i) students' language development in science and the use of genre pedagogies, (ii) collaborative writing in science, and (iii) online pedagogy?

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GLOSSARY OF ABBREVIATIONS

5m	Five Minutes - "m" is used throughout to refer to minute	84
A	Abstract	133
Σ	Lexical Tokens	123
ADJ	Adjective	123
ADV	Adverb	123
AFAIK	As Far As I Know	143
API	Application Programming Interface	97
ASL	Authentic Science Learning	20
B	Body Section	133
C	Conclusion	133
CLE	Collaborative Learning Environment	19
CWE	Collaborative Writing Environment	87
D/D	dyad/dyad	73
EAP	English for Academic Purposes	26
ESL	English as Second Language	24
ESP	English for Specific Purposes	42
FCL	Fostering Communities of Learners	21
FMS	First Main Study	66
I	Introduction	133
IBEC	Irish Business and Employers Federation	164
ICT	Information and Communications Technology	23
I/D	individual/dyad	73
I/I	individual/ individual	73
L2	Second Language	55
LRP	Library Research Paper	48
LV	Lexical Verbs	123
MASUS	Measuring the Academic Skills of University Students	85
N	Nouns	123
NCTE	National Centre for Technology in Education	83
NNE	Non-native English	74
NUIM	National University of Ireland Maynooth	87
OECD	Organisation for Economic Co- operation and Development	69
PISA	Programme of International Assessment	70
POS	Parts-of-Speech	100
PRS	Pilot Research Study	66
Q&A	Questions and Answers	83
R	References	133
[R]	Reshuffling of Statements	137
R&D	Research and Development	60
[RM]	Rhetorical Machining	137
[RMc]	Changes which relate writers' claims to writers' own hypotheses	137
[RMd]	Rhetorical machining of discourse structure and information	137
[RMp]	Rhetorical machining that relates to the writers' purpose	137
SFG	Systemic Functional Grammar	29
SFL	Systemic Functional Linguistic	12
SMS	Second Main Study	66
[+TD]	Addition of technical detail or statements	137
[-TD]	Deletion of technical detail or statements	137
VBG	Verb, gerund or present participle	123
WYSIWYG	What You See Is What You Get (user interface)	41

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Chapter One

Why Authentic Science Writing?

This introductory chapter provides the background and motivation for the current study on authentic second-level science literacy development in Irish second-level schools. The motivation and rationale for this research, together with a brief research context are presented. The chapter concludes with an outline of the thesis.

1.1 Research Motivation and Rationale

This research is concerned with authentic science writing, and in particular, investigating collaborative science writing at secondary school level, using an online collaborative-writing environment. Mike Montgomery, in an article on authentic science writing (Montgomery, 2005), argued that writing is a valuable learning tool in science classrooms as it provides teachers with tangible demonstrations of learning and offers opportunities for students to “connect their personal experiences to the content of the course” (ibid, p.28). Furthermore, thoughtful writing assignments demand a deep analysis of the subject material and encourage expansive science thinking beyond the classroom. Montgomery specifically highlighted that the primary challenges of authentic science writing include (i) engaging students in the “kind of writing found in professional science” (ibid, p.28), and (ii) providing them with the instruction to develop these skills. He contended that it is crucial, therefore, that teachers develop and support their skills in planning and developing writing assignments as well as in evaluating students' written work.

Authenticity, Keys et al (1999) argued, gives scientific writing a voice of ownership of scientific knowledge. She associated authentic learning in science with writing in “accepted” scientific genres, and elaborated on how genre-based writing provides opportunities for in-depth thinking and promotes the crystallisation of new thinking. Melber (2004), however, equated scientific authenticity with experiential learning,

and argued that inquiry based activities are critical in creating meaningful experiences in science. While acknowledging that “traditional” writing is important, experiencing science by way of investigation is a crucial aspect of authenticity. In their handbook on *Creating Authentic Literacy Activities (K-3)* Purcell-Gates et al. (2006) defined authentic literacy as “reading and writing of real-life texts for real-life purposes” within a literacy learning context. While they argued that there is no such thing as inauthentic literacy or instruction, there are other kinds of “school-only” writing that are not authentic, as defined.

From my own background as a scientist (with a background in Atmospheric Physics), and as an academic (predominantly in the area of computer science) working with science graduates, I recognise “exposition” as pivotal in scientific writing in that many issues within science are open to debate and contestation. Exposition presents arguments for a position on a controversial topic, such as whether dinosaurs were warm- or cold-blooded (Martin, 1993), where students use first- or second-hand reference sources. It was for this reason that in my study the writing topic chosen was “The Physical Process of Global Warming” which is a hotly contested topic in the physical and natural sciences. I have considerable background knowledge in the physics of atmospheric processes and believe that I could determine the authenticity of student writing in this area.

An additional aspect of authenticity, from my perspective, is that modern scientific research is conducted by research teams, and research results are communicated via collaboratively written genres. Furthermore, it is commonplace that various forms of collaborative writing tools, systems, and practices are utilised by research teams to plan, create, draft and redraft versions of documents before a final version is considered for dissemination to the research community. Additional tools may be used by a writing team to comment on writing, for example, email, change tracking, and commenting. Given my experience of designing and developing online collaborative writing environments for use in secondary level Irish schools, I was motivated to conduct a deeper study of collaborative tools that support online science literacy development.

An additional, inherently personal, motivation relates to the fact that I did not pursue physics as a subject at second-level, and only engaged with the subject at

university. The difference between me and my peers was one of enculturation; I initially learned about being a physicist through active inquiry, collaborative laboratory work, exposition, and writing, whilst most of my contemporaries learned about the “subject” physics, as if it were something divorced from the praxes of the scientific community.

This research takes the perspective that science learning is inherently bound up with learning language and learning to use language in new ways, i.e., organising new kinds of text, appropriating linguistic resources that are fundamental to the scientific literacy development, for example, grammatical metaphor/nominalisation.

The research, therefore, sets out to answer the following questions:

- 1. How authentic are students' science (library research) papers collaboratively produced in an online environment? For this research, measures of successful authenticity relate to (i) how close to the text-structure of a prototypical library report genre are the papers (i.e., how close to the model students were taught)? (ii) to what extent do the papers use the language of science as expected at this level of schooling, for example, use of nominalisation, and finally, (iii) what is the degree of participation and contribution by students in the collaborative writing task?*
- 2. How do students' collaboratively written texts evolve, or change, over time (i) in terms of text structure, and (ii) in terms of key linguistic features?*
- 3. Can text changes and evolution be explained in relation to the online dialogue and feedback?*
- 4. What are the implications of the above for pedagogy and policy, i.e., for (i) students' language development in science and the use of genre pedagogies, (ii) collaborative writing in science, and (iii) online pedagogy?*

In general, science learning and scientific literacy development tends to be discussed across the social sciences and science literature, and may be researched from a range of perspectives such as a sociocultural, sociocognitive, social constructivist or linguistic. A challenge for this project was the identification of a theoretical lens with the capacity to track the learning development of students participating in a collaborative science writing context. It was decided that the most appropriate lens for this research focus is one that views language development as integral to learning and situates all development within a social context. The research is therefore situated within a social constructivist perspective (Wells, 1994), one that focusses on learners within a specific social context of language usage, constructing language to serve the functions called for within that context (Purcell-Gates et al; 2007; p 11). It also draws on systemic functional linguistics (Halliday, 1985; Halliday and Martin,1993), a theory of language that recognises the role of language in learning and development as well as its contextual nature.

The following section provides further discussion on authentic science and scientific writing and the usefulness of a sociocultural perspective. It provides further insight into the motivation for the study and for the particular research questions devised.

1.2 Perspectives on Authentic Science Writing

Keys (1999) provided an excellent overview of the history and theoretical paradigms associated with learning to write in science, and provided particular insight into the debate surrounding the teaching of traditional scientific genres such as “experiment”, “explanation” and “report” and more contemporary, “communicative genres”, including creative writing. Her study focused on the development of a case for the “revitalization of writing in scientific genres ... as a mode of learning in the science classroom” (p 116). She argued that teaching transactional or communicative genre production is important at all educational levels, but is particularly important in upper elementary and middle schools (secondary) where “children begin to develop connections between scientific content and the process of knowledge production in the scientific community”.

Her findings and recommendations are important considerations for this research in that she supports the Systemic Functional Linguistic (SFL) arguments led by Halliday and Martin (1993), i.e., that scientific genres should be explicitly taught (in parallel with scientific bodies of knowledge) so that all children may have access to the discursive power of scientific texts. She supported her arguments for genre-based writing, over say, story writing, expressive, or directive teaching of conventional writing using the work of others (Christie, 1985; Delpit, 1986; Berkenkotter and Huckin, 1995) and asserted that the compelling reason for increased teaching of scientific genres was that “writing in scientific genres promotes the production of new knowledge by creating a unique reflexive environment for learners engaged in scientific investigations” (p. 119). In other words, learning to write in scientific genres ensures that learners involved in authentic scientific inquiry, in an instructional setting, will take personal ownership of their own scientific ideas. Authenticity, she argued, will give scientific writing a voice of ownership of scientific knowledge. She associated authentic learning in science with writing in “accepted” scientific genres, and elaborated on how genre-based writing provides opportunities for in-depth thinking and promotes the crystallisation of new thinking.

The arguments put forward by Keys et al. (1999) are ones that I was interested in investigating in the context of online writing in a secondary school science classroom in Ireland. Of particular interest to me was the recommendation that scientific literacy exercises should focus on the little-used, yet powerful genre “exposition”, referred to earlier (p. 116). Engagement with this genre encourages students to become immersed in an understanding of evidence, adopt a particular view, and formulate some understanding of scientific argument.

Melber (2004) was particularly interested in the impact, and importance, of such activities for students with special needs, but successfully argued that her approaches are readily applicable to a general education classroom. This research is interesting in that it advocates introducing additional inquiry-based scientific experiences into the science classroom together with concrete strategies for overcoming challenges faced by students in the special education classroom. This approach dismissed the use of certain non-traditional pathways, i.e., writing assignments, in favour of experiential ones followed by oral presentations or

discussions. Authenticity in science, she argued, is primarily related to experiential scientific inquiry and that the first step in the process of creating scientifically literate students, and adults, was active inquiry. I believe that this approach has benefits, and could have been used by, for example, Montgomery (2005) to address non-participation by reluctant learners. For this research project, however, which focusses on the writing aspect of authentic science learning, it would have been difficult to incorporate any of the proposed activities in a meaningful or measurable way. I would argue that the authenticity considered by Melber relates to an authentic personal learning experience, i.e., that the approach enhances a learner's experience and the ability to understand and communicate this experience in a specific context. The collaboration is in the inquiry, but not in the reporting. The goal of this project, however, is the co-creation of knowledge and communication of a specific collaboratively written genre targeted at a specific scientific community.

The science literacy development research presented here, which incorporates reading real-world scientific texts and collaboratively writing an assessed real-world genre would be considered authentic by Purcell-Gates et al. (2006) writing about creating authentic literacy activities for students at level K-3. In their TEXT project, Duke et al (2006) conducted an authentic science writing study with second- and third-grade teachers and their students, and found that reading and writing real-life science texts for real-life purposes increases student comprehension and composition scores. Furthermore, they found that for each increase in the frequency of authentic literacy in the classrooms investigated, there was a corresponding increase in literacy achievement; see Purcell-Gates et al (2007).

These relevant reports, however, offer little insight into conducting collaborative writing activities at secondary level, as they focus on primary education research. However, they used the same theoretical lens as this research, and essentially constructed similar authentic reading and writing exercises. This means that there were crucial overlapping aspects to their research that informed the choice of research questions. One particularly interesting aspect related to how the choice of texts used in scientific literacy projects can “add a dimension of authenticity to within-school literacy activities” for students (Purcell-Gates et al; 2007, p 15). They

proposed that teachers are actively involved in selecting texts, and making these texts available, for their students, and that it would be best practice to select “science informational text” and “science procedural text”. The former have defined as “text written for the purpose of conveying information about the natural world, typically from one presumed to be more knowledgeable on the subject to someone presumed to be less so” (ibid, p 15). The authentic purpose for reading science information text is to acquire knowledge about the natural world for real-world purposes, i.e., other than school-only purposes. The latter is defined as “text that is written for the purpose of instructing the reader in how to conduct investigations, or experiments related to scientific content, typically written by someone who knows how to do the procedure to someone who must rely on the written procedures to conduct the investigation appropriately”. The authentic purpose for reading science procedural text is to properly conduct the procedure.

Qualification as an authentic science informational, or procedural, text requires that a real audience, or reader, must be involved, and in the case of the latter, actually follow the procedures and enact them. These guidelines on scientific text were adopted for this research project, which focused on the topic of “The Physical Processes of Global Warming”. An initial analysis of review literature in this area indicated that there were both science information and science procedural texts available. For the research, therefore, it was decided that teachers would recommend an appropriate mixture of informational and procedural texts and work with their writing teams on choosing the texts that suit their purposes.

Purcell-Gates et al (2007) assessed students' performance when writing in a specific genre by determining how “effective” the entire genre was as its genre type. Specifically, they developed feature-based scoring guides for informational and procedural text writing assessment and used these guides together with a Likert-based holistic analysis to determine degree of authenticity and explicitness scores. Their empirical data, albeit with a limited sample, in their longitudinal study were obtained by excellent experimental and correlation designs, quality measurement, and comprehensive statistical analyses. These researchers explicitly called for more studies of this kind, i.e., situated instruction and levels of growth, which was an important consideration for this research proposal.

1.3 Thesis Organisation

The structure of this thesis is as follows:

Chapter One (Introduction) introduces the research and thesis topic (authentic scientific literacy) together with the motivation for the choice, and importance, of the specific questions investigated.

Chapter Two (Literature Review) focuses on theories and empirical findings relating to (i) authenticity and science learning with particular reference to collaborative writing, (ii) language based learning, and genre pedagogy (largely within an SFL framework and largely in science to make this manageable), (iii) online environments for learning with emphasis on systems focusing on writing to learn, and finally (iv) the role of peer interaction, and in particular, feedback within collaborative writing environments.

Chapters Three (Theoretical Framework) and Four (Methodology) elaborate on the SFL theoretical framework together with the research design and methodology associated with the first two research questions given in section 1.1 above, i.e., “How successful are science papers collaboratively produced in an online environment?” and, “How do collaboratively written texts evolve over time?”. Chapter Three also outlines ethical considerations related to this research.

Chapters Five (Are collaboratively written students' science texts authentic?) and Six (The Evolution of Collaboratively Written Student Genres) present the research findings based on the analysis in relation to the first two research questions outlined in section 1.1 above.

Chapter Seven (Discussion) presents a summary of the key findings from Chapters 4 and 5 and discusses these in relation to the literature review. In particular, it addresses the remaining (third) research question (see section 1.1) which is concerned with how text changes and text evolution may be explained in relation to online dialogue and feedback generated within the collaborative writing environment. It concludes by considering the final research question concerned

with the implications of these research findings for pedagogy, policy, and future research in the area of online authentic science literacy development.

Chapter 8 (Summary and Reflections) provides a brief reflection on the outcome of the project overall, evaluating the methodology and the findings.

1.4 Conclusion

In this section I have introduced the research and thesis topic (authentic scientific literacy) together with the motivation for the choice, and importance, of the specific research questions investigated. An overview of the thesis organisation was also provided. The following chapters outline, in greater detail, research question development following an appropriate literature review, a comprehensive SFL motivated methodology and analysis, and detailed discussions of the research questions in light of the key study findings.

Chapter Two

Authentic Science Learning - A Literature Review

This chapter introduces various theories and empirical findings relating to science writing and learning within a Systemic Functional Linguistic (SFL) framework. Specifically, it addresses: (i) authentic science learning with particular reference to collaborative writing, (ii) language based science learning, and genre pedagogy, (iii) online environments for learning with emphasis on systems focusing on writing to learn, and finally (iv) the role of peer interaction (and in particular, feedback) within collaborative writing environments.

2.1 Introduction

The motivation for this research is to gain some insight into the relationship between authentic science learning and the discourse of science at secondary school level in Ireland, and in particular, into the relationships between peer and teacher-student discourse on the evolution of writing. This research is of interest as it is concerned with key issues in science learning as identified by, for example, Melber (2004), which include questions such as:

- How does writing in scientific genres foster conceptual knowledge development, metacognitive development, and an understanding of the nature of science?
- What special features of scientific writing specifically support cognitive and metacognitive development?
- What types of classroom activities may be developed to support integrated inquiry and scientific writing?

The last question was particularly stimulating to me, as I was interested in the use of online collaborative writing environments when used as a classroom activity. Melber (2004) identified as a particular concern the paucity of specific data on the way in which teachers use scientific genres, their goals and purposes for using

these genres, and their expectations for students' writing products. By establishing a collaborative writing methodology, contextualised within a Systemic Functional Linguistic framework, I believed that my EdD project would enable the capture of written products and the "surrounding" discourse in an authentic science writing learning context, and so provide the kinds of essential research data identified by Keys (1999; p. 128) as necessary for providing insight into the relationship between scientific writing and scientific learning and development.

Halliday (1993) argued in his theory of a language theory of learning, that when children learn language they are learning the foundation of learning itself, and that the distinctive characteristic of human learning is that it is a process of making meaning - a "semiotic process" (p. 93). Furthermore, he argued that the "ontogenesis of language is at the same time the ontogenesis of learning"; in sum, language has a central and unique role in learning. Wells (1994), responding to Halliday's article, argued that the language theory of learning was highly compatible with, and complementary to the work of his mentor Vygotsky (Wells, 1994, p. 42). He also argued that systemic functional linguistics provided a framework within which to devise coding schemes to be used in the analysis of the large corpus of educational data collected by himself and colleagues, as reported in Wells (1985). Wells wrote that for both Vygotsky and Halliday, language was a "human invention, to be used as a means of achieving the goals of social living ... and that the best way to understand it ... is by adopting a genetic approach to the study of the ways in which it functions as a tool in the situations in which it is used" (Wells, 1994, p. 46).

These key perspectives on learning, language and social context, from Halliday and Vygotsky, presented articulately by Wells (1994) were the key drivers for the development of a theoretical background and associated methodology for this research. The project focused on a social learning context where students undertook authentic collaborative writing in science education, in an online environment. Throughout the research project, tools were important drivers in establishing, coordinating, communicating, and mediating learning relationships. Central to this project was the "tool of tools", language, which Vygotsky considered to be the most significant (Vygotsky, 1987), because language is the true enabler of planning, coordination and mediation of otherwise internal discourse.

Wells accepted that learning is a semiotic process for which the prototypical resource is language. However, he argued that “it involves learning to do as well as to mean - to expand one’s potential for meaningful action as well as one’s potential for meaning through language. Discourse, both spoken and written, plays an essential, mediating role in these processes, as do other semiotic tools.” (Wells, 1994, p. 84). He stressed that learning is not just the development of the learner’s resources for the “construction and linguistic articulation of discipline-based knowledge, but the development of the resources for acting, speaking, and thinking that enable the learner to participate effectively and creatively in further practical, social, and intellectual activity” (ibid, p. 84). The implication of Wells’ analysis of two key theorists in a language of learning and social constructivism for my research was; that it was necessary to understand (i) the social, learning, context for the learning, (ii) the importance of language in students “articulation” of discipline-based knowledge, and (iii) student participation in further practical, social and intellectual activity. Central to this research was the argument that authentic enculturation into science is achieved by constructing pedagogic environments that engage students in the practice of science, in addition to learning about science. A key aspect of authentic enculturation is participation in all aspects of the discourse associated with scientific learning, i.e., engagement in team-based collaborative working and participation in the development of collaboratively written scientific genres. The remainder of the literature review, therefore, includes a review of relevant literature on authentic science learning with emphasis on collaborative working, underpinned by a language theory of learning.

It has been argued that online collaborative learning environments (CLEs) can support discursive and collaborative writing, and it is this aspect of the authentic science learning process that motivates this research. Ligorio and Veermans, for example, described CLEs as tools that “enhance collaboration within the classroom as well as across classrooms” (2005, p. 271). CLE is the generic term used to describe a variety of related frameworks (for example, Collaborative Virtual Environments, Powerful Learning Environments, Computer Supported Collaborative Learning) that have “adopted principles of student-centred, collaborative, and problem-driven learning” (2005, p. 271). This review, therefore,

reviews the role of online collaborative writing environments and their success in authentic science learning.

The importance of pedagogical design for collaboration is echoed by Schwartz (2005) who argued that the underlying social, technological and epistemological infrastructures of classroom activity, when combined with appropriate web-based environments, facilitated scaffolded knowledge construction (ibid, p. 377). In other words, software is next to useless without an appropriate pedagogical context. Furthermore, he questioned the belief that knowledge is constructed solely from informal discussion, and argued that, in fact, tools that support integrated scientific inquiry and informal discussion are more likely to be successful in constructing knowledge. He recommended that through evaluation, pedagogical principles should be challenged by empirical findings from “newly designed environments”, with a view to producing more robust pedagogical underpinnings in future developments (ibid, p. 378). The sociocultural pedagogical context underpinning the research described in this literature review focusses on whole-text writing in context from a functional perspective. It uses SFL as the evaluative framework, and includes a section on the theory of SFL and science writing.

2.2 Authentic Science Learning and Collaborative Writing

The importance of writing in science, as one aspect of authentic discourse, was introduced in the previous chapter (see section 1.2 for perspectives on authentic science writing). This section contextualises the importance of authentic writing within the general field of Authentic Science Learning (ASL). ASL is the general term used to describe pedagogical and scientific literacy development practices whereby student learners engage in scientific inquiry and learn about scientific doctrines in the same manner as professional scientists.

ASL, according to Michelle McGinn and Wolff-Michael Roth (McGinn and Roth, 2004) relates to teaching enculturation and preparation of science students for competent and authentic scientific practice or utility in modern society, preferably within a social constructivist paradigm (Bruner, 1996; Driver et al., 2004). Some notable features of ASL relevant to this research include: (i) the introduction of developmental corridors as represented in the Open Classroom (Driver et al.,

2004, p. 58) or FCL (Brown, 2004), and (ii) optimal and supportive trajectories in science education relying on strong links between primary, secondary and tertiary curricula and emphasis on the importance of such trajectories from school to communities (McGinn and Roth, 2004, p. 113). Adoption of an authentic science curriculum based on social interactions between learners, teachers, social and scientific experts (industrial and academic) and other scientific personnel would provide a deeper understanding of science and scientific knowledge. Both Brown (Brown, 2004) and Murphy et al (2005b) argue that greater community involvement of practising and professional scientists is one of the best scaffolds that can be used to aid scientific learning.

More recently, ASL advocates recommended incorporating some form of scientific inquiry and opportunities to talk about science within reading or writing assignments. Cervetti and Barber (2008) and Cervetti et al. (2009), for example, have observed that despite evidence that modern scientific literacy development practices tend to be inadequate, and fall into two extremes (text-dominated and hands-on-dominated); integrated models of science instruction in school classrooms are still fairly uncommon. They argued that it is preferable for students to learn science by both “doing” science and having opportunities to participate in scientific discourse. “Doing” science includes tasks such as exploring, finding evidence to support theories, creating explanations, conducting investigation and revising explanations based on new evidence, while discourse participation includes activities such as reading (situating research, self-critique, finding new methods and information), writing (describing practice, critiquing research of others), speaking and listening (communicating findings, learning from others, questioning other scientists’ claims, evidence and reasoning). By doing, talking, reading and writing students secure the same opportunities to learn as professional scientists (Cervetti et al., 2009).

The best form of authentic instruction, Cervetti and Barber (2008) argue, is one that includes an appropriate balance of multiple learning modalities and utilises reading and writing strategies that are authentic to the scientific discipline. Furthermore, they have found in their research studies that authentic learning approaches lead to significantly greater gains in understanding of scientific concepts and science vocabulary (Cervetti et al., 2009). They report that the most

successful inquiry-based curricula are those that explicitly incorporate reading and writing in ways that are authentic to the scientific discipline, i.e., where students are taught how to read and write science together with opportunities to participate in science talk. In particular, they argue that authentic science learning specifically addresses the respective disciplinary discourse, i.e., learners gain familiarity with the disciplines' unique language registers, register usage, and gain exposure to relevant genres that demonstrate appropriate textual features.

This foregrounding of the role of text in inquiry-based science learning is crucial for ensuring authenticity, and the authors argued that students need to be provided with scaffolding opportunities to practice and gain independence in the journey from novice to expert science literacy. Authenticity in science requires text roles that (i) include context provision and delivery, where learners situate their research and read to learn; (ii) include modeling, where learners read and replicate the procedures and approaches of others; and (iii) support first- and second-hand investigations, where learners read reference material, and interpret other's findings and data, respectively. Finally, authentic science pedagogical strategies require learners to be presented with authentic writing opportunities; ideally having repeated opportunities to engage initially with a single relevant genre, and later writing across the range of science genres, for example, those concerned with systematic observation, understanding processes, conceptual understanding and comparative analyses.

McGinn and Roth pointed out that with adoption of authentic science learning, some "traditional topics may fall by the wayside", but with allied curricula utilising spiral revisitation of scientific topics, these topics could be discussed in a more relevant, authentic, context (McGinn and Roth, 2004, p. 113). Researchers like Cervetti et al. (2007b) working in the field of ASL, however, provide numerous examples of how to scaffold authentic learning around inquiry-based science curricula together with recommendations that students are taught how to read and write science. A key consideration for the research presented here, and not referred to by these researchers, is the additional essential criterion that ASL should also promote engagement and exposure to scientific disagreement, i.e., *contested science*. Furthermore, students should become aware that scientific knowledge is not "fixed" and that currently accepted theory has not always been

accepted. Moreover, ASL should encourage the incorporation of selected experts, or expert groups with differing theories and practices (where possible) in dialogic social interactions to provide more authentic learning contexts for science learners, as emphasised by Brown (2004) and Murphy et al. (2005b), for example.

There is general agreement, therefore, that the production of written documents, which are presented to the peer and scientific community for review and discussion is central to dialogic interaction in scientific practice and that ASL pedagogies should scaffold the writing of such documents (planning, structure and content). Ideally, authenticity in the curriculum should encourage different types of scientific writing (i.e., different genres), with the expectation that students become capable of reading and constructing different genres as intended for different audiences (McGinn and Roth, 2004, p. 110). Authentic writing assignments, using a constructivist model (incorporating writing scaffolds), should be delivered concurrently with student reading, investigation and research and could utilise portfolio-based techniques as outlined by Catherine Haines (Haines, 2004, p. 42).

Programmes and activities supporting ASL pedagogies are currently extant in Irish classrooms, not least within the secondary school level Transition-Year programmes in Ireland (Department of Education, 2004). ICT usage in classrooms at secondary level is prevalent in Ireland, and although the ASL research referenced in this section does not explicitly refer to how ICT might be used to support ASL, or writing in particular, it is important for ASL pedagogies that authentic use of software tools be incorporated into learning strategies and scenarios. Additionally, certain inquiry-based science curricula, such as the Transition-Year programmes mentioned earlier, promote peer-group, student-teacher, and other social interactions. These learning contexts provide opportunities for meaningful comparative discourse focusing on boundary objects (for example, graphs, presentations, and reports) resulting from visual representation activities. As with professional science, such peer group discourses are particularly important as they assist identification of broad agreements and disagreements following research activities (McGinn and Roth, 2004, p. 112). It could be argued therefore, that ASL is present to some extent within Irish classrooms.

Achieving successful ASL is a complex undertaking as there are so many factors to consider, not least those related to describing “authentic science”. First, there is the issue of identifying and describing authentic science, which is difficult as “science” is actually a term given to a collection of ethnosciences; defined by Meehan (1980) as the set of concepts, prepositions, and theories that are unique to each particular culture group in the world. Fundamentally, ethnosciences are cross-disciplinary, based on increased collaboration between social sciences and humanities with the natural sciences each having their own theories, praxes, language registers, discourse norms, genres and communities. Second, there is the issue of the differing usages of ICT within the ethnosciences, and in particular, the strategies implemented for collaborative writing of specific genres. Third, there should be a clear understanding of how the practices, methods and activities (i.e., the “doing” referred to by Cervetti and Barber (2008, 2009)), relate to the written genres, which in turn, become primary or secondary readings for new participants in a particular scientific community. Finally, it is important to have some understanding of how the basic ‘theory-research-discourse’ cycle operates for different science subjects, and how each phase in that cycle acts as a catalyst for the other phases. With so many variables, i.e., indicators of authenticity, it is unsurprising the literature tends to be either very general, or exceptionally specific. Research in ASL, it would appear, requires substantial contextual situation in order to clearly report results from new studies. It may also unfortunately be the case that specific research results from one study may not be readily transferable to another learning context, although it appears that certain general findings may be helpful.

Mak and Coniam (2008) investigated authentic writing, situated within the domains of creativity and task-based learning, through the use of wikis by Year 7 ESL learners in a secondary school in Hong Kong. They identified three approaches to writing; (i) writing against teacher constructed models, (ii) process based writing based on iterative writing and re-writing, and (iii) writing within a social context, i.e., for an audience. Authenticity could be achieved, they believed, by addressing the latter approaches, i.e., when purposeful texts are produced for a particular audience.

Cope et al. (2012) argued that writing is an important site of assessment in itself and that writing scientific reports, for example, provides opportunities to assess deeper understanding of the nature of science evidence, reasoning and argumentation. Writing and reading science, they believe, brings students closer to the practices of science and scientists, i.e., they explicitly state “It is not possible to get closer to science than scientific writing” (ibid, p. 80). Albeit focussing on a writing perspective rather than science pedagogy one, and not specifically referring to authenticity, Cope et al. (2012) appear to be strong advocates of authentic science writing as it supports situated learning (Gee, 2004; Latour & Woolgar, 1986).

Parkinson and Adendorff (2004), following discourse feature analyses of two target forms for students (textbooks and scientific articles), argued that popular science articles cannot serve as models of scientific writing. They concluded, however, that the latter make science accessible and have a useful role in teaching scientific writing. Their support for the use of popular science articles was primarily based on the assertion that this genre presented research findings as “provisional” rather than “incontrovertible fact”, as is usually presented in textbooks and appears to be presented in research articles. Furthermore, they argue popular articles are usually collaboratively-written by scientists, and reflect the collaborative nature of science. This presentation of scientists as a community of “ordinary people” appealed to Parkinson and Adendorff (2004) who appeared to be critical of science writing being associated with “iconic status” figures.

For this research, and for pedagogical studies in general, several important questions emerge from reviewing ASL literature: (i) science practitioners use a variety of ICT techniques to support their research, so how should ASL pedagogies incorporate software tools in an authentic way?, (ii) many scientists tend to work in teams on collaborative research, so how should an ASL approach scaffold the learning of authentic collaborative working strategies?, (iii) how could ASL explicitly incorporate best practice approaches to authentic science writing, to reflect collaborative, team-based writing typical of modern scientific research teams?, (iv) and what kinds of texts and topics should be chosen as exemplars for online collaborative writing in school science and how should writing be evaluated in order to establish the success, or otherwise, of authentic science writing? This

research focusses on these key issues from a Systemic Functional Linguistic perspective.

Woodward-Kron (2009) argued that there are potential benefits to be gained for teachers and students by viewing the role of student writing, within an EAP (English for Academic Purposes) paradigm, from a disciplinary perspective. An emphasis on successful writing disciplines, she argued, can be a catalyst for learning, clarifying and developing understanding of subject matter, and is more successful pedagogically than student writing focussing on assessing and scrutinising students' understanding of course material. Woodward-Kron referred to earlier related cognitive process research by Bizzell (1982) and Berkenkotter and Huckin (1995) who claim that knowledge about genre is a form of situated cognition embedded in disciplinary activities (Woodward-Kron, 2009, p. 166).

Ho (2009) using a combination of the genre-based theory and Systemic Functional Linguistics (SFL) identified the approach as a potential instruction tool in the ESL (English as Second Language) classroom. Central to her successful approach was a teacher-learner collaborative analysis of various text types in terms of structure and texture. Hewings and Coffin (2007) also used a functional approach to examine writing in multi-party conferences and single-authored assignments, albeit at graduate level. Chase and Argamon (2005, 2006) applied computational linguistic methods to the study of genre, and in particular, compared the rhetorical styles between different genres communicated by scientists through their publications in peer-reviewed journals. According to Cleland (2002) such publications in the philosophy of science tend to be either experimental or historical, therefore Chase and Argamon (2006) examined the linguistic features of the two groups using a functional approach. Their corpus included articles published throughout 2003 in twelve peer-reviewed journals in six fields.

Their approach, i.e., using Systemic Functional Linguistics (SFL), as a method of investigating science texts, was particularly useful for their research which required a framework for analysing authentically written science text (i.e., a collaboratively written science genre). Furthermore, SFL could be used to examine the evolution of collaborative discourse and the collaboratively produced texts over time. For example, Woodward-Kron (2009) used SFL to provide analytical tools,

and a theoretical framework for a longitudinal study which mapped, from a lexicogrammatical perspective, how students' writing developed as their disciplinary knowledge increased.

For Chase and Argamon's (2006) research, their SFL approach, as a method of investigating science texts, was particularly useful because it provided a framework for analysing authentically written science text (i.e., a collaboratively written science genre). Furthermore, Woodward-Kron (2009) used systemic functional linguistics to provide analytical tools, and a theoretical framework for a longitudinal study which mapped, from a lexicogrammatical perspective, how students' writing developed as their disciplinary knowledge increased. It was hypothesised therefore that SFL could be used to examine the evolution of collaborative discourse and the collaboratively produced texts over time.

A notable feature of over two decades of interdisciplinary collaborative writing research, however, has been the continued disagreement on a suitable definition of collaborative writing (Lowery et al., 2004; Dillon, 1993; Beck, 1993; Ede and Lunsford, 1990; Bosley, 1989). Beck (1993) referred to fundamental difficulties arising from an absence of a common taxonomy, and appropriate nomenclature, suitable for interdisciplinary discussion. Both Bosley (1989) and Beck (1993) maintained that collaborative writing research is a complex, dynamic process, and that it is unsurprising that researchers and practitioners often disagree on the definition of collaborative writing. Ede and Lunsford (1990) reported that "we had difficulty eliciting information, primarily because we lack a vocabulary to discuss what people do when they write collaboratively" (p. 63). Bosley (1989), however, defined collaborative writing to describe the situation where two or more people work together to produce one written document in a situation (or context) in which the group takes responsibility for having produced the document (p. 6). Dillon (1993) believed that collaborative writing refers to group-based writing activity in addition to the group dynamics. Rice and Huguley (1994) offer a definition which emphasised the primary activities of collaborative writing, arguing that it referred to "any writing performed collectively by more than one person that is used to produce a single text; and we define writing [*italics added*] as any activity that leads to a completed document, including brainstorming or idea generating,

gathering research, planning and organising, drafting, revision, and editing.” (pp. 163-164).

Lowrey et al. (2004) defined collaborative writing as “an iterative and social process that involves a team focused on a common objective that negotiates, coordinates, and communicates during the creation of a common document.” (p. 72). Cerratto (2002) argues that there is an “extra twist” (p. 139) associated with computer-mediated, or online, collaborative writing where the collaborative activities are mediated by text. Here the “writing is a very complex and specific collaborative activity that differs from others in that written language is both the group’s product and its means for communication between the writers” (p. 139). More recently, Heeter & Jeong (2012) argued that “with deeper, more precise, and more thorough understanding of the collaborative writing process, new wiki tools, interfaces, and instructional interventions can be developed to ..” (p. 12) improve our understanding of the complex processes associated with increased online writing group performance.

Given the complexities associated with defining collaborative writing, it is important for this research, therefore, that a clear working definition of collaborative writing is provided, i.e. *“collaborative writing describes the activities involved in the production of a document, using online computer supported software, by more than one author, together with pre-draft discussions and arguments, the drafts and final document, together with post-draft analyses and debates”*.

For this project, therefore, it was decided to use a functional frame for investigation of online collaborative student authentic science writing. The following section provides a short review of SFL, with particular reference to the language of science.

2.3 Language-based Science Learning, and Genre Pedagogy

In this section Systemic Functional Linguistics (SFL) is introduced within the context of scientific literacy development as discussed earlier. SFL was used for this research as an analytical framework for analysis of a specific pedagogic aim:

second-level students participate in an online group discussion in order to then collaboratively write a scientific library research paper.

Systemic functional linguistics or systemic functional grammar (SFG) is a model of grammar that was developed by Michael Halliday in the 1960s. It is part of a broad social semiotic (i.e., sign process) approach to language called systemic linguistics. The term "systemic" refers to the view of language as "a network of systems, or interrelated sets of options for making meaning". The term "functional" indicates that the approach is concerned with meaning, as opposed to formal grammar, which focuses on word classes such as nouns and verbs, typically without reference beyond the individual clause. SFL takes into account the contextual dimensions of language and conceptualises language as a semiotic resource intimately involved in the negotiation, organisation, and construal of human experiences. In the SFL formulation, language is more than a conduit for meaning; it is a principal resource for making meaning. Halliday writes that it is "a part of reality, a shaper of reality, and a metaphor for reality" (Halliday, 1993, p. 8). Furthermore, he said that "the value of a theory lies in the use that can be made of it, and I have always considered a theory of language to be essentially consumer orientated" (Halliday, 1985a, p. 7). The objective of SFL, therefore, is to be relevant to the kind of work linguists do, for example, investigation of the use of language in classrooms.

SFL places the function of language as central (what language does, and how it does it), in preference to more structural approaches, which place the elements of language and their combinations as central. SFL begins with social context, and looks at how language both acts upon, and is constrained by, this social context. It also has a structural component, and the theory indicates that particular aspects of a given social context (such as the topics discussed, the language users and the medium of communication) define the meanings likely to be expressed and the language likely to be used to express those meanings. Since language is viewed as semiotic potential, the description of language is a description of choice. Systemic linguists examine the choices language users can make in a given setting to realise a particular linguistic product (the available choices depend on aspects of the context in which the language is being used). By selecting particular lexicogrammatical items, writers and speakers are able to simultaneously engage

in presentation of topic, negotiation of role relationship and structuring of text (Schleppegrell, 2004). Text produced in different contexts contains different linguistic features and realises different social functions (these differences reflect the diversity of the structures and processes of social systems or registers).

Within SFL, language is analysed in terms of four strata: context, semantics, lexico-grammar and phonology-graphology. Context concerns the field (what is going on), tenor (the social roles and relationships between the participants), and the mode (aspects of the channel of communication, for example, monologic/dialogic, spoken/written). Systemic semantics relates to the metafunction of language and includes ideational semantics (the propositional content), interpersonal semantics (concerned with speech-function, exchange structure, expression of attitude) and textual semantics (how the text is structured as a message, for example, theme structure, rhetorical structure). Lexico-grammar concerns the syntactic organisation of words into utterances and also uses a functional approach (analysis of roles such as actor, agent/medium, theme mood). SFL aims to explain how the continuous emission of sounds or the continuous concatenation of characters (wordings) construes meanings. In this system adult human language is not viewed as a finite rule system, but rather as a system realised by instantiations which is “back-fed” by the very instantiations that realise it. Halliday (1973) outlined seven functions of language with regard to grammar used by children:

- an instrumental function that serves to manipulate the environment, to cause certain events to happen.
- a regulatory function that is the control of events.
- a representational function that is the use of language to make statements, convey facts and knowledge, explain, or report to represent reality as one sees it.
- an interactional function that serves to ensure social maintenance.
- a personal function that is to express emotions, personality, and “gut-level” reactions.
- a heuristic function used to acquire knowledge, to learn about the environment.
- an imaginative function that serves to create imaginary systems or ideas.

When using SFL, the approach is non-sterile; the functional meaning potential of language is realised in units no smaller than texts, which are always analysed within their originating context. Each text may be subdivided into smaller elements of the lexicogrammar for investigation purposes, but are always examined in terms of their contribution to the contextual meaning of the whole text.

The linguistic structures of SFL include the lexicogrammar and the genre, i.e., the text structure (Chappelle, 1998). The former is a combination of syntax, lexicon and morphology, which, according to Halliday, appear to be inseparable as humans appear to store chunks of language that are larger than just words. This structure is derived from the formal theory of grammar proposed by SFL theorists who view language structure as a system of meanings accompanied by forms through which meanings can be realised (Halliday, 1985b, pp. 7-11). In SFL theory, therefore, the lexicogrammar is both context and register based.

This functional view of language strongly suggests that the language used to construe, or interpret, scientific knowledge and values is different from other registers of language, because the structure and function of scientific activities are different from other human activities, for example, everyday communication (Fang, 2005, pp. 336-7). As seen earlier, science is a separate form of culture, and central to the culture of science is the language of science. Halliday (1993b) clearly demonstrated that scientists' ways of describing the physical world in science (problem identification, hypothesis formulation, experiment design, data collection and analysis, and drawing a conclusion) have given rise to a very specific variety of language as a means of producing and organising scientific knowledge.

SF linguists view scientific language as functional for construing scientific knowledge and beliefs, and argue that it (the language or grammar) embodies a very specific view and way of thinking and reasoning. This specialised language makes it possible for scientists to construct alternative perspectives or interpretations of the physical world to that provided by the everyday language of spontaneous speech (Halliday, 2004). Essentially, the SFL perspective is that learning the language of science is synonymous with learning science itself. Learning to be a scientist requires competence in the unique linguistic forms and

structures that communicate scientific principles, knowledge and beliefs. Scientific literacy is a semiotic process involving systematic remodeling of everyday grammar and naturally accompanying reconstrual of everyday ordinary life experiences (Wells, 1994).

Halliday (1993) has identified a number of features of typical scientific writing that make it difficult (to comprehend). These features include:

- Interlocking definitions - this is the way definitions are presented in relation to each other, i.e., the sentences depend on each other to make sense;
- Technical Taxonomies - When science classifies things or phenomena, and builds a taxonomy, it re-names (creating technical terms) and re-orders them, often establishing new relationships between them;
- Special Expressions - "A kind of syndrome by which we recognise that something is written in scientific language", and include Lexical density, Syntactic Ambiguity and Grammatical Metaphor; for example, "smaller electrical appliance";
- Lexical Density - The density of information in any passage of text, according to how tightly the lexical items (content words) have been packed into the grammatical structure. It can be measured as the number of lexical words per clause;
- Syntactic Ambiguity - Ambiguous verbal groups; Nominal clauses, i.e., group of words that function as a noun in a sentence; Polysemous verbs and verbal groups, i.e., have more than one meaning; for example, "Plants grow using minerals in the soil.";
- Semantic Discontinuity - Where writers make semantic leaps, across which the reader is expected to follow in order to reach a required conclusion; for example, "Heat passes through metals quickly and so they often feel cold".
- Grammatical Metaphor - A grammatical metaphor is a substitution of one grammatical class, or one grammatical structure, by another; for example, "his departure" instead of "he departed";

The last feature, Grammatical Metaphor, is significant for this research. When replacing "he departed" with "his departure", the lexical items are the same, but their place in the grammar has changed. Instead of "(Pronoun) he + (Verb)

departed” functioning as actor and process in a clause, we have “(Determiner) his + (Noun) departure” functioning as Deictic plus Thing in a nominal group. Deictic words are dependent on the context in which they are said or written. In the sentence “I want him to come here now”, the words “I”, “here”, “him”, and “now” are deictic because the determination of their referents depends on who says that sentence, and where, when, and of whom it is said. A nominal group comprises a noun surrounded by other lexical items that all, in some way, characterise that noun. Within a clause, a nominal group functions as though it is that noun, which is referred to as the head; items preceding the head are pre-modifiers, and items after it are postmodifiers. The nominalisation of actions and processes is slightly more common in written language, and tends to express meanings as more stable, permanent states. For example, consider the following sentences, where the latter is a rewrite of the former in nominalised form:

“To prepare a poster requires EdD students to prepare the text and graphics, check all material for accuracy, justify included material, and organise the elements into logical sections.”

“Preparing an EdD poster requires the preparation of the text and graphics, checking all material for accuracy, the justification of included material, and the organisation of the elements into logical sections.”

In the former, the actions and processes are expressed as verbs, which are good at expressing meanings as dynamic and changing, and may be characteristic of spoken language. The latter, as indicated earlier, is more likely to be used in written communication. Halliday and Martin (1993) provided several scientific examples in the context of a discussion on rewording, for example,

[The 36 class only appeared on this train] in times of reduced loading, or engine failure.

Halliday and Martin (1993) said that we could reword as “when the loadings were reduced, or the engine failed”; or reword the first part over again as “when the load was smaller or even when fewer goods were being carried”. They also brought to our attention the nature of rewording, and in particular, posed the questions: “What is the nature of this rewording?”, “Which wording would we use for a 9-year old child, say?”, and “Why choose that wording?”. They argued that it is possible to

retain the vocabulary, but change the grammar by using clauses (i.e., using clausal form) rather than nominal groups in order to “make it younger”. This is because children learn to talk using clauses; replacing clauses with nominal groups comes later in their language development. Another example, from Halliday, illustrated how metaphorical rewording from a clausal form can be used to turn events (verbs) into things (nouns) thereby making the original events appear “more permanent”. Halliday referred to metaphorical rewordings of the form “happening a caused happening x”, and he illustrated this using the following piece of scientific text

“In the years since 1850, more and more factories were built in northern England. The soot from the factory smokestacks gradually blackened the light-coloured stones and tree trunks. Scientists continued to study the pepper moth during this time. They noticed the dark-coloured moth was becoming more common.

By 1950, the dark moths were much more common than the light-coloured ones. However, strong anti-pollution laws over the last twenty years have resulted in cleaner factories, cleaner countryside and an increase in the number of light-coloured moths.” Halliday (1993)

The last paragraph has two processes with one connection between them, i.e., illustrating “happening a caused happening x”. Scientists tend to use this metaphorical form to present as a package something presented before (happening a). However, in this example selected by Halliday, this is not the case, and the reader was required to decode the meaning, and use it as starting point for something else. The difficulty was compounded by the complex coordination of three processes resulting in “happening x”, i.e.,

“However, strong anti-pollution laws over the last twenty years have resulted in cleaner factories, cleaner countryside and an increase in the number of light-coloured moths.”

By rewording, that “the factories have become cleaner, the countryside has become cleaner, and there are more light-coloured pepper moths than before”. The moths, it would appear, have become cleaner as there is less dirt in the air. Of course, this is not the intended meaning, as there is a complex packed relationship that is not obvious here (related to natural selection). Halliday has demonstrated,

therefore, that the first part is misleading, and in the second part the reader must insert two causal connectives and work out the implications of the second.

Scientific writing has evolved to be quite complex and favours the metaphoric form of representation. A consequence of this form of scientific writing is that the texts may contain semantic discontinuities that make the texts difficult to read; subsequently learning about science, or to be a scientist, using these texts is hazardous. Halliday has been emphatic in his criticism of scientific writing ...

“many of those who write in the language of science write it very badly. They leave implicit things that need to be made explicit, create multiple ambiguities that cannot be resolved, and use grammatical metaphor both inappropriately and to excess. The language thus becomes a form of ritual, a way of claiming status and turning science into the prerogative of the elite” Halliday (1993).

Understanding the functional model of grammar, therefore, can help learners understand science writing by teaching them the metafunction of language. Science writing as indicated earlier, is a broad term that includes many different genres produced in different contexts and for different purposes, for example, single-author textbooks, collaboratively written research articles, popular articles. In a typical science literacy development context focused on writing deliverables, students would read and discuss sample genres and then produce some target genre.

Recently, Gao (2012), conducted an SFL comparison of nominalisation in medical papers (Halliday 2004b; Halliday and Martin 1993) written by native and non-native English writers, and argued that lexical density, as a measure of nominalisation, is “just a matter of degree” and is “not absolute”. Furthermore, Gao stated that the nominalisation in a text is meaningful only when compared with that of other related genres. For this research project, therefore, calculations of the lexical density and measures of nominalisation rates in collaboratively written student texts are only meaningful for comparison with other texts in the corpus. It would be worthwhile, however, to compare the results of the present study with findings elsewhere in an attempt to provide some indication of whether collaboratively written scientific genres are similar, linguistically, to the published discourse accessible to the student writers. Holtz (2009), utilised an SFL and

Register Analysis (Biber 1988, 1995; Conrad and Biber 2001) theoretical framework, to present findings on a corpus-based comparative analysis of research articles and abstracts from several disciplines. She focused predominantly on information density and how it is linguistically construed. She conducted a quantitative and qualitative analysis of instances of nominalisation in the corpus' abstracts and articles.

Holtz's (2009) SFL approach to investigating nominalisation in science writing seemed so appropriate for the present study that her methods were selected as the basis for the SFL evaluation framework. The approach is described in detail in the project methodology section of the following chapter. The following section provides an overview of key literature in the area of online collaborative writing environments that supporting Authentic Science Learning. It concludes with a list of key features of successful collaborative writing environments that could provide interim and final writing products (together with collaborative discourse), arising from an authentic science writing project, that would be amenable to longitudinal SFL analyses.

2.4 Online Collaborative Writing Environments and Writing to Learn

This section provides an overview of recent research in online collaborative working and writing with particular emphasis on those findings that feature, directly or indirectly, authentic writing in science. Much of the literature focusses on using collaborative writing systems to support writing to learn, which relates to authentic writing in science. Research in this field tends to focus on the practice of writing and how well online systems support writing to learn; few articles focus on the writing products per se, and even fewer examine the writing products from an SFL perspective as proposed in this research. Nevertheless, the literature presented below provides considerable insight into key issues associated with online collaborative writing and science learning.

A collaborative learning situation may be defined as one in which two or more students work together to fulfill an assigned task within a particular domain of learning in order to achieve a joint goal (Cohen, 1994). Online collaborative working and writing have become popular choices for educators in recent years as

software have shifted from offline to online cloud-based systems specifically targeted at the collaborative worker, for example, Google Docs! (and Google Drive!), which provide support for multiple author usage, revision tracking and document integration facilities. Recently, there have been several surveys highlighting the penetration and general pervasiveness of online collaborative systems used in education worldwide, as part of formal instruction (Minocha, 2009, Deters, Cuthrell, & Stapleton, 2010) or as personal learning supports (CDW-G, 2010). The success of such environments, in terms of positive influences on learning outcomes in student teams, as argued by Koh and Lim (2012) and others (Laurillard, 2009; Chou & Min, 2009) is largely dependent on design elements supporting sociability and visibility. In terms of sociability and how it impacts on collaborative working, gender, camaraderie, and facilities that support “higher” social levels of interaction, solidarity, comradeship and togetherness, all have potential to affect learning outcomes. Furthermore, visibility should have two modes, private where group participants can engage privately as a group, and a public mode where work is shared with others. This notion of visibility is important for authentic writing, as that it provides the group with an audience. As discussed earlier in section 2.2, Koh and Lim (2012) believe that, although their work contributes to the nature of impact of sociability and visibility within collaborative writing environments further research is needed. Nonetheless, they have been strong advocates of collaborative writing environment use, and have argued that their research into collaborative working using wikis provided empirical support for technology-mediated collaboration.

Mak and Coniam (2008) also used wikis in their authentic writing project because they considered this technology to be appropriate for process-writing; providing, as they do, access to feedback and revisions which added to the writing process for a social purpose. They concluded that engaging in collaborative writing, while generally rare since writing tends to be something that students do on their own, was rewarding for the students. Their student writers spent longer expanding, reorganising and correcting text than they would have if writing alone. However, while there was greater coherence to the writing, there were insufficient data to determine if writing accuracy improved in a collaborative context.

Cope et al. (2012), as indicated earlier, are advocates of situated learning approaches to genre based writing. This involves learners working in a community of practice (McDermott, & Snyder, 2002) where writing to learn involves higher-order thinking, engaging with scientific argument and evidential reasoning. Learners are practitioners and engage with authentic practices as outlined by Lemke, (1990), for example, observing, questioning, and challenging.

Cho, Schunn & Lesgold (2007) reported that peer collaboration for writing purposes was effective because students working alone are unlikely to detect their own misunderstanding, appreciate contradictions in text, or consider audience. Gee (2004) argued that learning is integrally related to learner identity, i.e., that one learns if one belongs to a learning context where your knowledge making and actions are seen by fellow learners. Without doubt, collaborative writing in science as reported in this EdD project provided learners with explicit authentic opportunities to engage with deep disciplinary knowledge, and for their knowledge formation to become visible, and be appreciated by, their fellow writers and learners (Gee, 1996). This may not always be the case, however, as Benwell and Stokoe (2002) have asserted that when “novices” use academic or technical “expert” language they risk “face” threats from their peers and consequently, may resist displays of knowledge, seeking to maintain their ‘student’ identity. Furthermore, Lillis (2001) has suggested that learners might also resist knowledge displays and authentic register acquisition because they feel ambivalent about, or resistant to, the academic identities that the language conveys.

Cho and Schunn (2007) favour asynchronous collaborative writing software systems, and provided excellent arguments for utilising asynchronous writing technologies for their research based on evidence from collaborative writing literature. For example, Rada et al. (1994) reported that interaction is not correlated with the quality of writing and that students preferred to write asynchronously rather than synchronously (Hartman et al., 1995). Furthermore, Galegher & Kraut (1996) have found that collaborative writers reduce their interactions while writing. Miyazoe and Anderson (2010) focused on learning outcomes and students’ perceptions of online writing using simultaneous implementations of a forum, blog and wiki and found that in blended learning

scenarios student writers preferred wikis. Following quantitative text analysis, students showed progress in their ability to differentiate English writing styles.

There is strong evidence that the use of tools for, or to support, science writing is beneficial in terms of improving science learning. For example, Keys, Hand, Prain and Collins (1999) used the science writing heuristic as a tool for learning from laboratory activities in secondary science, and found that this tool facilitated students' adequate understanding of the nature of science. Furthermore, tools are ideally suited to providing novice writers with prompts and protocols which foster students' self-regulated learning, for example, (Nuckles, Hubner & Renkl, 2009). Cope et al (2011) recently argued that there was an "urgent need" to create dedicated applications for web-based writing environments, especially those that support continuous formative and summative assessments. Ideally, they argued, systems should: use a multimodal format appropriate to differing expressive needs and learning styles; provide access to individual learners' writing and to cooperative, or comparative writing; track individuals' writing over time; allow comparison of individual performance and be able to track cohorts of students.

Cope et al (2011) have not specifically recommended support for collaborative writing per se, but all of their recommendations are key aspects of any collaborative writing setup. Interestingly, while they acknowledged that teachers and students are increasingly using online writing spaces such as Wikis or Google Apps, they argued that none of the current tools have been developed specifically with science writing in a learning context. They argued that current software offerings lack appropriate scaffolds relevant to science genre production, and that none support reliable and valid infrastructures for assessment. Furthermore, writing tools that support science, for example, are fundamentally inadequate without support for incorporation of important boundary objects such as tables, diagrams, graphs, images, or audio and video. Interestingly, they asserted that the specific educational benefits of web-based writing technologies have been barely explored.

As this research was concerned with the temporal analysis of a written genre produced in a school setting, it was necessary that the collaborative writing environment chosen for this research project provided crucial additional features:

- that the writing environment should be social, yet private, secure, and that the anonymity of the writers is preserved (i.e., requiring authenticated login);
- that the writing environment support team-based organisation and be multimodal, i.e., support general communication (forums for enhancing camaraderie) and specific peer assessment (comment on own and others' text);
- that the collaborative writing environment support the inclusion of boundary object (graphs, images) which are important for science writing;
- that the writing environment includes genre planning, template generation, and revision tools in addition to writing and editing tools together with appropriate scaffolds to help learners visualise complete document;
- that there are controlled private and public messaging facilities whereby the teacher can broadcast to a writing team, or send private messages to students;
- that the students cannot send private messages to each other using the collaborating environment; this reduces the possibility of online bullying that can occur in forum-type messaging environments;
- that the system provide functionality to track individuals' writing over time, be able to compare individuals and track cohorts of students;
- that the software be free-to-use, require minimal training, and work with legacy operating systems; it should be essential that the schools involved in the research should not have to pay for software, training or new computer operating systems.

Several candidate free-to-use, online, collaborative writing systems were evaluated for this research project. In addition to the research literature there are several online reviews of collaborative writing tools that contributed to choosing the eventual system, for example, the independent forum about online collaboration "Kolabora" (www.kolabora.com), authored by Robin Good. Potential popular candidates included: Wikis (www.wikispaces.com), Zoho Writer (writer.zoho.com), Writeboard (37signals.com), Socialtext (www.socialtext.com) Google Docs and Spreadsheets (docs.google.com).

Zoho Writer, a collaborative editor, provided an intuitive interface, public or private access to documents and document revisions. Unfortunately, it did not provide any text-based messaging facilities or real-time editing. Writeboard provided an excellent, intuitive editor that also gave access to document revisions, but did not provide text messaging or real-time co-editing. Furthermore, it was possible for participants to invite other participants as authors; this would have been an undesirable feature of the software for this research project, which had fixed writing teams. However, Writeboard integrated with another software package (Backpack, also from 37Signals) which provided excellent organisation tools suitable for collaborative planning. Socialtext provided document revisions but did not include messaging facilities; it did support an in-document commenting facility, however. The free-to-use version had limited functionality, but it did provide an excellent WYSIWYG editor. Google Docs and Spreadsheets were an excellent, comprehensive suite of online software applications providing real time co-editing, document revisions, document comments, an exceptional editor interface and author management functionality. The real-time co-editing feature worked well, and was intuitive if authors consulted the revisions pane. Unfortunately, the communication mechanisms were cumbersome for this project. It was necessary to set up a Google Group, create Google email addresses for authors, add authors as members, and include the researcher in all email communications in order to capture the discourse. This was cumbersome and unsuitable for secondary school usage as it was impossible to control usage of the email accounts - a student could disable the functionality required to capture the discourse, for example. Furthermore, there were security and access issues with using external email accounts for discourse. If Google Docs provided standard forum-like facilities, or if the project was examining collaborative writing of adult participants, it would have been the system of choice for this for this project. Finally, Wikis were also considered appropriate but would have required considerable modification to capture the discourse required for the project. Like Google Docs, the disconnect between the collaborative discourse and the actual writing projects made Wikis unsuitable for this research as they did not support the discourse capture required for the temporal analysis.

A number of professional collaborative writing and working environments were examined (for example, SynchroEdit, Near-Time) but costs made them prohibitive,

while most “free” options (for example, ACE, Gobby and Groove) had complicated setup arrangements and provided poor revision support. It was decided, therefore, to use the EVE collaborative writing system for this research project as it was co-developed by the author and specifically developed for science writing; the system is discussed in some detail in the following chapter.

2.5 Peer Interaction and Collaborative Writing

Haines (2004) suggested that the use of ICT (Information and Communication Technologies) is an “essential tool” in assisting peer- and self-assessment in authentic social constructive learning environments, be they virtual or real (Haines, 2004, p. 44). In this section, the relationship between peer assessment and collaborative writing in an authentic ASL context is examined. This select literature focusses on reports from projects, and theoretical perspectives, that identified improved learning outcomes using online, collaborative ASL writing projects. Some projects adopted a functional perspective on linguistic analyses of written products, although in the main, it is more common that an ESP (English for Specific Purposes) approach is adopted.

Peer Assessment (or Peer Reviewing), particularly in relation to writing (Onghena & Struyven, 2010; Venables & Summit, 2003; Yang & Tsai, 2010), is a form of assessment where writers receive and provide feedback on their own, and others' writing, respectively. Peer assessment is considered by some to be as valid as expert assessment (for example, Cho et al., 2006; Topping, 2008) and it often provides concrete examples and ideas about how learners may modify their own writing. Peer assessment is often used in conjunction with self-assessment, although it has been found that self-assessment scores tend not to correlate with corresponding scores from expert assessors (Papinczak et al., 2007) and is not considered valid (Liang and Tsai, 2010).

Mak and Coniam (2008) found that an outcome worthy of note in their authentic writing project was that the process of engaging in peer review during writing was found to be a new, and rewarding, experience for the students. Rivard & Straw (2000) have found that discussions with peers, when combined with writing, appear to enhance the retention of science concepts over time. Trautmann (2009),

reporting students' understanding of biology, concluded that receiving reviews from peers was positively related to the revisions of written reports. Furthermore, van den Berg et al. (2006) found that most students perceived improvement in their writing as a result of peer assessment.

Cho and Schunn (2007) worked on student writing and rewriting practice which placed emphasis on reciprocal peer reviews rather than instructor-based reviews. They found that software support, provided by their system SWORD helped improve writing. However, because students are novices in their disciplines, and lack considerable subject knowledge, they are often unable to accurately comment on writing quality. Flowerdew et al (2001) report that novice writers tend to focus on style issues rather than make theoretical commitments. They have developed a number of interesting indices, that may be determined algorithmically, that assist peer reviewing, i.e., review accuracy and authors' back-evaluation. Furthermore, they determined that multiple-peer feedback offered significant improvements in writing relative to the traditional form of single-expert (teacher or mentor) feedback.

Some negatives associated with peer-reviewing have also been noted. Critical advice is not always constructive, especially in networked collaboration (Sproull & Kiesler, 1991). Also people can take task-oriented critiques personally (Crampton, 2001), causing strong emotional reaction. Lee (2000) reports that students prefer comments about how to improve writing, including global and specific suggestions as long as they are provided within a supportive context. Ferris (2003) believes that teacher conferences and peer response groups help with addressing a specific student's needs when writing feedback. Therefore appropriate collaborative writing environments such as the one used in this research (and described in detail in the following chapter) allow individual (teacher to student) and global (student to student, but visible to all peers) peer review. An important consideration, however, is that the technology alone will not necessarily provide effective peer feedback. Research shows that appropriate training in review strategies and collaborative working are necessary for collaborative learners to establish a culture where constructive feedback provision, rather than negative or highly-judgmental, is the norm (Simmons, 2003).

Recently, Liang and Tsai (2009, 2010) and others (Wen & Tsai, 2006; Hou, Chang & Sung, 2007; Xiao & Lucking, 2008) have reported on their development of science activities using online tools, with particular emphasis on the role of peer assessment in learning biology through writing. Research has shown that peer feedback on writing is an important aspect of student learning, and that students tend to take the process seriously by providing thorough and constructive comments. Tseng and Tsai (2007) reported that learning task improvement is more likely to occur following suggestive feedback than from corrective or didactic feedback. This concurs with earlier research from Sproull & Kiesler, (1991), for example, who reported that critical advice is not always constructive especially in networked collaboration, and Crampton (2001) who reported that strong emotional reactions are provoked when people take task-orientated critiques personally. Student reaction to peer comments (adapting peer comments and self-reflection) may be related to individual metacognitive ability, i.e., those with better metacognitive ability are likely to benefit more from the peer-assessment process (Tsai, 2009; Yang & Tsai, 2010).

Liang and Tsai (2010) welcomed future research that conducts more in-depth analyses of how online peer assessment for science writing can help students construct and reconstruct scientific knowledge. They also highlighted that the role of peer feedback and comments requires further investigation, particularly studies that examine how each student evaluates and adapts peer comments for improving science writing. Finally, they recommended that repeated studies for students with different ages, and from different cultural backgrounds, would be useful.

Aluísio and Gantenbein (1997) applied SFL within writing support tools for categorising major text adaptations, during a self-review process. Their work was of particular interest for this study, as their software learning environment for scientific writing (called AMADEUS) targeted the understanding of the processes involved in the creation of successful scientific papers. They found that localised errors in written texts do not interfere with communication (via the text) as much as errors that affect the global meaning of the text. Semantic errors, they believe, are better corrected using input material derived from "naturally occurring" material

obtained from models based on the schematic structure of the scientific genre (p. 181).

Aluísio and Gantenbein (1997) made use of an analysis methodology, based on four revision categories, for the analysis of textual revisions in scientific text, as described by Gosden (1995). Gosden's categories are: addition of technical detail or statements [+TD], deletion of technical detail or statements [-TD], reshuffling of statements [R], and rhetorical machining [RM]. The final category is subdivided into three further sub-categories: rhetorical machining of discourse structure and information [RMd], changes which relate writers' claims to writers' own hypotheses and limitations [RMc], rhetorical machining that relates to the writers' purpose, reasons for, results of research action taken and conclusions reached [RMp]. They also outlined a procedure for mapping procedural revision categories (based on clause organisation within sentences, sentence markers, discourse organisation, and modality, i.e., use of adverbs) into Gosden's SFL-based categories which may be used to present text-linguistic justifications for revisions that may be understood by the authors (and presumably researchers).

The research presented in this thesis contributes to the discourse on peer assessment on science writing, and without doubt, addresses several of the recommendations posited by Liang and Tsai (2010). Chapter Four outlines how Aluísio and Gantenbein's (1997) methodology was adapted for this research. The research results presented in Chapters 5 and 6, in particular, provide insight into how peer comments impact on text revision. Furthermore, this research utilised peer reviewing, a limited form of peer assessment whereby students are restricted to commenting on writing and providing recommendations, i.e., students engaged in peer review do not provide scores in an attempt to reduce strong emotional reactions that may arise from potentially low scores from peers. Furthermore, the research focused on the evolution of writing based on textual feedback, rather than peer assessment scoring methodologies, and reactions to scoring.

Cope et al. (2012) provided an excellent exploration of technology-mediated writing assignments using an assessment lens, and with particular interests in how such technologies support new forms of formative assessment. They reported that regular and multiple forms of feedback produced enhanced learning outcomes.

2.6 Conclusion

This chapter introduced various theories and empirical findings relating to science writing and learning within a Systemic Functional Linguistic (SFL) framework. Specifically, it addressed: (i) authentic science learning with particular reference to collaborative writing, (ii) language based science learning, and genre pedagogy, (iii) online environments for learning with emphasis on systems focusing on writing to learn, and finally (iv) the role of peer feedback within collaborative writing environments. The following two chapters develop further the research project's theoretical framework (Chapter Three), and describe the project methodology in detail (Chapter Four).

Chapter Three

Theoretical Framework

The purpose of this chapter is to detail further the theoretical framework used to capture and examine the textual evolution of collaboratively produced student papers, in order to investigate the first three research questions. This chapter provides the theoretical motivation and rationale for the choice of methods, based around a hybrid case study approach, together with sections on the research setting and ethical considerations.

3.1 Introduction

This research study was motivated by a desire to understand the processes by which science learners become science practitioners, and in particular to understand the role of writing and collaborative discourse in that transformation from learner to professional scientist. Based on my personal and professional experiences, and research, it became apparent that learning science, and learning to write in science, were inextricable. In order to understand scientific literacy development, it was necessary to conduct an educational research project in a school setting that focused on collaborative scientific writing in an authentic context where all writing products and associated communication (teacher-student, student-student) could be captured and become available for analysis. A detailed description of the theoretical development associated with the individual research questions is given in 3.2 below.

My stance in this study was that of a third-level educator (physicist and computer scientist) investigating authentic science education pedagogy at second-level, from a language-based theory of learning perspective. The position taken was that observation and analyses of the spoken and written discourse generated by secondary school level students, writing collaboratively in an online setting, would provide important indicators as to how successful this form of enculturation could

be. The context of the study was a group of transition-year students, and their teachers, from three feeder-schools close to the university.

This approach was similar to an in-depth case study as it focused on specific students, classrooms, and schools, with the aim of producing a description of the pervading situational context that affected scientific literacy development through writing, and an account of the written interactions that took place between students and their teachers. Initially, it was decided that an exploratory study would suffice as it was believed that the key variables and their causal linkages were the subject of conjecture. However, with further research, particularly in the area of Systemic Functional Linguistics (SFL), I decided to conduct a confirmatory study focussing on the gathering and analysis of grammatical metaphor in student scientific writing. Section 3.4 below provides a detailed description of the hybrid case study approach used in this research.

Scientific writing is, in general, characterised by a style, which is different from the narrative forms associated with everyday social contexts, or other registers. Learners, in particular, often begin writing using narrative forms in humanist subjects in early schooling; these tend to be active-voice, experiential or participatory, stories centred on personal agents (Wray, 2004; p. 71). Beginning science writing is often difficult for learners, as the language of science is characterised by elements that are unfamiliar, i.e., absence of colloquial terms, use of technical terms, and avoidance of figurative and personal language (Lemke, 1990). Scientific writing and communication is typically multimodal as it mixes symbols and words to convey meaning, for example, charts, equations, graphs, pictures and diagrams; many of these are unfamiliar to children when they first begin reading, discussing and writing scientific texts (ibid, p. 139). Learning scientific language is similar to learning another (foreign) language which means children have to learn a new grammar and meaning-making system. For this research project, I decided to focus on students writing a single narrative form (genre) - a library research paper, (LRP) which is fundamentally multimodal. This genre is described in detail in section 3.2 below.

One characteristic of scientific writing is that, grammatically, scientific texts have denser use of lexical items (words or phrases that refer to content or factual knowledge). Halliday uses the term *lexical density* to refer to the number of lexical items in a clause; the measure may be used to ascertain the difficulty, or readability, of the text. Another feature of scientific writing is the use of *grammatical metaphor* where one kind of grammatical structure is replaced by another, for example, *nominalisation* where a noun is substituted for a verb, and nouns are used as adjectives. Grammatical metaphor is a key characteristic of scientists' technique to objectify physical reality. Unsurprisingly, continual metaphoric refinements that are used to describe causal relationships between processes and objects mean that lexical density is increased - the text becomes packed with meaning. For this research, it was necessary to construct a methodology that would provide opportunities to capture the written products in an evolving collaborative context. I decided to utilise an online collaborative writing environment with a customised data-capture module to capture all writing products and communication. These data would become the core texts for the research project's SFL analyses.

Learning science requires children to learn this language of science; it is an enculturation process that requires specific instruction, practice and scaffolding, ideally through dialogic and peer interaction in a social constructivist learning environment. Enculturation into science may be difficult, however. Whitelegg and Smidt note that students require assistance in making links with science and culture in order to achieve effective learning (Whitelegg and Smidt, 2005, p. 9). Furthermore, they question the relevance of social constructivism which appears to be "limited by its preoccupation to enculturate all students into *western* (their emphasis) science" (Millar et al., 2002, p. 250). The goals of the Irish curriculum would most likely be approved by Peter Fensham, as the curriculum promotes science "as a way of knowing" (Fensham, 2004, p. 157). Fensham also believes that scientific "content to be learned must have some future significance [to the learners]" (Fensham, 2004, p. 161). Whitelegg and Smidt believe that irrelevant scientific experiences (for reasons of ethnicity, race, gender and sexuality) will result in "engaging only a minority of students" (Whitelegg and Smidt, 2005, p. 7) in a diverse student body. They also posit that success in science learning is not just related to the ability and interest of the participant, but to the social worlds of

family, peers and the ease with which individuals make transitions and connections between their societal and cultural norms to the culture of the science classroom (Whitelegg and Smidt, 2005, p. 8). I decided to choose a writing topic entitled "Physical processes of Global Warming" as the significant topic straddled social, economic, ethical, geophysical and physical sciences, and perhaps provided several avenues into science.

Hodson (1998, p. 100), in discussing problems of assimilation and exclusion from science education, reports that there are four types of transitions between these groups, or worlds: congruent worlds (smooth transitions); different worlds (require managed transitions); diverse worlds (hazardous transitions); and highly discordant worlds (resisted or impossible). Supporting the recommendations of Catherine Haines for technological learning support he also emphatically argues that enculturation into science is a "matter of acquiring familiarity with the specialised language of science and an ability to use it appropriately" (ibid, p. 102). Furthermore, teachers must assist students to understand and manage classroom activities through linguistic discourse, and provide "appropriate feedback on their learning process through dialogue" which will assist border crossings (ibid, p. 102). Hodson acknowledges that enculturation into science is not only reliant on scaffolding teacher talk; it is also concerned with the "way to talk science" (ibid, p. 103). In fact Western Modern Science (WMS) talk may be alienating to certain learners (irrespective of teacher scaffolding) as it can be perceived to be "male rather than female, white rather than black, middle- and upper-middle class ... committed to the values of North-European middle-class culture" (Lemke, 1990, p. 138). These research findings prompted the development of an intervention programme for this research project - this focused on the development and delivery of training programmes for teachers and students participating in the project. The training and interventions are described in section 3.5.3.

This section introduced the motivation behind the choice of research approach, for this study. The following sections elaborate on the theoretical foundations underpinning the methods described in Chapter Four for each of the research questions described above.

3.2 The Research Context

This research examined text-based electronic collaborative exchanges between student writing teams and teachers engaging in collaborative writing projects, with a view to providing insight into the impact of asynchronous dialogue occurring in virtual collaborative environments. It investigated the evolution of a collaboratively written scientific library research paper genre and asynchronous dialogue over the writing period and investigated the core relationships, if any, between the collaborative exchange and text evolution. This authentic science literacy development activity took place in an online instructional setting, with groups of four students supported by one teacher. The writing topic was "*The Physical Processes of Global Warming*" and the genre was a Library Research Paper (referred to here as "genre", "student paper", or "paper").

The writing teams, and their teachers, were supported in their planning, writing and communication using tools provided by the online collaborative writing environment, and received extensive training and support by the researcher. The online system captured all of the interim writing products, i.e., drafts or versions. It also captured the various kinds of communication channels occurring in the collaborative process, for example, student exchanges in pre-planning activities, general project discussions (forums), teacher-student private messages, and various commenting modes, i.e., local comments on specific writing, or global comments on the overall genre.

This section provides a theoretical framework for the research and outlines the methods of analysis used to address the research questions presented earlier, i.e., (1) How authentic are students' science (library research) papers collaboratively produced in an online environment? For this research, measures of successful authenticity relate to (i) how close to the text-structure of a prototypical library report genre are the papers (i.e., how close to the model students were taught)? (ii) to what extent do the papers use the language of science as expected at this level of schooling, for example, use of nominalisation, and finally, (iii) what is the degree of participation and contribution by students in the collaborative writing task? (2) How do students' collaboratively written texts evolve, or change, over time (i) in terms of text structure, and (ii) in terms of key linguistic features? (3)

Can text changes and evolution be explained in relation to the online dialogue and feedback? (4) What are the implications of the above for pedagogy and policy, i.e., for (i) students' language development in science and the use of genre pedagogies, (ii) collaborative writing in science, and (iii) online pedagogy? The remainder of this section provides a brief overview of the theoretical framework and methods used to address these research questions using the research context described above.

3.2.1 How successful are students' science (library research) papers collaboratively produced in an online environment?

This question was concerned with whether the discourse structures associated with collaboratively produced student science research papers reflected that of the scientific community. The purpose of this research question was to examine authenticity, to identify the communicative purpose and overall structure of the student research papers, and the roles students and teachers adopted during the production process. The theoretical framework and methodology, therefore, examined the evolution of discussions, drafts and revised documents within a Systemic Functional Linguistic (SFL) framework, with particular emphasis on the language of science (Halliday, 2004), i.e., grammatical metaphor in the form of nominalised processes. This framework facilitated examination of the extent to which the language register reflected the context of the text's production, and at the same time the text realised the context. Halliday (1994) describes social context in terms of what is talked about (field), the relationship between the writer and reader (tenor), and expectations for how specific text types should be organised (mode).

For this research question, choices of words and phrases (register), and how clauses were constructed and linked in the student papers, were examined, with specific emphasis on the prevalence of nominalised processes typical of the language of science. A register is the constellation of lexical and grammatical features that characterises particular uses of language (Halliday & Hasan, 1989; Martin, 1992). Considerable theoretical insight into key aspects of SFL, and the application to academic writing analysis has been provided by Jones (2005), for

example, who highlights and summarises how SFL has informed research and teaching practice, how it has been recontextualised for students and staff within disciplines, and how it facilitated a “genuinely transdisciplinary approach” to research and practice (*ibid*, p. 263).

3.2.2 How do students' collaboratively written texts evolve, or change, with time (i) in terms of text structure, and (ii) in terms of key linguistic features?

The purpose of this research question was to ascertain if specific strategies emerge, and are adopted, by collaborating writers, during the genre drafting and review processes, i.e., were there specific textual or revision strategies that lead to successful scientific writing within the genre/discipline? For this study, the specific definition of the library research paper genre was that proposed by Samraj (2004) and Hale et al (1996). The term “student paper” will be used throughout to refer to papers written by students where they discuss previous research focused on a particular area. Such papers are secondary sources and involve some library, or other repository, research. The terms “Library Research Paper” (LRP) and “genre” are used when referring to the genre prototype or expected model paper.

Hale et al (1996) in a study of writing tasks of graduate and undergraduate students in American Universities found that the library research paper, based on bibliographic sources, was one of the most commonly observed genres in the different disciplines. For this research, it was established early in the pilot study that Irish second-level schools adopted similar genres for learning and assessment purposes, although students did not typically engage in collaborative writing exercises. Furthermore, a comprehensive literature research on genre analysis of Irish secondary school level science writing resulted in few, if any, appropriate theoretical framework analyses. It was decided, therefore, to adopt frameworks and methods related to *relevant genre realisation* as a core activity for this project, while bearing in mind that the research contexts would be different to that considered in the study conducted.

Genres, according to Schleppegrell (2001), are “purposeful, staged uses of language that are accomplished in particular cultural contexts” (p. 432), and

appear as specific text types that systematically relate context and grammatical structure. Genres that appear in school settings include, for example, expository essays (Martin, 1989) and (library) research papers (Swales, 1990). However, Schleppegrell (2001) argued that although each genre has its own register features, school-based genres exhibit many common register features due to the similar contexts of academic genres. She asserted, for example, that “authoritativeness is reflected in the choice of declarative mood and the use of grammatical and lexical resources instead of intonation to convey speaker/writer stance or attitude toward what is said” (ibid, p. 431).

Samaj (2004) elaborated on the definition of genre by identifying it as a “set of texts sharing a particular communicative purpose and a set of discourse conventions, including overall organisation, and grammatical vocabulary choices” (p. 6). She also pointed out that the label “research paper” is problematic, as it is a generic, cross-disciplinary term, and has no conceptual or substantive identity (see Swales, 1990, 2001). Furthermore, students may have difficulty understanding what the genre stands for because of the variation in the tasks required associated with the label (Johns, 1997).

For this research, it was decided to concentrate on two features of evolution, i.e., the textual structure itself, and the key linguistic features. In the case of the latter, for example, evolving nominalised structures over a series of drafts would be an important evolutionary measure. Key theoretical perspectives on understanding revision strategies, and methods pertinent to this research question were those proposed by Aluísio and Gantenbein (1997) and Jones (2005).

3.2.3 Can text changes and evolution be explained in relation to the online dialogue and feedback?

This research question was designed to determine if writers selectively incorporate feedback, and if so, why. Also, it was designed to investigate if collaborating writers show a preference for, or place greater value on, teacher or peer comments. This research question also addressed to what extent students revise their research papers based on local and global peer comments during the drafting and revision stages of the writing exercise. The approach presented by Liu and

Sadler (2003), who examine the effect and affect of peer review in electronic versus traditional models on L2 writing, will inform this latter aspect of the research question.

Further to these research questions are those related to the collaborative process. In particular, using data from this research, it may be possible to determine if there are specific textual or revision strategies that lead to successful scientific writing within the genre/discipline adopted by collaborating writers during the drafting and review processes. Revision strategies may be examined using methods proposed by Aluisio and Gantenbein (1997) and Jones (2005), for example, but are outside the scope of this research which focuses on linguistic issues rather than those related to collaboration.

The following section deals with the ethical issues associated with this research project.

3.3 Ethical Issues

The goal of this research was to conduct a study in the area of scientific literacy development, with a view to establishing effective pedagogies in the general areas of online collaborative learning and writing science. A crucial aspect of any educational research program is that careful consideration is given to the ethical issues that may arise from the study. Standard ethical practice required that best practice should be observed throughout while selecting and working with participants, for example, adhering to standard anonymity practices. Pecorino et al (2008) advise that even "seemingly mundane" activities like choosing a textbook, or deciding to use a new technology in the classroom, have ethical implications (p. 3), i.e., that two fundamental principles of the teacher-learner relationship apply ("do no harm" and "maximise pedagogical benefit"). Given that this project used (i) non-core texts (research papers) not traditionally used in the classrooms, (ii) collaborative working in teams, (iii) engaging with a contested topic (global warming), and (iv) the use of collaborative writing technologies, it was decided to seek advice and approval from the University Ethics committee, together with the university-school liaison officers, prior to formally contacting the schools. These liaison officers were routinely involved in establishing ethical pedagogic studies

involving schools, their students and university staff in, for instance, research projects, internships, and laboratory visits.

The following key statements, outlined in my institution's ethical approval form entitled "*Conducting Research with Humans and Human Derived Material*" were considered appropriate to the research, and were shared with the school liaisons as part of the negotiations to conduct a research project in their school:

- I will, in all circumstances, consider the ethical implications and, where applicable, psychological consequences for the participants in their research. Researchers have a primary responsibility to protect participants from physical and mental harm during the investigation. The risk of harm should be no greater than that in ordinary life, i.e., participants should not be exposed to risks greater than or additional to those encountered in their normal lifestyle (addressing 2.1; Respect for Human Dignity).
- I accept that I have a special obligation to highlight the situation of groups (i.e children, under-privileged, people who have been institutionalised), vulnerable groups may not always be best equipped to protect their interests in relation to research. Accordingly, I will adopt the normal procedures for obtaining information, and consent may need to be examined further (addressing 3.1; Respect for Vulnerable People)
- I will ensure that, in the gathering of information on the behaviour of persons and groups, I should avoid using designations which could give rise to unreasonable generalisation, resulting in possible stigmatisation of particular social groups (addressing 3.2; Respect for Vulnerable People)
- I will inform all participants of the objectives of the investigation and include all aspects of the research intervention that might reasonably be expected to influence willingness to participate (addressing 4.1 and 4.2; Informed Consent).
- At the onset of the investigation, I will clearly indicate to participants their right to withdraw from the research at any time (addressing 4.1 and 4.2; Informed Consent).
- I acknowledge that subject to the requirements of legislation, including Data Protection Act and Freedom of Information Act, information obtained about a participant is confidential unless otherwise agreed in advance (addressing The Right of Confidentiality).
- I acknowledge that every person has the right to confidentiality, privacy and/or anonymity in all aspects of human/human derived research and that I will ensure that results from research work will not be used deceptively or without the consent of the participant (addressing 5.1 and 5.1; The Right of Confidentiality).

- In situations where my research may involve addressing behaviour or experiences that participants regard as personal and private, I will ensure that the participants must be protected from stress by all appropriate measures, including the assurance that answers to questions need not be given (addressing 6.1; Minimising Risk).
- I will inform participants of the procedures for contacting the researcher within a reasonable time period following participation should stress, potential harm or related questions or concern arise despite the precautions undertaken by me (addressing 6.2; Minimising Risk).

Once contact with the schools had been established, and an “in principle” agreement secured with the designated school contact that they were willing to collaborate in a scientific literacy development study, I indicated that I was agreeable to them vetting my suitability to conduct research in their school, if required. The *National Vetting Bureau (Children and Vulnerable Persons) Bill 2012* made it mandatory for persons working with children or vulnerable adults to be vetted by the Gardaí (Ireland’s police force). All organisations which recruit people who have substantial unsupervised access to children and vulnerable adults are required to complete a *Garda Vetting Application* form by the school (a designated registered organisation). Furthermore, it would have been a criminal offence had I failed to notify the schools if I had been guilty of certain criminal offences before participating in the research study. In practice, I was not asked to complete the Garda Vetting Application by any of the three schools that participated in the study.

A “Letter of Consent” (shown in Appendix A) was sent to parents/guardians, via the school, seeking their, and their son/daughter’s consent, to participate in the pilot research. This letter was approved by the Deputy Principals, and the schools requested that they pre-select students in the Transition Year programme, and handle the allocation and return of consent forms. This meant that it was not necessary to engage in communication with students directly prior to the project start. The letter explained that the planned research would focus on conducting research on online collaborative science writing, using a web-based collaborative writing environment developed at the researcher’s institution. Students taking part in this project would spend a minimum of one class per day (on average), each day for two weeks, learning, talking and writing about an environmental science topic (global warming).

At the end of this project, students would have collaboratively written a short article about “global warming”. It was explained that students would benefit from this research by learning more about collaborative working and writing science articles. Parents and guardians were requested to provide specific consent to include their son or daughter in this research project. They were assured that their child’s participation in the project was completely voluntary and the choice to participate or not would not impact their grades or status at school. Furthermore, they were assured that all information obtained during the research project would be kept strictly secure and would not become a part of their child's school record, the information would be kept in a locked file cabinet and would be accessible only to project personnel. Additionally, the writing products and online discussions, would be transcribed and coded to remove the child's names and would be erased after the project was completed. In addition, no personally identifying data would be collected about students at any stage during the project. Finally, the participation request explained that the results of this study may be used for a dissertation, a scholarly report, journal article and conference presentation and that pseudonyms would be substituted for the names of students who may have been represented in the results.

The school advised that normally students were supplied with one option in letters of consent, i.e., agree to participate. However, it was eventually decided that the letter should contain a section where the parent or guardian could indicate whether they did or did not agree to their son/daughter’s participation in this project. The participation request also explained that should the parent, guardian or participant have any questions about this research project they could contact the researcher or the project supervisor either by mail, e-mail, or telephone (full contact details were included).

It is important to record that the ethical concerns related to providing a rewarding pedagogical experience for all participants were just as prevalent throughout the project lifecycle, and not just at the beginning. In fact, there were several “ethical dilemmas” that required meetings with teachers and school principals prior to deciding on the most appropriate intervention, if required. For example,

In general, student participation was voluntary, but there were timetabling constraints and it was necessary to limit numbers of students into the study. In one school, there was a small percentage of students who did not have English as their first language, and had poor fluency, comprehension and writing capabilities. However, these students volunteered to participate, but it became apparent that equitable participation was going to be an issue. When writing teams were being constructed, which was the best team to place such a participant? Without going into too much detail the dilemma was as follows: if the participant was placed in a team with better-than-average writers, s/he would jeopardise the team's performance, but if s/he was placed in a team of individuals with similar capabilities, the team may be unlikely to succeed at all. In practice, it appeared that the student did not really wish to participate in the project, but merely wanted to use the classroom time to access the computer to play computer games, or to be in a classroom with friends. What was the appropriate intervention? (Project Diary, 2010).

In this, and similar circumstances, advice was sought from the school liaison and/or deputy principal according to the particular school's policies. In reality, there were many instances where team members did not participate as expected, and it was generally accepted that the outcome was the normal practice associated with data collection.

3.4 Research Approach - Critical Analysis of Science Writing

The starting point for this research was typical of an action research, but the body of the research analysis was based on a selection of data from that study. The output, therefore, was typical of a critical systemic functional linguistic analysis of authentic writing in science education. In order to understand the interrelationships between online peer and teacher-student discourse and online production of a collaboratively written science genre, a hybrid case study approach focusing on the full collaborative writing process, and associated online communication, was chosen. The rationale for this approach, together with an explanation for adopting a hybrid case study, rather than a more traditional one, is outlined below. The case study approach was required as it was necessary to create specific cases whereby students' and teachers' online written and spoken discourse could be captured for later discourse analyses. The approach adopted

for the critical review of the student writing (language) was Systemic-Functional Linguistics (SFL) which explores how language is used in social contexts to achieve particular goals, in this case, collaboratively writing a library research paper in science using a collaborative writing environment. SFL examines the discourses produced (spoken and written), and the contexts of the production of these texts. It also emphasises language use and places higher importance on language function usage rather than on language structure (composition). The research approach taken therefore, was to construct learning cases where the outputs were texts comprised of spoken and written discourse. These texts (student papers and accompanying discourse) provided the researcher with a view of the social context as understood by the writers (Coffin, 2001, p.95).

There are many types of approach to conducting educational research, which are classified according to the particular phenomena being investigated, for example, teaching methods and classroom environments. Research types are also classified according to whether they are exploratory or confirmatory. In the case of the former, such studies aim to establish some theoretical understanding about the phenomena being investigated, where causal linkages between key variables are the subject of conjecture. The latter, however, tests a previously established theoretical model through gathering and analysis of field data (Postlethwaite, 2005). Another approach to classifying educational research is to define the type according to the kinds of information provided; typical categories include: Historical, Descriptive, Correlational, Causal, Experimental, Case Study, Ethnographic, and R&D (Research and Development) (Postlethwaite, 2005, pp. 5-6).

The Case Study and Experimental approaches to research design were of particular relevance to this study. According to Postlethwaite (2005) there are two distinct research approaches to conducting Case Studies: (i) "an in-depth study of a particular student, classroom, or school with the aim of producing a nuanced description of the pervading cultural setting that affects education, and an account of the interactions that take place between students and other relevant persons" (ibid, p. 3), and (ii) the "application of quantitative research methods to non-probability samples - which provide results that are not necessarily designed to be generalisable to wider populations" (ibid, p. 4). Experimental research is

used in situations where variables that define one or more “causes” can be manipulated in some systematic way in order to establish “effects” on other variables (ibid, p.4). Essentially an experimental study seeks to determine whether some intervention had the intended causal effect on study participants. In order to ascertain the true effects of some program or intervention, it is necessary to have both a “treatment group” and a “control group”. The former group receives the intervention under investigation, and latter group only receive interventions typical of “normal” conditions, i.e., those received had they not participated in the study. Experimental studies rely on random selection of, typically 30, statistically similar participants, and collect pre-and post-test data analysed using specific scientific methods to establish relationships, if any, between cause and effect.

The research design for the present study incorporated elements of experimental and case study design, in that it conducted in-depth studies of particular groups of students, with a view to presenting a “nuanced description” of a particular setting, i.e., authentic science writing. Adopting a case study approach would have assisted with the first two research questions, i.e., examining the writing context, how close the student papers were to a prototypical science genre, and examining the evolution of the library research paper genre throughout the lifecycle of the writing project. Furthermore, the case study approach also considered the group interactions within that setting.

From an Experimental Design perspective, one of the present study's research questions explicitly sought to establish cause and effect relationships between changes in written drafts, i.e., are the changes in the student papers related to peer or mentor comments. However, while this research was interested in examining the emergence and impact of this kind of intervention, expected to occur naturally in a collaborative writing exercise, it did not specifically create control and test groups and schedule interventions for the purposes of statistically establishing causality. The approach, therefore, was not an exclusively traditional experimental, or indeed quasi-experimental, one. Without doubt, the research context was designed, cause and effect criteria established, and the data sources were clearly identified, but the approach could not be considered classic experimental design. It would be accurate to say, therefore, that this research

adopted a hybrid approach to Case Study Research as it incorporated elements from Experimental Design.

The components of a case study include the study's question, its propositions, units of analysis, linking the data and prepositions, and interpreting its findings. Case study research is often concerned with "how" and "why" questions, therefore the initial task is to clarify precisely the nature and scope of the research questions and identification of key aspects that should be examined (Yin, 1994, pp. 111-121). Units of analysis relate to the fundamental problem of defining what the case (phenomenon) is - for this research study it is second-level collaborative science writing (a library research paper genre) using an online collaborative writing environment. In general, a unit of analysis is some aspect of the phenomenon that can be sampled (using a variety of methods) and which becomes available for analysis, for example, the online discourse between the study participants, the resultant library research paper genre, classroom assignments, researcher observations, and survey responses. For this research, the component concerned with interpreting the findings utilised methods from systemic functional linguistics to relate information obtained from the case to key theoretical propositions.

Systemic Functional Linguistic (SFL) researchers always research text in context, but do not usually consider themselves to be participating in the kinds of "case studies", as defined earlier. For this research, however, a subset of SFL's comprehensive set of tools for examining language in context were used for the purpose of analysis. The research methods and procedures were undertaken to educate, observe, record and promote self-reflection on online student collaborative writing of a library research paper genre. Furthermore, the methods and procedures provided sufficient data for the researcher to perform linguistic analyses, and address the research questions outlined in Chapter 1. In particular, the research design aided the discovery of insights and understanding (from the perspective of the participants) into the rationale for particular linguistic choices in the preparation of, and the discussions about, a collaboratively written genre.

Case studies typically provide both emic (participants' view) and etic (researcher's interpretation) perspectives so that the researcher can make sense of the case and the findings. These neologisms, coined by the linguistic anthropologist

Kenneth Pike (1954), refer to the two perspectives (intrinsic and extrinsic) that may be employed in the study of a cultural system. Both perspectives may be interpreted as an insider or outsider.

A case study is an intensive description and analysis of a bounded system (for example, a person, a group, an activity, a process) that addresses specific research questions and issues. It is a qualitative research approach concerned with determining the characteristics of a single case or the comparison of multiple cases ultimately providing a rich description together with a discussion of themes, issues and implications. Case studies attempt to convey understanding of a procedure or event as perceived by the participants in that event or by external observers. As the foundations of case study research are interdisciplinary (for example, law, social science, business, medicine), different concepts and theoretical perspectives are used to describe and explain the approach. A case study is not a method, but rather an approach, and in this research one that combines qualitative methods. In general multiple methods are used by the researcher (for example, observations, interviews, and documents) to provide a holistic description of a case, or cases, as the approach also includes cross-case analyses (Patton, 2002, pp 40-42).

Yin (1994) points out that "a case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used" (p. 23). Miles and Huberman (1984) argue the importance of thinking of a case study as "a phenomenon of some sort occurring in a bounded context" (p. 25). They believe that a case study may be selected by a researcher in order to achieve as full an understanding of the phenomenon as possible. Stake (1995) believes that a "case study is an intensive, holistic description and analysis of a single instance, phenomenon, or social unit" (ibid, p. 21). Stake goes on to classify three kinds of case study research: (i) an intrinsic case study where the interest is only in understanding the particulars of the case; (ii) an instrumental case study where the interest is in understanding something more general than the case; and (iii) a collective case study where interest is in studying and comparing multiple cases in a single research study (Stake, 1994; pp. 3-5).

One purpose of a case study is the provision of a detailed account of the phenomenon, i.e., provide a thick description (Geertz, 1973), which includes statements that re-create the phenomenon in as much of its context as possible (Stake, 1994, p. 43). In preparing a thick description for a case, the researcher identifies constructs (concepts that are observed from phenomena) and themes (salient, characteristic features of a case). Other case study purposes include interpretation and evaluation. Interpretative and evaluative data are used to develop conceptual categories or to illustrate, support, or challenge theoretical assumptions held prior to data collection. For this research the interpretative and evaluative evidence (or data) are contextualised within a systemic functional linguistic interpretation of the case.

Case studies utilise a variety of methods to gather quasi-judicial (qualitative) evidence about the phenomenon. According to Gillham (2000), the emphases are on non-experimental methods, inductive theorising (hypothesis seeking), subjectivity, qualitative data giving meaning to results, meaning of processes that lead to outcomes, meaning of changes that have occurred, questioned generalisation (understanding that context specificity is necessary), understanding importance of context in shaping behaviour, and evidence searching in context (ibid, p. 8). Typical data collection methods associated with case studies, therefore, include interviews (structured, semistructured, unstructured) and surveys, both qualitative and quantitative, where information is elicited from participants, observations which provide the researcher with first-hand encounters with the phenomenon under investigation (typically from wide-angle to narrow-angle lens), and data mining of documents associated with the study. For this research data collection included student survey questionnaires, teacher interviews, automated logging (recording) of all human discourse and writing (including all drafts) using special purpose software, observation (by researcher) of intervention scenarios, and the collection of assessment texts created by teachers participating in the study.

A case study analysis, while dependent on the methods utilised to collect evidence, is one of three types: (i) interpretational, which involves finding constructs, themes, and patterns that can be used to describe and explain the

phenomenon being studied, and developing categories, coding segments, and grouping category segments; (ii) structural, which is the process of examining case study data for the purpose of identifying patterns inherent in discourse, text, events, or other phenomena; (iii) reflective, whereby the researcher relies mainly on their own judgment and intuition to evaluate the phenomena being studied. For this research, a structural approach, based on systemic functional linguistics and its associated genre theory, will be the primary method of analysis. Kohn (1997) refers to a particular tension in case study design related to how much structure should be built into the instrument, i.e., a highly structured instrument (leading to lost opportunities for uncovering subtle distinctions and understanding multiple perspectives) versus flexible, yet standardised, approaches focussing on consistent implementation and improved reliability (p. 4). She suggests adopting an approach for achieving both standardisation and flexibility by building a modular protocol for critical components of the study, and recommends preliminary identification of multiple perspectives where possible. Furthermore, when there are more variables than cases, or data points, therefore traditional statistical analyses cannot always be applied to data obtained using case studies. Therefore, different techniques need to be used to organise and systematically review the large amounts of evidence associated with the case (Kohn, 1997, p. 5). For this research, the analytic focus is on the overall pattern of variables within a single case, looking at the parts in relationship to the whole; this is referred to as a variable-orientated analysis (Miles and Huberman, 1984). The methods are applicable to other similar cases, however, and if at some later point there are multiple cases, or case families (Miles and Huberman, 1994) it will be possible to perform cross-case analyses, referred to as a case-orientated analysis.

Two related issues associated with qualitative or quantitative data collection are reliability and validity; the former refers to the consistency or stability of the instrument evidence or data, while the latter refers to the accuracy of the inferences or interpretations determined from those evidence or data.

According to Postlethwaite (2005), validity is the most important characteristic to consider when constructing or selecting a test or measurement technique (p. 39). Valid tests are those which measure what was intended to measure and must always be examined with respect to the use which is to be made of the values.

Reliability refers to “the degree to which a measuring procedure gives consistent results” (p. 41), i.e., reliable tests are those that provide a consistent set of scores for a group of individuals when administered independently on several occasions. In general, reliability is a necessary, but not sufficient, condition for validity, i.e., if the instrument is to be valid it is necessary to have reliability, but reliability in itself is not enough to ensure instrument validity. Reliability is determined empirically and is associated with specific scores for specific sets of participants, i.e., reliability associated with the case, not in general. There are four ways to measure reliability: test-retest, which refers to consistency of test scores over time, equivalent forms which refers to two equivalent forms of test designed to measure the same thing, internal consistency which refers to the consistency with which test items measure against a single construct, and inter-scorer which refers to the consistency or degree of agreement between two or more testers (Johnson and Christensen, 2007). There are three main methods of collecting validity evidence: evidence based on content, evidence based on internal structure and evidence based on other variables (Johnson and Christensen, 2007).

As indicated earlier, this research was concerned with collecting data related to authentic online collaborative writing of a science genre. As Purcell-Gates et al. (2006) has defined authentic literacy as “reading and writing of real-life texts for real-life purposes” within a literacy learning context, the process of data collection for this research was considered valid (from an evidence based on content perspective) in that it measured what it intended to measure. The data collection methods and instruments are described in greater detail later in this chapter. Furthermore, from an SFL perspective, it was reliable as it provides text in context, albeit a very specific context, amenable to genre analysis, and testable for the presence of grammatical metaphor (nominalisation).

The research data were obtained from three separate studies, described in detail, later in this chapter: (i) A Pilot Research Study (PRS) conducted Mar 2008; (ii) a First Main Study (FMS) conducted in May 2009; and a Second Main Study (SMS) conducted in Dec 2011 - Jan 2012. The following sections describe the research context, and provide further details on the participants and the cases used for data collection and analysis.

This programme of research did not support multiple investigators, therefore, investigator triangulation could only be addressed by conducting reflexive and reflective analyses (for example, diaries were kept by the researcher following visits to schools, after conducting training sessions) and were available throughout the data analysis phase of the study. Where possible, to assist with reliability of coding qualitative data and data analysis, assistance had been sought from an experienced SFL researcher (supervisor) to verify one sample analysis.

For the purpose of theory triangulation, which consists of using several theoretical schemes in the interpretation of the phenomenon, several linguistic analysis approaches specific to the study of collaboration, writing, peer and teacher review, and online environments were examined. For example, Liu and Sadler (2003) recommended an overall framework for data analysis (p. 201) based on the model from Wolcott (1994) who advised on data description, analysis and interpretation on transformation of qualitative data. Hyland (1998) examined the impact of written teacher feedback on individual student writers, and was influenced by theories of SFL, and in particular, theories grounded in data but informed by theory. Schleppegrell (2001), also theorising within an SFL context, has identified the (functional) linguistic features of language that realise the context of schooling, and in particular, the relationship between context and the linguistic features that comprise the composition of different registers, i.e., the “constellation of lexical and grammatical features that characterises particular uses of language” (Schleppegrell, 2001, p. 431).

Typically in educational research, measures must be taken to ensure content reliability and overcome researcher bias using triangulation and data validation. Triangulation is the term given to the technique that ensures more than two methods are used in a study, with a view to (normally) triple checking results. For this research, data triangulation included repeated measures in different school settings and teacher–student combinations, which provided different perspectives on the data sources (students and teachers). Methods of triangulation were addressed by including the collection of interview, questionnaire, observations, and feedback in addition to the automatically collected textual and discussion data. As the primary focus of this research was the linguistic analysis of the collaboratively written genres, secondary data was only utilised when required.

3.5 Conclusion

This section detailed the theoretical framework underpinning the methodology for a research study of the potential relationship between text-based electronic collaborative exchange and a collaboratively written scientific library research paper genre. It described the proposed educational research study in terms of a hybrid case study. It outlined the rationale for evaluating the success of the student papers using a systemic functional linguistic (SFL) theory of language (genre analysis) together with an analysis of grammatical metaphor (nominalisation). In terms of addressing the impact of online collaborative exchange on the evolution of the draft papers, it also recommended using an SFL approach. The actual methods associated with three key research questions are discussed in detail in the following chapter on the project methodology.

Chapter Four

Methodology

The purpose of this chapter is to detail the methods used to capture and examine the textual evolution of collaboratively produced student papers in order to investigate the first three research questions. The chapter concludes with a methods summary which considers the implications for data analysis in the following chapters.

4.1 Introduction

According to Drudy (Drudy, 2009), Irish education has undergone unprecedented change in the last two decades. In this period, Ireland moved out of recession, embraced a tiger, knowledge-based economy, and crashed into recession again. Secondary level schools are no longer stratified along social-class lines, now cater for children from a variety of cultural and linguistic backgrounds, and “team teaching” is commonplace. In spite of more children staying in education until early adulthood, it is unfortunate that educational disadvantage based on social class and socioeconomic status is still a problem (ibid, p. 3). Drudy argues that the development of Ireland as a knowledge economy places additional challenges on Irish education and its teachers as it is unclear how education can actually contribute significantly to economic recovery. Irish educational policy is not immune to international ranking (for example, by the Organisation for Economic Co-operation and Development - OECD) and international evidence-based policy making (for example, policy and practice influenced by experiments evaluating replicable programmes, or qualitative-research based approaches). The challenges and changes emerging, therefore, may be understood by examining Irish education and its policies under three themes; a changing system, diversity and inclusion in schools, and teacher education (ibid, p.4).

Drudy (2009a) identifies Ireland's investment in the digital technology base, together with investment in education and general educational performance, as key indicators for assessing the performance of a knowledge infrastructure. With regard to investment in schools' digital technology base, she highlights two measures: (i) the ICT infrastructure, and (ii) broadband access, as being significant (ibid, p.40). Drudy argues that Ireland made "faltering progress" (ibid, p. 44) in these areas during its period of high economic growth and that these have profound implications for educational participation and outcomes for the population and policy making during this period of deepening recession. Furthermore, Ireland's PISA (Programme of International Assessment) scores for 15-year-olds are high for literacy, but only average for science and mathematics. Drudy recommends that Ireland's goal of becoming a knowledge and innovative economy relies on policy interventions that support high-quality teacher education and training (ibid, p. 52) to address these deficiencies.

McElwee (2009), investigating the relationship between Irish science education and knowledge economy creation, identifies the types of knowledge required for an Irish knowledge economy within a constructivist framework. Utilising PISA studies he argues that the development of Ireland's knowledge economy must take into account the different forms of scientific knowledge, i.e., knowledge of science (fundamental concepts) and knowledge about science (purpose of scientific inquiry). He is critical of the approaches to measuring science competencies (based on identification, explanation and application of scientific knowledge) and believes that it is essential, for future scientists, that learners become "scientifically literate in an increasingly scientific age" (ibid, p. 249). In Ireland, there is an emphasis, arising from constructivist approaches, on participation in science learning by teaching problem-solving skills, which (it may be argued) lead to a deeper understanding of science. McElwee reports that this process is teacher-centric, however, with the most frequent student activities being listening to "teachers explaining in class", "writing in notebooks" and "reading textbooks" (ibid, p. 250). Students also perform classroom experiments, usually focussing on "proving" some theory already explained in class, or engage in enquiry-based learning which tends to be problem-based learning. Notwithstanding new program changes, student interest in science continues to decline, which may be related to pervasive teaching methodologies and "an

incongruence between the intention of the curriculum planners and the minds of the teachers” (ibid, 251). McElwee argues that while there is a significant body of research into constructivist approaches to teaching science, and despite considerable curriculum reform, there has been “little transfer” to the real teaching situation.

A further challenge for Irish Education, arising from the findings of this research, and which has not been elaborated upon elsewhere, is the complexity of realising and assessing authentic (for example, enquiry-based learning) science learning in Irish classrooms; learning that ensures Irish students score highly in PISA-like assessments and contribute to a developing knowledge economy. Drury points to the necessity for an extensive broadband and ICT infrastructure, which now exists because of a national implementation plan but this does not necessarily result in improved school-based learning environments. It provides learners with an infrastructure to access learning materials within school and in other social and home learning contexts. In fact, the use of ICT for science, or any other form of, learning has not been developed in Drury's 2009 edited volume “Education in Ireland Challenge and Change”. This lack of attention to analysing authentic learning in the Irish context, particularly authentic science writing, was a key factor in the selection of this research topic.

This remainder of this chapter, therefore, outlines the general methodology of this research study on authentic science writing, the research design, research instruments, interventions, and the procedures used to select participants, construct writing teams, together with a description of the online collaborative writing environment and subsequent modifications to facilitate the capture of interim writing products. As this was a longitudinal study conducted over a three year period, involving groups of writing teams drawn from three collaborating schools, the procedures used to locate the sample data are also described.

This chapter also describes the procedures and methods by which the writing products residing in an online collaborative writing environment were constructed, captured and made available for later SFL analyses. Finally, it details the specific methods used to capture and analyse data associated with the individual research questions described earlier.

4.2 The Research Context: Participants, Writing Team Construction, Interventions and Training

For this research, student writing teams drawn from second-level schools, co-operatively wrote a library research paper genre on an agreed scientific topic: *“The Physical Processes of Global Warming”*. The writing products, i.e., the final papers, drafts, and all online discourse emerging during the writing period, were collected for analysis. These data were used to address the research questions presented earlier. This section provides background on the schools, participants and writing team construction, together with the interventions and training used to set up systems for data collection, which is described in the context of research questions, later in this chapter.

4.2.1 Participants: Schools, Teachers and Students

This research project collected collaborative-writing case study data from teachers and 15–16-year old children attending three different secondary-level schools in Ireland. These students were from the *Transition Year* programme, which provides opportunity for flexible and novel pedagogic learning experiences. Transition Year is a bridging year, usually in year four (15-16 year old), and falls between the Junior and Leaving Certificate (national) examinations. It is a rewarding and valuable year where students experience different (for example, blended) kinds of learning, engage in work experience (for example, one placement in a company, University), collaborative projects (for example, mini-company formation and management), and take time to consider their subject choices for the Leaving Certificate examination. Participation in this study was voluntary, but encouragement and support from the schools (who highlighted the personal and pedagogical benefits) assisted in successfully finding participants. Participating schools had access to sufficient numbers of computers, and an internet connection, in order to participate in collaborative writing sessions. Furthermore, the Transition Year teachers were experienced in managing small-group teams for project work and were competent information technology users.

Irish secondary school students do not normally engage in collaborative writing as part of their regular school work for a variety of reasons, i.e., assessment issues,

infrastructural (computer and classroom) supports, and lack of teacher experience in conducting collaborative writing assignments. However, the science teachers that participated in this project study were very experienced Transition Year teachers. One teacher, involved in the Pilot Research Study (PRS), for example, had been very successful in organising and running collaborative projects for Ireland's national science competition (BT Young Scientist & Technology Exhibition). She explained that based on her, and other teachers' experiences, the collaborative writing aspect of many, including successful, projects was the most difficult component of collaborative projects. The students would regularly independently write argumentative essays as part of their assessed school work, and would be familiar with sourcing, reading, abstracting and arguing. However, these students, she explained, just "do not have opportunities" to write collaboratively, and that it should be an essential component of the science curriculum; "after all, most scientists work in groups in the lab". The teacher, a biology and chemistry major, who had conducted postgraduate research prior to becoming a teacher, also believed that the Transition Year was an excellent opportunity for students to engage in authentic, collaborative, science projects, i.e., she said that the students could "be scientists". The other science teachers involved in the study had similar views on science teaching, enculturation, and writing.

As many of the participating schools' previous science projects in Transition Year were based around sourcing/researching/assimilating information related to experiments that would be later conducted in the science laboratory, it was agreed that the collaboratively written library research paper genre would be an appropriate collaborative writing exercise. It was posited that it would be beneficial for the students to concentrate on this aspect of project collaboration as they would definitely be working on collaborative projects (with a writing component) for future competitions in later years.

Zammuner (1995), in a study of individual and co-operative (albeit not online) computer-supported story writing and revision by IV elementary school grade (9-10 year old) Italian children, observed that individually written, and co-operatively revised (I/D) (individual/dyad) writing conditions, led to more original and well organised contents, used a more sophisticated language, contained

fewer mistakes and exhibited greater grammatical complexity than I/I (individual/individual) or D/D (dyad/dyad) conditions. She found that children, especially when they engage in peer revision, are able to carry out local and global revisions even without explicit training. The collaborative writing environment, described above, provides a similar, albeit more automated locally-written/peer-evaluation context, and provides complete access to the discourse and in-process drafts. Zammuner (p. 106) indicated that in process drafts, which include text planning, and revisions made while writing were not available for her research; many of these interim products were available for investigation for this study.

Student and teacher participants provided limited personal information at the beginning of the study. This included students' demographic information, students' and teachers' attitudes towards collaborative working and peer review, students' and teachers' attitudes towards the use of technology in the classroom, and whether the student is a native English or non-native English (NNE) speaker. Writing competence and scientific literacy information were obtained from students' performances in previously taken school tests, and teacher ratings.

For this research, it was decided to select a single school for the Pilot Research Study (PRS), and two collaborating schools for the Main Research Study. The Pilot Research, conducted in a single school with a small participant group, was crucial in that it helped refine methods and approaches for the later inter-school collaborative writing studies using larger groups of participants. In practice, it was necessary to work with three schools (referred to as School A, B and C), as it was necessary to conduct the Main Research Study on two separate occasions (see below). However, it was necessary to overcome a number of constraints before the research could proceed, i.e.,

- obtain school, student and parent/guardian permission;
- organise a writing trial of sufficient duration with a non-examination class;
- organise a collaborative writing exercise between two schools (co-mentoring);
- obtain school support for pre-exercise teacher and student training.

School A was a Catholic-ethos, all-boys secondary level school. School B was a Catholic-ethos, all-girls secondary level community school. School C was a Catholic-ethos, secondary level, mixed-sex community school. Schools A and B

were located in the same town. Almost all of the school-going students in this research study were from two towns situated within a 12 mile radius. I was informed by the schools that only a “tiny minority” of school-going students attend schools (usually fee paying) outside of the town. I was also informed by School A’s deputy principal that the socio-economic profiles of the participating student cohorts in this study were similar, even though they were attending different schools.

It was necessary to secure an additional school as the Main Research Study unexpectedly concluded prematurely due to School B’s participating teacher becoming ill. The school was unable to find a replacement teacher and needed to withdraw from further participation. The school agreed to make all collected data available for the research, however. School C was located in a second town and was one of two mixed-sex secondary level schools in that town. Given that the time available for schools to participate in research studies of this kind was limited, it was necessary to wait until the following academic year to conduct a second Main Research Study.

The research data, therefore, were obtained from students and teachers participating in three case studies: (i) the Pilot Research Study (PRS) using School A, (ii) the First Main Research Study (FMS) using School A and School B, and (iii) the Second Main Research Study (SMS) using Schools A and C.

The schools provided an overview of their Transition Year student timetable; and for the FMS dates in March/April appeared to suit both schools. A four-week writing exercise was agreed, where each school allocated a minimum of four scheduled teaching periods per week to the process. There was a caveat, however, in that disruptions might have occurred due to timetabling, core school activity, holiday complications, and participating in competitive sporting events. Furthermore, students were required to be in the computer room for the classes because not all students would have computers and internet connectivity at home. For the SMS, a similar negotiation was necessary, but the collaborative exercise took place for four weeks during November/December, just prior to the Christmas vacation. It was an excellent sign of commitment that all schools absorbed the cost of providing substitute cover, where necessary, for the teachers involved in the

project. A workable solution was found, and involved compromise by both schools. It was a time consuming process and it was necessary for the researcher to act as a liaison as there was no official mechanism for the schools to engage in discussions about cooperative ventures.

The same writing topic (*The Physical Processes of Global Warming*) was used during the pilot and main research studies. Although chapter one presented several reasons for the choice of topic, from research and personal perspectives, it became apparent while dealing with the schools that there was a further excellent reason for choosing it. There are different science curricula available to Irish schools, and different schools work through the various science curricula at different rates and in different topic order. Furthermore, each school has the flexibility to run their Transition Year programme differently. The topic chosen was considered to be appropriate as it pervaded all curricula and was considered to be an appropriate science topic for transition year students in all schools.

4.2.2 Writing Team Construction

Writing groups were constructed from a single school for the PRS and two volunteer groups from two different schools for the FMS and SMS. For the main research, both volunteer groups consisted of a minimum of twelve students and one teacher, and were used to create six writing groups which include one teacher and four students randomly drawn from both volunteer groups. This arrangement resulted in six collaboratively-written genres for each pair of volunteer schools.

Having 24 students (12 female; 12 male) and two teachers provided the collaborative writing case studies with six different kinds of writing team:

- a team consisting of four randomly-selected *male* students, mentored by an *external* teacher, i.e., a teacher from the collaborating school.
- a team consists of four randomly-selected *male* students, mentored by a *local* teacher, i.e., a teacher from the students' own school.
- a team consisting of two randomly-selected *male* students, and two randomly-selected *female* students, mentored by a teacher *local to the female* students.

- a team consists of two randomly-selected *male* students, and two randomly-selected *female* students, mentored by a *teacher local to the male* students.
- a team consists of four randomly-selected *female* students, mentored by a *local* teacher.
- a team consists of four randomly-selected *female* students, mentored by an *external* teacher.

It was not possible, given the constraints of in-school timetabling and collaborating school timetable alignment, to have complete random selection participants in schools. This design, therefore, included two within-subjects variables (draft versus revision), three commenting-environment variables (local, global and private contexts) and three fundamental writing conditions: (i) the Teacher and Writing Team were from the same school; (ii) the Teacher and Writing Team were from the different schools; and (iii) the Writing Teams were from mixed schools. All measures were repeated measures. All text sources and accompanying discussions were analysed for each of the writing conditions. Multiple data gathering instruments were used, including the automated collection of all collaboratively-written and communication products, questionnaires, face-to-face interviews with teachers, and any feedback or queries arising from the exercises.

The teams' compositions and inter-school mentoring relationships are illustrated in Figures 4.1 - 4.3, below. It was not expected that more than 24 students, per school, would be involved as participation would be limited by the size of the computer classrooms. However, in the Main Research Studies (FRS and SRS), there were additional participants, therefore supplementary teams were constructed as necessary. In some instances it was necessary to increase the number of members to five, for certain groups, depending on student take-up and attrition over the writing exercise.

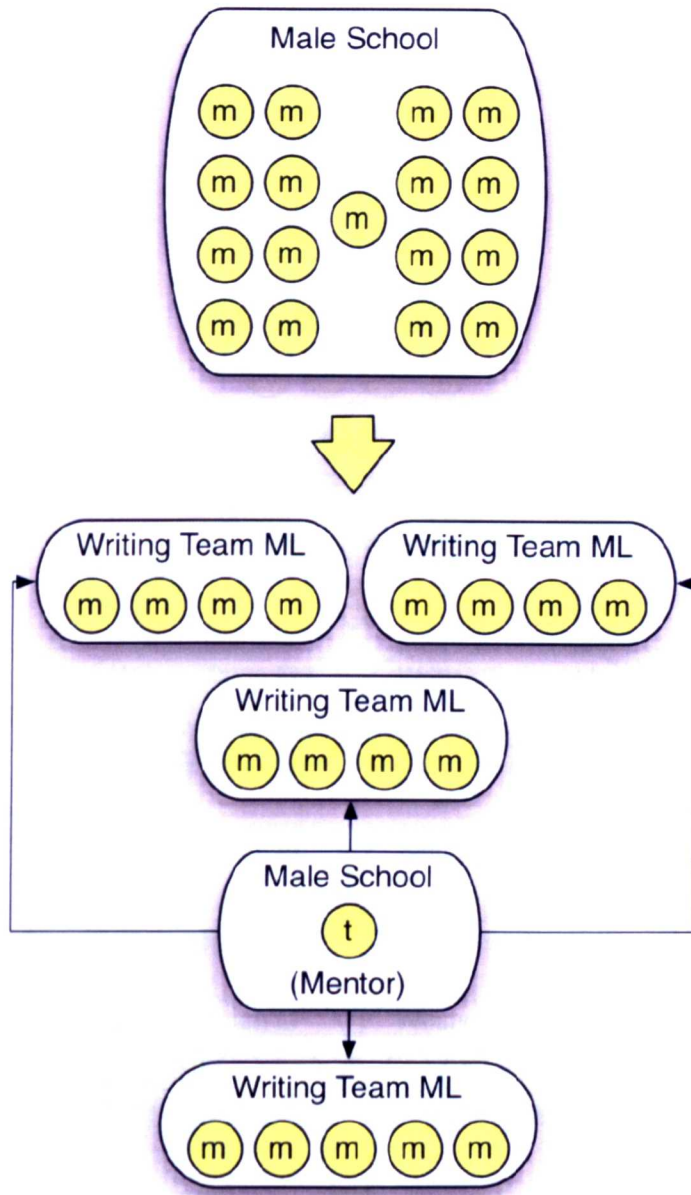


Figure 4.1
Collaborative Writing Team Organisation for Pilot Research Study (PRS)

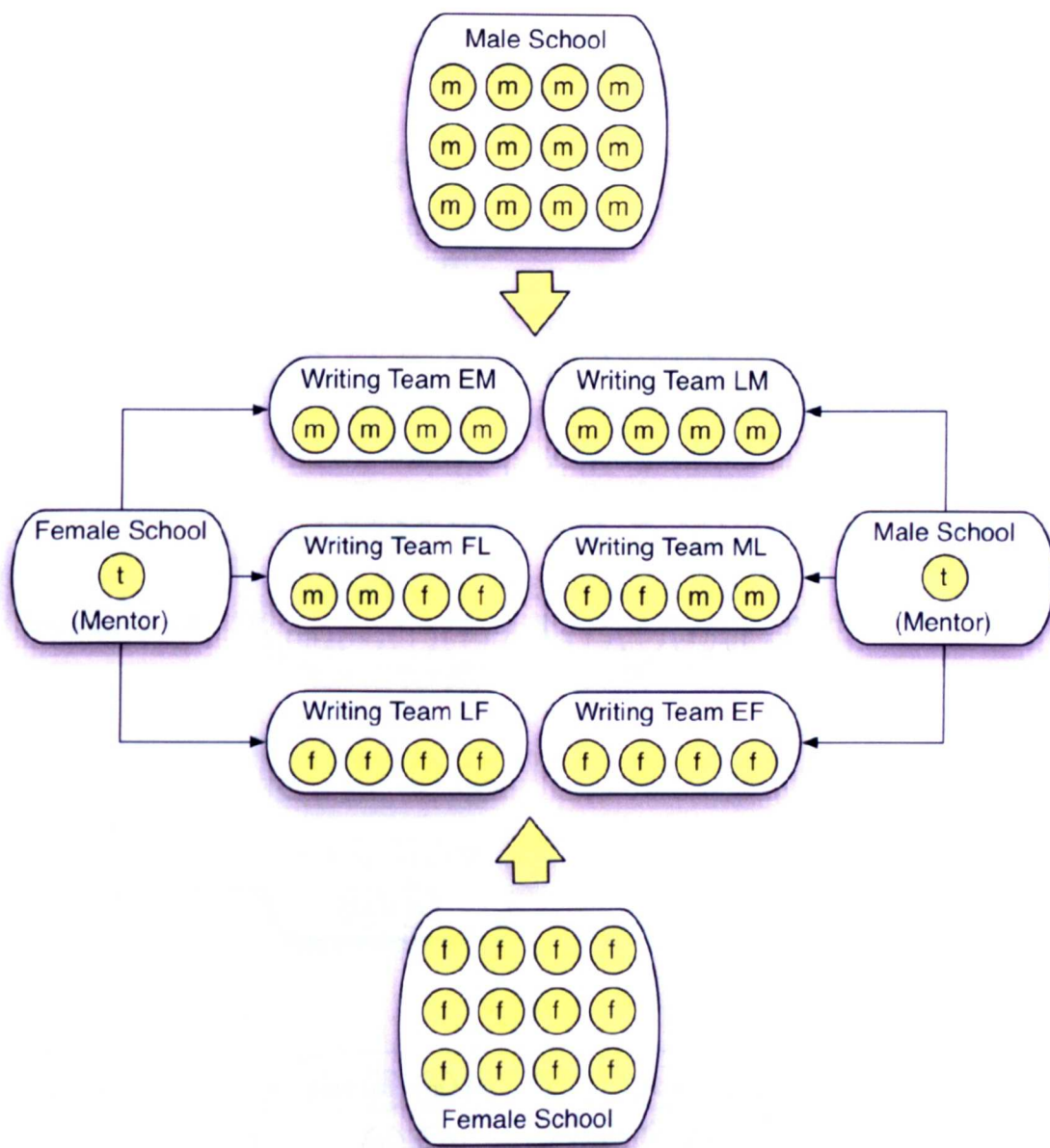


Figure 4.2
Collaborative Writing Team Organisation for First Main Research Study (FRS)

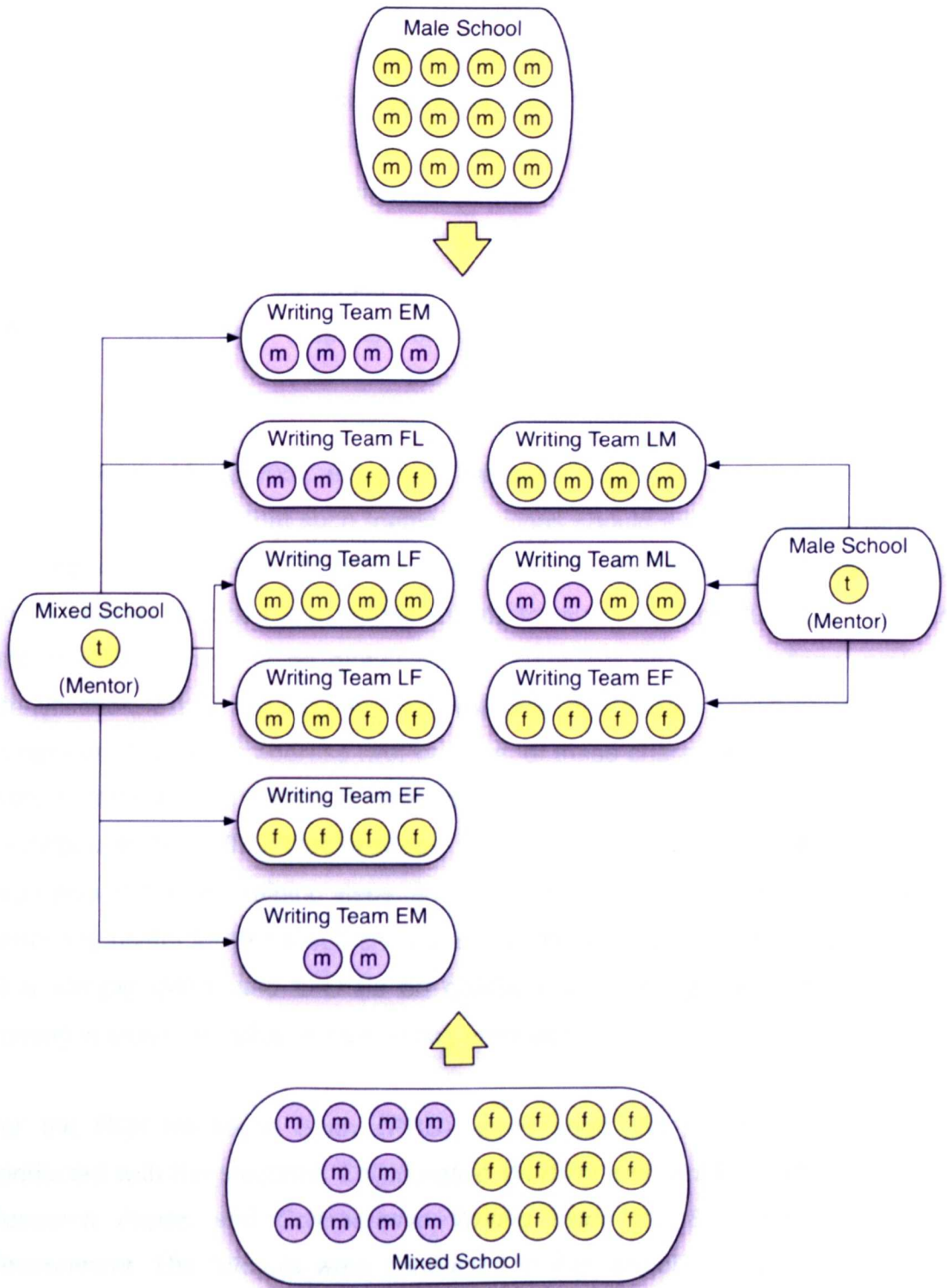


Figure 4.3

Collaborative Writing Team Organisation for Second Main Research Study (SRS)

4.2.3 Training and Interventions

Writing occurred, primarily, in the computer laboratory of the students' natural instructional setting following a short period of training in using the collaborative writing environment. Before the students embarked on the collaborative writing exercise, they attended several short training sessions to ensure that they were well informed of the rationale and the purpose of (i) collaborative science writing and (ii) peer-review. Liu et al (2003) recommend that the latter should have a discussion format, and be based on the work of Berg (1999) who examined the effects of trained peer response on ESL students' revision types and writing quality.

More recently Min (2005), evaluating research within a Vygotskyan theoretical framework, indicated that such training sessions should address specific issues if training is to ensure that ESL students become successful reviewers. In particular, her guidelines included four characteristics for successful production of relevant and specific comments on global issues: clarifying writers' intentions, problem identification, explaining the nature of problems, and making specific suggestions. In general, if students address two, or three, of these characteristics they become more confident, have improved language acquisition and enhanced metacognitive strategy use. Min (2005) also provides, as appendices (pp. 306-7), definitions and examples of her four training steps, and a peer-review guidance sheet, which were extremely useful for this research. It was also necessary to provide students with (i) a sample genre and tutorials on collaborative working and writing, and (ii) training in using the collaborative writing environment.

For the Pilot Research Study (PRS), three short (35 minute) tutorials were conducted with the students; *Collaborative Working and Writing*, *Writing a Library Research Paper*, and *Collaborative Writing using the EVE Virtual Learning Environment*. The tutorials were conducted in the school's computer laboratory. The students were inattentive as the layout of the room was ill disposed to teaching and learning; it was designed for solo working at a computer terminal. It was also clear that the students required minimal support in the "hands-on" training in the Collaborative Writing Environment (named EVE); they came to grips with the forum features within minutes. There was little evidence, throughout the

pilot, that the students followed the checklist provided in the collaborative working and writing document, especially the sections on peer-review and team management. The students did appear to use the sample genre for reference, although there were few references to the genre throughout the assignment.

The teacher appeared to require little support and did not involve herself in the production of the sample genre, or the software training; she provided excellent support, however, when selecting the reference material used in the writing assignment. She was actively involved in mentoring the writing trial and provided excellent motivation, encouragement and support. She found the moderation difficult, as it was time-consuming to (i) manage 5-6 writing teams, (ii) personally respond to a good deal of messages, (iii) moderate the discussions, and (iv) provide feedback on the writing. Another contributory factor was the time allocated to the complete trial was only two weeks (five days, amounting to about 3-4 hours per week). There was no assessment component included in the pilot collaborative writing trial; the teacher just did not have time to perform assessment. The Pilot Project Timetable was amended to include the agreed training schedule, and is shown in Figure 4.4 below. Certain school activities (participation on sporting events, attending lectures from visiting speakers, off-site visits, or illness) could impact on participation. Furthermore, the (pre-selected) students would be moved from other classes, when necessary, for the duration of the project.

A *Collaborative Writing Guide* (included in Appendices) was prepared by the researcher, and used as part of an in-class discussion on collaborative working. Additionally, a sample library research genre (on the advantages and disadvantages of genetically modified foods) was produced and used by the researcher during an in-class discussion on the genre (included in Appendices). These documents were based on a selection of online guides that provide examples of library research genres, and tips on writing in the genre, for example, "How to write a library research paper" (Tufts University Biology Department, <http://ase.tufts.edu/biology/courses/bio14/paper.htm>). The Research Paper Planner (<http://library.sasaustin.org/paperOrganizerUS.php>) from St. Andrew's Episcopal School (Austin, Texas, USA) was also used to explain the genre.

All 17 students were provided with the following supports prior to embarking on the collaborative writing project: (i) an overview of the project, (ii) four/five reference sources per group (one per individual), (iii) in-class discussion on collaborative writing using two-page document (planning, issues, methodology, roles, and peer evaluation), (iv) in-class discussion on the writing assignment using the sample library research paper genre written by researcher. Additionally, students had access to the Internet during the writing exercise and were free to source additional material themselves. All material accessed by school-based Internet searching is pre-filtered (pre-approved) by a national infrastructure managed by the NCTE (National Centre for Technology in Education). Furthermore, every student indicated that he had broadband internet access at home.

Collaborative Writing Project Timetable (Pilot Research Study)	
Week One	
Day 1	Introductory meeting with Teacher. Explained the Project's Purpose. Agreed a work plan for the two weeks. Discussed sample reference sources for writing assignment.
Day 2	Met with Students. Introduced the Project and EVE Collaborative Writing Software. Groups already selected by Teacher. Q & A Session with Students.
Day 3	Software Setup. Configured Logins and Groups Membership.
Day 4	Software Demonstration and Teacher Training. Obtained reference sources from Teacher and made copies for students.
Day 5	Meet Students for two periods. Discussed Collaborative Writing using Handout. Distributed reference sources. Discussed Genre (Library Research Paper) Opened Discussion Forum for students.
Week Two	
Day 6	Attended Writing Session. Distributed Sample Genre on Genetically Modified Food. Opened Collaborative Writing Module. Handled Usability Issues.
Day 7	Attend Writing Session. Handled Usability Issues. Captured Interim Writing.
Day 8	Attend Writing Session. Handled Usability Issues. Captured Interim Writing.
Day 9	Captured Interim Writing. Email contact with Teacher.
Day 10	Captured Interim Writing. Email contact with Teacher. Visited School.

Figure 4.4
Collaborative Writing Project Timetable (Pilot Research Study)

For the First Research Study (FRS), a more extensive training schedule was constructed for all participants, i.e., students and teachers. Furthermore, as the researcher had access to appropriate large-class training facilities in his institution, both schools agreed to attend for training rather than have in-school training. There is a bus service between the two towns and the principals indicated that students could travel to the university for classes on the specified day, instead of traveling to school. Many of the Transition Year students had already visited the researcher's university for additional laboratory sessions and research visits, and therefore were familiar with the layout. The students were also covered by the insurance policies of the university and the school. For the Second Research Study (SRS), it was not possible to have School A and School C leave the school for training, therefore the training sessions were conducted in the schools separately. The phases of the Main Research Studies are shown in Figure 4.5 below.

The following training sessions (45 minute duration) were provided for the students who presented themselves with a signed Letter of Consent (note "m" here refers to "minutes"):

- Presentation on the *Collaborative Writing Project* and the project's aims and objectives (10m); Question and Answer session (5m); Overview and purpose of the training to be provided (10m); Pretest Survey Questionnaire completion (15m); Summary (5m).
- Presentation on *Collaborative Working and Writing* (15m); Group-based role play session on collaborative problem solving, using *The Jigsaw Classroom: A Cooperative Learning Technique* (Aronson, and Patnoe, 1997) (15m); Feedback session (10m); Summary (5m).
- Presentation on *Writing a Library Research Paper* (LRP) (20m); Group-based collaborative writing session. Using the Jigsaw Classroom model; supply the teams with parts of a sample genre and encourage the groups to structure the components in some sensible structure (10m); Feedback session (10m); Summary (5m).
- Presentation on *Peer Evaluation and Peer Assessment* (10m); Discussion on a peer-evaluation framework along the lines of

that recommended by Teresa Bulman (Bulman, 1996) in her article on peer assessment in group work (10m); Conduct a Peer Assessment exercise for the activities of each group in the previous two sessions (10m); Feedback session (10m); Summary (5m).

- Presentation on *The EVE Collaborative Writing Environment* (15m); Hands-on session using the software (15m); Questions and Answers session (10m); Summary (5m).

For the FRS, there were appropriate breaks between sessions, and refreshments and a light lunch available for all participants. These sessions were not recorded, but all materials were provided in printed form for the students to take away. These sessions were about five to ten minutes longer than school classes, however, the students maintained focus, as there was substantial variety (material and methods) within each session. The teachers accompanied the students in these training sessions.

The following training sessions were provided for the teachers:

- Presentation on *The Teacher's Guide to using the EVE Collaborative Writing Environment* which includes setting up online groups, their management and administration (15m); Hands-on session using the EVE collaborative writing software component (15m); Questions and Answers session (10m); Summary (5m).
- Presentation on *E-moderation and Online Facilitation* which includes some issues and examples from Gilly Salmon's books on the topic (Salmon, 2002; 2004) (15m); Hands-on session using EVE Forums (15m); Questions and Answers session (10m); Summary (5m).
- Presentation on *Collaborative Writing Assessment* (10m); Introduction to the MASUS instrument (for genre assessment) and one (as yet undecided) *Forum Participation* instrument (10m); Hands-on session using MASUS to assess the sample genre (10m); Feedback and Discussion (10m); Summary (5m).
- Hands-on Collaborative Writing Session where the teachers use EVE to collaboratively write a sample genre based on three articles; I acted as mentor (30m); Discussion and Feedback (10m); Summary (5m).

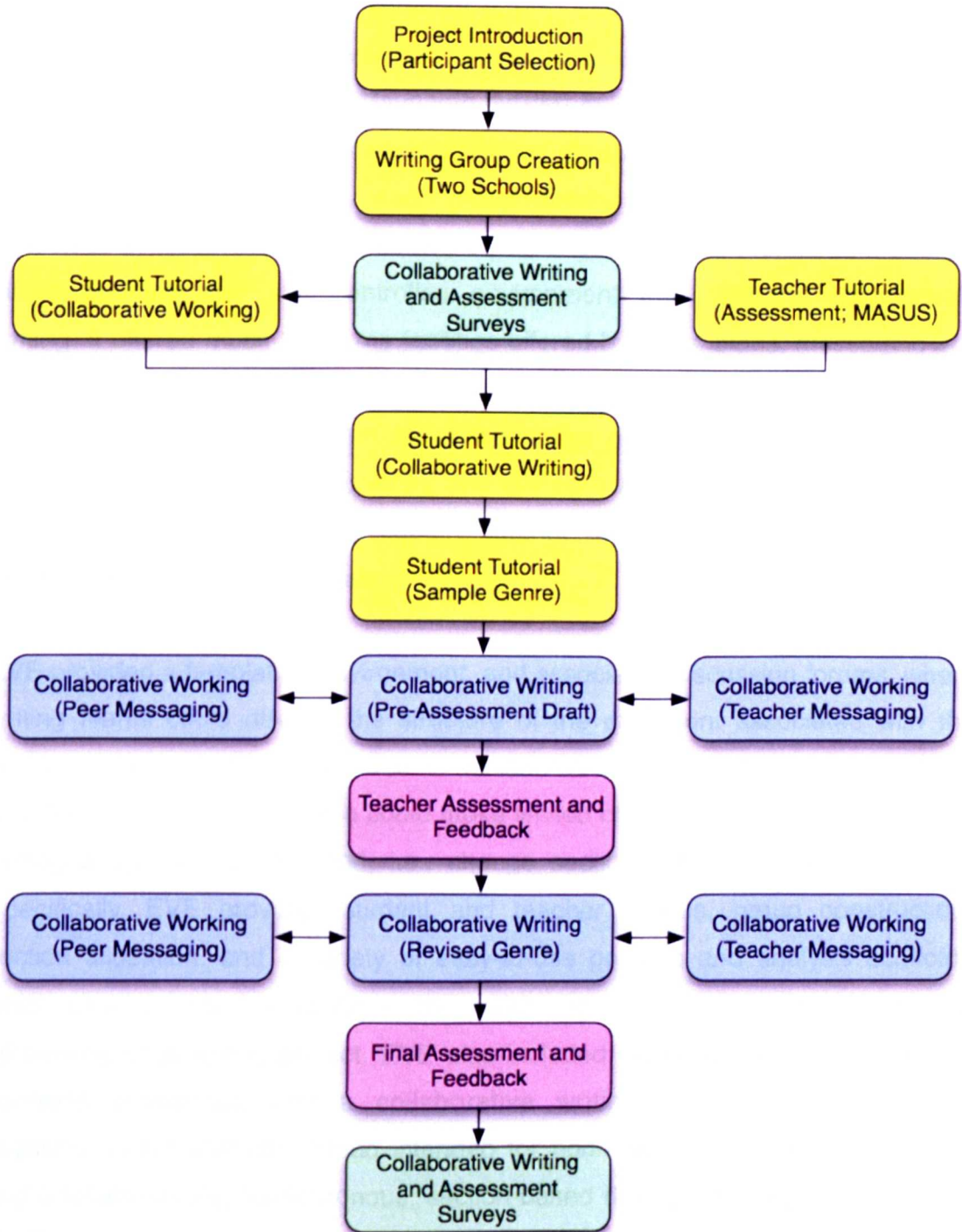


Figure 4.5
Collaborative Writing Project (Data Collection) Phases for the FRS and SRS

4.3 The Collaborative Writing Environment, Data Collection and Anonymisation

The Collaborative Writing Environment (CWE) software, named EVE, utilised in this project is a custom-developed online VLE developed by researchers at *National University of Ireland Maynooth* (NUIM) in Ireland (Busschots et al, 2006; Raeside et al., 2007). The software supported group-based, online, asynchronous collaborative writing whereby each group member wrote a previously agreed section of the report. The EVE software was chosen for this project as it offers a single authenticated and controlled environment that supports collaborative writing. It offered much the same facilities offered by wikis, blogs, messaging and other kinds of electronic conferencing software, but the primary advantage, from a research perspective, was that all of the online discourse associated with the collaborative writing was captured by, and available within, a single environment. It was possible, using EVE, to capture interim writing products and associate changes with specific individuals.

EVE provided a templating environment, and associated discussion forums, where writing teams could discuss the structure of the document associated with the writing assignment. Once the students decided on the structure of the document, it was “fixed” by the teacher who could make limited changes to the structure as the writing assignment progressed, i.e., change section titles, or reorder sections. Specifically, EVE provided student and teacher access, group construction, section allocation, and a variety of easy-to-use portfolio and analysis scaffolds which could be used to configure the collaborative writing environment prior to embarking on a writing project. EVE also included global and local commenting contexts associated with a collaborative writing project, i.e., a (global) asynchronous discussion thread intended for non-revision-orientated comments, and a locally-visible, asynchronous, section-based discussion thread intended for localised, review-orientated comments.

The software also provided whole-class, and team, discussion forums where students could exchange ideas or engage in general communication. Teachers could also send private messages to a student; these comments were not available for general viewing, however. In theory, all messages within the

collaborative writing system were available to the researcher during the exercises as it would have been possible to write programs to extract any data from the underlying database. Additionally, the researcher had access to all user accounts (including passwords) and could have signed in as a user or teacher to observe the communication from a particular perspective. In practice, however, none of these data were observed by the researcher in these ways until the writing projects were completed. All student (peer) and teacher comments and interim collaborative writing products were saved (with appropriate time-stamps) and were readily available for ongoing or later linguistic analyses. Writers also had access to “the EVE Scrapbook” which was a personal and group accessible portfolio system for shared resources and references that could contribute to the writing task, and to a static *Group Biography Page* which contained a contributed brief personal description of every member in each collaborative writing group.

Another important feature of EVE was that, by design, all student-student exchanges were public; this reduced the possibility of online bullying that can occur in forum-type environments (which was a significant concern for one teacher). Whole class exchanges were possible using a class forum where students could develop topic based threads. To help students focus on the writing task, EVE also provided a team-only visible commenting facility (essentially a discussion thread) associated with each section.

As indicated earlier, the EVE software also supported an option whereby students’ real names, rather than pseudonyms, could be used. School A’s deputy principal, however, believed that this would not be problematic, ethically, as students are no longer concerned with “this kind of privacy”. This was confirmed with Schools B and C. It was agreed, however, that secure server would be used for the collaborative writing exercises; this would help secure the system against unwarranted intrusion and theft of personal data. In practice, pseudonyms were used throughout the PRS, and students’ first names were used in conjunction with a number throughout the main research studies (FRS and SRS). Of course, following the research studies, all data were anonymised prior to analysis, and the database containing the data was taken offline and archived.

The EVE collaborative writing environment provided the students and their teachers with a usable, productive collaborative working environment, and there were no negative comments recorded throughout the research. The teachers offered some suggestions for additional features, related to information management and enhanced commenting facilities, but requested permission to use the software for future projects. Several students also indicated that they would like to continue using the system for future project work.

Prior to data analysis it was necessary to collect and anonymise the teacher and students' discourse. This proved to be cumbersome as there were so many terms of address used by the participants and it was necessary to preserve terms of address, which are important in terms of constructing tenor relations. For the pilot research, the students were randomly assigned a (EVE software) username in the range *Student 1 .. Student 17*; these names were not available to the researcher. It was necessary, however, to construct a table of name variants for each student prior to textual analyses in order to unambiguously identify participants. This was not an issue in the main studies as the participants could easily identify each other from the first names assigned during team construction. The teachers were also anonymised, and are referred to using the names Ms. Kelly (PRS), Mr. Black (FRS) and Mr. Green (SRS), and the student name variants (from the discussion forums and planning forums) are shown in Figure 3.6, below.

Some decisions included in the choice of pseudonyms included (i) using first and surname initial pairs, (ii) whether to preserve nicknames, (iii) preserving addition of "bo" to first names (usually from surnames), (iv) preserving variant forms of shortening, i.e., choosing between say Daniel, Danny, and Dan, (v) conversion from English spelling to Irish (Gaelic) spelling and preserving pronunciation, i.e., Aidan/Aedan. Early in the pilot, when the students first started using the discussion forums, and were unaware of others' identity, one student (Student 15) suggested that they use their first name in the discussion post's title. In this discussion thread only, that student used a first name that did not correspond with any of the students involved in the trial; this pseudonym was not anonymised.

All of the student papers together with their associated (anonymised) discourse components, i.e., project (pre-writing) discussion thread, private messages and

section comments, were assembled into a single data file together with general class discussion threads that contained posts from the team's members. These data files were used for the analysis part of the project, and are included in full, in Appendix B. The class and pre-writing discussions data will help identify tenor relationships, which were necessary for understanding, and establishing the nature of the collaboration where present.

The following section describes the data collection methods used to extract data from the online collaborative writing environment and select final texts for genre and linguistic analysis.

Student	Terms of Address (self, peer and teacher used)
Student 1	Luke
Student 2	Conor / CT
Student 3	James / Jim
Student 4	Ken Martin / Kenneth Martin / Kenneth
Student 5	Finn / finnbo
Student 6	Fionn / FN / Fn
Student 7	David / DOS
Student 8	Daniel / Danny Murphy / Padzilla
Student 9	Oisin
Student 10	C / Cian / CK
Student 11	Niall / Corrigan
Student 12	Fergus Mulligan / Mully / MULLO
Student 13	Brendan / Smithy
Student 14	Darragh / DJ / Jerk / Jerkins
Student 15	Aedan / Aidan / Skimpy / Skimps
Student 16	Dermot / Dermot Quinn
Student 17	Thomas / Tom

Figure 4.6

Students Participating in Pilot (Team 2 participants are shown in bold typeface)

4.4 How successful are science papers collaboratively produced in an online environment?

This section provides an overview of the two-stage method used to collect the collaborative writing data (science genre, or papers) used in this research, together with the key aspects of Systemic Functional Linguistics (SFL) related to the genre and linguistic analyses. These methods were specifically related to addressing the first research question concerned with how successful are science papers collaboratively produced in an online environment. It also provides an overview of the collaborative writing system used by the students, and the software (computer programs) specifically developed to automate certain aspects of the linguistic analysis.

4.4.1 Data Collection using an online collaborative writing environment.

A key feature of data collection for this research question was the automated collection of the following data within the EVE collaborative writing environment (EVE):

- (i) forum discourse,
- (ii) student-student and student-teacher private messaging, and
- (iii) genre (collaboratively written student paper) evolution.

While it was possible to capture these data within EVE v. 1.0 in the PRS (Pilot Research Study), there were some problems: (i) the inability to change section titles, and reorder sections, after the planning phase, (ii) students could not continue to discuss document organisation, or re-plan, once the writing phase began, (iii) it was necessary to use real-time software programs to capture the interim writing products and store these data in a custom database with appropriate time-stamps. It was necessary to work with the EVE development team to implement a new version to support this research. The rationale for the upgrade to facilitate this research is outlined below.

In order to support the two main (FRS and SRS) writing studies, there was a requirement that teams could reorder sections and change section titles. Furthermore, teachers wanted to pause and re-open discussions, especially those

related to planning. In EVE v. 1.0, it was not possible to view pre-writing (i.e., planning) discussions once the writing phase began, however in EVE 1.5 writers could re-visit the plan while engaging in the writing phase. Another feature of the earlier version related to thread and message deletion: if a student or teacher deleted a private message, or a thread, it was removed from the system. In the updated version, items are marked for deletion, and are not visible to users; they are available for research purposes later, however, as all exchanges (even deleted ones) could have had some impact on text evolution. It was explained to all participants, at the beginning and throughout the project, that all exchanges, even deleted ones, would be available for research investigation. In the later version, students could use pseudonyms or their real names within the collaborative writing environment. During the PRS, quite a lot of time was spent establishing online identities, which was distracting. These recommended changes to the collaborative writing environment, established in consultation with the teacher involved in the preliminary study, were implemented by the EVE developers and were sufficiently tested, by the developer, researcher, and a participating school teacher, in trial usage sessions prior to utilisation in the main research studies (FRS and SRS).

The issue of capturing the interim writing products was more complex and several candidate software solutions were available; all required design, development, deployment and testing. A new software solution, proposed by the researcher, recommended that EVE v. 1.5 be changed at a fundamental database level for this research. In practice, this meant that a separate auditing database, co-existing and interoperating with the underlying EVE database, needed to be created. Essentially, this would be an audit table that is updated every time there is a change to pre-selected EVE database tables. This change was important for this research, i.e., if a student wrote something and saved the document, the EVE software (i) made a backup (overwriting the previous backup) of the current version, and (ii) saved the new version of the paper as the current version. This was realised using “database triggers” associated with underlying EVE database tables. Triggers are event-handling computer programs that execute when some pre-defined event occurs (i.e., a “trigger” occurs). So when an update, addition or deletion was made to a database table (i.e., to the collaboratively written genre), it would be possible to copy old and new data to another database (audit) table for

preservation purposes. This meant that it was possible to track versions of papers as they evolved over time during the writing process.

Following testing of a number of software development approaches, a “database trigger” solution was designed and implemented for the research project; which meant that all data were captured and preserved in the audit database, and available for later analysis. Solving this problem, and integration with the EVE system, took a good deal of time, but it meant that no data were lost during the experiments. Previously, in the pilot research study (PRS), data-capture programs were manually executed every five minutes and one could not be sure that every database change had been captured. Furthermore, it meant that the researcher did not have to be present at a computer, monitoring the activity and performing data capture, at every writing session. While this was possible for one school, and one class period per day, it was not feasible for the Main Case Studies (FRS and SRS).

As mentioned earlier, in each of the case studies, some students were unavailable to participate at the designated times, as they had to participate in other school activities. In selecting sample genres for further analysis, it was decided to choose reasonably active teams where there was (i) exchange in the planning (pre-writing) forum, (ii) a reasonable number of comments on other student writers’ work, and (iii) sufficient updates to sections which could provide some insight into a text evolution analysis. In the Preliminary Research Study (PRS) all members of one writing group were available throughout the full pilot, so it was decided to analyse this group’s discourse for the pilot research project. All students participated in the exercise, and every team wrote and submitted a library research genre. Notwithstanding their full participation, there is no reason to expect that this team’s contributions would not be a representative sample of the discourse, and should be considered an authentic discourse. Given the time constraints associated with reporting, it would be impossible to analyse all collected data; it will be necessary, however, to do so at a later stage for comparison purposes, and planning future investigative experiments. For the First (FRS) and Second (SRS) Research Studies, the selection of the writing team’s Library Research Paper was based, primarily, on the length and versions of the sections as there were few comments

on others' writing for all teams. All students appeared to participate, and contribute, to the discourse in the planning discussions.

4.4.2 Genre Analysis of Final Texts

A library research paper (or *Internet research paper*) genre is a report on other people's work, documented by library or Internet sources; it is essentially a literature review of material on a specific topic. This genre was chosen as it is one of the most commonly observed, and studied, genres in the different disciplines (Hale et al., 1996) and as outlined in the previous section, it was of pedagogic interest to the school, especially for collaborative writing assignments associated with project work. The library research paper genre analysis presented in the following chapter, is based on three sample final genres, one from each of the pilot, first main, and second main studies. The complete texts, together with related student-student (peer) and teacher-student discourse for the three selected genres is given in Appendix B.

Two different approaches to genre analysis were identified in the relevant literature. One approach, by Samraj (2004), examined the overall structure of library research papers, the claims made, the intertextual links established, and their epistemic or phenomenal focus. Another approach, used by So (2005) applied a semantic functional linguistic model to examine if teachers can learn how to use newspaper genres and genre-based pedagogy to teach intermediate ESL learners to write school genres. Her analysis framework is a modified version of that presented by Tribble (2002) to include contextual and linguistic analyses. Her analytical framework for and notion of language metafunction is based on the work of Halliday and Hassan (1989).

Neither author, however, examined collaborative pedagogical strategies to conduct genre analyses of collaboratively written library research papers. Furthermore, although Samraj's (2004) genre (research paper) and theme (environmental science) are similar to those used in this research, the analytical framework does not provide sufficient contextual or language metafunction tools to correlate the genre analysis with the collaborative exchange. So's (2005) analysis framework,

however, is appropriate for the genre analysis as it is SFL based. Using a single linguistic theory it is possible to investigate how language is used to construe scientific meaning, both in the context of text-based electronic collaborative exchange and a collaboratively written library research paper genre. It was decided, therefore, to adopt So's (2005) analysis framework for genre analysis of the final texts. Returning to the research question "*How successful are science papers collaboratively produced in an online environment?*"; successful science papers are those which would appear to be typical of the genre - where typicality is guided by So's genre analytical framework.

4.4.3 Linguistic Analysis of Final Texts

The linguistic analysis of the final texts focused on the presence of grammatical metaphor, and in particular, nominalisation, as it is commonly found in scientific writing is nominalisation, i.e., when a verb (process) is realised as a noun (entity). In general, the unmarked function (Banks, 2005) of a noun is to express an abstract or physical thing or entity, and the unmarked function of a verb is to express a process. When realisation departs from this framework grammatical metaphor is produced. Banks succinctly highlights the difference between semantic and grammatical metaphor: with the former preserves the grammatical form while changing the meaning, while with the latter the grammatical form is changed while the ideational meaning is preserved. One example of grammatical metaphor, for example, would be the use of the word "argument" rather than "argue" (or "enhancement" rather than "enhance") - the words are lexically different but they encode the process (arguing or enhancing) in noun form (also referred to as *being realised as a noun*).

For the purposes of evaluating the student collaborative writing (the first research question), those that demonstrate levels of nominalisation, and lexical density typical of science writing would be considered successful. Holtz (2009), utilising an SFL (Halliday 2004b; Halliday and Martin 1993) and Register Analysis (Biber 1988, 1995; Conrad and Biber 2001) theoretical framework, presents findings on a corpus-based comparative analysis of research articles and abstracts from several disciplines, focussing predominantly on information density and how it is linguistically construed. She conducted a quantitative and qualitative analysis of

instances of nominalisation in the corpus' abstracts and articles. This research used Holtz's SFL methodology to perform the nominalisation analysis of three sample student papers (one from each study).

4.4.4 Automated Methods

This section provides an overview of the general methodology and specific techniques employed to (i) prepare individual drafts for analysis, and (ii) generate accompanying word-sense analysis. Several computer programs were developed specifically for this research project, and this section presents the motivation for their development together with descriptions of their functionality (using screenshots).

The data collected for analysis came from the three separate studies discussed earlier in this chapter, and were accumulated in the Collaborative Writing Environment (CWE) used for the team-based writing projects. The CWE provided mechanisms for initial planning, whole-class and writing-team discussion, student-teacher private messaging, draft commenting on peers' writing, teacher commenting. Writing teams consisted of four students that were allocated two sections of the student paper. The CWE also provided limited backup functionality as it only kept one previous draft of a particular section. In order to obtain as many interim drafts as possible it was necessary to re-engineer the CWE software's database module to record all drafts. This revision meant that it would be possible to obtain and record a new draft every time a section was updated.

Given that there were hundreds of drafts arising from approximately 50-90 drafts per writing team (and fifteen writing teams) it was decided to automate, where possible the initial analysis of the drafts prior to analysis. Feedback on my initial case study's analysis indicated that the approach should be used in the main study, i.e., word-sense analysis, colour coding where possible, and visualising the evolution of writing where possible. While this was possible for a small number of drafts for a single writing assignment it became apparent that it would be very time consuming to do this for the whole study. It was decided, therefore, to analyse previous manual approaches and automate those where possible.

Program “*MakeXMLDraft*” (written in Perl) read and parsed all student paper drafts (encoded in XML) for a particular Writing Team and performed the following: (i) identified and encoded active, stative and relative verbs using lists contained in external data files, (ii) identified and encoded word-sense (i.e., nouns, verbs, adverbs and adjectives) for every word in the text sections using the WordNet system, (iii) anonymised student names using hand-coded specifications held in external files, and (iv) produced a new XML version of the draft suitable for viewing in a web browser. A Perl program, together with visualisation within a web browser was chosen as it was quicker to write custom programs in this way than developing software for a specific operating system (for example, Apple Mac OS X). Also, the program utilised the functionality of the WordNet software and it was simpler to embed the WordNet system within the Perl program developed, rather than engage in other candidate approaches.

The WordNet system, when installed on a computer, provides comprehensive word sense information using command-line tools, but does not provide the same comprehensive functionality when accessed via software libraries (called application programming interfaces, or APIs) within Perl or other programming systems. Furthermore, these APIs provide limited word stem analysis functionality directly, especially with plurals, for example, analysing “calves” will not return the required sense information, whereas “calf” will return the correct sense list. Therefore, some word stem analysis would need to be performed prior to word sense analysis. For this research, misspelled words were not corrected prior to word sense detection, but could be performed at some later stage.

Figure 4.7 below shows a visualisation of the newly created XML file (for Writing Team 20; Draft 12) following automated analysis by program `mkxml.pl`. It uses text decoration to indicate the word sense. Nouns are shown in **bold** typeface, adverbs and adjectives are shown in *italics*, and verbs are underlined. Similarly, the different verb types are shown with different colour background, i.e., action verbs with orange, stative verbs with lime, and relative verbs in magenta. These verb lists were derived from a broader SFL taxonomy of processes/verbs found in the literature, i.e., relational, material, mental, behavioural, verbal and existential. Furthermore, a fixed width, sans serif font (courier new) was used to

render the text for inspection online as it is clearer to read and compare drafts alongside each other. The automated method only computed word sense (using WordNet) on single words and did not always produce accurate results. This is why, as shown in Figure 3.7 below, 'have' rather than 'have been' is shown in magenta, and the "like" in "like floods" is not a verb in the context (it means "similar to" here). This meant that careful reading of the processed documents was necessary as the visualisations were for guidance purposes only.

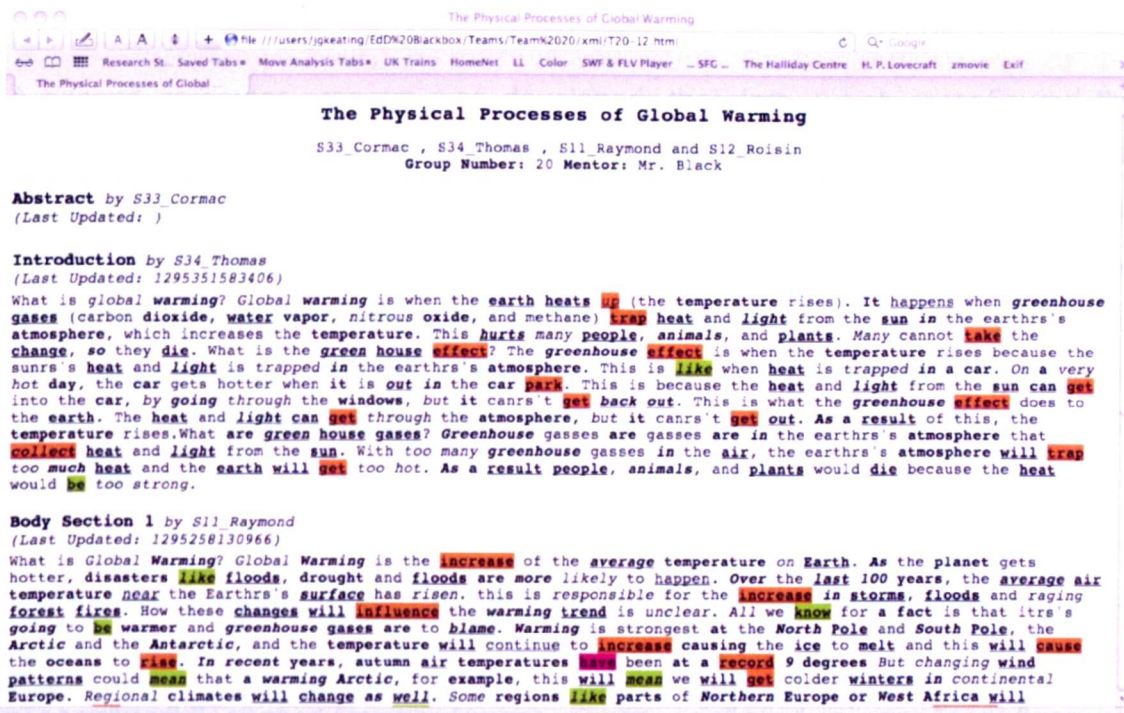


Figure 4.7

Visualisation of paper draft following automated analysis by program mkxml.pl

These encoded versions of the student drafts were XML files contained encoded word-sense tagged information, and were amenable to further computation, for example, by linguistic analysis software, or for visualisation in a web browser as shown in Figure 4.7 above. While such tags are necessary for computer inspection and analysis, it meant that the files were no longer human readable, as a typical encoded file contain heavily-nested, XML encoded sentences that required appropriate conversions in order to make them human readable, as shown in Figure 4.8.

The standard approach to achieving this readability is to develop an XML transformation (for tag analysis) together with an accompanying style (for visualisation) and dynamically employ these when rendering the student paper draft being examined in the web browser. This requires a custom program (see Program Two below), developed in XSLT, to transform the XML encoded drafts from the Collaborative Writing Environment (CWE) used to gather the research data. While the encoding was useful for storage of the information for use within the CWE it was not appropriate for inspection as part of the linguistic analysis required for this project.

A second computer program was developed, therefore, which reconfigured the organisational storage structure, and removed metadata and backup information included in the original encoded draft. Finally the program added the timestamp to the text, and provides clear labelling of the section author, in order to make the draft more amenable to data analysis. The first research question was concerned with the final draft, however, and although the methods outlined above were applied to all drafts, only the final draft was selected for genre and linguistic analyses.

```
<span id="sfl" class="ads">Global</span> <span id="sfl" class="noun"><span id="sfl" class="ads">warming</span></span> is when the <span id="sfl" class="noun"><span id="sfl" class="verb">earth</span></span> <span id="sfl" class="noun"><span id="sfl" class="verb">heats</span></span> <span id="sfl" class="actionverb"><span id="sfl" class="verb"><span id="sfl" class="ads">up</span></span></span> (the <span id="sfl" class="noun">temperature</span> rises).
```

Global warming is when the earth heats up (the **temperature rises**).

Figure 4.8

Visualisation of project XML tag set to produce human-readable sentences

For the linguistic analysis, it was necessary to remove all text formatting information and images contained within each draft in order to (i) focus on the written text and (ii) add the word-sense formatting described above. This was a time consuming task as there were hundreds of draft files and each draft required up to twenty-five automated formatting-removal steps followed by human

inspection to correct errors, i.e., occasionally formatting was incorrectly applied in the draft and data was deleted. This semi-automated data cleansing method, albeit time consuming, provided an excellent opportunity to examine each draft and provided a sense of how the writing progressed. It also provided insight into which teams provided a sufficient number of drafts for subsequent analysis, and which writing projects appeared to contain text suitable for the proposed linguistic analysis.

Identifying the lexical words in the three sample student papers under investigation was accomplished using Stanford's open source part-of-speech (POS) tagger (Toutanova et al., 2003) and another custom developed suite of computer programs. The tagger labeled all of the words in each LFR with POS tags indicating whether they were verbs, nouns, adjectives, and adverbs using the Penn Treebank tag set, for example, tokens that have a POS tag that starts with a "V" (VB, VBD, VBG, VBN, VBP, and VBZ) are verb forms. It was a straightforward task to write Perl programs to calculate produce frequency lists of the various lexical words. Lexical density measures the ratio of content words to grammatical (or functional) words in a text. Content words include nouns, adjectives, most verbs, and most adverbs and grammatical words include pronouns, prepositions, conjunctions, auxiliary verbs, some adverbs, determiners, and interjections.

The data computed by these programs were used in the linguistic analysis focussing on the occurrence of nominalisation, and measures of lexical density, in the final drafts. The following section describes the approach and methods used to establish how the collaboratively written texts evolved over time.

4.5 How do collaboratively written texts evolve over time?

This section describes the specific methodologies designed to establish how collaboratively written texts evolve over time. This required similar data collection techniques to those described in the previous section, in addition to methods used to categorise the kinds of evolution from draft to draft.

4.5.1 Linguistic Analysis of Draft Texts

As outlined in Chapter Two (Literature Review) there are many excellent examples of data analysis approaches that utilise an SFL approach to examine student writing, the impact of teacher and peer feedback, and peer revision within a social and cultural perspective that define a specific genre and associated linguistic register. In the previous section, So's (2005) genre analysis framework, for example, was based on Systemic Functional Linguistics, and was considered suitable for analysing the final texts generated from this research. However, no single evaluation methodology was found, to date, (i.e., a multivariate SFL model describing the relationship between teacher and peer comments on collaborative writing in an online environment), i.e., one which utilised the data requiring analysis in this study. It was necessary, therefore, to adopt an approach similar to Jones (2005) or Aluísio and Gantenbein (1997), for example, who both used SFL, for the purpose of this study.

The benefits of Aluísio and Gantenbein's approach (described in section 2.5 above), in particular, for this research were twofold: (i) it outlined sound procedures for categorising local and global draft revisions within a co-operatively written document and mapping these procedural revisions into an SFL framework, which were suitable for later text-linguistic analysis, and (ii) it recommended this approach for a variety of genres within scientific disciplines. For this research semi-automated examination of the drafts (obtained using the methods described in the previous chapter) were conducted and analysed using the procedure described above.

4.5.2 Software Supports

It was decided to develop draft presentation tools that allowed the researcher to compare pairs of drafts. Figure 4.9 below shows a screenshot of the software tool developed to compare drafts for a particular writing assignment.

In order to enhance the comparative analysis of the drafts it was determined that the interface should be divided to contain two scroll panes. Initially, the researcher could click on a panel title to move to the next draft (as shown in Figure 4.9), but

the final version included an associated dropbox providing the researcher with a list of available, and uniquely identifiable, encoded drafts thereby allowing the researcher to select the drafts he wishes to compare. The panels were realised in XHTML using updatable <div> elements that had accompanying JavaScript functions for repositioning, changing the z-index (overlapping order), and adjusting the transparency of the text background. When the panels are overlapped in the centre of the page (shown in Figure 4.10 below), the backgrounds become transparent in order to view overlapping colour-coded drafts. Both panels also implemented co-operative (synchronised) JavaScript scrolling event handlers which, if selected, automatically scroll the other panel if the user is examining the same text (but different encodings) in both panels.

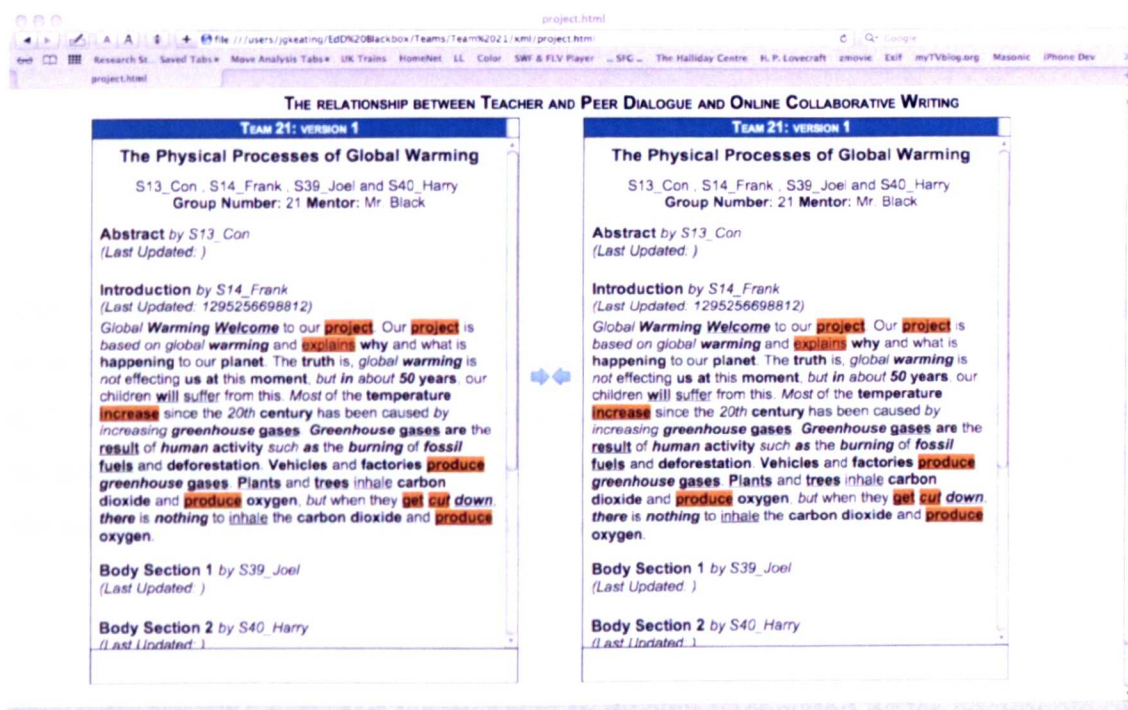


Figure 4.9

A browser application that allows the comparison of pairs of drafts (shown for Team 21)

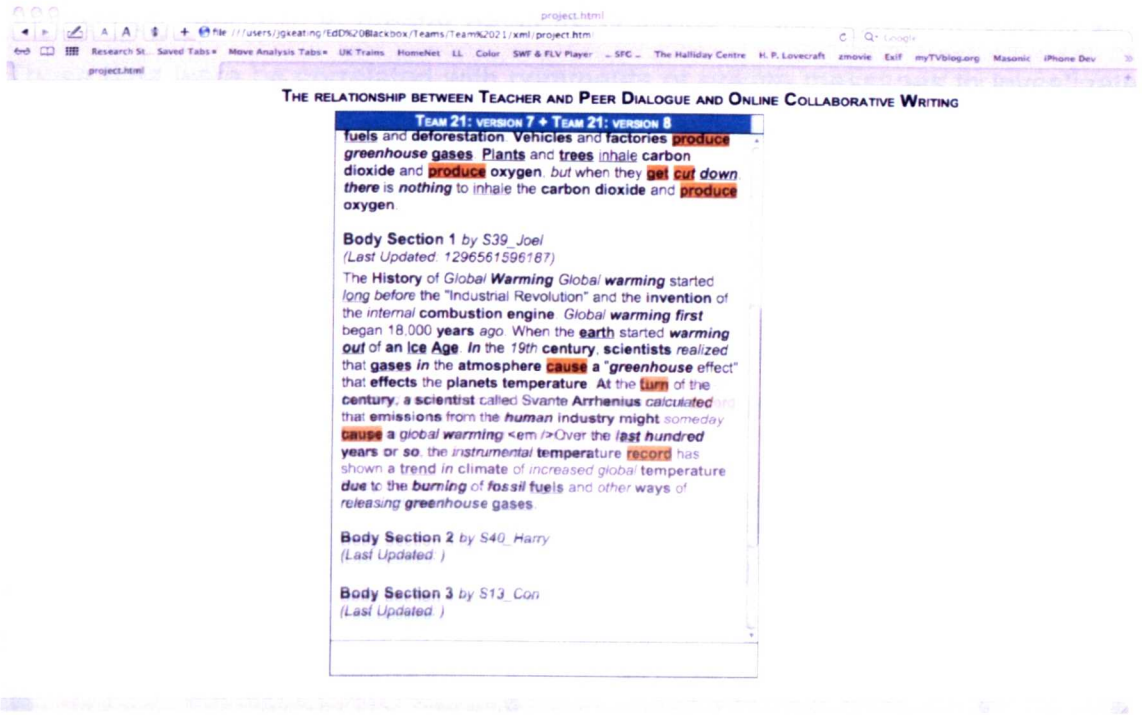


Figure 4.10

Overlapping drafts for Team 21 (7 and 8) using an online browser application

Figure 4.10 shows how the overlapping functionality worked and made it easy to identify where the text changes from draft. Simply clicking on the “arrows” icon (shown in Figure 4.9) between the panels overlaps the two drafts. The software was not overly intuitive. However, as it was only used as a personal organisational tool for this research, and was not the primary focus of this research, the poor-quality user interface was not considered to be of concern.

The software also provided functionality to display associated writer comments on the draft, i.e., those comments from the CWE that may relate to reasons for draft changes. However, given the volume of data collected in this research, all comments have not yet been associated with the appropriate sections. Figure 4.11 (above), however, demonstrates how the comment visualisation worked. When the researcher was examining a particular section, the relevant comments were displayed in the appropriate panel.

Once the individual drafts were identified it was possible to systematically identify pairs of drafts where noticeable change occurred. These drafts were recorded and

linguistically analysed in greater detail for changes in nominalisation, specifically. These data were be correlated with comments or private messages to investigate reasons or motivation for textual change (see third research question). In addition to the software developed, and described, above, the software package Kaleidoscope, was used for further nominalised text evolution. A sample comparison between two drafts is shown in Figure 4.12, below. Examples of evolving nominalisation are given in Chapter Five which specifically presents the findings, together with an analysis, of this research question.

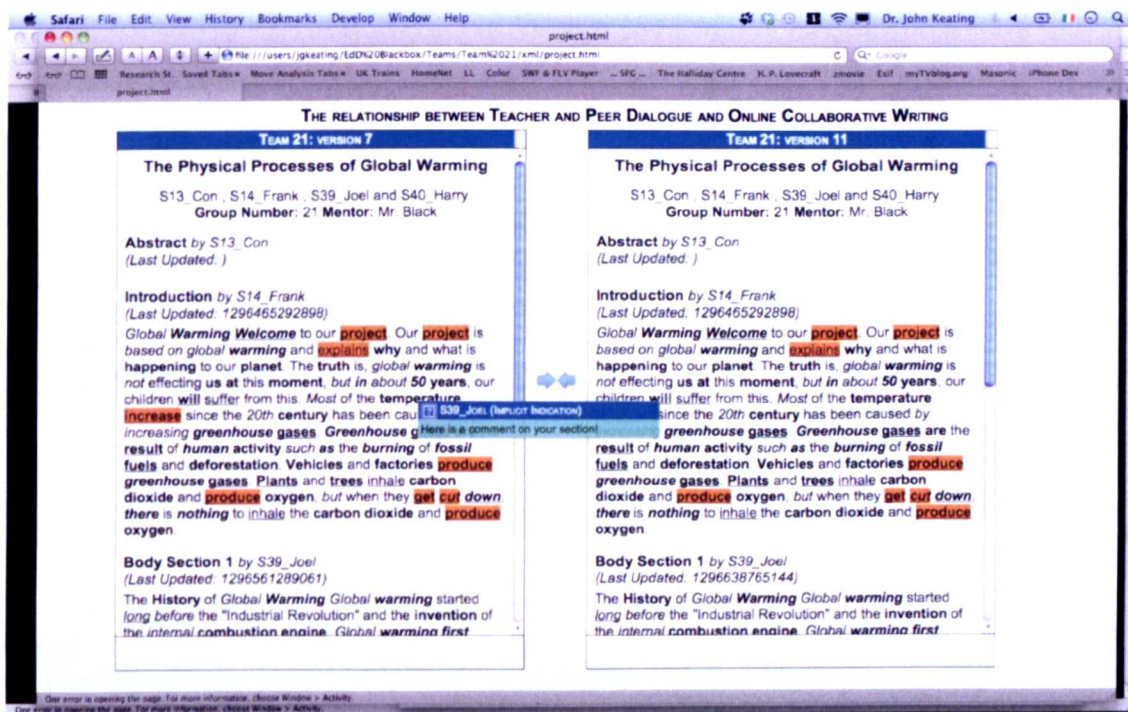


Figure 4.11
Comment display functionality

4.6. Can the changes be explained in relation to the online dialogue/ feedback?

This research question was necessary as it seeks to determine if writers selectively incorporate feedback, and if so, why. Also, it is necessary to determine if collaborating writers show a preference for, or place greater value on, teacher or peer comments. This research question also addressed to what extent students revise their research papers based on local and global peer comments, during the drafting and revision stages of the writing exercise. The approach presented by Liu

and Sadler (2003) informed this latter aspect of the research question. This research focused on examining the text-based electronic collaborative exchange between students (and with their teacher) engaging in collaborative writing of the genre, and the relationship to the development (and re-development) of the genre itself. Based on the research outlined above, the analytical method focused on identifying (i) revisions categories in the genre, (ii) changes in grammatical metaphor, and (iii) association of these changes with collaborative exchange, i.e., an analysis of speech function and associated tenor relationships.

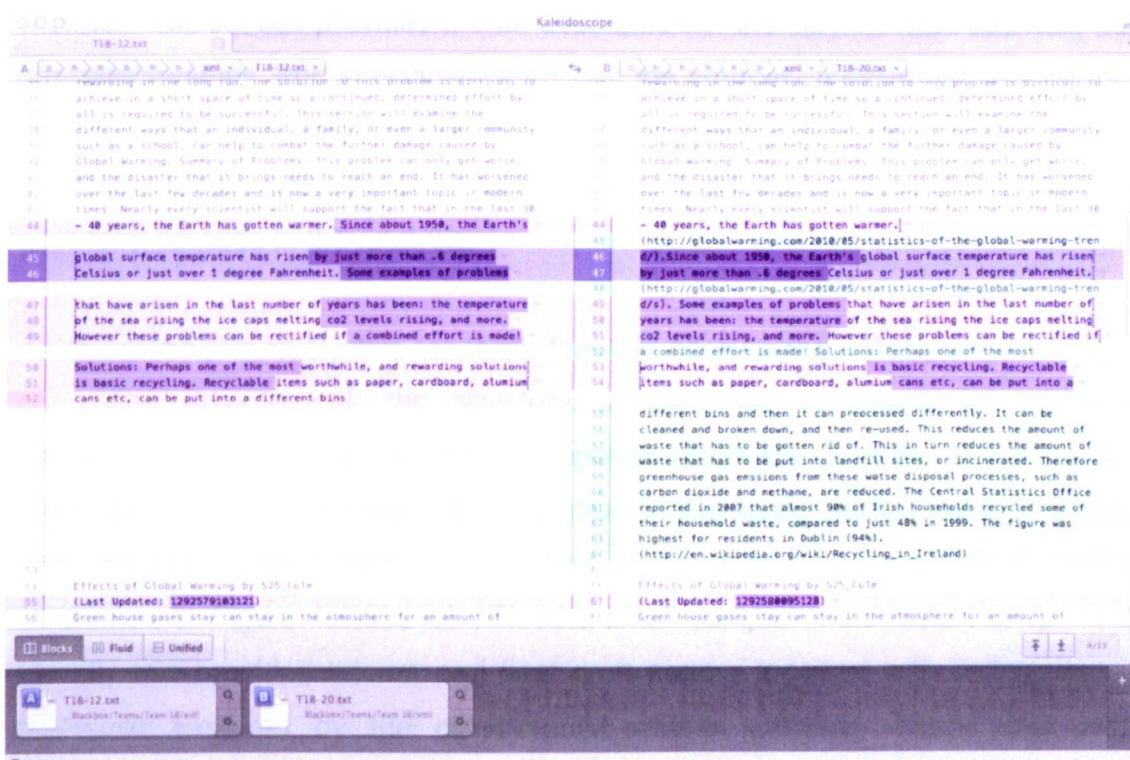


Figure 4.12
Nominalised Text Evolution Analysis aided by Kaleidoscope

In order to examine the comments and the impact on the accompanying co-operatively written reports, the discourse was examined (see Chapter Five for the full analysis) using a linguistic framework, for example, an analysis of speech function and mood with a view to establishing tenor relationships, use of nominalised processes as a method of realising grammatical metaphor. Hewings and Coffin (2007) used an SFL methodology to examine the writing in multi-party computer conferences associated with single-author writing assignments. They examined the linguistic features of writer representation in discussion forums by examining the use of pronouns in two genres. A variation of the methodology used

by these researchers was applied in this study, as it required adaption for multi-authored documents and the genre of interest (i.e., scientific reports produced by second-level students rather than essays in two aspects of linguistics and second language acquisition).

4.7 Data Selection and Exclusion

There were a considerable amount of data collected throughout this research project which spanned over three years, and included a pilot study and two main studies. This section provides a brief description of the various data sources, their interrelationships, and specifically identifies the sources selected for investigation together with the rationale for selecting the data presented in the following chapters. Where appropriate, it also provides brief explanations for not utilising particular sources in the analysis.

As indicated previously this research focused on evolving collaborative writing in an online environment, the structure of the final document, and possible relationships between the writing and spoken discourse. In order to collect data associated with online collaborative science writing three studies were conducted with the participating schools. The first study, a pilot research study (PRS), (described in Figure 4.4 above) utilised a small sample of students from a single school, and provided interim and final draft papers together with online spoken discourse captured by the collaborative writing software. These data were analysed with a view to preparing a main study and appropriate interventions, should they be required, prior to embarking on the main study. Preliminary genre and nominalisation-evolution analyses were also conducted after the pilot, and an intervention plan and main writing study were planned (shown in Figure 4.5 above). As indicated earlier in this section, the main study did not provide sufficient data for analysis and it was decided to conduct a second main study to gather sufficient data to conduct a meaningful analysis. This results in two main study data sets, which are referred to throughout this thesis as the first main study (FMS) and second main study (SMS). As the focus of this study was concerned with a systemic functional linguistic analysis of the discourse arising from the project the primary focus was on the capture and analysis of the online discourse. Attitudes to collaborative writing, project experiences and science learning were of

secondary interest and there was less emphasis placed on the collection of these data. It was decided to collect some additional contextual data before and after the writing projects, and throughout the collaborative writing gaining (interventions) phases only, in order to minimise the workload on the students and teachers.

The analyses required final drafts for nominalisation and genre analyses, introduced in sections 2.3 and 2.4 of the Literature Review. Further details on the data typically used in SFL nominalisation and genre analyses of final drafts are also given in Chapter 4. Examination of evolving nominalisation throughout the writing project, and possible relationships with accompanying online spoken discourse required capture of interim drafts, as outlined in section 2.6. Data sources that were peripheral to these analyses were not included, therefore.

The data collected included:

(i) *Final Papers*: In total, eighteen online collaborative writing teams were constructed with an initial allocation of four students per team. Several teams did not complete any writing tasks or had students that withdrew from the project which resulted in thirteen collaborative-writing papers; one from the PRS, and six each from the FMS and SMS. Of these, three papers were selected for final-draft and temporal-draft analyses; one paper per study. The three primary factors associated with the selection of the candidate papers were: that papers were “complete”, i.e. those containing complete sections with contributions from all writers; that papers had many drafts (approximately 80-100) spread over the writing period; that papers had accompanying spoken discourse (teacher-student and student-student). These factors were derived from the research questions which focused on the linguistic structure of the final papers (nominalisation), the temporal evolution of nominalisation, and the interrelationship between paper evolution and spoken discourse. In the case of the PRS, there was only one paper that met these criteria and was selected for analysis. There were several candidates in each of the FMS and SMS therefore two papers, one from each study, were selected at random. The final drafts of the chosen papers are shown in Appendix B. Selected examples of evolutionary text appearing in the interim paper drafts of the three analysed papers are shown in Appendix C.

(ii) *Online Spoken Discourse (Commenting Discourse)*: The collaborative writing software provided mechanisms for students to communicate publicly with co-writers, and privately with their teacher. It was also possible for the teacher to communicate publicly or privately with individual students. The timestamped public comments were always associated with a particular section and remained available for viewing throughout the lifetime of the writing project. Private messages were also timestamped, but could be deleted by the teacher or student. A record of all private messages, undeleted or otherwise, was kept for later analysis. All of the thirteen final papers referred to earlier had accompanying spoken discourse. Only the spoken discourse associated with the three selected papers were used in the analysis, however. The comments associated with the final drafts of the chosen papers are shown in Appendix B.

(iii) *Online Spoken Discourse (Planning Discourse)*: The collaborative writing software also provided an online planning forum for each collaborative writing team. This recorded unstructured comments from all team members and their teacher. The teacher made the first post to the forum giving instructions on what was expected of the team in terms of paper organisation, task assignment and individual responsibilities. There were thirteen Planning Discourse forums captured, one for each of the successful collaboratively written papers described above. These data were not included in the research analysis as this research was primarily focused on the collaboratively written paper. These data would be more suited to an analysis on collaborative planning which was not the focus of this research. Furthermore, they could be used to provide further insight, or rationale, when evaluating the project overall. A sample of these data are presented in Appendix F.

(iv) *Survey Questionnaire (Pre- and Post-Intervention)*: Pre- and Post-Intervention surveys were conducted to determine background information on previous student participation in team-based and/or collaborative writing projects. There were five main categories of question that related to individuals; participation in previous team-based projects, participation in previous team-based collaborative writing projects, contribution to previous team-based collaborative writing projects, and the kinds of previous team-based projects. Students were also invited to provide comments, or opinions, on their current attitudes to collaborative writing projects.

Two pre-intervention surveys were conducted at the beginning of the collaborative-writing intervention day (structure shown in Figure 4.5) for the FMS and SMS. All students participated in these surveys and a total of 60 responses were collected. The post-intervention surveys were sent to the schools and were completed by students at the end of the writing project. There were fewer returns than for the pre-intervention survey with 23 completed returns. The poor return rate, according to the schools, was due to the end of the writing projects coinciding with study periods prior to end of term examinations. These data were primarily collected for the purpose of adapting the intervention sessions to the previous experiences of the students (pre-intervention survey), and to determine if there were any changes in experiences following the project (list-intervention survey). In general, these data were not intended to be utilised in the research analysis which focused on the structure and evolution of collaboratively written papers, and the investigations of the relationships between document change and spoken discourse. The anonymised survey data have been tabulated and presented in Appendix F.

(v) *Collaborative Writing (Intervention Sessions)*: Samples of student writing during the collaborative-writing intervention days (structure shown in Figure 4.5), for the FMS and SMS, were also collected. These were recorded during short collaborative-writing sessions using paper templates. There were no recordings of the spoken discourse associated with these writing sessions, as the primary purpose was to expose the students to collaborative working and writing prior to engaging in online collaboration. Transcribed and anonymised copies of the collected data are presented in Appendix F, but these were not analysed or used for this research.

(vi) *Research Diary Notes*: A Research Diary was kept throughout the pilot research, and contained a daily record of interactions with the students and teachers, together with the researcher's experiences, biases, and perspectives on the study. This diary was used to plan the collaborative-writing intervention days associated with the main research studies. Apart from informing research planning, these data were not utilised in the analysis of the research data collected during the pilot study.

4.8 Conclusion

This section detailed several aspects of the methodology for a research study of the potential relationship between text-based electronic collaborative exchange and a collaboratively written scientific library research paper genre. Methods associated with three key research questions were discussed in detail. It proposed to evaluate the success of the student papers using a systemic functional linguistic (SFL) theory of language to genre analysis, together with an analysis of grammatical metaphor (nominalisation). The data analyses are presented in detail in the following chapters.

Chapter Five

Are Collaboratively Written Students' Science Texts Authentic?

This chapter will present the results of a systemic functional linguistic analysis of three collaboratively written Library Research Papers. In particular, it details the research findings used to address the first research question concerned with whether the semantic structure and linguistic features associated with collaboratively produced student science library research paper genres reflect that of a typical genre exemplar. The analysis will focus on the use of language using SFL theory and tools of analysis as a means of analysing the students' language use in the library research paper genre.

5.1 Introduction

In order to address the first research question concerned with the authenticity of student science (library research) papers that were produced using an online collaborative writing environment, three aspects of the student papers were considered, (i) what was the degree of alignment between the text-structure of the sample library report genre and that of the final papers? (ii) to what extent did the final papers use the language of science as expected at this level of schooling, for example, use of nominalisation? and finally, (iii) what was the degree of participation and contribution by students in the collaborative writing task?

The analysis presented here utilised a generalised Systemic Functional Linguistic approach to analysing examples of authentic science writing collected throughout several collaborative writing assignments. The sample assignments, or genres, are "real texts" which are "fundamental to the enterprise of theorising language" (Halliday 2004b, p. 34) as they (i) are examples of naturally occurring language, (ii) having language as text, and (iii) are real examples of contexts in which language is used. Furthermore, they are specific examples of scientific

discourse lexically and grammatically organised and realised within an interdisciplinary scientific discipline, i.e., physical and geographical sciences (“physical processes of global warming”).

Specifically, this chapter addresses each of the questions outlined above in turn (sections 5.2 - 5.4) and concludes with an assessment of whether three final papers considered reflect that of a prototypical exemplar. This chapter predominantly addresses the first research question, and the other will be dealt with in later chapters. Section 5.2 reports on an SFL-motivated genre analysis methods used (after So, 2005) to examine the “macrostructure” of the papers for comparison at a genre level. Section 5.3 reports on an analysis of Lexical Density and Nominalisation used to examine the “microstructure” of the sample genres; the SFL method used was that described by Holz (2009). Finally section 5.4, in general, examines the students’ approaches to structural development of their respective sections and genres, and specifically addresses intertextual referencing in the samples using a move-analysis method (after Dudley-Evans, 1994).

5.2 What was the degree of alignment between the text-structure of the sample library report genre and that of the final papers?

As indicated earlier, the library research paper genre is a report on other people's work, documented by library or Internet sources; it is essentially a literature review of material on a specific topic. This genre was chosen as it is one of the most commonly observed, and studied, genres in the different disciplines (Hale et al., 1996) and as outlined in the previous section, it was of pedagogic interest to the school, especially for collaborative writing assignments associated with project work. The library research genre analysis presented here is based on one of the four collaboratively-written library research genres collected during the Pilot Research Study (PRS) described in the previous section. The complete text, together with related student-student (peer) and teacher-student discourse is given in Appendix B. The appendix also includes sample genres from the First Research Study (FRS) and the Second Research Study (SRS). These samples were chosen for analysis as they were (i) reasonably complete final papers suitable for a linguistic analysis establishing the degree of scientific authenticity, (ii) had a sufficient number of drafts in order to perform an evolutionary analysis of

nominalisation, and (iii) had accompanying discourse (from the planning phase and throughout the writing phase). This chapter, and in particular this section, is focused on the linguistic evaluation, while the latter two aspects are covered in Chapters five and six, respectively.

Key features of the project genre (the Library Research Paper - LRP) include: preparation and research, use of sources, information-gathering procedures, organisation of the paper's content, and presentation of references. The purpose of the review may be a state-of-the-art review, a historical review, or a comparison of perspectives. Where there is controversy, the student should take a stand, supported by the library or Internet references. Problems associated with these kinds of writing assignments (topics) include being overly broad in perspective, or the need for expert knowledge to perform interpretation. Additionally, students may not be sufficiently informed to assemble information garnered from the research sources intelligently (Samraj, 2004, p. 6).

This section presents the detailed results of a systemic functional linguistic genre analysis of a sample genre. In practice, the three sample genres referred to earlier were analysed, but this section only presents the results for one. In general, it was found that the resultant sample genres (Library Research Papers) were linguistically similar, across the three studies. The papers written during the PRS were different to the FRS and SRS in that, to a greater extent, they specifically dealt with the physical processes rather than the socio-cultural issues related to the impacts of global warming, and subsequent methods to address the problem. Furthermore, the latter genres contained twice as many sections as the PRS sample, which meant that the students wrote more, in general, and had to focus on a wider variety of topics. It is believed, following the analyses, that this increased writing load (i.e., more sections) may have increased the complexity of the writing task, as the students appeared not to engage in, or engaged poorly with, intra-textual referencing.

Students participating in the PRS conducted the writing over a focused two week period; writing every day in a supervised classroom environment. Students in the FRS and SRS wrote their genre over much longer periods (~ 6-8 weeks), did not write every day, and encountered significant disruptions throughout the writing

period, for example, inclement weather which closed schools and stymied momentum. Furthermore, during the FRS and SRS, one of the teachers was unable to continue mentoring so in both cases the students did not have a definite termination; the activities waned towards the end of the study and participants became disillusioned. This may also have been a significant contributor to the lack of document revision in response to the MASUS feedback provided by the teacher (discussed in more detail in Chapter six).

As indicated in Chapter Three, it was decided, therefore, to adopt So's (2005) analysis framework for genre analysis of the final texts to provide insight into the research question "*How successful are science papers collaboratively produced in an online environment?*"; i.e., successful science papers are those which would appear to be typical of the genre, where typicality is guided by So's genre analytical framework. Her framework was applied to three final drafts, one selected from each of the research studies described earlier. It was found that the sample genres were all similar contextually and linguistically. Tables 5.2.1 - 5.2.4 provide the detailed breakdown of one analysis, i.e., the analysis for a paper selected from the Pilot Research Study (PRS).

Table 5.2.1 is an analysis of the writing context for the sample genre. The first contextual feature difference between the sample paper presented in this section and the other genres analysed was the duration of the writing project. For the PRS, the writing duration was one week, however, there were longer writing periods associated with the other writing exercises (as described earlier in Chapter Three). Furthermore, the PRS was the only one of the three studies where the writing project was completed to the satisfaction of the researcher. This meant that the organisation of the final drafts analysed were considerably different from each other. The PRS sample was truly final, whereas the final draft for the other two research studies (FRS and SRS) were the terminal drafts available for analysis. In the later research studies the projects were terminated early, as explained previously. Nevertheless, the drafts selected were good exemplars of the student writing collected across the three-year study, examples of authentic writing in context, and suitable for linguistic analysis.

A second contextual feature that differentiated the PRS sample from the latter two studies was the training context for the latter studies; again, the differences have been described in detail in the methodology chapter. A third, and final, contextual feature difference between the sample shown in the following papers, and the other genres analysed was the reference material used for the writing project. In the PRS the students use a pre-selected group of, primarily physical science related, reference papers supplemented by material sources by the student writers on the Internet. The students participating in the later writing projects used a mixture of reference material selected by the students and teachers and these resources were predominantly socio-cultural with few physical science related contents.

Analytical Framework - PCS Library Research Paper

Contextual Analysis

1. Genre type and subtypes	It is a collaboratively written school-based library research paper written in the school situation, based on four reference sources (texts) selected by the teacher. It may also be referred to as an internet research paper and is also similar to an argumentative essay .
2. Context of situation	
(a) Mode	Discourse collaboratively written as classroom assignment, to be submitted to the teacher for commenting.
(b) Tenor	Students (collaborative writing group) -> teacher (as assessor) and classmates. Apart from the teacher's expectation each student needs to adjust the tone to the collaborative writing group members.
(c) Field	It is concerned with the physical processes of global warming. This includes the relationship between global warming (climate change) and increased levels of carbon, methane and water vapor.
3. Purpose	The primary purpose of this text is to collaboratively identify and explain the physical properties of global warming as derived from four scientific texts selected by the teacher. This should be achieved by working and communicating collaboratively, with each student writing an agreed section based on one reference source.
4. Institutional practice/discourse community	<p>This is a collaborative writing task written by students in a classroom based on given instructions, team construction, a series of reading sources, and metalinguistic activities (<i>e.g.</i> genre explanation, collaborative writing function). The students communicated with each other and their teacher, wrote their texts, rated other students' writing, and engaged in informal discourse using an online collaborative writing environment called EVE. The writing teams were constructed by the teacher based on her knowledge of the class. This setting imposed certain constraints, for example, students had to establish online identities, write collaboratively using previously unseen online software, engage in peer and teacher communication using the software, and read texts not typically encountered in the school context.</p> <p>The writing period was one weeks' duration. Students could communicate, read or write (using the software) in class and also had access to the software outside of scheduled classes and from home. All students had access to computers and broadband from home.</p> <p>The online collaborative writing software imposes certain production processes that influence the schematic structure of the text. The process encapsulated in the system demands the following phases: informal discussion on topic, formal discussion on paper's section identification, selection of section titles, section writing and commenting phase, closing phase and section aggregation.</p>
5. Socio-cultural context	This topic was chosen as the teacher indicated that it was of interest to students, was suitable given their science education experience to date, and because the students, in general, had an interest in and opinion on environmental issues.

Table 5.2.1

Genre Analytical Framework (after So; 2005) - Contextual Analysis

Analytical Framework - PCS Library Research Paper

Linguistic Analysis

Introduction^Discussion^Conclusion^References

Introduction (first section): The first section (Introduction to Global Warming) introduces the topic, and presents a structure for the section, not the entire text. Each section provides some form of introduction and includes "Informational" and "Finding" moves. The first section includes the highest total for Informational, Finding and Explanation moves, and includes no Recommendation moves.

Discussion (second section): Each of the following sections (The Physical Changes behind Climate Change, Methane Produced By Plants, Carbon) contribute to a "discussion", although there is no formally identified discussion section. Each section includes a series of Finding, Statement of Result and Reference to Previous Research moves. The move structure in each of the sections is erratic, and does not follow a definite, or expected, pattern, for example, Informational, Findings or Statement of Results, References to previous research and followed by Explanations or Claims. Each section presents an isolated, and contributory, aspect of the physics of global warming, but no section discusses the complex dynamics of global warming. The Informational moves are predominantly contextualisation. There are two "Unexpected outcome" moves in the third section.

1. Semantic Structure

Conclusion (fourth section): There is no formal Conclusion in the text. The last three sections include Recommendation moves, which elaborate on what needs to be done to reduce global warming and subsequent effects. The recommendations are directed at humanity, governments, countries, the school and individuals.

References (final section): These are included but are incorrectly presented. There are ten direct "Reference to previous research" moves in the text. None of these directly refer to the sources used but, in general, refer to scientists, studies and tests.

The organisation of the text, i.e., an aggregation of related topics, rather than a coherent *Introduction^Discussion^Conclusion^References* structure likely related to the social/institutional practice and purpose described above. Each section contains a locally organised set of Informational, Finding, Explanation and Recommendation moves (see section 5.4 on Movement Analysis). Participants had no previous collaborative writing experience, did not use the software previously, and were unskilled in commenting/rating other writing team members' contributions.

The local organisation of the individual sections is similar to the structure of the reference sources used by the participants.

Table 5.2.2

Genre Analytical Framework (after So; 2005) - Linguistic Analysis (Semantic Structure)

Analytical Framework - PCS Library Research Paper

Linguistic Analysis

2. Linguistic Features

- | | |
|--------------------------|---|
| a. Experiential meaning | The use of “we” (referring to humankind) occurs in 24 of the 59 (40%) moves, and only once referred to the writing team (Section 3; “argument we would like to make”). Also in Section 3, the writer refers to himself once (“seems most logical to me”). An analysis of the interim writing products (text evolution over the writing period) shows that, in general, two writers’ earlier versions of the sections included sentences that were personalised (“I” and “me”). These were later (consciously) changed to convey a team perspective. It is expected, therefore, that the remaining “me” is an editorial oversight. Scientists, as a group, are highlighted in the majority of the Reference to previous research moves. |
| - Participants | |
| - Verb (process) types | <p>Actional Verbs (verbs of doing): 59%</p> <p>Relational Verbs (verbs of being or having): 30%</p> <p>Mental Verbs (verbs of thinking, perceiving and feeling): 9%</p> <p>Verbal Verbs (verbs of saying): 2%</p> |
| b. Interpersonal meaning | Mixture of formal and informal. Tends to be formal when presenting findings or making statements, although usually supported by an unspecific reference. Conversational in two places with the use of “we” and “I” occurring only twice. Earlier drafts were much more personalised but were redrafted following comments from the teacher. The text is packed with: Conditional sentences (10 “If” sentences), Modals (Epistemic positive and negatives - “can”, “can/not”, “will”; Remote Epistemic positives - “could”, “should”, “might”; Direct and Remote (epistemic) positive modals followed by “have”), Involvement and personal tone (written with perspective of humankind - “we”), No use of personal mental clauses, Rhetorical questions (“Why?”), Evaluative lexis (e.g. “a bit too hard on ourselves”) |
| c. Textual meaning | |
| - Theme | It relies on conjunctive adjuncts to show relationships between phrases and construct contexts for clauses: conjuncts (“therefore”), heavily used coordinating conjunctions (“and”, “but”). Mostly commenting adjuncts with some mood adjuncts. |
| - Connectives | There are connectives in the text: Some Cause and Effect (“in order to”, “so”) and many Concession (“but”, “however”), and some Listing (“first” but no “second”, etc.). Some explicit Exemplification (“for example”, “of course”). |

Table 5.2.3

Genre Analytical Framework (after So; 2005) - Linguistic Analysis (Linguistic Features)

Analytical Framework - PCS Library Research Paper

Linguistic Analysis

Grammatical Metaphor

Nouns that can be used as verbs are included in the text. Certain words such as “earth” (in this register - environmental science) refer to the noun “Earth” rather than the verb “to earth” which would be more typical of a text referring to electricity.

Also, the noun phrase “Greenhouse Effect” is a nominalised term (to replace “the effect of greenhouse gasses on the Earth’s atmosphere” is a key nominalisation used by one writer). It is also presented as a nominal group, for example, “natural greenhouse effect” and “significant greenhouse effect”. The verb “to question” is nominalised and presented in a nominal group - “main question”, “most important question”, “last question”.

Nominalisation of the verbs “to change” and “to increase” appear frequently, for example, “our increase”, “global increase”, “16.8% increase”, “such a dramatic increase”. “Increase” is used as a verb (rather than a noun) as frequently as it is nominalised. “Change” is used exclusively in noun form.

There are many verbs conveyed as objects or things, and are used in the “-ing” form, for example, “causing”, “occurring”, “happening”, “increasing”, “burning”, “flooding”, “growing”, and there is at least one elaborate construction, i.e., “adopt recycling methods at home and at school”.

3. Intertextual analysis

Participants did not cite sources. The sources are listed at the end of the document but are not specifically cited in the text. Each writer has drawn on the reference source provided. With the exception of one small phrase, the writers have not directly quoted the original texts. A comparison of the full text with reference sources (those provided and those available online) using the Turn-It-In Digital Assessment Suite (Plagiarism Prevention) indicated that there is less than 10% similarity to the original sources. The similarities are mainly in the use of technical terms.

Table 5.2.4

Genre Analytical Framework (after So; 2005) - Linguistic Analysis (Grammatical Metaphor)

Table 5.2.2 outlines the semantic structure of the sample genre, which consisted of four distinct sections, each written by a different student; this differed from the latter research studies’ samples in that they had eight separate sections, with two

sections assigned to each collaborative writer. The organisation of the text appeared to be an aggregation of related topics, rather than a coherent *Introduction, Discussion, Conclusion, and References* structure (in the case of the PRS). Each of the sections contained a locally organised set of Informational, Finding, Explanation and Recommendation moves (see section 5.4 on Movement Analysis). The local organisation of the individual sections was similar to the structure of the reference sources used by the participants. In general, students had difficulty implementing a coherent conclusion or introduction. These sections tended to contain summaries of the writers' findings or arguments, but neglected to provide appropriate information on the structure of the genre, for example.

Tables 5.2.3 and 5.2.4 summarise the linguistic features associated with the genre, which has many features that are typical of a library research paper. In each of the three papers considered, there was a clear message conveyed by the writers; as established in the pre-writing discussion. An interesting feature of all papers, however, was the lack of cohesiveness across the genres as a whole, which meant that the meaning conveyed in the whole paper appeared to be an aggregation of several un-unified themes. In the PRS, the students did not cite sources in the text, perhaps because the sources were provided. There were a number of citations in the FRS and SRS, but citation in general was uncommon. There was little evidence of intertextuality or intratextuality across all papers. This will be discussed further in section 5.4 below.

5.3 To what extent did the final papers use the language of science as expected at this level of schooling, e.g. use of nominalisation?

This section reports on an SFL-based, comparative, quantitative nominalisation analysis of three collaboratively written final genres, one from each of the research studies described earlier. Nominalisation, as indicated earlier in the literature review, is an acknowledged powerful linguistic technique for realising grammatical metaphor, and contributes to complexity in scientific language. Using nominalisation, processes and properties are re-construed metaphorically as nouns, resulting in informationally dense text. Following the method of Holz (2009), a quantitative comparative analysis of instances of nominalisation in the three sample genre was conducted. A quantitative analysis of the relationship

between nominalisation and information density within the student papers was also conducted.

The purpose of these analyses was to ascertain if the student writing demonstrated features typically found in related scientific discourse, i.e., informationally dense and extensive realisation of grammatical metaphor through nominalisation. Although, the sample is small (only three papers), a comparative analysis was conducted to identify similarities and differences in the resultant quantitative data.

Prior to the quantitative analysis, every example of student writing was manually examined for occurrences of grammatical metaphor, and it was established that there were sufficient instances of nominalisation to warrant a quantitative study. A typical example of grammatical metaphor (realised using nominalisation) occurring in the texts investigated, for example, was the use of the word "*argument*" rather than "*argue*" (or "*enhancement*" rather than "*enhance*") - the words were lexically different but they encoded the process (arguing or enhancing) in noun form.

A useful feature of nominalisation, as a form of grammatical metaphor, is that it supports the inclusion of modifiers and qualifiers. One such example, found in one of the student papers (shown in Appendix B), was "*scientists make a good argument*" which is a packed version of "*scientists argue that*". The former is a more packed version of the latter in that it allowed the writer to use nominalised processes to concentrate information, especially when used in argument construction, i.e., using "*good*" implied that the writer was commenting on the research ("*argument*"), taking a stance and showing agreement. Later in the same text, the nominal group "*greenhouse effect*" (essentially a packed version of "*the effect of greenhouse gasses on the Earth's troposphere*") dominated the first section, and its concentrated use (as a nominal group) provided writers with opportunity for pre and post modification, for example, "*natural greenhouse effect*", "*significant greenhouse effect*". In later sections, the nominalised group "*physical change*" was used, semantically, as a replacement for "*greenhouse effect*".

The first stage in the quantitative analysis of nominalisation, described in the following section, was to establish the *Lexical Density* for the student papers.

Lexical density measures the ratio of content words to grammatical (or functional) words in a text. Halliday and Webster (2006) identify lexical density in general terms as “how tightly the lexical items ... have been packed into the grammatical structure”, and further define it as the “number of lexical items per clause” (p. 168). They indicated that in science writing the lexical density may be as high as 10-13 (for lexical items per clause).

5.3.1 Lexical Density

Lexical density measures the ratio of content words to grammatical (or functional) words in a text. Content words include nouns, adjectives, most verbs, and most adverbs and grammatical words include pronouns, prepositions, conjunctions, auxiliary verbs, some adverbs, determiners, and interjections. As indicated in the previous section, texts that contain many content words typically convey more information and have a higher lexical density.

Identifying the lexical words in the three sample Library Research Papers under investigation was accomplished using Stanford's open source part-of-speech (POS) tagger (Toutanova et al., 2003). The tagger labeled all of the words in each student paper with POS tags indicating whether they were verbs, nouns, adjectives, and adverbs using the Penn Treebank tag set, for example, tokens that have a POS tag that starts with a "V" (VB, VBD, VBG, VBN, VBP, and VBZ) are verb forms. It was a relatively straightforward task to write Perl programs to calculate and produce frequency lists of the various lexical words, shown in Table 5.3.1 below. This table provides calculations of the Lexical Density for (i) three sample genres, i.e., one sample genre selected from the Preliminary Research Study (PRS), the First Main Research Study (FRS) and the Second Main Research Study (SRS), and (ii) a summary of Holz's (2009) quantitative analysis of lexical density for 12 sample scientific research articles, for comparison purposes.

A comparison of the calculated lexical density data for the three papers analysed indicates that they were almost identical, quantitatively, speaking. All three papers had a similar lexical density (~54-55%) and the relative proportions of the different classes of lexical words were also similar. A comparison of the individual, and

average (not shown), genre data with that of Holz (2009) shows that the student papers had slightly higher lexical density profiles to the average measure (50.5%) obtained in her study of twelve scientific articles containing 420,000 tokens.

For this research, nouns were the most frequent lexical word in the three sample genres which, according to Holz (2009), indicates a strong use of a nominal style in the selected genres, which would be expected in this kind of scientific discourse (Biber et al.; 1999). Lexical verbs were the second most frequent type of lexical word, followed by adjectives and adverbs, respectively. Holz (2009) describes the relative proportions of adverbs and adjectives in relation to their modification of verbs and nouns, respectively. Since nouns were proportionally more frequent than verbs in the student papers, it would be expected that adjectives also be proportionally more frequent than adverbs, which was the case. Holz (2009) compared both research articles and abstracts, and found that the lexical density profiles were significantly different. For this research, it was clear that the collaboratively written student genres compared favourably with the lexical density profiles of genre exemplars.

Lexical Words	PRS		FRS		SRS		Holz (2009)
	Count	Percentage	Count	Percentage	Count	Percentage	
Nouns (N)	639	49%	529	48%	839	52%	54.02%
Adjectives (ADJ)	178	14%	185	16%	226	14%	15.18%
Adverbs (ADV)	115	9%	89	8%	107	7%	6.77%
Lexical Verbs (LV)	373	28%	311	28%	423	27%	24.03%
Lexical Tokens (Σ)	1305	100%	1114	100%	1595	100%	(212,472) 100%
Total Tokens	2413		1998		2955		420,000
Lexical Density	54%		55%		54%		50.5%

Table 5.3.1

Lexical Density calculation for (three) Student Papers and that computed by Holz (2009)

The following section examines, in greater detail, the kinds of nominalisations that occurred in the student papers, and compares the results with those typically found in similar scientific discourse.

5.3.2 Nominalisation Analysis

This section presents a comparative analysis of the various nominalisations that occurred in the student papers. Specifically, it deals with three sample genres; one drawn from each of the research case studies.

Nominalisations can be derived from verbs (for example, discover - discovery), adjectives (for example, carelessness - carelessness), or nouns (for example, child - childhood). For this research, however, nominalisations derived from nouns were not considered as they do not play a significant role in scientific discourse. Identifying, extracting and computing frequency distributions for all the nominalisations within the three sample genre was accomplished using the Stanford POS tagger and custom-developed programs. Following the selection approach used by Holtz (2009), the following nominalisation sets were extracted from the sample genres:

- (i) those derived from adjectives, originally realising properties, by querying for nouns ending in the suffixes -ity (complex - complexity) and -ness (thick - thickness);
- (ii) those derived from verbs, originally realising processes, by querying for nouns ending in the suffixes -age (store - storage), -al (propose - proposal), -(e)ry (discover - discovery), -sion / -tion (discuss - discussion / motivate - motivation), -ment (argue - argument), -sis (synthesise - synthesis), -ure (proceed - procedure), and -th (grow - growth).

Furthermore, nouns ending in above mentioned suffixes (for example, global, earth), which are not instances of nominalisation, were identified using the POS (Parts of Speech) tagger, and then manually deleted. Holtz (2009) did not consider nouns ending in the suffix -ing, likewise, these were not considered in this study due to the “extensive manual proofing required to correctly classify them as either instances of nominalisation derived from verbs or not, for example, as gerund”. For this considerably smaller study, the POS tagger was used to identify

nominalisations by identifying all of the -ing tokens and eliminating those tagged to be the gerund form (i.e., tagged with _VBG - verb, gerund or present participle). No systematic manual checks were performed, although, several randomly selected tokens were checked using the Oxford English Dictionary online.

The extracted nominalisations are shown in Table 5.3.2 below and are ordered using the method of Holtz (2009) for comparison purposes, i.e., the -ing tokens have not been included. The -sion/-tion (verb) nominalisations occur more frequently than any other form, ranking 33%, 48% and 37% for the PRS, FRS and SRS respectively. These results indicated that there was general similarity within cases analysed for this study, and that the genres had nominalisation frequencies consistent with all research disciplines examined in Holtz (2009). The next highest nominalisation category is the -al (adjective) nominalisations with 23%, 16% and 17%. Research has shown that -al nominalisations are generally higher in linguistics discourse, not science, but repeated use of the word “physical” in the student papers is probably contributing to the high frequencies extracted.

The extracted -ure nominalisation was significant for two of the papers (PRS and SRS). This was most likely related to the subject matter under discussion in the papers selected for analysis (Global Warming), i.e., frequent use of the nominalisation “Temperature”. This kind of nominalisation, functioning as a technical term, is an example of a dead grammatical metaphor - it can no longer be unpacked. Similarly, occurrences of “global” and “warming” are related to the linguistic practice associated with the research topic. Interestingly, the intention when specifying the writing topic, was to consider the “physical process” of global warming, thereby contextualising it within a physical sciences discourse and language register. However, almost all student writing teams ignored the physical science discourse and opted instead for a more interdisciplinary discourse. This also contributed to the lexical density of the selected genres, as outlined in the previous section. This thematic difference was evident in the three sample student papers selected for investigation here, i.e., in some instances “global warming” is the subject, and in other instances it is the object:

- (i) For the PRS LRP “physical processes” is the subject (cause) and “global warming” is the object (effect),

- (ii) For the FRS LRP “global warming” is the subject (cause) and “prevention” and “impact” are the subjects (effects),
- (iii) For the SRS LRP “physical processes” and “global warming” (causes) are both subjects, while “global warming” and “consequences” are the objects (effects).

The implication of this variation in object and subject, it is believed, is that there are different kinds of nominalisations present in the three sample texts, and that these may be related to the different kinds of scientific discourse associated with different scientific subjects.

Nominalisation	PRS		FRS		SRS	
	Count	Percentage	Count	Percentage	Count	Percentage
-age	7	7%	4	5%	8	9%
-al	22	23%	13	16%	16	17%
-(e)ry	9	9%	8	10%	6	6%
-sion / -tion	32	33%	38	48%	34	37%
-ity	5	5%	7	9%	9	10%
-ment	7	7%	5	7%	3	3%
-ness	0	-	0	-	3	3%
-sis	0	-	0	-	0	-
-ure	13	14%	4	5%	9	10%
-th	2	2%	0	-	5	5%
Nominalisation Tokens (Σ)	97	100%	79	100%	93	100%

Table 5.3.2
Nominalisation in sample (three) Student Papers

The three sample student papers contained 2413, 1998 and 2955 running words (total tokens) respectively, from which 639, 529 and 839 were nouns (nouns tokens), respectively (as shown in Table 5.3.3 below). There were 97, 79 and 93 instances of nominalisations (nominalisation tokens), respectively. The nominalisation rates for the selected papers were, therefore, one per 23.87 running words (or one per 6.58 nouns) for the PRS, one per 25.29 running words

(or one per 6.69 nouns) for the FRS, and one per 32.20 running words (or one per 9.02 nouns) for the PRS. These compared favorably with the results calculated by Holtz (2009) who found that nominalisation rate in her corpus of research articles was one per 26.12 running words (or one per 7.12 nouns). Holtz (2009) also found that nominalisation was a significantly more frequent linguistic phenomenon in the abstracts than in the research articles themselves. For this research, it was decided to only focus on the combined nominalisation rates because (i) the corpus of student papers under investigation was small, (ii) the number of total tokens was small, and (iii) in many instances students did not provided abstracts, or provided extremely short abstracts.

For the sample student papers, the nominalisation was generally similar across the nominalisation types, and nominalisation rates. The PRS and FRS were exceptionally similar (approximately 6.5 nominalisations per noun) while the SRS was lower at approximately 9 nominalisations per noun. This decreased rate may have been due to (i) the greater range of nominalisation types used by the writing team, and (ii) the greater number of noun tokens in the longest genre investigated. Holtz (2009) provides some insight into identifying the reason for different nominalisation rates in that different subject domains have preferred nominalisation, for example, biology papers have the widest vocabulary range while computer science has the lowest. For this writing project, while the overall theme of the three sample student papers analysed are broadly similar, the thematic content within the individual section differed considerably, i.e., some were more physics orientated, some were socioeconomic and some were general. Perhaps an analysis of the lexical density on individual sections would have provided more insight, but with such a small sample, the significance of these results would be questionable, and therefore was not conducted.

Earlier, it was mentioned that the -ing nominalisations were extracted for additional analysis. The nominalisation types and frequencies for the three sample student papers are shown below in Table 5.3.4(a) and Table 5.3.4(b) below. In total, 100 different nominalisations were extracted, with 77, 67 and 91 unique occurrences for the PRS, FRS and SRS, respectively, providing nominalisation rates (per noun) of 8.29, 7.89 and 9.21, respectively. Again there was general agreement in terms of nominalisation rates, although there appear to be different classes of

nominalised terms within the three papers, with those from the PRS being more typical of a paper dealing with physical processes of global warming rather than socio-cultural concerns about global warming. The papers in the FRS and SRS were technically orientated, but not to the extent hoped, and offered little in the way of explaining the physical process of global warming.

	PRS	FRS	SRS
Noun Tokens	639	529	839
Nominalisation Tokens	97	79	93
Total Tokens	2413	1998	2955
Nominalisation Rate (per noun)	6.58	6.69	9.02
Nominalisation Rate (per running word)	23.87	25.29	32.20

Table 5.4.3
Nominalisation Rates for sample (three) Student Papers

One reason that the preliminary and the later research studies differ in terms of focus could have been the differing reference material used by the writing teams. In the case of the PRS students were provided with five key references by the teacher and not selected by the students themselves. The reference samples were chosen from a selection of about ten sample papers, with varying degrees of readability difficulty, provided by the researcher. Also, each student was provided with a printout of the paper, rather than providing access electronically via a link. In the case of the FRS and the SRS, students researched the topic using Google and chose their own references. With Google searches (using term “physical processes of global warming”, for example), the technical papers (of interest for the writing exercises) are only accessed using Google Scholar and the links are provided at the top of the search results page. However, the majority of the links provided in the search related to impact of global warming or addressing rectification, therefore it was unsurprising that students have utilised these kinds of resources as reference material for their writing projects. Furthermore, the students did not receive instruction from their mentors on appropriate reference material.

Nominalisation (-ing)	PRS	FRS	SRS	Nominalisation (-ing)	PRS	FRS	SRS
absorbing	1			depending		1	
according		1		destroying			1
adjusting			1	developing		1	
becoming	1			drafting	1		
beginning	1	1	1	driving	2		1
being	4		2	emitting	1		
breeding			1	encouraging		1	
bringing		1		escaping	3		
building	1			expanding			2
burning	2	1	1	expecting	2		
carrying		1		finalizing	1		
causing	3	1	4	finding			2
changing				flooding	1		
combating	1			getting			1
coming			2	giving		1	
composting		1		going	2	1	1
conditioning		1		growing	3	1	
considering	1			hammering	1		
continuing		1		happening	1		2
contributing	2			having	1		1
cooling		1		heating		1	
creating			1	impacting			1
cutting	1			incasing	1		
cycling			1	including	1		1
damaging	4			incoming	1		

Table 5.4.4 (a)
Nominalisation (-ing) Frequency in sample Student Papers

Nominalisation (-ing)	PRS	FRS	SRS	Nominalisation (-ing)	PRS	FRS	SRS
increasing	2	1	3	releasing	1		
interesting	3			relying			1
keeping	2			removing	1		
leading		1		resulting	1		2
leaving		1		returning			1
living	1	1		revising	1		
making			4	rewarding		1	
melting	1			rising	1	1	1
melting		1	2	sharing	2		
migrating			2	shrinking			1
mining		1		stalking			1
noting		1		starting	1		
occurring	1		1	storing	1		
ongoing			1	striving	1		
overheating				suggesting	1		
packaging		1	1	surprising	1		
parking		1		surviving			1
preventing	1		2	swimming			1
producing	1			switching		1	
ranging		1		taking			1
reaching	1			trying	1		
reading	1			using		1	4
recycling	1	1		waiting			1
reducing	1		1	waking			1
refining		1		warming	3	32	31

Table 5.4.4 (b)
Nominalisation (-ing) Frequency in sample Student Papers

The -ing nominalisation rates per noun are given below in Table 5.4.5 below. There were similar nominalisations rates (for -ing) across the three papers, with the SRS having the highest rate (at 9.21) and the FRS the lowest (at 7.89). The SRS paper was the longest, and there were several repeated statements in a number of the sections which contributed to the higher nominalisation rates.

	PRS	FRS	SRS
Noun Tokens	639	529	839
-ing Tokens	77	67	91
Total Tokens	2413	1998	2955
Nominalisation Rate (per noun)	8.29	7.89	9.21
Nominalisation Rate (per running word)	31.33	29.82	32.47

Table 5.4.5
Nominalisation (-ing) Rates per Noun in sample Student Papers

One interesting observation from Table 5.4.4, which lists the -ing nominalisations, was that there was not significant overlapping of nominalisations across all the papers. This may also have been related to the different language registers associated with different subjects (i.e., physical sciences, physical geography and social geography).

This section presented a comparative analysis of the various nominalisations that occurred in three student papers, one for each of the research studies. It was shown that there were strong similarities between the lexical density and nominalisation usage in all papers, but with some striking differences, i.e., while the nominalisation rates were similar, the kinds of nominalisations used were different. The students' use of nominalisation in the papers was similar to that in found by Holz (2009) who conducted an analysis of nominalisation usage in science articles. Based on the analysis here, it would be reasonable to assert that the nominalisation usage was authentic, and that from this perspective, the collaboratively written genres are authentic.

5.4 What was the degree of participation and contribution by students in the collaborative writing task?

This section considers the students' approaches to structural development of their respective sections and genres, and in particular, examines the overall structure of the genre in terms of the intertextual structuring and referencing in the samples using a move-analysis method (after Dudley-Evans; 1994).

The genre analysis of the semantic and linguistic structure of the sample genre, presented in section 5.2 above, indicated that the sample was not concordant with expectations. This was typical of the other student papers examined. It was shown that from a genre perspective, the semantic structure did not compare favourably with exemplars, and did not bear a strong resemblance to the sample genre provided. This result was particularly interesting, given that it was shown in section 5.3, that (i) the genres compared favourably with the lexical density profiles of genre exemplars, and (ii) the students were competent users of nominalisation techniques. It was decided, therefore, to examine if the genre was just a poorly-constructed organisation of authentic scientific "mini-papers" rather than a coherent whole, i.e., was the organisation of the sample text an aggregation of related topics, rather than a coherent *Introduction, Discussion, Conclusion, and References* structure?

Authentic scientific discourse structure can be considered to be a series of textual (discursive) moves, with each different genre having a typical movement structure. It was decided to perform a text movement examination of three sample student papers using the approach presented by Dudley-Evans (1994). This model has nine moves, most of which could be used for the analysis of the sample genres as they were primarily a discussion of previous results, i.e., Move 1 (*Informational move*), Move 2 (*Statement of result*), Move 3 (*Finding*), Move 4 (*Unexpected outcome*), Move 5 (*Reference to previous research*), Move 6 (*Explanation*), and Move 9 (*Recommendation*). Moves 7 (*Claim*) and 8 (*Limitation*) were not used in this exercise.

The movement analysis findings are shown for the PRS (Preliminary Research Study), First Research Study (FRS) and Second Research Study (SRS) in Tables 5.4.1, 5.4.2 and 5.4.3 below, respectively. The PRS genre consisted of four

sections only, with each student participant writing a single section (S_1). For the FRS and SRS, each student was assigned two sections; a Body section (B_{1-4}) and one of the Abstract (A), Introduction (I), Conclusion (C), or References (R). For all genres investigated, it appears that each individual body section typically contains a locally, and somewhat loosely organised, set of *Informational*, *Finding*, *Explanation* and *Recommendation* moves. The local organisation of the individual sections is similar to the semantic structure of the reference sources used by the participants. The organisational structure of the individual sections tends to begin with *Informational* moves and end with *Recommendation* or *Explanation* moves. The genre sections that deal with scientific issues (i.e., the physical processes) contain more *Finding* moves, and *Statement of Results*, and the sections dealing with recommendations on ways to combat global warming, unsurprisingly, contain a large proportion of *Recommendation* moves. It is clear, however, that inter-sectional movement organisation is not present, in general, although there were some inter-textual references, as outlined in section 5.2 above.

The conclusion for this authentic writing project, therefore, was that semantic structure and linguistic features associated with collaboratively produced student science library research paper genre does not reflect that of a typical genre exemplar. Furthermore, given the paucity of genre-related discourse using the private and commenting messaging systems, it was apparent that participants, (i) having no previous collaborative writing experience, (ii) being unfamiliar with the software, and (iii) being unskilled in commenting/rating other writing team members' contributions, were contributory factors. The individual sections (across all three sample genres examined) related to articulately presenting information, findings and statement of results are the best organised, as are the sections on combatting global warming.

From these data, it appeared that the primary issue with the sample genres is that, although the content is appropriate they are, in general, poorly organised. A key question, therefore, was why was this the case? The students and their teacher discussed, and agreed on the structure in a pre-writing discussion forum, and had time and opportunity to communicate suggestions for improvement, re-organisation, and style, i.e., overall genre structure. There are some indications

that the genres contained elements that are typical of scientific writing, particularly in the writers' use of grammatical metaphor.

No.	Move	S	S	S	S
Move 1	Informational move	4	6	1	5
Move 2	Statement of result	3	2	0	1
Move 3	Finding	6	2	1	3
Move 4	(Un)expected outcome	0	0	2	0
Move 5	Reference to previous research	0	4	3	3
Move 6	Explanation	4	2	1	1
Move 7	Claim	-	-	-	-
Move 8	Limitation	-	-	-	-
Move 9	Recommendation	0	2	1	2

Table 5.4.1 Preliminary Research Study (PRS) Move Analysis Table (after Dudley-Evans, 1994)

Move	A	I	B	B	B	B	C
Informational move	9	0	0	5	4	3	2
Statement of result	1	2	0	5	4	2	2
Finding	2	2	3	9	3	1	1
(Un)expected outcome	0	0	0	0	0	0	0
Reference to previous research	0	5	0	7	0	0	0
Explanation	0	2	0	10	4	0	0
Claim	-	-	-	-	-	-	-
Limitation	-	-	-	-	-	-	-
Recommendation	0	0	0	0	9	0	3

Table 5.4.2 First Research Study (FRS) Move Analysis Table (after Dudley-Evans, 1994)

Move	A	I	B	B	B	B	C
Informational move	3	3	1	11	3	2	1
Statement of result	0	2	3	22	7	12	2
Finding	0	1	3	9	8	10	1
(Un)expected outcome	0	0	0	0	0	0	0
Reference to previous research	0	0	0	2	2	1	0
Explanation	0	3	1	5	6	0	0
Claim	-	-	-	-	-	-	-
Limitation	-	-	-	-	-	-	-
Recommendation	0	1	0	9	0	0	3

Table 5.4.3 Second Research Study (SRS) Move Analysis Table (after Dudley-Evans, 1994)

5.5 Conclusion

This chapter presented the results of a systemic functional linguistic analysis of three collaboratively written Library Research Papers. In particular, it presented research findings used to address the first research question concerned with whether the semantic structure and linguistic features associated with collaboratively produced student science library research paper genres reflect that of a typical genre exemplar. It was found that, while the students' use of nominalisation was similar to that found in typical genres, the student papers demonstrated little evidence of intertextuality or intratextuality. The papers, from a quantitative analysis of lexical density and grammatical metaphor perspective, appeared to be authentic, but do not reflect the structure of authentic genres. For this writing project, the student writers appeared to know how to produce scientific discourse as individual writers, but did not have sufficient skills to collaboratively produce satisfactory authentic genres.

The key findings presented in this chapter will be considered further in the following chapters. Chapter 5 examines the temporal evolution of the sample genres (addressing the second Research Question), and Chapter 6 addresses the impact of the teacher-student and student-student discourse on the collaboratively-written genre (i.e., the third Research Question).

Chapter Six

The Evolution of Collaboratively Written Student Genres

This chapter will present the results of a systemic functional linguistic analysis of three collaboratively written Library Research Papers. In particular, it details the research findings used to address the second research question concerned with how the collaboratively written texts evolved over the lifetime of the writing project.

6.1 Introduction

Using the “final versions” of three student papers for its analysis, the previous chapter established the extent to which the semantic structure and linguistic features associated with collaboratively produced student science library research paper genre reflect that of a typical genre exemplar. It was shown, following a systemic functional linguistic analysis (SFL), that students writing in an authentic science context, were reasonably successful in producing the expected genre. Furthermore, student writers successfully used grammatical metaphor in a fashion that is typical of science writing.

This findings chapter addresses the second research question which is concerned with how students' collaboratively written texts evolve, or change, over time (i) in terms of text structure, and (ii) in terms of key linguistic features. In essence, it seeks to determine if there were specific textual or revision strategies that led to their successful authentic writing within the genre, and the production of successful final papers. The following section presents the findings of an SFL approach to structural evolution of the genres using a revision analysis method applied to all drafts. This is followed by a more detailed examination of the evolution of linguistic features, i.e., nominalisation, over time.

6.2 Structural Evolution of collaboratively written genres

For this research question, a Systemic Functional Linguistic (SFL) approach was chosen to examine the structural evolution of a collaboratively written genre, i.e., a revision analysis of the textual structure for all of the captured drafts. As indicated in earlier chapters, the approach used was based on Aluisio and Gantenbein's (1997) revision analysis methodology as they presented SFL-based categories that may be used to present text-linguistic justifications for revisions that may be understood by the authors and researchers. These categories were based on the work of Gosden (1995), who established that there are four kinds of revision: the addition or deletion of technical detail or statements (category [+TD] and [-TD], respectively), reshuffling statements (category [R]), and rhetorical machining ([category RM]). Rhetorical machining may be further subdivided into three categories: [RMd] which is rhetorical machining of discourse structure and information, [RMc] which related to writers' claims or hypotheses, and [RMp] which relates to the writers' purpose, reasons for, results of research action taken and conclusions reached. For the analysis, pairs of drafts were inspected visually using the Kaleidoscope version management tool (discussed in Chapter 3 - Methodology) which provided visual, colour-coded, indicators of change between draft pairs. The relevant sections were then manually inspected and assigned one of Gosden's revision categories. The analysis utilised 69 and 57 automatically collected drafts for the FRS and SRS, respectively. In reality there were more drafts available, but occasionally pairs of drafts differed by having a new timestamp. This meant that one of the writers examined a section, but did not make any revisions, presumably to read their own or another writer's contribution.

Figure 6.1 shows a summary of the Revision Categories for two of the student papers presented earlier, i.e., those from the First Research Study (FRS) and the Second Research Study (SRS). There were considerably fewer drafts collected in the pilot study, as the software available for that study did not perform automatic draft collection (see Chapter 3 - Methodology), and were not included in this analysis, therefore. We can see, from Figure 6.1, that in the FRS 54% of the revisions were in the Rhetorical Machining category, and the Addition and Deletion

categories numbered 23% and 21% respectively. There were only a few occurrences of Statement Reshuffling (2%). The STS revision summary differed from the FRS in that there were similar numbers of revisions across the Addition, Deletion and Rhetorical Machining categories. i.e., 30%, 34% and 31% respectively. Once again, the writers did not reshuffle statements as this category only occurred 1% of the time. Figures 6.2 and 6.3 provide a detailed list of the revisions, for each draft, for the FRS and SRS, respectively.

With such a small sample of writing, i.e., two writing sessions, it was be impossible to draw any general conclusions from this analysis. However, it was possible, using such data, to describe how the student papers in this research evolved over the writing period. For example, it was interesting that student writers, in these studies, did not appear to engage in reshuffling. A more detailed examination of the rhetorical machining occurring in the individual drafts (i.e., focussing on the actual text changes) provided two interesting insights into the evolution of these particular papers:

- (i) rhetorical machining almost always appeared with an addition or deletion
- (ii) rhetorical machining was almost exclusively [RMd], with a few instances of [RMc]

In the case of (i), the writers generally appeared to change existing text by way of addition or deletion, and incorporated revised text where appropriate. It was rare that rhetorical machining occurs independently of addition or deletion, i.e., rhetorical machining where the meaning is revised by completely replacing clauses, or sentences. Finally, when students removed text it was not saved and reintroduced later; deleted text was not reused. This was established by searching for removed text in all following drafts.

In the case of (ii), the writers focused almost exclusively on discourse restructuring. There were no occurrences where writers revise their claims or hypotheses - they adopted a position and write to support that position, rather than researching, arguing and hypothesising using some revision strategy. One reason for this was that during the writing planning phase of the project, there were comprehensive discussions about the topic (physical properties of global

warming), where each student writer decided on the section they would write. It is clear from the Revision Analyses that the students did not deviate from their writing plan. Finally, the writers did not revise text to incorporate the [RMP] category, as the writing exercise was a Library Research Paper, and such rhetorical machining revisions were unlikely to appear anyway.

Revision Category (Gosden; 1995)	FRS	SRS
Addition of technical detail or statements [+TD]	30 (23%)	30 (23%)
Deletion of technical detail or statements [-TD]	27 (21%)	34 (33%)
Reshuffling of statements [R]	3 (2%)	1 (1%)
Rhetorical machining [RM]	70 (54%)	31 (30%)
Drafts	69	57
Total Revisions	130	104

Figure 6.1
Gosden's (1995) Revision Categories for two writing samples

In examining the Rhetorical Machining, it was also observed that the writers did not deviate from their original planning to any great extent. They only wrote about the topic assigned and did not engage in any intertextual referencing, i.e., they did not refer to the other sections. All revisions were local to the assigned section topic.

The following section presents findings related to the second part of the research question concerned with genre evolution, i.e., the evolution of key linguistic features, in particular, nominalised text evolution.

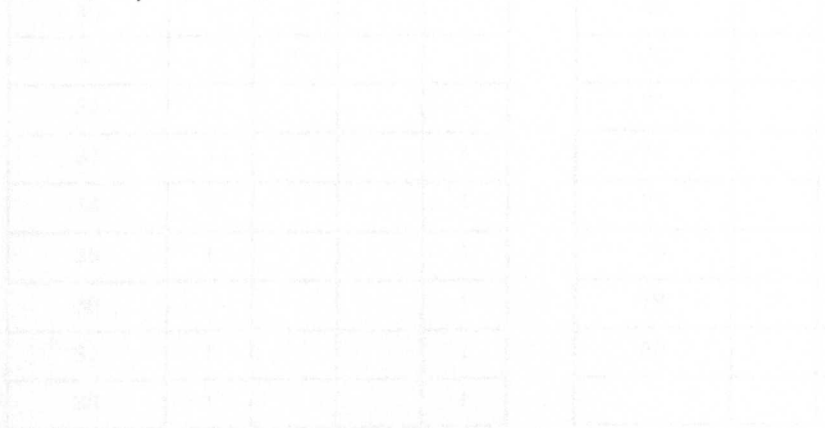


Figure 6.2
Revision Categories for a sample from the second writing sample

Draft	Revision Category			
	[+TD]	[-TD]	[R]	[RM]
1	1			
2	1			1
3				1
4	1			
5	1			
6	1			
8		1		1
9				1
10	1			
11	1			1
12	1			1
13	3			4
14	1			
15				1
16				1
17	1			
18				1
19				1
20	1			
21	1			
22				1
23	1			2
24	1			
25	1			1
26	1	1		
28		2		
30		1		1
31		1		
32				1
33	1			1
34	1			1
35	1			1
36				1
37	1			1
38	1			1

Draft	Revision Category			
	[+TD]	[-TD]	[R]	[RM]
39				1
40	1			1
41		1		1
42				1
43		1		1
44				1
45		1		1
46				1
47				1
49				1
50	2	1		3
51		1		
52				1
53		1		1
54				1
55				1
56		1		1
60				1
61		1		1
62	1			1
63		1		1
64		1		1
65		1		1
66				1
67		1		1
68		1		1
69	1	1		1
70		1		2
71		1		1
74				1
75			1	1
78	1	3	1	4
79	2	2	1	3
80		1		1

Figure 6.2

Revision Categories for a sample genre from the First Research Study (FRS)

Draft	Revision Category			
	[+TD]	[-TD]	[R]	[RM]
1	1			
2				1
3	1			
4	1			
5	1			1
6	2			
8	1	2		2
9		1		
10		1		
11		1		
12	1			
13	1			
14	1	3		2
15	1			
17	1			
18	1	1		
19		1		
20		1		
21		1		
22		1		
23				2
24			1	
27		1		
28		1		
30				1
31		1		
33	1			
36	1			
39	1			

Draft	Revision Category			
	[+TD]	[-TD]	[R]	[RM]
40	1			
41	1			
42	1			
43	1			1
44	1			
46		1		
47	1			
51	1			
55		1		1
56	1			
57	1			
59		1		
61				1
62		1		2
63	1			
65	5			2
66		2		2
70	1			1
72	1			
76		4		4
77	1			
79		1		1
86		2		2
91	1			1
92	2	4		4
95	1			
96	1			
97	1			

Figure 6.3

Gosden's (1995) Revision Categories for a sample genre from the Second Research Study (SRS)

6.3 Text Evolution of key linguistic features - Nominalised Text

A useful feature of nominalisation, as a form of grammatical metaphor, is that it supports the inclusion of modifiers and qualifiers. One such example in the student papers was *“scientists make a good argument”*; a packed version of *“scientists argue that”*. The former is a more packed version of the latter in that it allows the writer to use nominalised processes to concentrate information, especially when used in argument construction, i.e., using *“good”* implies that the writer is commenting on the research (*“argument”*), taking a stance and showing agreement. In this text, the nominal group *“greenhouse effect”* (essentially a packed version of *“the effect of greenhouse gasses on the Earth’s troposphere”*) dominates the first section, and its concentrated use (as a nominal group) provides writers with opportunity for pre and post modification, for example, *“natural greenhouse effect”*, *“significant greenhouse effect”*. In later sections, the nominalised group *“physical change”* is used, semantically, as a replacement for *“greenhouse effect”*.

Examining the progression of the writing for individual genres, by analysing all drafts collected throughout the full writing period, provided some insight into the positive progression of student writing. For example, the genres included gerund use (moving from conveying personal processes, such as *“surprised”*, to more persistent permanent processes, such as *“surprising”*), depersonalisation (evidence of collaboration), and grammatical metaphor (nominalisation and packing).

A gerund (verb that ends in *“-ing”* and functions as a noun), like the other two kinds of verbals, is based on a verb and therefore expresses action or a state of being. However, since a gerund functions as a noun, it occupies some positions in a sentence that a noun ordinarily would, for example: subject, direct object, subject complement, and object of preposition. In this study, there was evidence of considerable gerund usage in the individual drafts, for example, there was repeated usage of the gerunds *“causing”*, *“occurring”*, *“happening”*, *“increasing”*, *“burning”*, *“flooding”*, *“growing”*. There were occasional elaborate constructions, i.e., *“The first thing we can do and has been growing over the last couple of years is to adopt recycling methods at home and at school.”*. In many cases, the gerund

was preceded by an expected verb, for example “keep” or “adopt”, for example, “Well if we keep *burning* fossil fuels the way we are ...”.

Figure 6.4 shows one example of progression towards enhanced grammatical metaphor, in a section on natural methane production. It was particularly interesting as it exemplifies one student writer’s response to another student’s request to depersonalise the text, and to “be a scientific account”, or “a more factual account”. The complete exchange that prompted the changes for the example shown in Figure 6.4 is given in Figure 6.5. This was not an isolated incident, and examination of the draft papers shows that the paper evolution did follow comments that gave clear instructions on how to proceed with changes and did not relate specifically to textual changes, for example, “Kristen your work is very good. Maybe you could put in some more pictures of the animals affected?”.

It is interesting that one student (Student 14) commented on the same subject twice. There was a tone change in the second comment which changed from “it is more supposed to be a scientific account as opposed to be a reflection, afaik” to “afaik, it should be more a factual account than a reflection”. The position of “afaik” (as far as I know) moves to the beginning of the clause and “it is more supposed to be” is replaced with “it should be”, both conveying a more authoritative tone and change the meaning from a comment on the text, to an instruction to change the text. This is an example of the student writer, acting in a rater role, deciding to change the speech function (from a giving role, containing an offer, to a more demanding role, issuing a command), and choosing to do so by changing the grammatical (i.e., semantic) meaning in the latter comment. Further examples of interesting comments of this type may be seen in Appendix C, which contains the final drafts for the three sample genres analysed in this study and also contains the complete list of comments associated with each section.

Figure 6.4 shows the evolution of nominalised text over three drafts from a sample writing assignment in the Preliminary Research Study (PRS). A colour coding scheme was used throughout the analysis to identify evolving clauses over two sentences. In the sample shown, there are four clauses of interest coded in yellow, green, orange and blue. Following a specific colour in the three draft passages, it may be seen, for example, that “I was quite amazed and surprized to hear” and “I

was also surprized to hear”, occurring in two sentences were replaced with “*It was amazing to hear*” and “*surprising also to hear*”, respectively. In redrafting the sentences, and adopting a more scientific tone, the personalisation (indicated by the colour pink) was removed. Finally, the first clause was dropped in the final version of text and only retained in the second sentence. Note also the error injected by the depersonalisation in the second sentence of the final draft; it is missing an “it was” presumably. Another interesting observation in this example is the limited reshuffling arising from rhetorical machining, as discussed in the previous section. Following the green and orange coloured clauses provides similar insights into positive progression of scientific writing by the participant.

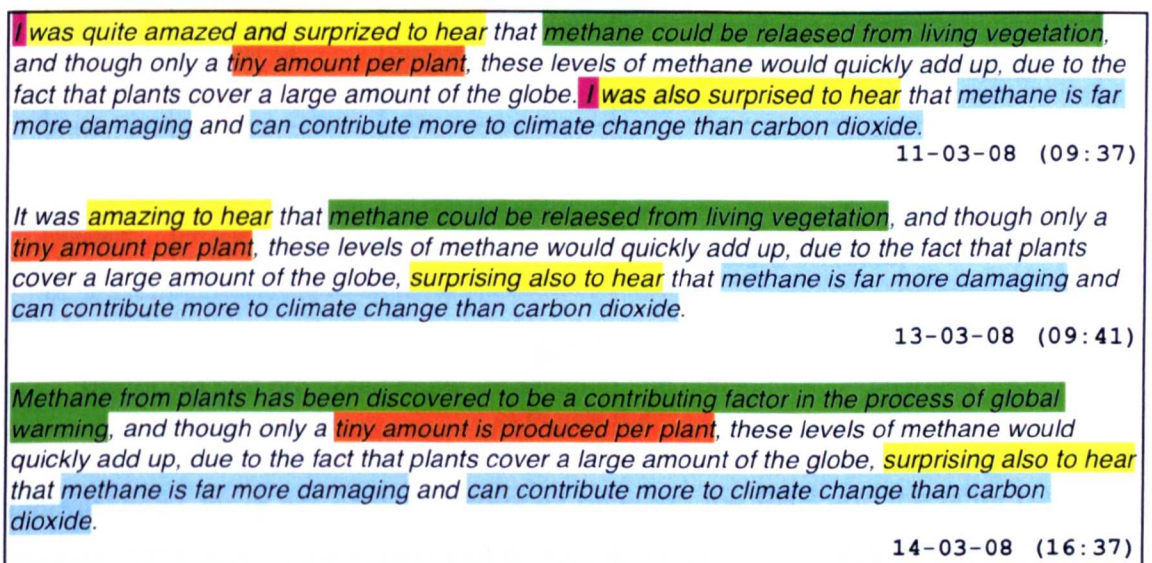


Figure 6.4

Sample sentence evolution (depersonalisation, nominalisation) from PRS-01

It is interesting that several of the clauses in the text remained immune from revision, for example, those shown in blue. These are interesting clauses, in themselves, in that the writer appears to make one usage choice (the nominalised form “*damaging*”) for the verb “*damage*”, and another for (the verb) “*contribute*” (rather than the nominalised form “*contributing*”). Why not refer to the noun “*the damage*”, for example? It is believed that these choice were intentional, and that these choices reflect the meaning intentionally conveyed by the writer, i.e., that the form “*damaging*” conveyed the traditional usage of the word referring to express some sustained completed or ongoing action (the effect of methane on the atmosphere), whereas use of the word “*damage*” may have indicated some quantum of damage at some unspecified time. Similarly, it is believed that

“contribute”, preceded by “can”, indicates future possibilities of rectifying the damaging effects. Perhaps the persistence of these clause structures indicates that this particular writer was confident in the meaning that he wished to convey. Alternatively, it may be the case that the writer only changed the text in response to specific comments from his teacher and another writing team member. Appendix C provides further examples of text evolution for the three sample genres investigated in this study.

From	Date	Title	Comment (for Student 10)
Student 14	Thu Mar 13 09:20:18	Style of writing	No need for the "I was surprised" etc, it is more supposed to be a scientific account as opposed to a reflection afaik
Student 14	Thu Mar 13 09:31:12	Style of writing (take2)	No need for <I was surprised> etc, afaik it should be more a factual account than a reflection.
Student 6	Thu Mar 13 09:36:26	CK	Well done! Looks great. CK
Student 10	Fri Mar 14 09:51:12	.F.N	I've changed it so that there is no more Is in it, Kelly said that to me already

Figure 6.5

Discourse that prompted depersonalisation and nominalisation changes shown in Figure 6.4

Linguistically, there are some differences between the PRS and the latter research studies (FRS and SRS) in terms of textual evolution of key linguistic features. For the latter cases, there are less examples of refined scientific nominalisation similar to the one shown in Figure 6.4 above. Many of the revisions centre on reformulating clauses to remove personalisation, or to introduce more complex nominal groups. Typical examples of this kind of sentence evolution are shown in Figure 6.6 below, which also included one of the few instances of shuffling, arising from rhetorical machining, as discussed in the previous section.

In summary, it is not always obvious why individual writers revise text, and it is probably a reasonable assumption that is a mixture of self-criticality coupled with offline comments from teachers or peers. There is some evidence in the data that there are three likely reasons why, or when, this is the case: (i) there are very specific comments from a teacher that indicates some change is required, (ii) there are general comments from a peer writer indicating that there is some error in the

text, and (iii) there are general peer comments indicating that inter-sectional referencing is required.

As a direct result of global warming, animals from all climates have been effected by the warmer climate. The severity of the impact on each species varies from just coming out of hibernation earlier to some animals on the verge of extinction.

As a direct result of global warming, animals from all climates have been impacted in some way by the warmer climate. The severity of the impact on each species varies from just coming out of hibernation earlier to some animals on the verge of extinction, like polar bears and penguins.

As we have seen from the previous point, animals from all climates have been impacted in some way by the warmer climate. Here, one can see the severity of the implications global warming is having on animals, in detail. The severity of the impact on each species varies from just coming out of hibernation earlier to some animals on the verge of extinction, like polar bears and penguins.

Figure 6.6

Rhetorical Machining (reshuffling [RM]p) and Evolving Nominalisation in FRS-01

6.4 Conclusion

This chapter presented the results of a systemic functional linguistic analysis of three collaboratively written Library Research Papers. In particular, the chapter focused on establishing how collaboratively written student scientific texts evolved over the writing period. In terms of text structure, it was shown that students adopted revision approaches incorporating addition, deletion and rhetorical machining, although surprisingly, the latter did not include reshuffling of statements.

In terms of evolving linguistic features, it was shown that student writers respond to comments from peers, and that revision usually results in further nominalisation and depersonalisation. It was found that student writers understand that nominalisation is a key scientific writing activity, and that it is likely they understand the function of nominalisation in scientific text. The student papers show little evidence of intertextuality, and there was a marked difference between the evolution of text in the preliminary, and later research studies.

The following chapter addresses some of the key issues arising from the interrelationship between the peer and teacher-student exchanges that occurred during the writing projects, and the subsequent evolution of the texts.

Chapter Seven

Text Evolution and Feedback - Research Implications

This final chapter addresses the two remaining research questions, i.e., can textual evolution of authentic science writing be explained in relation to the online dialogue and feedback occurring in a collaborative writing environment? Finally, it considers the implications of this research for pedagogy and policy, i.e., for (i) students' language development in science and the use of genre pedagogies, (ii) collaborative writing in science, and (iii) online pedagogy.

7.1 Introduction

The previous chapter presented findings related to the second research question concerned with genre evolution, i.e., the evolution of key linguistic features, in particular, nominalised text evolution. It has been already shown that in several instances student writers revised text in response to peer feedback. In this chapter, a selection of the captured peer and teacher-student discourse associated with the writing products are presented and analysed from an SFL perspective.

In order to address this remaining research question on authentic online collaborative writing it is necessary to focus on the captured discourse associated with the writing rather than the genres. As this discourse is functional, i.e., text in a specific functional context, it is amenable to SFL evaluation. However, given the considerable amount of data collected, and the limited time available for this EdD project, it was impossible to conduct a full SFL analysis on the collaboration discourse in addition to the temporal and final genres analyses presented earlier. However, it will be shown that, using SFL, the textual evolution of authentic science writing can be explained by examining the online dialogue and feedback occurring during the authentic collaborative writing project.

Finally, this chapter concludes with some thoughts on the implications of this research for: (i) future authentic learning in science, and in particular, the use of genre pedagogies, (ii) collaborative writing in school science, and online pedagogy.

7.2 Text Evolution and Peer/Teacher Feedback

There were five kinds of captured online discourse available for analysis after the collaborative writing studies had completed: (i) peer feedback on the drafts available once the writing project began, (ii) teacher feedback on the drafts available once the writing project began, (iii) discourse centred on the planning phase, prior to writing, (iv) private messaging between teacher and students, and (v) general communication forums for all students. The first three were examined to investigate the relationship between peer and teacher feedback on evolving writing. The latter two were not considered as private messaging usage was virtually non-existent and, in general, did not relate to writing, and the general communication forums were not used by the participants once planning began. Furthermore, the teacher/peer feedback were visible to all participants during the writing phase, but the planning discourse was only available during planning. The following sections address the relationship of each of these online dialogue to authentic science writing.

7.2.1 Peer Feedback

Earlier it was shown that peer feedback, achieved using the collaborating environment's commenting functionality, could directly lead to textual revisions (see section 6.3), and to enhanced use of nominalisation. It was shown, for example, how the exchange shown in Figure 7.1 below prompted several nominalisation changes over three successive drafts.

It was also possible to examine this peer feedback exchange using an SFL framework. When we use language to interact we are establishing a relationship between participants, for example, in a turn-taking sequence (Halliday, 1984). Each participant will take on a different "speech role" in the exchange, for example, giving or demanding roles. Associated with each role is a "commodity" that is exchanged, i.e., information or goods and services. This structure presents

four basic move types statement, question, offer and command, what Halliday calls “*speech functions*” (Eggs, 2005, p. 141). In an interactive dialogue, one speaker's exchange is likely to influence how another responds, i.e., the responding move (and role) is constrained by the initiating move (and role). Responding moves may be supporting or confronting and the predominant or expected response depends on the register. Eggs (2005) presents a summarised picture of the semantics of dialogue, based on speech function pairs, shown in Figure 7.2 below.

From	Date	Title	Comment (for Student 10)
Student 14	Thu Mar 13 09:20:18	Style of writing	No need for the "I was surprised" etc, it is more supposed to be a scientific account as opposed to a reflection afaik
Student 14	Thu Mar 13 09:31:12	Style of writing (take2)	No need for <I was surprised> etc, afaik it should be more a factual account than a reflection.
Student 6	Thu Mar 13 09:36:26	CK	Well done! Looks great. CK
Student 10	Fri Mar 14 09:51:12	.FN	I've changed it so that there is no more Is in it, Kelly said that to me already

Figure 7.1
Example of Peer Feedback Exchange

SPEECH FUNCTION (Initiations and Responses)		
Initiating Speech Function	Responding Speech Function	
	Supporting	Confronting
offer	accepting (may be non-verbal)	rejection
command	compliance (may be non-verbal)	refusal
statement	acknowledgement	contradiction
question	answer	disclaimer

Figure 7.2
Speech function pairs, adapted from Halliday (1994, p. 69) by Eggs (2005, p. 146)

Returning to the brief discourse above, and evaluating it in the context of Halliday's Initiating/Responding speech function model, it can be seen that the structure follows the following pattern (for example, S14 refers to Student 14):

S14 initiates and gives an offer ("supposed to be ... afaik") - **S14** initiates and issues command "afaik ... it should be") - **S6** responds and gives an offer ("looks great") of support to **S10** - **S10** eventually responds (in a different discussion thread) and supports with compliance ("I've changed it") and a disclaimer ("Kelly told me already").

The students were actively involved in commenting on the written products of their collaborator and the exchange occurred as a direct consequence of student writing. Furthermore, the exchange prompted important changes in the collaboratively written genre, although this may have occurred in any case as the student had previously received an offline comment from the teacher.

There was some correlation between the meaning construed by each participant, i.e., their choice of speech function, and the realisation of this function grammatically. The choice of speech function, and the subsequent grammatical realisation was, I believe, greatly influenced by tenor relationships, and in particular, those established perhaps during the "Project (Pre-Writing) Discussion" phase of the collaborative writing project. In the sample discourse above, the disclaimer from Student 10 indicates that he changed it, not because he was asked (and later told) to do so by Student 14, but because his teacher ("Kelly") had previously indicated that he should do so. The disclaimer construes the meaning "*I've done it but not because you told me to it*". There was no record of the teacher giving this comment to Student 10 from any of the data recorded within the online collaborative writing environment. It is most likely that there was a verbal (not computer mediated) communication about this.

The term of address (grammatical realisation) used by Student 10, referring to his teacher by her surname, also provides insight into the tenor relationship associated with the collaborative writing process, and the associated commenting dialogue. Using the teacher's surname indicates that they understand this public discursive context's tenor to be student-student. In fact, Student 10 was the only group member not to receive private messages or any comments on his work from

the teacher. So perhaps the intention, or meaning, here is that Student 10 is fabricating comments on his work as he did not receive any. Furthermore, in the planning (pre-writing) discussion forum, Student 10 and Student 14 appeared to be engaged in a confronting speech function related to determining a leadership role. Student 10's repeated appropriate offers on structure and planning received little supporting acknowledgement. He was clearly unimpressed with the lack of supporting response when he initiated the question "*Are people just purposely ignoring my points or what?*".

7.2.2 Teacher Feedback

Overall, a stark feature of these three writing projects was the limited teacher input into the overall genre production. There were some initiating and responsive private messages, predominantly statements, questions or commands, but very few messages containing appropriate offers. In some cases, specific teachers went to great lengths to comment on text in detail. For example, messages typically contained offers of support (praise) and commands (to collaborate or write scientifically) but the students were not provided with any firm offers indicating how they should *work collaboratively*, or *write scientifically*. In fact, both the teacher and the students appeared to be equally lacking in effectively communicating how to collaboratively write a scientific library research paper genre. Perhaps one reason for this inability to engage in meaningful collaborative exchange is that neither the teacher nor the students essentially knew how to collaborate. They did not have, nor understand the metafunction of the discourse (or register) to realise the genre. Although the research findings from the previous chapters would indicate that the students demonstrated capabilities towards authentic writing, i.e., though they had some difficulty producing a typical genre, they understood and used nominalisation.

In terms of realising a collaborative discourse, however, participants did not understand, nor have a clear idea of what constituted a collaborative scientific discourse centred on delivering a coherent document; they did not know the linguistic features of scientific communication. In advance of the authentic writing projects, students and teachers were provided with training sessions on peer assessment and feedback, collaborative working, planning and writing. This was

probably a mistake on behalf of the researcher, as a sample scientific genre was provided and discussed at length with teachers and students. However, this training did not include specific examples of appropriate collaborative discourse, i.e., documentation provided did not contain specific examples of successful dialogue centred on peer feedback leading to textual change. The focus of the training was on “what” to do, but not “how” it might be achieved. Nevertheless, it was expected that teachers, in particular, would be expert in delivering feedback on written work, albeit on a one-to-one basis with individual writers.

Surprisingly, there were numerous examples, however, where detailed teacher feedback was contributed, yet consistently ignored by student writers. One teacher, in particular, provided explicit comments on all aspects of the writing teams’ contributions. For example, in reviewing the sentence *“Recycling is enforced in Ireland in a number of ways :”* the following feedback was provided to the student:

“A number of ways” gives the impression that the reader will read about more than one way. You only write about the plastic bag levy. What other ways is recycling enforced? If there are no other ways of enforcement, are there ways in which recycling is encouraged? Which of the following sounds better to you? 1. Recycling is enforced? 2. There are ways in which recycling enforcement has occurred in Ireland? 3. There are ways in which recycling has been encouraged? Try to get feedback from your team on how best to structure this sentence.

In this sample, the teacher provided clear details on why he found the sentence problematic, then encouraged the student to reflect on the original intention, subsequently provided the student with options for changing the meaning of the sentence, i.e., a move from *“enforcement”* to *“encouragement”*. Finally, the teacher encouraged the student to *“try”* to elicit feedback from the collaborative writing team members on how best to structure the sentence. In general, this teacher devoted considerable time and attention to providing feedback to the students; much of it with this level of detail addressing the semantic and grammatical structure of the text.

However, it was generally the case that comments of this nature were ignored by students and the text was usually retained without change. Furthermore, students

invariably did not elicit support from peers in relation to obtaining suggestions for improvement, and no collaborating team members provided further insight into how to change the sentence. All comments were available to all participants, so it would appear that the decision may have been deliberate. In this instance, two peers responded to the teacher comments; one responded to make the comment “*good work*” and another asked “*why do you have random links?*”. The student that wrote this sentence on enforcing recycling did not make further changes despite the detailed feedback. Interestingly, ignoring detailed comments related to textual revision of key ideas, from the teacher, was a normal occurrence in the three writing studies. Suggestions for grammatical changes were likely to be implemented by most writers, however, as were some semantic changes recommended by peers, as indicated in the previous chapters.

In trying to understand why these students, in general, did not respond to recommended changes from their teacher, some insight into the success of online collaborative authentic science writing may be established. I believe that there may have been several factors, operating simultaneously, that could explain the apparent unresponsiveness.

First, I believe that the fundamental intention of the student was to convey that recycling was enforced, and not encouraged. From an SFL perspective, the writer’s word choices were deliberate, and were selected to convey the writer’s feelings about recycling in Ireland. Recommending a change to the original meaning was perhaps unwelcome, and therefore ignored by the student. It was, perhaps, a conscious decision to retain the original text, and not engage in a discussion on the merits of “encouragement” over “enforcement”.

Second, perhaps the teacher complicated the revision scenario by asking for additional examples of enforcement, and if the student could not find any alternatives, then recommending a change of the intent. However, the student provided a single concrete example (i.e., the levy on plastic bags) of enforcement, so it is surprising that the teacher did not simply recommend changing the clause “*in a number of ways*” to refer to the plastic bag levy. In this case, the original intention of the writer would have been retained and there may have been additional linguistic choices to develop further nominalisation in the sentence, for example,

“recycling has been enforced in Ireland with the introduction of a plastic bag levy”. Perhaps the teacher did not make this suggestion because his perspective on recycling was different to the student’s?

Third, the teacher provided the student with three contradictory options for reviewing the sentence; the first option provided the student with an unqualified, or unsupported, statement and would not be typical in a scientific article; the second was a more nominalised (and perhaps better) version of the student’s original sentence; and the third was a replacement sentence that changed the intention of the original sentence. None of the suggestions addressed the initial requirement for further examples.

Fourth, the teacher asked the student to elicit recommendations from fellow team members. However, in this research, students only asked their peers for assistance when they had difficulty choosing what to write, not how to write it. I believe that the linguistic choice, used repeatedly by the teacher, *“Try to get feedback from your team on ...”* may have been problematic for the students. For example, the student would have to first establish how to get feedback (how to “try”), determine what to elicit via this feedback from the teacher’s message, and finally evaluate responses with a view to reworking the original sentence. Perhaps the student perception in this exchange was that the teacher was conveying, to the whole team, that his writing required improvement, and that he would have to acknowledge this by asking the whole team for their input. This could have been an example of a “face threat” experienced by novice writers as indicated in Chapter 2. (Benwell and Stokoe, 2002). Although, I believe that the intention of the teacher was to encourage peer communication, it is surprising that he did not adopt an approach whereby he commented on the writing and then invited comments from the other writers.

As indicated earlier, teacher and student participants were provided with an overview of the research project’s aims and methodology together with linguistic supports to help understand the metafunction of (i) collaborative writing and (ii) scientific discourse. A specific approach to implementing this scaffold, for teachers, was to introduce the MASUS (Measuring the Academic Skills of University Students) instrument (Bonanno and Jones, 1997) which includes a

diagnostic to assess students' writing skills. The MASUS instrument is a procedure requiring students to write a short essay or other genre based on some disciplinary content such as course readings or lectures. The instrument assesses students' ability to write about a given body of knowledge in a reasoned and critical way, together with their ability to use the language resources appropriate for the task.

Writing is rated from 4 (excellent) to 1 (inadequate) on each of four main criteria: Use of source material, Structure and development of the text, Academic writing style appropriate for the task, and Grammatical correctness. The criteria are further sub-divided into sub-criteria or descriptors representing a complex spectrum of perspectives on the student's writing, i.e., from a macro-level (genre and discourse/register), to a micro level (lexico-grammar). The descriptors were formed from an extensive SFL analysis of a large corpus of examples of student writing from different disciplines. The technical SFL descriptors in the instrument were translated into "mutually agreed versions" with subject lecturers involved in marking. Feedback to the students was in the form of four ratings; one for each of the four main criteria thereby enabling them to identify strengths and weaknesses in their writing. The feedback also included explanations of the ratings and appropriate follow-up actions available. Validation of the MASUS instrument and the relationship between MASUS results and other student variables have been conducted by Webb and Bonanno (1995) and Webb et al (1995).

One teacher, in the second main research study, implemented the MASUS instrument to provide formal feedback to each writing team. This was an impressive application of the diagnostic within the collaborative writing environment, delivered using the inline commenting system. Unfortunately, students did not respond, in any obvious way, to the recommendations and there were no changes recorded in the collaboratively written genre in response to this structured feedback. Once again, this may be because the students themselves were not presented with some kind of intervention that highlighted MASUS and its importance within a writing project.

For this research, it would appear that online teacher feedback during collaborative writing did not lead to textual change to the same extent as peer feedback (third research question). This is not to say that teacher input was

ignored, however. Where input contained clear instructions on corrections, normally related to grammar, the students readily implemented the suggestion. Feedback that relied on students revisiting textual meaning, perhaps in conjunction with their peers, was less likely to effect a revision. Without doubt, the students were provided with offline support from teachers, especially where writers were from the same school as the mentoring teacher. Furthermore, where group participants were from the same school, they also engaged in offline discussion. Both kinds of offline discussion, i.e., peer and teacher/student, were observed regularly by the researcher during school visits. Ironically, teachers were often explicitly heard verbally telling students to use the online system for communication and feedback, but never communicated these instructions online.

7.2.3 Planning Discussions

The final body of captured online discourse available for analysis was the pre-writing planning discussions where students decided on who would work on which aspects of the paper. As part of the initial training intervention students participated in a face-to-face collaborative planning and writing activity and later conducted a similar activity using the online environment's planning forums. Here the students were required to decide on the structural plan for the collaboratively written paper, assign authors to sections, assign roles to authors and inform the teacher upon completion. In general, these were extremely active discussions, in comparison with discursive exchanges during the writing phase, with almost all students participating. Figure 7.3 provides an example of one short pre-writing planning discussion.

Planning discussion
Mr. Black (Teacher)

S25 - Colm
S26 - Jason
S27 - Brian
S28 - Derek

This asynchronous planning discussion occurred between Wed Dec 8 12:00:40 2010 and Wed Dec 15 11:36:20 2010.

S26 hello :)
S27 hey jax
S26 sup
S25 stry
S27 who are you ???
S25 jesus
S25 who r u ?
S27 no your not your the cod master
S25 im Jesus :L
S27 you wish
S25 Saviour of Nicbs
S25 Umpda Umpda Umpda
S26 you wish
S28 who is going to be team leader? need to decide
S26 i think it should be colm
S25 why? :L
S26 coz your the first one on the list :L
S25 sound
S28 i think thats how its done though
S26 same
S25 yh i know :/
S26 team name?
S27 it deto should be me is that ok n
S28 choose leader!!
S27 that was not me
S28 for my section im doing how we can help to combat global warming because theres a link on this that can help me
S27 it should be you derek :))))))))))
S25 :i do effects on animals?

S26 yeah it should be derek
S26 im doing the intro and ill do physical effects too
S26 brian jason and colm which ones are u doing?
S26 colm i think brian is doing the effects
S25 abstract and main body 3 i link?
S28 like has gonna do general effects. try pick something else not in the ones that were previously done
S27 im doing the causes of global warming !!!!!
S28 ah grand, between jason and colm someone do effects in general and someone do something else
S26 ill do what causes it
S28 brians doing that
S25 ill do general effects of global warming
S28 ok this is it Derek: how we can combat GW
Brian causes Colm: effects? Jason: something else i duno
S28 think we're sorted
S25 ill write about what could happen in the future if we dont combat global warming
S26 ok cool everyone happy with that? what about leader and do we need a team name?
S25 i tink its me cause im 1st? n do we need one?
S26 you be team leader... do we even need a team leader? :L
S26 how are we supposed to write this? do we just use word?
S25 i link they just read over and make sure everything is ok?
S26 yeah like an editor. and yeah use word i think not sure though
Mr. Black Well done lads, this is what is about. discussing about your assignment through EVE
S26 do we write it on this yeah? or word. ?
S27 what do we have to do ??????
S25 tink he sed soon when u click on main body or any of the others you'll be able to write on that
S28 ahosh so its part of this website? grand job
S27 do we know what the titles are ??
S28 ohm i know mine i think we make up our own. brian urs is probably the causes of global warming or somethin, mine is ways you can combat against global warming

S25 yh im doing the effects of global warming and abstract
S28 are we not ab e to get started yet?
S25 dno tink afr 2day? :/
S27 im doing causes :D
S28 here write what ones ur doing? im doing ways to combat GW. colm and jason what are yours again?
Mr. Black Hi lads. What are the 4 titles for body sections 1-4?
S28 body section 2. ways we can combat further global warming. thats the one im doing
Mr. Black When you have the 4 titles, write them on a comment and i will make the appropriate changes on your official template
S25 body section 3. effects of global warming
S28 brian and jason write yours
S26 Body Section 4 : future consequences of global warming
S27 Body Section one. causes of global warming
S28 This is the 4 titles for the body sections, are these ok with all of you? Body Section 1: Causes of Global Warming Body Section 2: Ways to Combat Global Warming Body Section 3: Effects of Global Warming Body Section 4: Future Consequences of Global Warming
S26 yeah thats fine
S25 grand
Mr. Black Hi lads. I have just changed the names of the 4 body sections.

Figure 7.3

A pre-writing planning discussion from the Second Main Research Study (SRS)

As mentioned previously, it was not possible to perform a comprehensive SFL analysis of the online communication in addition to the analyses of the genres themselves. For the planning phase, where the text was realised within a forum, it would be necessary to evaluate using a strategy similar to that used by Hewings and Coffin (2007), for example, who examined writing in multi-party computer conferences and single authored assignment. In the absence of a formal linguistic evaluation of this text it is obvious that there was substantially more peer engagement during planning than that occurring later during writing. This discussion had very little teacher input and progressed entirely with the support of the group. One student, S28, appeared to take on the role of teacher, moderator and decision-maker given the lack of participation by the teacher until decisions had been made by the group. This was a deliberate decision by the teacher (and was confirmed by the researcher later).

What is striking about this exchange, however, is that the students appeared fluent in their exchanges and actively progressed towards a conclusion, i.e., what they hoped to achieve, and who would do what. This interesting collaborative discourse

highlights the lack of collaborative discourse during the writing itself, and would tend to support earlier assertions that the students were not averse to collaborating, but perhaps did not know how to successfully engage in peer reviewing (as reviewers or recipients). It is unclear whether the context for the planning dialogue (i.e., forum), or the students' earlier training, contributed to successful collaborative planning, and this warrants further investigation.

In conclusion, therefore, the research findings show that peer and teacher discourse in an online collaborative science writing environment can effect textual change in the target genre. The nature of the relationship between textual change and feedback in authentic science writing is complex and may be related to individual writers' development as perception of self, and to "situation definition". Situation definition refers to the way in which a setting or context is represented, or defined, by those who are operating in that setting (Wertsh, 1985). Recently van Horne (2012) investigated situation definition in relation to writing using online synchronous writing conferencing situation, and found that by focusing on students' definitions of rhetorical concepts that often implicitly guide students' writing processes, writing tutors can help students improve how they approach writing. Progression through the student's Zone of Proximal Development (ZPD) (Vygotsky, 1935; 1978), she argues, is more related to how students grow their own understanding, rather than on the correcting of their texts. In sum, this research appears to indicate that students require interventions on how to collaborate discursively in online authentic writing in addition to interventions on the nature, structure creation and importance of scientific genres.

Finally, it was not possible to determine whether the students benefited from the collaborative writing experiences, although many participants confirmed that they enjoyed the experience. From an individual learner's perspective, however, it provided insight into authentic science and the importance of collaborative writing of scientific genres.

7.3 Research Implications

The previous section provided some evidence that that novice writers do not necessarily benefit from peer and teacher discourse when using an online collaborative writing environment for authentic science writing. However, is clear from the nominalisation evolution described in chapters four and five, that strategic collaborative (peer) exchange (i.e., commenting, messaging and discursive dialogue) impacts on successful science writing, albeit locally (i.e., within sections). In terms of evolving linguistic features, it was shown that student writers respond to comments from peers, and that revision usually results in further nominalisation and depersonalisation. With reference to text structure, it was shown that students adopted revision approaches incorporating addition, deletion and rhetorical machining. There is little evidence, however, that a successful evolutionary revision strategy will emerge from unstructured discourse in a collaborative writing environment. The collaboratively written genres demonstrated little evidence of intertextuality or intratextuality. Finally, from a quantitative analysis of lexical density and grammatical metaphor perspective the writing appears to be authentic, but does not reflect the structure of authentic genres.

There are implications of the research findings of this research for: (i) authentic science learning and in particular language development, (ii) online collaborative writing in science, and (iii) online pedagogy focussing on authentic writing.

For language development in science - there is pedagogic potential in focusing on the language of science, however, greater structured support for students' authentic language development and use is critical when writing to learn science. In particular, exposure to, and repeated practice in writing science genres is important. Understanding the nature of grammatical metaphor, and its use in science writing, would assist students in becoming successful expert writers. Science teachers need to become more aware of the role of language in constructing scientific knowledge, and in particular, how to establish a learning dialogue that provides useful scaffolding feedback when revising texts.

For collaborative science writing, it is essential that appropriate scaffolds are provided to support students engaging with this approach to authentic writing. Although this is still reasonably innovative for the school sector there is scope to introduce assessed collaborative working and writing in the junior, transition and senior cycles within the Irish education system. Without doubt, teachers need to understand better how collaborative writing works and how to ensure there is participation by all students. Furthermore, students need to engage in repeated scaffolded practice writing before attempting to produce an authentic genre. Both students and teachers need to become familiar with the language of collaboration associated with authentic science writing.

Finally, for online pedagogy, structured support for both teachers and students, particularly in relation to peer and teacher assessment, is required. In particular, need for teachers to develop the kind of dialogue and feedback, or commentaries, that will help students to develop their language and writing abilities and science learning.

7.4 Research findings in Irish Context

According to Drudy (Drudy, 2009), Irish education has undergone unprecedented change in the last two decades. In this period, Ireland moved out of recession, embraced a tiger, knowledge-based economy, and crashed into recession again. Second level schools are no longer stratified along social-class lines, now cater for children from a variety of cultural and linguistic backgrounds, and “team teaching” is commonplace. In spite of more children staying in education until early adulthood, it is unfortunate that educational disadvantage based on social class and socioeconomic status is still a problem (ibid, p. 3). Drudy argues that the development of Ireland as a knowledge economy places additional challenges on Irish education and its teachers as it is unclear how education can actually contribute significantly to economic recovery. Irish educational policy is not immune to international ranking (for example, by the Organisation for Economic Co-operation and Development - OECD) and international evidence-based policy making (for example, policy and practice influenced by experiments evaluating replicable programmes, or qualitative-research based approaches). The

challenges and changes emerging, therefore, may be understood by examining Irish education and its policies under three themes; a changing system, diversity and inclusion in schools, and teacher education (ibid, p.4).

Drudy (2009a) identifies Ireland's investment in the digital technology base, together with investment in education and general educational performance, as key indicators for assessing the performance of a knowledge infrastructure. With regard to investment in schools' digital technology base, she highlights two measures: (i) the ICT infrastructure, and (ii) broadband access, as being significant (ibid, p.40). Drudy argues that Ireland made "faltering progress" (ibid, p. 44) in these areas during its period of high economic growth and that these have profound implications for educational participation and outcomes for the population and policy making during this period of deepening recession. Furthermore, Ireland's PISA (Programme of International Assessment) scores for 15-year-olds are high for literacy, but only average for science and mathematics. Drudy recommends that Ireland's goal of becoming a knowledge and innovative economy relies on policy interventions that support high-quality teacher education and training (ibid, p. 52) to address these deficiencies.

McElwee (2009), investigating the relationship between Irish science education and knowledge economy creation, identifies the types of knowledge required for an Irish knowledge economy within a constructivist framework. Utilising PISA studies he argues that the development of Ireland's knowledge economy must take into account the different forms of scientific knowledge, i.e., knowledge of science (fundamental concepts) and knowledge about science (purpose of scientific inquiry). He is critical of the approaches to measuring science competencies (based on identification, explanation and application of scientific knowledge) and believes that it is essential, for future scientists, that learners become "scientifically literate in an increasingly scientific age" (ibid, p. 249). In Ireland, there is an emphasis, arising from constructivist approaches, on participation in science learning by teaching problem-solving skills, which (it may be argued) lead to a deeper understanding of science. McElwee reports that this process is teacher-centric, however, with the most frequent student activities being listening to "teachers explaining in class", "writing in notebooks" and "reading

textbooks” (ibid, p. 250). Students also perform classroom experiments, usually focussing on “proving” some theory already explained in class, or engage in enquiry-based learning which tends to be problem-based learning. Notwithstanding new program changes, student interest in science continues to decline, which may be related to pervasive teaching methodologies and “an incongruence between the intention of the curriculum planners and the minds of the teachers” (ibid, 251). McElwee argues that while there is a significant body of research into constructivist approaches to teaching science, and despite considerable curriculum reform, there has been “little transfer” to the real teaching situation.

A further challenge for Irish Education, arising from the findings of this research, and which has not been elaborated upon elsewhere, is the complexity of realising and assessing authentic (for example, enquiry-based learning) science learning in Irish classrooms; learning that ensures Irish students score highly in PISA-like assessments and contribute to a developing knowledge economy. Drury points to the necessity for an extensive broadband and ICT infrastructure, which now exists because of a national implementation plan but this, I believe, does not necessarily result in improved school-based learning environments. It provides learners with an infrastructure to access learning materials within school and in other social and home learning contexts. In fact, the use of ICT for science, or any other form of, learning has not been developed in Drury’s 2009 edited volume “Education in Ireland Challenge and Change”. I would recommend that teachers, teacher trainers, curriculum developers, policy-makers, and educational researchers in Ireland shift focus from foregrounding the *provision* of infrastructures facilitating “cool projects or case studies” to substantive science literacy development in schools *utilising* the ICT infrastructures in meaningful ways. Science learning challenges, and resultant changes from this perspective, involve deep engagement with modular curriculum design, new teaching methods, specific scientific literacy development approaches, improved assessment methods, and improved science teacher training that focusses on the interrelationship of learning and language acquisition and production. Drawing on the arguments of McElwee (2009), I believe that a key change would involve a shift from reading for the purpose of knowing science, to reading for the purpose of communicating science. My research, albeit a small contribution, highlights the necessity for supporting

existing and new teachers in sociolinguistic perspectives on learning, engagement with ICT supported learning, and constructivist approaches to creating and assessing authentic science learning contexts.

My research findings indicate that students can write and communicate science in a manner required by Ireland's knowledge economy stakeholders, i.e., government and industrial stakeholders. Recently, in a response to proposed changes in the second-level Junior Cycle, ICT Ireland (the association within IBEC representing the high-tech sector) responded that "over-crowded, rigid and subject-based curriculum dominates secondary school organisation and teaching practice. This concerns business and employers." (ICT Ireland, 2012, p. 1). This influential group argues that students must become "synthesisers", and have a demonstrable ability to gather together information from a variety of sources and "put it together in ways that work for themselves and can be communicated to other persons" (ibid, p. 3). Specifically, they recommend that, in addition to formal assessment, continuous assessment by teachers, portfolios of achievement, and learning journals are essential authentic skills. Unsurprisingly, they also recommend that ICT environments should be utilised where possible to enhance student learning. I believe that the positive outcomes of my research, notwithstanding the challenges faced by teachers and students, could contribute to new methods for teaching authentic science that would be welcomed by Ireland's knowledge economy makers.

McElwee (2009), in promoting a constructivist view of science learning for a knowledge economy, appears not to consider the social dimension associated with this theoretical perspective. While Irish science classrooms are specific social settings, there is little emphasis on collaborative activities that could enhance the learning process. Furthermore, the new proposals in the Irish Junior and Senior curricula still favour engagement in, and assessment of, individual work. My research highlights the difficulties with collaborating and communicating and the impact on writing, but there is scant curricular provision for learning support for these key skills in the near future. It would be a considerable task, I believe, to implement collaborative working and assessment, even with teacher support, given the current policy. Nevertheless, educational research continues to inform policy, as indicated earlier, and successful future collaborative writing projects of

this nature may assist in curriculum reform, enhanced learning experiences and successful participants in Ireland's knowledge economy.

Chapter Eight

Summary and Reflections

This chapter provides a reflection on the outcome of the project overall, evaluating the methodology and the research findings. The research is about analysing the relationship between discourse (peer-peer and teacher-student) and evolving collaborative science writing in a school setting. Final versions of student writing were evaluated using Systemic Functional Linguistic (SFL) genre and grammatical metaphor analysis. The evolution of students' interim written texts/production of the library research paper genre was also investigated using SFL analysis, and revision strategies employed by students were identified. Finally, the possible relationships between text evolution (as measured, for example by enhanced use of grammatical metaphor) and peer-peer discourse were investigated.

8.1 Introduction

This thesis argued that students writing and communicating in online environments can write “scientific texts” (using grammatical metaphor) and that student writing evolves in response to peer and teacher comments. However, it was found that students have some difficulties writing collaboratively which may be related to ineffective or inappropriate language-scaffolding. The key argument presented was that SFL provides the best model for theorising and systematically investigating authentic science literacy learning. The contribution to knowledge is twofold: (i) methodologically, the presentation of a method to capture evolving student writing and accompanying discourse, and (ii) contribution to the body of work on student writing and learning in science, by providing an SFL analysis of how discourse impacts on textual evolution.

Using SFL, it was possible to identify, compute and analyse collaborative student writing in an authentic science literacy study. It was found that: (i) many students understood, had control of, and used grammatical metaphor both appropriately and effectively, (ii) students understood the concept of, and could produce, library research paper genres, (iii) student writing evolved in response to peer/teacher

comments, (iv) students had difficulty understanding collaborative writing, and that (iv) teacher-student collaborative discourse may have been a weak scaffold in instances where there had been insufficient training in, or an insufficiently developed understanding of the relationship between spoken and written collaborative discourse.

8.2 Methodology Evaluation

The project methodology was described in detail in Chapter Four, and contextualised within an SFL research study in Chapter Three. The approach was a particular theoretical and methodological perspective on the analysis of a student activity, in this case collaborative science writing in an online environment. Although there are other approaches to discourse available, for example, Critical Discourse Analysis (CDA), it was decided that SFL was the best approach for the analysis of writing generated in a social context. It could be argued that if the discourse was disputational, then CDA might be appropriate as it tends to focus on relationships of power (such as gender) in text. This was not the focus of the research presented here, however. Furthermore, SFL provided a system of analysing language which would work with the five different sources of text available for analysis.

The research contributes to an increasing body of literature from those engaged in inquiry-based learning where the focus is on evaluating student activities, and associated discourse. Traditionally this focus has been on “real” classroom activity, i.e. not online. As such the research would be of interest to non-SFL researchers investigating group-based dynamics and associated learning, particularly in online environments, in addition to SFL researchers engaged in SFL and Authentic Science Learning. More broadly it would be of interest to researchers interested in IBL (Inquiry Based Learning), PBL (Problem Based Learning), science learning, as well as language-based research into learning such as EAP (English for Academic Purposes).

The research conducted for this project, focused on the language and the language products, not just the activity, which is a different approach. This is primarily because the research did not have at its core some kind of physical

activity such as a scientific experiment. Everything was focused on writing and language use/acquisition, i.e. it focused on *Authentic Science Learning*. The methods employed in the research facilitated capturing temporal evolution of the student writing, and provided explanations for revisions based on accompanying peer-peer and student-teacher discourse.

A problem with the selected approach was that the electronic capture of all interactions and writings online provided a great deal of electronic material that was very time-consuming to analyse. For example, focusing on the writing and associated discourse meant that certain discourse datasets, which were not core to the research questions, were not given sufficient attention, for example, discourse associated with the pre-writing phase. A further issue with the data analysis was that nominalisation was the only type of grammatical metaphor examined; a more extensive grammatical metaphor analysis in future projects would provide additional insight into student collaborative writing in science.

Additionally, the methodology would have benefited from more rigorous pre-and post-survey data collection, particularly in relation to student attitudes to writing. Some data on participants' attitudes to collaborative writing were collected (shown in Appendix F) and examined within a holistic project context, but, as explained in Chapter Four (Methodology) they were not rigorously analysed for inclusion in this thesis. Another possible focus for data collection and analysis would have been project related discourse such as planning discourse, and, in future projects, these types of data (student attitude and planning discourse) may be fruitful avenues to explore.

The methodology involved capturing writing products residing in an online collaborative writing environment. To do this I used a very specific collaborative writing environment and on reflection it may have been better to use more ubiquitous software that school teachers and students would be more likely to work with in future years. However in order to capture the data in the way required by the research study other systems would have needed adaptations and this would have necessitated an in-depth understanding of the underlying database architecture of the collaborative writing system.

Equally in hindsight, I now think that it would have been better to work with a single school/class for shorter periods of sustained writing and capture less data. This would have allowed more time for extensive analysis. The research was also stymied by timing issues mostly related to availability of students to work collaboratively and have access to the online writing environment. The research required three separate studies in order to capture sufficient data appropriate for analyses. Many of the issues could have been avoided with a different approach to data collection.

8.3 Contextualising the Research Findings

In the area of Science Learning, Inquiry-Based learning, Problem-Based Learning and other related approaches there is a long-running debate arising from Kirchner et al.'s (2006) article criticising “minimal guidance”. Their analysis of the failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching prompted much response in the literature. The findings here would indicate that an SFL-based analysis of the writing products from each of these various methods would provide greater insight into how effective the various strategies and methods are. An SFL approach could provide a common instrument for independent method evaluation.

In the area of Science Literacy and Language of Science, there have been several recent articles on argumentation and discourse, and on analysing students' learning in online classroom discussions about socioscientific issues, for example, (Crane, 2012). Although these methods are not using an SFL approach they appear to confirm Mercer's (2000) claims about types of classroom conversation, that is not all classroom argumentation tasks promote scientific reasoning equally. This research focusing on how students write science would contribute to understanding the relationship between science learning and science writing.

In the area of Continued Professional Development (CPD) there is considerable research interest in investigating interactions between classroom discourse, teacher questioning, and student cognitive engagement in schools. The research presented in this thesis would indicate that much work needs to be done to help

teachers effectively support students writing in online environments. This research could contribute meaningfully to the literature on scientific classroom discourse analysis, together with the analysis of discourse and writing in online settings. Perhaps it may sow the seeds for automated analysis of text and discourse with a view to providing online users such as teachers with intervention strategies.

8.4 Implications of Data Selection on Findings

Appropriate data selection is crucial to any research programme, and for this research, there were several sources of data that ultimately were not included in the analyses. This section reflects on the implications of the project data selection and exclusion. For reference purposes, UNESCO's Systematic Education for All (EFA) online programme (UNESCO, 2013) was consulted as it provides excellent guidelines for, and key issues associated with, educational indicators (data) and selection practices (UNESCO, 2013, Module A3, Section 7). The purpose of any data selection process is to identify the most appropriate data for the given purpose, to ensure that the indicators are used to reliably describe the situation, issues and implications, and to guide decisions and actions. For this research, the most appropriate data for the given purpose of conducting a linguistic evaluation of evolving written and spoken discourse associated with an online collaborative writing exercise were the interim and final drafts, together with the captured online discourse. However, for practical reasons, only three sample papers from thirteen available were examined in considerable detail. While this might seem to be a small sample, it should be noted that there were approximately one hundred interim drafts associated with each final paper, and that each paper required a nominalisation and genre analysis. Further analysis of additional samples would have extended the project beyond the allocated time allocation. All of the remaining writing team's papers were, however, systematically analysed using the Kaleidoscope software described in section 4.2, to verify that evolving nominalisation occurred regularly in paper drafts that were not the primary sources for comprehensive linguistic analysis (genre analysis and nominalisation analysis), thereby confirming the findings presented in section 6.3. Given the time required for a systematic linguistic analysis, however, these examples of evolving nominalisation were not analysed to determine if there was accompanying spoken discourse motivating the change. It is believed, therefore, that the data (and

analyses) presented reliably explain the situation, issues and implications associated with the research context (authentic online collaborative writing in science).

Reflection on UNESCO's criterion on data selection, that they should assist decision making and actions, has certain implications for this research. It was understood that SFL analysis examines specific text in context, and is not necessarily predictive in itself. The analyses presented imply that the results presented are for the particular groups of students participating in the research and their discourse. Apart from two limited post and pre-study surveys, focussing primarily on attitudes to collaboration, there were not a great deal of additional contextual data collected throughout. One lesson learned from this is the value of extensive pre- and post-study surveys.

An additional reflection at the end of the research is the consideration of whether data exclusion (described in detail in section 4.7) led to misunderstanding of the situation, or to poor decisions following the analyses? For example, did the exclusion of the planning data from the systemic functional linguistic analysis, but inclusion in the subsequent overall study analysis lead to incorrect interpretation, and poor recommendations? It is believed that evaluation of the pre-planning data set (as shown in Figure 7.3 above) was not core to informing the linguistic analysis, but was certainly core to understanding team dynamics and teacher-student communication. In hindsight, the data collected were reliable, but the methodology indicators associated with the collaborative training intervention (the planning data) were poorly defined in terms of their relationship with the core online collaborative writing part of the project. Exclusion of these data was in all likelihood the best decision, not only given the scale of the project, but in order to improve reliability, reduce errors and minimise decision errors.

Finally, the experience gained from issues associated with data selection and exclusion have been valuable. Future research will give greater consideration of data sources and their interrelationships, in order to minimise the risk of choosing the wrong data indicator, asking incorrect questions, misusing data sources, using incorrect data sources or data, conducting erroneous calculations and analyses,

poorly presenting or interpreting results, and incorrectly using results for decisions and actions.

8.5 Additional Mediating Factors in Research Design

This section considers additional mediating factors in the research design, what the likely impact of these factors were. Specifically, it considers existing relationships with teachers, teacher interaction and feedback on students' work, and the software scaffolds.

As indicated in section 3.3 on ethical issues associated with this research, all participating schools had previous working relationships with the university, as students from local schools regularly attend science departments to conduct laboratory experiments necessary for state examinations, and for general interest. There were a number of previous professional interactions between the researcher and two of the schools (Schools A and B), however. The vice principal of school A was known to the researcher, as they attended university together and maintained regular contact. This meant that the initial request to the school to participate in the research project could have been received favourably. Furthermore, School A's vice principal introduced the researcher to Schools B and C, and recommended that they participate in the project. The researcher also had a previous professional relationship with the mentoring teacher from School B, as he had mentored a team of four students in national mini-company competition focussing on the development of digital humanities software. These students worked with the researcher weekly and won county and national prizes for their efforts. School B and the researcher decided that it would be inappropriate for these students to be included in student group selected by school to participate in the research project. Finally, a teacher from School A, involved in the Pilot Study had previously been taught Computer Science at University by the researcher during her first year.

Throughout the project there were interactions with the teachers, mainly about the research, but occasionally to discuss students, in general and specifically. The general format of the discourse during these interactions were to inform me that the students, although not focussing on state examinations, were very busy and

that poor participation was probably due to study pressures elsewhere. Discussions about individual students, sometimes prompted by the researcher, were related to lack of participation by certain students, and focused on ensuring students knew that they did not have to continue if they did not wish to do so. It is difficult to ascertain the impact of these professional relationships, and teacher interactions, on the project outcomes. Without doubt, it became easier to secure school participation because of the professional relationships. The teachers did not dispute the work programmes for themselves or their students, and did not voice concerns that would necessitate changing the study design. As indicated in Chapter Four, however, both main studies ended prematurely because of pressures of work. This poor scheduling (of study close to exam times), and resultant incomplete data collection, may have been averted had the researcher and schools been on less familiar terms. Perhaps there was an expectation, from schools and researcher, that the additional school pressures were known, when in fact they were not. Had all students completed the final sections of the writing project (responding to the teachers' MASUS comments), perhaps the final papers would have had a higher standard of completeness. The timing issues related to student unavailability, may have contributed to collaboration difficulties; perhaps students just did not have time to collaborate.

Section 4.4.3 described the software environment used to scaffold and realise the team-based online collaborative writing projects for this study. As indicated earlier, the software was developed as part of an ongoing computer science project involving the researcher and colleagues from several collaborating institutions. The software had previously been used, for science-learning research, with primary and secondary school levels, where the focus was primarily on the analysis of astronomical data. It had also been used by the university's Geography department for planning and writing a field-based geography paper. The software was never intended to be used for analysing collaborative writing as its primary purpose. As indicated in section 4.4, however, it required minimal modifications in order to capture evolving written and spoken discourse. The main reason for selecting the software, however, is because it was approved for use in Irish schools as its development was funded by the National Centre for Technology in Education, and it was trusted by the participating schools. There may have been implications associated with using this particular scaffold for the project. As the

software emphasised supporting collaborative planning as the primary activity, a good deal of the writing project time was devoted to structured organisation of the paper, sections and associated writers. This could have been achieved in a shorter time if it had been done with a simple discussion forum. Additionally, once the planning phase of the project was completed, and the writing phase began, all of the planning notes became unavailable to the students. This was frustrating for some students, especially those who had contributed significantly (in terms of providing written notes) in the planning phase. As an intervention, at the request of the participants, the researcher extracted all of the planning notes and provided those to the team upon request. On reflection, the software may have been overly complex, but the disadvantages associated with complexity were compensated by being able to capture high-quality evolving data. It would be worthwhile, however, to investigate alternative methods of capturing evolving texts and accompanying spoken discourse for future investigations.

8.6 Conclusions

In conclusion this research study has provided new insight into online collaborative student writing in science. Specifically, the research: (i) shows insight into how students use language to collaborate and write and revise text, (ii) has the potential to change teachers' perspectives on writing, (iii) indicates that despite spending a great deal of time on web 2.0 (social) environments learners have not yet learned to collaborate meaningfully when writing about science, (iv) highlights the importance of the teachers in the science writing process, and (v) demonstrates how successful SFL can be for whole-project writing analysis.

The research also shows that just because students incorporate online resources, write, and communicate online, there are no guarantees that they will learn to be successful collaborative writers in science without appropriate intervention by teachers. There is a requirement for tools and methods to support teachers' analysis of online collaboration and writing when used in scientific literacy development contexts.

As a final reflection on the project's methodology, analyses and findings I would argue that, despite the difficulties in capturing the dynamics of online collaborative science writing at secondary school level, it was possible to gather sufficient data to perform an SFL nominalisation analysis and analyse the evolving discourse of student writing. Furthermore, it was possible to explain the temporal evolution in terms of peer-peer and peer-teacher discourse. This research demonstrates the value of actually analysing what the students say and write in context, and it is on this basis that I would argue that future online authentic science learning environments should provide facilities to support teachers' analyses of online collaboration and writing, in order to assist with scaffolding their students' scientific literacy development and thus science learning.

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APPENDICES

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Appendix A

Sample Letter of Consent

The Letter of Consent, overleaf, was sent to the Deputy Principals of three different schools over a three year period. For the Pilot Study, it was sent to a single, all-boys, secondary school level (School A) in 2008. For the First Research Study, it was sent to School A, and an additional all-girls, secondary school level (School B) in 2009. For the Second Research Study, it was sent to sent to School A, and an additional mixed-sex, secondary school level(School C) in 2010.

For each school, the Deputy Principals decided that the school would select appropriate participating classes (to minimise timetabling disruption) and organise the distribution of the Letters of Consent to the parents and/or guardians of the students. The schools also selected the requisite number of students from the cohort with parental or guardian approval. In general, there appeared whole-class participation over the three-year period. I was not provided with any details on how many students sought approval to participate but were not facilitated but their parent or guardian.



November 10, 2010

Dear Parent/Guardian,

My name is John Keating and I am the Associate Director of An Foras Feasa: The Institute for Research in Irish Historical and Cultural Traditions, at National University of Ireland Maynooth (NUIM). I am also a part-time Doctorate of Education student with The Centre for Research in Education and Educational Technology (CREET) at The Open University. My doctoral research is on "The relationship between Teacher and Peer Dialogue and Online Collaborative Writing", and I am writing to you in this capacity.

I am working with the Transition Year class in **XXXXXXXXXXXXXXXXXX** and **XXXXXXXXXX**, their Deputy Principal teacher, to conduct research on online collaborative science writing, using a web-based collaborative writing environment developed at NUIM. Students taking part in this project will spend on average 1 class a day, each day for three weeks, learning, talking and writing about an environmental science topic (global warming). At the end of this project, students will have collaboratively written a short article on global warming using an online collaborative learning environment. It is anticipated that students may benefit from this research by learning more about collaborative working and writing science articles. The students, accompanied by their teacher, will also spend one day at NUIM attending classes on collaborative working and writing prior to embarking on the project. As part of this project, the school is also collaborating with **XXXXXXXXXX XXXXXXXXXXXXXXXX**, and some participants will be randomly selected to collaboratively write a document with students from the other school and have comments on their work by a teacher from the other school. Both schools have agreed to cooperate in this reciprocal collaborative working arrangement, and consider it to be a valuable learning experience for the participants.

I would like your consent to include your son in this research project. Each student's participation in this project is completely voluntary and the choice to participate or not will not impact his grades or status at school. All information that is obtained during this research project will be kept strictly secure and will not become a part of your son's school record. The information will be kept in a locked file cabinet and will be accessible only to project personnel. The writing products and online discussions, will be transcribed and coded to remove student's names and will be erased after the project is completed. In addition, no personal data will be collected about students at any stage during the project.

The results of this study may be used for a dissertation, a scholarly report, journal article and conference presentation. Pseudonyms will be substituted for the names of students who may be represented in the results.

In the space at the bottom of this letter, please indicate whether you do or do not want your son to participate in this project. Ask your son to bring one copy of this completed form to his teacher (Mr. Andrés) on Monday 15 November 2010. The second copy is to keep for your records. If you have any questions about this research project, please feel free to contact me, my project supervisor, or my institute director, either by mail, e-mail, or telephone.

Sincerely,

Dr. John Keating

Tel: (01) 708 3854

Fax: (01) 708 4797

Email: john.keating@nuim.ie

I do/do not (circle one) give permission for my son _____ to participate in collaborative-writing research that would be used for educational purposes.

Parent's/Guardian's signature: _____ Date: _____

If you have any questions about this project, please contact research supervisor: Dr. Caroline Coffin, Dr Caroline Coffin, Reader in Applied Linguistics, Faculty of Education and Language Studies, Centre for Language and Communication, Walton Hall, Milton Keynes, MK7 6AA. Tel: +44 1908 858495. Email: c.coffin@open.ac.uk. My Institute Director, xxxxxxxx xxxxxxxxxxxx may be contacted at: Tel: xx xxxxxxx. Email: xxxxxxxx.xxxxxxxxxx@nuim.ie.

Appendix B

“The Physical Processes of Global Warming”

Library Research Genre and Discourse

This Appendix contains the final draft of three Library Research Papers together with accompanying comments from teachers and fellow writers. All names have been anonymised. The comments on each section follow that section. Each section has written by a single author (indicated). Specifically, it presents:

- PRELIMINARY RESEARCH STUDY (PRS) - Sample Genre (PRS-01)
- FIRST RESEARCH STUDY (FRS) - Sample Genre (FRS-01)
- SECOND RESEARCH STUDY (FRS) - Sample Genre (SRS-01)

PRELIMINARY CASE STUDY (PRS) - Sample Library Research Paper (PRS-01)

The Physical Processes of Global Warming

(Teacher: Ms. Green)

S-PRS-01, S-PRS-02, S-PRS-03 and S-PRS-04

Introduction To Global Warming (S-PRS-01)

1. How the Earth stays warm
2. The Greenhouse Effect
3. The greenhouse effect on other planets
4. Enhancement of the greenhouse effect

The theory behind the greenhouse effect can be understood by considering several factors. The radiation energy that comes from the sun and the Earth's own thermal radiation. These two radiation streams must always be in balance and if the balance is disturbed by anything, for example a global increase in CO₂ levels in the atmosphere, it can only be restored by an increase in the surface temperature of the Earth.

Approximately 84% of the energy from the sun is used to heat the Earth's surface. The rest is radiated out into space. In order to balance this incoming energy the Earth must radiate the same amount of energy back into space in the form of its thermal radiation. If the Earth successfully balances the equation the average surface temperature should be -6C. However this is not so. The average surface temperature has been shown to be around 15C. So some other factor must be taken into account in order to explain this.

The explanation is the greenhouse effect which is not caused by the gases of nitrogen and oxygen which make up the bulk of the atmosphere, but by the minor gases such as carbon dioxide, methane and water vapor. It is this natural greenhouse effect which prevents the thermal radiation from escaping the atmosphere and keeping the Earth's temperature at the average of 15C. However due to globally increased levels of carbon dioxide and other greenhouse gases the average surface temperature of the Earth is rising.

Examples of what could happen to the planet if this continues can be seen on other planets in the solar system. Mars and Venus, the closest planets to Earth, both suffer from significant greenhouse effect. While Mars has a very small atmosphere when compared to that of Earth, it is mainly composed of carbon dioxide. Venus however a very different atmosphere to that of Mars. While its atmosphere is made mostly of carbon dioxide, the clouds are made of almost pure sulphuric acid, which prevent most of the sunlight from reaching the surface of the planet. You might suspect that this would cause the planet to be relatively cool, but the greenhouse effect caused by the atmosphere is so extreme that the surface temperature is around 525C.

It is obvious that the natural greenhouse effect that occurs on Earth is important for keeping the planet warm. Without it the surface of the Earth would be so cold that life would be dramatically different. However the amount of the gases which cause the effect is increasing meaning the greenhouse effect is being enhanced causing a rise in the Earth's temperature. The amount of water vapor in the atmosphere is caused by the temperature of the oceans and not directly affected by human activities. CO₂ however is and the amount of it in the atmosphere has increased by about 30% since the Industrial Revolution. This is mostly due to human industry and the removal of forests. It has been projected that the current amount of CO₂ in the atmosphere will double within the next hundred years. This coupled with other contributing factors will cause the temperature of the Earth to rise by approximately 2.5C.

From	Date	Title	Comment (for S-PRS-01)
Ms. Green	2008-03-11 09:37:58	Advise	Do not worry about contacting each other regarding changes. You need to work together on your ideas. Remember that the essay has to come together as a complete article in the end. Try not to work too independently
Ms. Green	2008-03-12 09:33:00	Conor	Couple of typing errors just watch out for this. The introduction here is written in a very scientific manner, well done it looks very good. MAke sure to keep up the collaboration with your team.

The Physical Changes behind Climate Change (S-PRS-02)

The Physical Changes of climate change are the most important aspect when it comes to climate change because this will effect how we live, the future weather effects and life for our children.

In an artical it stated that Scientists believe that humans interfered with the climate and that any more interfearence will cause worse effects when it comes to weather. But what causes these physical changes, what are these physical changes and can we stop these changes?

The first and most important question is what causes these physical changes? Well gases that we realise into the atmosphere (carbon dioxide, methane, nitrous oxide and halocarbons) create a blanket in the atmosphere, then when the sun rays enter the earth's atmosphere they are trapped and cannot escape. This causes the earth to increase in temperature. This is a natural occurence but we as humans have increased the level of these gases by 90 percent in the last one hundred years which will have dier consequences.

The main question on everyones mind who is concerned about climate change is what are these physical changes that will occur? Well if we keep burning fossil fuels the way we are, the atmosphere will just keep increasing in temperature and at the north and south poles the giant glaciers and iceburgs will started to melt and this will cause sea levels around to rise, flooding coastal areas. Studies show that in the 21st century the sea level will rise from 30 to 40 centimeters. Preciptation is also a growing factor of these physical changes. With the increase in temperature more and more water is being evaporated into the atmosphere causing more rain. There is great evidence of this in Ireland's summer of 2007.

The last question scientists are always being asked is can we stop these physical changes from occurring? Well the answer is you cant just stop Climate change from happening it is a natural occurence that has been going on since the earth has been in existence and will continue to happen even if we dramatically reduce our level of emissions but we will reduce the level of speed at which these physical changes happen. What we need to do is find alternative methods to burning fossil fuels and different ways of removing our waste. The first thing we can do and has been growing over the last couple of years is to adopt recycling methods at home and at school. This will reduce the level of full landfills that give off a large portion of methane in to our atmosphere. Another change scientists are still trying to find is a different form of fuel that cars can run on and does not harm the envoirment we live in. But until this is discovered people will continue to use petrol in their cars even though they know the effects.

The physical changes from global warming is something that happens naturally but with our increase in emissions something that should take hundreds of years is taking place in this 21st century. We can lower our emissions before its too late.

From	Date	Title	Comment (for S-PRS-02)
S-PRS-03	2008-03-11 09:34:35	F	i with a capital I
Ms. Green	2008-03-12 09:36:27	Fionn	This is nicely written, but remember that it is a scientific account. You do not necessarily need to make it as descriptive as you are. Have a look at the style of writing being used by the rest of your team. Remember that this has to be compiled in the end as the one essay so the style of writing needs to be quite consistent throughout.

Methane Produced By Plants (S-PRS-03)

Methane from plants has been discovered to be a contributing factor in the process of global warming, and though only a tiny amount is produced per plant, these levels of methane would quickly add up, due to the fact that plants cover a large amount of the globe, surprising also to hear that methane is far more damaging and can contribute more to climate change than carbon dioxide. These tests that have been carried out are very interesting and it is an interesting theory that these scientists have come up with. If these plants are to blame for 10 to 40% of global emissions then perhaps we have been a bit harsh on ourselves for driving around flash cars and having to burn ridiculous amounts of fossil fuels such as oil and coal to heat our oversized homes, and power our LCD TV's. The tropical rainforests, which we believe today to be one of the earth's carbon sinks, could now be to blame for between 60 million and 240 million metric tons of methane and even though the rainforests may be absorbing carbon dioxide, they could potentially be releasing this much methane, which is far more damaging to the earth's climate than carbon dioxide ever will be.

The argument we would like to make here is that plants have been around for millions of years, cars, power stations, and airplanes have not, and if we have done this much damage in so little time, why did the methane, that has supposedly been building up in the atmosphere for millions of years not have a similar effect on the climate to what we believe is happening today. The scientists in this article say that this methane gas could have been a driving force behind historic climate change, and they are also suggesting that it may have had some part to do with the last ice age around 21000 years ago. If methane is a greenhouse gas then in theory it should have warmed the planet up and not caused an ice age. The scientists also make a good argument in saying that vegetation growth and thus methane levels would not have been as high during the ice age and this makes sense, but still this methane has been for millions upon millions of years and with it being more damaging than carbon dioxide we should have already have seen the detrimental effects of climate change we are expecting by the end of the century or sooner at the rate we are going. Is methane less damaging on its own? or is methane and carbon dioxide a lethal combination that both contribute to climate change in such a way that we have begun to see such things as desertification, the melting of the polar ice caps and an increased global temperature. This is a very interesting theory and could have a lot of truth in it but the more modern theory that we believe to be the biggest threat to mankind ever seems the most logical to me, and although methane may have been a massive contributor to pre-historic climate change.

From	Date	Title	Comment (for S-PRS-03)
S-PRS-04	2008-03-13 09:20:18	Style of writing	No need for the "I was surprised" etc, it is more supposed to be a scientific account as opposed to a reflection afaik

From	Date	Title	Comment (for S-PRS-03)
S-PRS-04	2008-03-13 09:31:12	Style of writing (take2)	No need for <I was surprised> etc, afaik it should be more a factual account than a reflection.
S-PRS-02	2008-03-13 09:36:26	CK	Well done! Looks great. CK

Carbon (S-PRS-04)

Carbon dioxide, along with other greenhouse gases, help keep the Earth warm by preventing some infrared radiation from escaping the Earth's atmosphere. However, human activities causing levels of CO₂ and other greenhouse gases to increase mean that the Earth is becoming warmer than it should be.

Since 1958, CO₂ concentrations have been measured at an altitude of about 4000 metres from the peak of the Mauna Loa mountain in Hawaii. Measurements from this position (which is isolated and far away from any local sources of pollution) clearly indicate a steady rise in atmospheric concentrations of CO₂. Based on the first readings taken in 1958, the mean concentration was approximately 316 parts per million by volume (ppmv), whereas by 1998 this figure had risen to 369, a 16.8% increase, an average of 0.42 per year. There are of course annual variations, but these are caused by CO₂ uptake by growing plants.

The biggest reason for such a dramatic increase in atmospheric CO₂ concentrations is industrialization, and the beginning of the use of fossil fuels as far back as 1870. The most significant CO₂-producing processes include energy production, transport and heavy industry. The biggest culprits are North/Central America, Europe and Asia, indicating that the industrialized countries must bear the main responsibility of reducing CO₂ emissions.

Other, slightly less significant CO₂ emissions include those resulting from changes in land use, such as the cutting down of rain forests (especially in South America), as when these forests are cut down, the land often has a far smaller capacity for storing CO₂.

The rich, developed nations have always been known for emitting more CO₂ and other greenhouse gases than any other countries in the world, ever since the start of industrialization and the introduction of fossil fuels. Therefore, the majority of the responsibility for combating climate change falls on them. However, because the less industrialized countries are always striving to increase their citizens' standards of living (therefore increasing their energy production, and in turn their CO₂ emissions), the debate over sharing of responsibility for climate change is a highly controversial one, and despite emissions being reduced in the industrialized countries, the level of CO₂ will most likely continue to increase. For example, China has the second largest volume of emissions in the world, but yet has a far lower average per capita compared to the biggest culprit on the list, the USA.

Organizations have been set up to help combat climate change, including the UNFCCC (United Nations Convention on Climate Change) and the IPCC (Intergovernmental Panel on Climate Change). The UNFCCC is the foundation of global efforts to combat global warming. It was officially opened for signature in 1992 at the Rio Earth Summit, and its purpose was (and still is) "the stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic human-induced interference with the climate system".

In 1988, UNEP and WMO established the IPCC, as climate change was now starting to become a serious issue. The IPCC's purpose was to assess the state of knowledge on various aspects of climate change, and its assessments have a profound impact on UNFCCC decisions, and its Kyoto protocol. It is recognized as the most authoritative voice on climate change, and involves 400 experts from 120 countries in drafting, revising and finalizing their reports, as well as another 2500 experts involved in the review process.

From	Date	Title	Comment (for S-PRS-04)
S-PRS-03	2008-03-14 09:51:12	.F.N	I've changed it so that there is no more Is in it, Green said that to me already

References:

1. Global Warming - The Complete Briefing, John Houghton
2. United Nations Environment Programme - environment for development, <http://www.unep.org>
3. The Physical Science behind Climate Change, William Collins, Robert Colman, James Haywood, Martin R. Manning, Philip Mote
4. Methane, Plants and Climate Change, Frank Keppler, Thomas Röckmann

FIRST CASE STUDY (FRS) - Sample Library Research Paper (FRS-01)

The Physical Processes of Global Warming

(Teacher: Mr. Black)

S-FRS-01, S-FRS-02, S-FRS-03 and S-FRS-04

Abstract (S-FRS-01)

As a team we were intrigued by the physical processes of global warming. We decided to research the general effects of global warming, the impact these effects would have on animals and how these impacts could be prevented. We also wanted to see what the advantages and disadvantages of these prevention methods were. In this research we hoped we would become further enlightened on the physical processes of global warming. It is evident that global warming can bring about negative results like increased precipitation and insect swarms but the positive effects of global warming are often ignored and seldom discussed. We hoped to look further into the advantages of global warming. We found advantages such as life itself!-humans would be incapable of surviving in temperatures that existed before global warming. During our research we looked into the effects of global warming on animals. We hoped that as a result of these findings we could try to do what little bit we can to stop adjusting the natural lifestyles of animals. We also reviewed some of the methods of preventing global warming. Nuclear power could be a useful power source as it does not produce green house gases that have caused global warming. Solution? No! The waste produced by nuclear power is potentially poses an unmeasurable long term threat to humanity creating horrific man made disasters. Various changes of lifestyles should be considered as a result of our findings in this assignment. Small things like taking the bus to work or cycling to the shop will reduce carbon emissions and reduce the negative effects of global warming.

From	Date	Title	Comment (for S-FRS-01)
S-FRS-01	2009-05-24 16:11:04	suggestions?	any suggestions on how i should start this off?
S-FRS-02	2009-05-24 16:15:17	...	From what I understand of what this is meant to be is the information thats in the paper..but not specific information..just an outline of what we are going to be talking about.
S-FRS-01	2009-05-24 16:37:04	thanks	Thanks would you mind scanning over wat iv written just now and see if it's the right idea?? thanks xx

From	Date	Title	Comment (for S-FRS-01)
S-FRS-04	2009-05-28 16:47:46	Maybe?	Maybe it could be a bit less detailed, I don't know but I think the abstract is suppose to be the shortest piece on the paper?

Introduction (S-FRS-02)

Global warming is the increase in the average temperature on the earths surface, air and oceans. Without the natural 'green house effect', temperatures on earth would be much lower than they are now, and life as we know it would not be possible. Instead thanks to green houses gases, and average temperature on earth is a hospitable 13 degrees Celsius. However problems arise when the concentration of these green houses gases increase in the atmosphere. Greenhouses gases like carbon dioxide are increasing. Scientists generally believe that the combustion of fossil fuels and other human activities are the primary reason for the increased concentration of carbon dioxide in the atmosphere. Fossil fuels being burnt to run cars and trucks, heat homes and businesses and provide electricity are responsible for 84.8% of the Americas carbon dioxide emissions.[1]

From	Date	Title	Comment (for S-FRS-02)
Mr. Black	2009-05-21 23:17:21	Some writing comments - Introduction - RAILTIN	Hi Railtin, well done on the introduction. Just two things to point out: Perhaps you can rephrase the sentence: 'Scientists generally believe that the combustion of fossil fuels and other human activities are the primary increase of the increased concentration....' You've used increase/ increased twice. You should change the first 'increase' to a more appropriate word. Just read over it yourself and you'll see what I mean. Also, you have a very good statistic at the end: '... are responsible for 98% of America's carbon dioxide emissions.' Do you have a reference for this?
S-FRS-02	2009-05-25 22:46:57		Hey this is the reference that I used for the fact at the end of my introsuction (*) 2009 Greenhouse gas inventory report. Heres a like for the site I got it from (*) www.epa.gov/climatechange/emissions/co2_human.html ;
S-FRS-02	2009-05-25 22:49:57	Ref	Heres the reference for the fact I had at then end of my introduction. I ts for the2009 U.S greenhouse gas inventory report The link for the site is; www.epa.gov/climatechange/emissions/co2_human.html
Mr. Black	2009-05-24 22:30:20	Soem writing comments-for Railtin-Intro	Well done Railtin on your edits. Can you pass your reference (i.e [1] corresponding to the 84.8%) info to Angela so she can include in the References section.
S-FRS-04	2009-05-28 16:49:21	Intro	You could perhaps put a clear definition of global warming to begin the introduction so everyone is in no doubt about what we are discussing in the paper

Effects of Global Warming (S-FRS-03)

Main Impacts of Global Warming on the world: * Melting of glaciers *Animal extinction beginning eg. penguins *Sea levels rising *Animals migrating due to climate changes *Increased precipitation *High temperatures resulting in insect swarms These are a number of impacts you can see already happening. <http://environment.nationalgeographic.com/environment/global-warming/gw-effects.html>

From	Date	Title	Comment (for S-FRS-03)
Mr. Black	2009-05-21 23:25:28	Comment for Alison	Hi Alison, You're made very good points in this section. Can you now expand on them and put them into a few paragraphs of writing instead of bullet points please. Your opening sentence could be something like: 'The main impacts of global warming on the world are manifold.' Then you can go on to explain the impacts you have listed.
S-FRS-01	2009-05-24 16:00:16		dude i need help.....wat do u mean??i thought it was in general.....:(

Impact of Global Warming on Animals (S-FRS-04)

As we have seen from the previous point, animals from all climates have been impacted in some way by the warmer climate. Here, one can see the severity of the implications global warming is having on animals, in detail. The severity of the impact on each species varies from just coming out of hibernation earlier to some animals on the verge of extinction, like polar bears and penguins. An example of an animal coming out of hibernation earlier is the dormice. A report from La Sapienza University in Rome has documented that their hibernation has decreased by an average of five and half weeks. This is as a direct result of spring like temperatures occurring earlier in the year. Resulting from waking up earlier, their feeding and breeding habits are out of sync which causes the animal to lose weight which puts the animal into distress. According to The Union Of Concerned Scientists USA [3.1] the geographic ranges of most plant and animal species are limited by climatic factors, including temperature, precipitation, soil moisture, humidity, and wind. Within this one sentence we realise exactly why global warming is impacting animals as much as it is. Below I'm going to detail the impact of global warming on polar bears, penguins and birds. Global warming is causing changes in climatic factors. For example, the once frozen Arctic sea is now slowly melting away. Polar bears need these conditions to survive. Polar bears are well used to swimming, they build up large deposits of blubber, which they use up during long swims to land. Due to global warming, their swims to land are now getting longer and longer. These longer swims are using up energy and the loss in this energy is making polar bears more vulnerable to other stalking animals. A group working to combat global warming issues [3.2], described the problem in a simple sentence "As the arctic warms, summer sea ice is shrinking rapidly and could disappear entirely in this century. If that happens, polar bears are unlikely to survive as species". I think this quote clearly conveys the issue, unless dire action is taken by the end of this century polar bears may not exist. Penguins, birds accustomed to cold weather are also hugely affected by the issue of global warming. According to Common Dreams [3.3] the numbers of a specific type of penguin, the adolie penguin, have dramatically dropped in recent years in the Antartica. Hypothetically, even if the penguin somehow managed to adapt to the warmer conditions, its livelihood would still disappear. The penguins staple food is a fish known as krill, which thrives in frozen, icy waters. Since the waters have warmed and ice begun to melt in recent years their stocks have depleted. Since 1980 it has been reported that krill populations have decreased by 90% [3.4]. If these populations follow the same trend in the coming years, penguins will die away, since their food chain will come to an end with the loss of krill from the waters. Birds, many different species, are impacted by the ongoing issue of global warming. Birds are mainly affected in relation to their migration habits. Their migration pattern has changed in recent years due to warmer temperatures. Observations by experts show that birds are migrating later, and returning much earlier due to warmer spring temperatures earlier in the year. Another problem faced by migrating birds is the

spread of the desert. The Sahara seems to be expanding due to global warming, the lack of rainfall and increase in temperatures causing the rapid evaporation of rainfall. Desertification may not seem like a huge problem, but during a bird's migration over the Sahara desert, their places of rest are getting farther and farther away. According to a report by ABC [3.5] many birds die of exhaustion and overheating as they fly over the desert, which is constantly expanding due to desertification caused by global warming. These are just a some of the many impacts global warming is having on animals. Repercussions from these effects are endless, causing an imbalance in the ecosystem and destroying food chains.

From	Date	Title	Comment (for S-FRS-04)
Mr. Black	2009-05-21 23:28:30	Comment for Kristen	Well done on your changes and improvements. Your section reads very well.
S-FRS-02	2009-05-22 21:43:29		Kristen your work is very good. Maybe you could put in some more pictures of the animals affected?
S-FRS-02	2009-05-22 21:47:43	Pictures	This is very good. Maybe you could put some more pictures of the animals affected in?.
S-FRS-02	2009-05-22 21:59:54	Thanks	Thanks you very much for that (:

Prevention Measures (S-FRS-02)

We as individuals can do our part in reducing the green house gas emissions by making less pollution choices. We can do this in many areas. On the roads; (*) Purchase a fuel efficient car. These are cars that are operable using comparatively little fuel to other cars. (*) Try to do all errands in one trip rather than making several. (*) Consider alternative methods of transport such as bus and bike. (*) Carpool to work or school In our homes; (*) Turn off lights, TV's and other electrical appliances when not in use. (*) Purchase energy efficient appliances that display the energy star label. Products that display the energy star label are products that use less energy, save money and help to protect the environment. (*) Replace all light bulbs with energy efficient fluorescent bulbs. (*) Make sure your water heater is wrapped in an insulation blanket. (*) Replace all window with double glazed windows. (*) Only use dishwashers and washing machines when they are full Chemicals; (*) Avoid chlorine at all costs. The use of chlorine compounds are very harmful to the environment. These are found in things such as spray paint and bleach. (*) Aerosols such as air fresheners and hairspray can contain butane which contribute to air pollution. Another method of prevention of Global warming is to use Nuclear power. Nuclear Power doesn't produce green houses gases there for would be better for the environment. But there are a few problems with this prevention method. (*) Uranium is radioactive and poisonous (*) Chernobyl. When this disaster happened in the 1950's they weren't using the sophisticated computers that we have today and that they weren't using any safety measures. It was a nightmare and basically an accident waiting to happen. The chances of another disaster like Chernobyl happening are slim to none, but the memory of Chernobyl and the horrific side effects that can still be seen mean that many people are very against the idea of Nuclear power being used anywhere else. (*) The waste is a huge problem. It is radioactive and there is no where good to put it.

Advantages and Disadvantages (S-FRS-01)

Global warming is here and is going to continue long into the foreseeable future. The prevention of Global warming is important and many small things like switching off electricity supplies when not in use are helpful in preventing it's increase. However not all measures of prevention will be without

SECOND CASE STUDY (SRS) - Sample Library Research Paper (SRS-01)

The Physical Processes of Global Warming

(Teacher: Mr. Black)

S-SRS-01, S-SRS-02, S-SRS-03 and S-SRS-04

Abstract (S-SRS-01)

This article that we are writing is about global warming. It is a guideline to the destruction it can cause and ways in which you can try and help to prevent global warming. It goes through the causes, ways to combat, effects and future consequences of global warming.

Introduction (S-SRS-02)

Global Warming is when the Earth Heats up (the temperature rises). This happens when greenhouse gases (carbon dioxide, water vapour, nitrous oxide and methane) trap heat and light from the sun in the Earth's atmosphere, which increases the temperature. This is called the Greenhouse effect. this effect can be compared to when heat gets trapped in a car on a sunny day in a parking lot. The rays of heat from the sun get into the car by going through the windows but cant get back out. This makes the temperature inside the car much higher. Global Warming is a serious problem and there is alot that needs to be done to reduce the effects quickly. Many countries have said that they will try to help combat global warming and a small amount of progress has been made up to this date. However more effort is needed by all the Countries in order to preserve our planet.

From	Date	Title	Comment (for S-SRS-02)
Mr. Black	2011-01-17 21:05:13	First Sentence	The first sentence introduces the topic. It is good because it is short and contains the necessary information. Perhaps you could change it by using the information in brackets. Therefore, "The rising temperature in the earth's atmosphere is the cause of global warming." This way the sentence remains short but there is a cause which is very important in science.
Mr. Black	2011-01-17 21:05:43	Second Sentence	Your second sentence starts with "it", could you change this to a noun?
Mr. Black	2011-01-17 21:06:25	Second Sentence - Part 2	This sentence contains very important scientific information because it explains what happens. Could you start this sentence by changing the verb trap into a noun? Try out some examples and we will discuss it further.
Mr. Black	2011-01-17 21:06:50	Car Example	The car example is very good.
Mr. Black	2011-01-17 21:07:18	Second Paragraph	The second paragraph starts with a sentence containing the word something. This word is too unclear. Try reworking the sentence so this word does not appear in it.

Causes of Global Warming (S-SRS-03)

Almost 100% of the observed temperature increase over the last 50 years has been due to the increase in the atmosphere of greenhouse gas concentrations like water vapour, carbon dioxide, methane and ozone. Greenhouse gases are those gases that contribute to the greenhouse effect. The largest contributing source of greenhouse gas is the burning of fossil fuels leading to the emission of carbon dioxide. The green house effect Green house gases act as a mirror and reflect back to the earth as a part of the heat radiation. The more green house gases in the atmosphere like carbon dioxide results in more heat reflected back to earthThe emission of carbon dioxide into the environment mainly from burning of fossil fuels eg.oil, gas, petrol has been increased dramatically over the past 50 years. The increase in these gas cause damage to the ozone. [IMAGE]While climate fluctuation is common in our atomosphere each year, it has come to the attention of scientists that an alarming increase in temperatures has occurred. Almost 100% of the recorded temperature increase over the last 50 years has been due to the increase in the atmosphere of greenhouse gas concentrations like water vapour, carbon dioxide (CO₂), methane and ozone (O₃). [IMAGE] (Greenhouse emissions individually)

From	Date	Title	Comment (for S-SRS-03)
Mr. Black	2011-01-17 21:09:08	First Paragraph	very clear first paragraph.
Mr. Black	2011-01-17 21:10:18	Second Paragraph	"Green house gases act as a mirror and reflect back to the earth as a part of the heat radiation." You introduce a new idea here with heat radiation which you should now explain.
Mr. Black	2011-01-17 21:11:30	Second Paragraph - Part 2	"The emission of carbon dioxide into the environment mainly from burning of fossil fuels eg.oil, gas, petrol has been increased dramatically over the past 50 years." Check the verb tense in this sentence.
Mr. Black	2011-01-17 21:13:15	Second Paragraph - Part 3	"The increase in these gas cause damage to the ozone." Check the subject-verb agreement here. Should it be "the increase ... cause damage to the ozone" or "the increase causes damage to the ozone."? Also should it be "the increase in these gas" or "the increase in these gases"?

Ways to Combat Global Warming (S-SRS-04)

Global warming is a worldwide problem, that is caused by every living person. Therefore this problem can only be solved if everybody makes a change and does their part. It cannot be solved with the help of only a fraction of the population. A combined effort is needed. However there are a variety of ways that an individual can play their part, and most of these are not too taxing at all. They are very rewarding in the long run. The solution to this problem is difficult to achieve in a short space of time so a continued, determined effort by all is required to be successful. This section will examine the different ways that an individual, a family, or even a larger community such as a school, can help to combat the further damage caused by Global Warming. Summary of Problems: This problem can only get worse, and the disaster that it brings needs to reach an end. It has worsened over the last few decades and is now a very important topic in modern times. Nearly every scientist will support the fact that in the last 30 - 40 years, the Earth has gotten warmer. (<http://globalwarming.com/2010/05/statistics-of-the-global-warming-trend/>). Since about 1950, the Earth's global surface temperature has risen by just more than .6 degrees Celsius or just over 1 degree Fahrenheit. (<http://globalwarming.com/2010/05/statistics-of-the-global-warming-trend/s>). Some examples of problems that have arisen in the last number of years has been: the temperature of the sea rising the ice caps melting co₂ levels rising, and more. [IMAGE]

[IMAGE]However these problems can be rectified if a combined effort is made! Some Solutions: There are many ways that global warming can be combatted. These are a few ways in which you can do it. Recycling: Perhaps one of the most worthwhile, and rewarding solutions is basic recycling. Recyclable items such as paper, cardboard, aluminium cans etc, can be put into a different bins and then it can be processed differently. It can be cleaned and broken down, and then re-used. This reduces the amount of waste that has to be gotten rid of. This in turn reduces the amount of waste that has to be put into landfill sites, or incinerated. Therefore greenhouse gas emissions from these waste disposal processes, such as carbon dioxide and methane, are reduced. The Central Statistics Office reported in 2007 that almost 90% of Irish households recycled some of their household waste, compared to just 48% in 1999. The figure was highest for residents in Dublin (94%). (http://en.wikipedia.org/wiki/Recycling_in_Ireland) According to the latest available EPA (Environmental Protection Agency) report(2005): 22.7% of household waste is recycled (2013 target: 50%). 34.6% of municipal waste is recycled (2013 target: 35%). 59.9% of packaging waste is recycled (2005 target: 50%; 2011 target: 60%). 86.9% of construction and demolition waste is recycled. The EPA planned to have 35% of all waste recycled by 2013, however this target was met eight years in advance, in 2005. (http://en.wikipedia.org/wiki/Recycling_in_Ireland) Recycling is enforced in Ireland in a number of ways : In 2002, a levy on plastic bags in all supermarkets was introduced. Ireland was the first country in the world to do so. All consumers were required to pay 15c for a plastic bag; this led to an immediate decrease of over 90% in the amount of plastic bags in circulation. From 328 bags per inhabitant per year when the levy was introduced, usage fell to 21 bags per inhabitant. (http://en.wikipedia.org/wiki/Recycling_in_Ireland) These are the top 5 countries in the world for recycling. Top 5 Recycling Countries : Switzerland 52% Austria 49.7% Germany 48% Netherlands 46% Norway 40% (<http://environmentalpictures.blogspot.com/2010/04/recycling-statistics.html>) This also shows the effectiveness of recycling in the world: Recycling: By the Numbers * 544,000: Trees saved if every household in the United States replaced just one roll of virgin fiber paper towels (70 sheets) with 100 percent recycled ones. * 20 million: Tons of electronic waste thrown away each year. One ton of scrap from discarded computers contains more gold than can be produced from 17 tons of gold ore. * 9 cubic yards: Amount of landfill space saved by recycling one ton of cardboard. * \$160 billion: Value of the global recycling industry that employs over 1.5 million people. * 79 million tons: Amount of waste material diverted away from disposal in 2005 through recycling and composting. * 5 percent: Fraction of the energy it takes to recycle aluminum versus mining and refining new aluminum. * 315 kg: Amount of carbon dioxide not released into the atmosphere each time a metric ton of glass is used to create new glass products. * 98 percent: Percentage of glass bottles in Denmark that are refillable. 98 percent of those are returned by consumers for reuse. * 51.5 percent: Percentage of the paper consumed in the U.S. that was recovered for recycling in 2005. (<http://environmentalpictures.blogspot.com/2010/04/recycling-statistics.html>) CFL Bulbs: CFL bulbs use 60% less energy than normal bulbs. This is a very simple basic change that everybody could make, yet have a very substantial effect on the world. It would save 300 pounds of carbon dioxide every year. This simple switch can help greatly, and it is a switch that everybody should be encouraged to make. Not Leaving Appliances On Standby: Many people when leaving their house do not use the on/off switch to turn all of the power off. Instead it is left on standby position, however this still uses energy that is wasted. The average time that Europeans watch TV for is 3 hours (<http://globalwarming-facts.info/50-tips.html>). In this time of the TV being turned on, and another 21 hours of the tv being left in standby mode, 40% of the energy is used in the standby mode. This is a great waste of energy and contributes greatly. Again this is a very simple switch. Thermostat and Boilers: Programmable thermostats can be installed that lower the heat and air conditioning at night, and raise them again in the morning when they are needed. This can save a lot of money on the energy bill, and also conserve energy. Also if the thermostat is set no higher than 50 degrees celcius, 550 pounds of carbon dioxide can be saved. 1000 pounds of carbon dioxide can also be saved by wrapping a boiler in a heat insulator. Windows: Although this change could cost a lot of money, its effect is priceless. By switching from a single glazed window to a double glazed window, the amount of heat that is lost from your house can be halved.

From	Date	Title	Comment (for S-SRS-04)
Mr. Black	2010-12-17 09:44:08	References	Hi Derek, all you wrote there looks very well, but I am missing references. Remember that you are getting this information from various sources (websites, scientific articles from magazines,...), so after writing a scientific statement, you should put between brackets, the reference. Mr. Black
Mr. Black	2011-01-21:17:44 GMT	Introduction Paragraph	Very clear ideas. It was nice that you mentioned individuals, families and groups/communities can work towards an improvement in the situation.
Mr. Black	2011-01-17 21:20:06	Second Paragraph - comment 1	"This problem can only get worse, and the disaster that it brings needs to reach an end." What is the one word (a verb) which you could substitute for "get worse"? Is there an adjective to describe the disaster which could change the sentence to: "This problem can only get worse, and the disaster needs to reach an end."
Mr. Black	2011-01-17 21:21:13	Second Paragraph - comment 2	"the Earth has gotten warmer" What about changing the "gotten" part of this sentence
Mr. Black	2011-01-17 21:24:01	Second Paragraph - comment 3	"Since about 1950, the Earth's global surface temperature has risen by just more than .6 degrees Celsius or just over 1 degree Fahrenheit" The sentence starts well with a time-related clause. Is there a way to rewrite the second part of this sentence, to start with "The Earth has experienced a rise of in its global surface temperature?" Ask your group for feedback on this change. They should have some ideas too.
Mr. Black	2011-01-17 21:27:03	Second Paragraph - comment 4	"Some examples of problems that have arisen in the last number of years has been: ..." Check the subject-verb agreement. Which is correct: "some examples has been" or "some examples ... have been"? Also is there a way to restructure this sentence in order for one of the verb structures to be removed? Perhaps you could think of using a stem sentence starting with "below are....."

From	Date	Title	Comment (for S-SRS-04)
Mr. Black	2011-01-17 21:37:30	Solutions Paragraph - comment 1	Do you need to use the word etc?
Mr. Black	2011-01-17 21:41:18	Solutions Paragraph - comment 2	"Recyclable items such as paper, cardboard, aluminium cans etc, can be put into a different bins and then it can be processed differently." Try starting the sentence with "By putting (or placing)" and ending it with "they can be processed differently." This way you are creating a more scientific sentence because you are dealing with one action leading to another. The first action is separating the recyclable items, the second action is enabling them to be processed differently.
Mr. Black	2011-01-17 21:42:34	Solutions Paragraph - comment 3	"It can be cleaned and broken down, and then re-used." What does "it" refer to? Can you rework this sentence so this becomes clearer to the reader?
Mr. Black	2011-01-17 21:47:27	Solutions Paragraph - comment 4	"Recycling is enforced in Ireland in a number of ways :" "A number of ways" gives the impression that the reader will read about more than one way. You only write about the plastic bag levy. What other ways is recycling enforced? If there are no other ways of enforcement, are there ways in which recycling is encouraged? Which of the following sounds better to you? 1. Recycling is enforced? 2. There are ways in which recycling enforcement has occurred in Ireland? 3. There are ways in which recycling has been encouraged? Try to get feedback from your team on how best to structure this sentence.
Mr. Black	2011-01-17 21:49:39	Top 5 Recycling Countries Paragraph	This is good information but it needs to be better placed with an sentence explaining why you are including it in your writing. Think about adding an additional sentence and get feedback from your team.
Mr. Black	2011-01-17 21:50:45	Recycling: By the Numbers paragraph	This same needs to be done for this paragraph as explained in the top 5 recycling countries comment.

From	Date	Title	Comment (for S-SRS-04)
S-SRS-03	2011-02-03 09:20:00	good work	good work dekkk
S-SRS-03	2011-03-03 09:36:20	?	why do you have random links ?

Effects of Global Warming (S-SRS-01)

Green house gases stay can stay in the atmosphere for an amount of years ranging from decades to hundreds and thousands of years. No matter what we do, global warming is going to have some effect on Earth. 5. Spread of disease As northern countries warm, disease carrying insects migrate north, bringing plague and disease with them. Indeed some scientists believe that in some countries thanks to global warming, malaria has not been fully eradicated. 4. Warmer waters and more hurricanes As the temperature of oceans rises, so will the probability of more frequent and stronger hurricanes. We saw in this in 2004 and 2005. 3. Increased probability and intensity of droughts and heat waves Although some areas of Earth will become wetter due to global warming, other areas will suffer serious droughts and heat waves. Africa will receive the worst of it, with more severe droughts also expected in Europe. Water is already a dangerously rare commodity in Africa, and according to the Intergovernmental Panel on Climate Change, global warming will exacerbate the conditions and could lead to conflicts and war. 2. Economic consequences Most of the effects of anthropogenic global warming won't be good. And these effects spell one thing for the countries of the world: economic consequences. Hurricanes cause do billions of dollars in damage, diseases cost money to treat and control and conflicts exacerbate all of these. 1. Polar ice caps melting The ice caps melting is a four-pronged danger: First, it will raise sea levels. There are 5,773,000 cubic miles of water in ice caps, glaciers, and permanent snow. According to the National Snow and Ice Data Center, if all glaciers melted today the seas would rise about 230 feet. Luckily, that's not going to happen all in one go! But sea levels will rise. Second, melting ice caps will throw the global ecosystem out of balance. The ice caps are fresh water, and when they melt they will desalinate the ocean, or in plain English - make it less salty. The desalinization of the gulf current will "screw up" ocean currents, which regulate temperatures. The stream shutdown or irregularity would cool the area around north-east America and Western Europe. Luckily, that will slow some of the other effects of global warming in that area! Third, temperature rises and changing landscapes in the arctic circle will endanger several species of animals. Only the most adaptable will survive. Fourth, global warming could snowball with the ice caps gone. Ice caps are white, and reflect sunlight, much of which is relected back into space, further cooling Earth. If the ice caps melt, the only reflector is the ocean. Darker colors absorb sunlight, further warming the Earth.

From	Date	Title	Comment (for S-SRS-01)
Mr. Black	2011-01-17 22:05:22	Paragraph 1	<p>"Green house gases stay can stay in the atmosphere for an amount of years ranging from decades to hundreds and thousands of years. No matter what we do, global warming is going to have some effect on Earth. If we do not put a stop to the way we live the effects of global warming could soon begin to threaten us. I have found what five of the deadliest effects of global warming are."</p> <ul style="list-style-type: none"> - check the verb structure at the start of your writing. - "no matter what we do, global warming is going to have some effect on Earth." This is a very strong statement, is it true? Please discuss it with your group and get feedback. - "If we do not put a stop to the way we live the effects of global warming could soon begin to threaten us." Another strong sentence. Have the effects not already begun to threaten us? Think about starting the sentence with "By not putting a stop to the way we live" - " I have found what five of the deadliest effects of global warming are." Please re-read this sentence and rewrite it, thinking about the following aspects: 1. Did you find these five most deadly effects or did other scientists? 2. Do you have a reference for this list of the five most deadly effects?
S-SRS-03	2011-01-03 09:33:57		we need references for were ever you got this

Future Consequences of Global Warming (S-SRS-02)

Global warming has become a major issue. The amount of carbon dioxide in the atmosphere is so far beyond normal that the ice caps will continue to melt way past 2050 and we are continuing to add more. This will speed up global warming, giving us less time to prepare for the consequences or to invent new technology to prevent it. There have been 5 ice ages in the past 600,000 years. In the past 600,000 years carbon dioxide has never exceeded 300 parts per million. Today it is 450ppm, and in 2050 it will be 700ppm. Ocean ice at the North Pole does not raise sea levels when melted. Land ice like Antarctica and Greenland does increase sea level when melted. The ice thickness at the North Pole has decreased 40% in the last 40 years. The polar ice reflects 90% of sunlight. Without the ice only 10% will be reflected. 90% will be absorbed by the ocean. Greenland ice would raise sea levels by 20 feet. A sea level rise of 20 feet will displace 100 million people. The ice on the entire continent of Antarctica has never completely melted in recorded history of 500,000 years. In 100 years it will completely melt and ocean levels will raise by 150 feet. [IMAGE]Consequences to Humans Besides an increase in natural catastrophes, agricultural yields could be modified and the zones where carriers of diseases such as cholera and malaria are present could be extended. Many growing populations living in tropical zones could be particularly impacted by climate change. Other populations could be displaced as a result of rising sea levels. Economic consequences Calculations of the economic impact of global warming are very difficult to make. Some economists speak of a cost of two euros per tonne of carbon, whereas others suggest 50euros. Among the various figures put forward, one estimates that global warming might cost up to one percentage point of economic growth. It is worth noting that banks, insurance

companies, farmers and developing countries are likely to be the most exposed. However, depending on the capacity of adaptation shown by the economy and by political organisations and on possible technological revolutions triggered by the challenge of climate change, a more optimistic outlook is not to be entirely excluded. Some positive consequences Already, global warming is beginning to stimulate governments to work together to fight a problem that concerns everyone. Global warming and energy issues also have a tendency to accelerate individual and political awareness of the impact of human activity on the environment. They are encouraging development of innovative technological solutions. Other more specific consequences expected are: lower winter mortality in the temperate zones, an increase in wood production, a rise in agricultural yields in temperate zones, increased water resources in certain dry zones close to the tropics, a drop in energy consumption for space heating (but a rise in that used for air conditioning)

Conclusion (S-SRS-03)

Conclusion Overall this paper shows one main message, global warming is an increasing problem in todays society. Governments must work together to combat the issue on a world wide scale. There are many different types of prevention methods that can be used such as using nuclear power instead of burning fossil fuels. However, each individual can make a difference. Global warming is not only increasing temperatures and causing severe climate change but also has a huge effect on animals, some of the worst effected being the polar bear and the penguin. Unless dire action is taken these animals, as well as others will be extinct by the end of this century. There are many prevention measures that we can use to slow down the rate of global warming.

References (S-SRS-04)

<http://globalwarming.com/2010/05/statistics-of-the-global-warming-trend/> http://en.wikipedia.org/wiki/Recycling_in_Ireland <http://environmentalpictures.blogspot.com/2010/04/recycling-statistics.html> <http://globalwarming-facts.info/50-tips.html>

Appendix C

Examples of Sentence Evolution from Drafts

This appendix contains additional sample writing excerpts, taken from Library Research Paper drafts, collected during the First and Second Research studies. Each excerpt contains an example of sentence evolution over a series of drafts. Colour-coding has been included in each excerpt to highlight the evolution of specific clauses, with each clause evolution in a fragment assigned a different colour. The colours need not be interpreted by the reader as they are purely a reading aid to assist locating related evolving clauses. Each excerpt has an associated header indicating the kind of evolution present, for example, depersonalisation, nominalisation.

SELECTED SENTENCE EVOLUTION

A. PRELIMINARY RESEARCH STUDY (PCS) - Sample Library Research Paper (PRS-01)

Sample sentence evolution (depersonalisation, nominalisation)

I was quite amazed and surprized to hear that methane could be relaesed from living vegetation, and though only a tiny amount per plant, these levels of methane would quickly add up, due to the fact that plants cover a large amount of the globe.

I was also surprised to hear that methane is far more damaging and can contribute more to climate change than carbon dioxide.

It was amazing to hear that methane could be relaesed from living vegetation, and though only a tiny amount per plant, these levels of methane would quickly add up, due to the fact that plants cover a large amount of the globe, surprising also to hear that methane is far more damaging and can contribute more to climate change than carbon dioxide.

Methane from plants has been discovered to be a contributing factor in the process of global warming, and though only a tiny amount is produced per plant, these levels of methane would quickly add up, due to the fact that plants cover a large amount of the globe, surprising also to hear that methane is far more damaging and can contribute more to climate change than carbon dioxide.

Sample sentence evolution (depersonalisation, nominalisation):

In an artical i read it stated that Scientists believe that humans interfered with the climate and that any more interfearence will cause worse effects when it comes weather.

In an artical it stated that Scientists believe that humans interfered with the climate and that any more interfearence will cause worse effects when it comes to weather.

Sample sentence evolution (spelling and punctuation)

The argument we would like to make here is that plants have been around for millions of years, cars, power satations, and aeroplanes have not, and if we have done this much damage in so little time, why did the methane, thats supposedly been building up in the atmosphere for millions of years not have a similar effect on the climate to what we believe is happening today.

The argument we would like to make here is that plants have been around for millions of years, cars, power stations, and airplanes have not, and if we have done this much damage in so little time, why did the methane, that has supposedly been building up in the atmosphere for millions of years not have a similar effect on the climate to what we believe is happening today.

B. FIRST RESEARCH STUDY (FRS) - Sample Library Research Paper (FRS-01)

Sample sentence evolution (nominalisation)

As a direct result of global warming, animals from all climates have been effected by the warmer climate. The severity of the impact on each species varies from just coming out of hibernation earlier to some animals on the verge of extinction.

As a direct result of global warming, animals from all climates have been impacted in some way by the warmer climate. The severity of the impact on each species varies from just coming out of hibernation earlier to some animals on the verge of extinction, like polar bears and penguins.

As we have seen from the previous point, animals from all climates have been impacted in some way by the warmer climate. Here, one can see the severity of the implications global warming is having on animals, in detail. The severity of the impact on each species varies from just coming out of hibernation earlier to some animals on the verge of extinction, like polar bears and penguins.

Sample sentence evolution (depersonalisation)

Within this one sentence we realise exactly why global warming is impacting animals as much as it is. Global warming is causing changes in climatic factors. For example, the once frozen Arctic sea is now slowly melting away.

Within this one sentence we realise exactly why global warming is impacting animals as much as it is. Below I'm going to detail the impact of global warming on polar bears, penguins and Global warming is causing changes in climatic factors. For example, the once frozen Arctic sea is now slowly melting away.

Within this one sentence we realise exactly why global warming is impacting animals as much as it is. Below I'm going to detail the impact of global warming on polar bears, penguins and birds. Global warming is causing changes in climatic factors. For example, the once frozen Arctic sea is now slowly melting away.

Sample sentence evolution (revision)

Global warming is here and is going to continue long into the foreseeable future. The advantages and disadvantages of Global warming also give an insight into the effects of global warming which have been touched on in the impacts of Global warming on animals.

Global warming is here and is going to continue long into the foreseeable future. There are both advantages and disadvantages when it comes to Global Warming.

Global warming is here and is going to continue long into the foreseeable future. There are both advantages and disadvantages when it comes to the prevention of Global Warming.

Sample sentence evolution (revision)

These longer swims are using up energy and the loss in this energy is making polar bears more vulnerable to **other animals**.

These longer swims are using up energy and the loss in this energy is making polar bears more vulnerable to **other stalking animals**.

Sample sentence evolution (revision)

We hoped that as a result of these findings we could try to do what little bit we can **to reduce global warming**.

We hoped that as a result of these findings we could try to do what little bit we can **to stop adjusting the natural lifestyles of animals**.

Sample sentence evolution (revision)

Without the natural 'green house effect', temperatures on earth would be much lower than they are now, and life as we know it would not be possible.

Global warming is the increase in the average temperature on the earths surface, air and oceans.
Without the natural 'green house effect', temperatures on earth would be much lower than they are now, and life as we know it would not be possible.

Sample sentence evolution (revision)

Greenhouses gases like carbon dioxide are increasing. Scientists generally believe that the combustion of fossil fuels and other human activities are the **primary increase of the increased concentration** of carbon dioxide in the atmosphere.

Greenhouses gases like carbon dioxide are increasing. Scientists generally believe that the combustion of fossil fuels and other human activities are the **primary reason for the increased concentration** of carbon dioxide in the atmosphere.

Sample sentence evolution (revision)

Reports from La Sapienza University in Rome is that their hibernation has decreased by an average of five and half weeks.

A report from La Sapienza University in Rome has documented that their hibernation has decreased by an average of five and half weeks.

Sample sentence evolution (revision)

Nuclear power could be a useful power source as it does not produce green house gases that have caused global warming. Solution? No!, as **when further research is carried out on nuclear power, it seems the waste** this power source does produce is

Nuclear power could be a useful power source as it does not produce green house gases that have caused global warming. Solution? No! **The waste produced by nuclear power** is potentially poses an unmeasurable long term threat to humanity creating horrific man made disasters.

Sample sentence evolution (revision)

Global warming is an increasing problem in todays society.

Overall this paper conveys one main message; global warming is an increasing problem in todays society.

C. SECOND CASE STUDY (SRS) - Sample Library Research Paper (SRS-01)

Sample sentence evolution (revision)

I have found what five of the deadliest effects of global warming are.

These five effects are some of the more disastrous effects caused by global warming if we do not begin to take heed to putting a stop to it.

Sample sentence evolution (revision)

Global Warming is when the Earth Heats up (the temperature rises). **It happens** when greenhouse gases (carbon dioxide, water vapour, nitrous oxide and methane) trap heat and light from the sun in the Earth's atmosphere, which increases the temperature.

Global Warming is when the Earth Heats up (the temperature rises). **This happens** when greenhouse gases (carbon dioxide, water vapour, nitrous oxide and methane) trap heat and light from the sun in the Earth's atmosphere, which increases the temperature.

Sample sentence evolution (revision)

Global Warming is a serious problem and **something needs to be done to reduce the effects quickly.**

Global Warming is a serious problem and **there is a lot that needs to be done to reduce the effects quickly.**

Sample sentence evolution (revision)

Various prevention methods can be used such as using nuclear power instead of burning fossil fuels. However, each individual can make a difference, relying less on CFCs in everyday life and walking instead of driving are simple yet effective ways, one individual can help slow down the effects of global warming. Global warming is not only increasing temperatures and causing severe climate change but also has a huge effect on animals, some of the worst effected being the polar bear and the penguin. Unless dire action is taken these animals, as well as others will be extinct by the end of this century. There are many prevention measures that we can use to slow down the rate of global warming. Each of these has its own advantages and disadvantages, which must be weighed up, are the consequences of global warming worse than the consequences of the prevention methods?

There are many different types of prevention methods that can be used such as using nuclear power instead of burning fossil fuels. However, each individual can make a difference. Global warming is not only increasing temperatures and causing severe climate change but also has a huge effect on animals, some of the worst effected being the polar bear and the penguin. Unless dire action is taken these animals, as well as others will be extinct by the end of this century. There are many prevention measures that we can use to slow down the rate of global warming.

Sample sentence evolution (revision)

Already, global warming is beginning to stimulate governments to work together to fight a problem that concerns everyone - in itself quite a novel development.

Already, global warming is beginning to stimulate governments to work together to fight a problem that concerns everyone.

Sample sentence evolution (revision)

Green house gases stay can stay in the atmosphere for an amount of years ranging from decades to hundreds and thousands of years. No matter what we do, global warming is going to have some effect on Earth. If we do not put a stop to the way we live the effects of global warming could soon begin to threaten us.

Green house gases can stay in the atmosphere for an amount of years ranging from decades to hundreds and thousands of years. If we do not put a stop to the way we live the effects of global warming could soon begin to threaten us.

Appendix D

Sample Software Programs Developed for Analysis

A number of computer programs were developed specifically for this project in order to collate, organise, analyse and data-mine the interim and final Library Research Paper drafts. Two primary programs are included here, for reference purposes.

Program One (written in Perl) read and parsed all student paper drafts (encoded in XML) for a particular Writing Team and performed the following: (i) identified and encoded active, stative and relative verbs using lists contained in external data files, (ii) identified and encoded word-sense (i.e., nouns, verbs, adverbs and adjectives) for every word in the text sections using the WordNet system, (iii) anonymised student names using hand-coded specifications held in external files, and (iv) produced a new XML version of the draft suitable for viewing in a web browser.

Program Two (written in Perl) was written for the purpose of reconfiguring the organisational storage structure of the draft papers. It also removed metadata and backup information included in the original encoded draft. Finally the program added the timestamp to the text, and provides clear labeling of the section author, in order to make the draft more amenable to data analysis.

Program One: mkxml.pl

```
#!/usr/bin/perl -w

use strict;
use warnings;
use diagnostics;
$|++;

use WordNet::QueryData;
use XML::LibXML;
use WordNet::BestStem qw( best_stem );
use WordNet::stem;

# Set up the anonymisation

my %names = (); open (F,"anon.txt");
while (<F>) {
    my ($name, $alias) = split /:/;
    $names{$name} = $alias;
}
close F;

# Dealing with all files in directory

my $files = (); my $dir = ".";
opendir (DIR, $dir) || die ("Cannot open directory");
my @files = readdir (DIR);
closedir (DIR);

# get the verbs lists

my %actverbs = (); open (F,"v-action.txt");
while (<F>) { chomp; $actverbs{lc($_)}++ } close F;
my %staverbs = (); open (F,"v-stative.txt");
while (<F>) { chomp; $staverbs{lc($_)}++ } close F;
my %relverbs = (); open (F,"v-relative.txt");
while (<F>) { chomp; $relverbs{lc($_)}++ } close F;

# Do the conversion thing for all files in the directory

foreach my $f (@files) {
    unless ( ($f eq ".") || ($f eq "..") ) {
        if ($f =~ /^T(.+)\.xml/) {
            # some setup
            my $filename = $f; print "\nFILE: $f\n";
            my $parser = XML::LibXML->new();
            my $wn = WordNet::QueryData->new("/usr/local/WordNet-3.0/dict");
            my $stemmer = WordNet::stem->new($wn);
            my @doc = (); open (F,$filename); @doc = <F>; close F;
            my $doc = $parser->parse_file($filename);
            # get the text from the sections
            my @sections = (); my @saved = ();
            foreach my $section (1..7) {
                my $query = "//paperCreator/sections/section[$section]/contents/text()";
                my ($node) = $doc->findnodes($query); my $content = "";
                if ($node) {
                    $content = $node->toString;
                    $sections[$section] = $content; $saved[$section] = $content;
                    $node->setData("__SECTION".$section."__");
                } else {
                    $sections[$section] = $content; $saved[$section] = $content;
                }
            }

            $doc = $doc->toString;

            # Find the nouns, verbs, adverbs and adjectives in the text
            foreach my $section (1..7) {
                ## get the nouns, verbs, ads in this block
```

```

my @nouns = (); my @verbs = (); my @ads = ();
my %nouns = (); my %verbs = (); my %ads = ();
foreach ($sections[$section]) {
  for my $word (split) {
    $word =~ s/\././g; $word =~ s/,/,/g; my $sws = ""; my $wnw = ""; #
    print "$word ";
    $wnw = join ("", $wn->queryWord($word));
    if (($wnw eq "") && (length($word) > 4)) {
      my $nw = "";
      if ($word =~ /(.)ies$/) {
        my $nw = "$1y"; $wnw = join ("", $wn->queryWord($nw));
      } elsif ($word =~ /(.)ses$/) {
        my $nw = "$1s"; $wnw = join ("", $wn->queryWord($nw));
      } elsif ($word =~ /(.)s$/) {
        my $nw = "$1"; $wnw = join ("", $wn->queryWord($nw));
      } else {
        $wnw = "";
      }
    }
    # print "$word $wnw\n";
    $nouns{lc($word)}++ if ($wnw =~ /\#n/);
    $verbs{lc($word)}++ if ($wnw =~ /\#v/);
    $ads{lc($word)}++ if ($wnw =~ /\#a/) || ($wnw =~ /\#r/);
  }
}
@nouns = keys %nouns; @verbs = keys %verbs; @ads = keys %ads;
my $data = join "", $sections[$section];
foreach my $n (@nouns) {
  $data =~ s/\b($n)\b/<span id="\sf1" class="noun">$1</span>/ig;
}
foreach my $n (@verbs) {
  # now look for specific kinds of verbs
  my ($verb) = $stemmer->stemWord($n);
  if ($actverbs{$verb}) {
    $data =~ s/\b($n)\b/<span id="\sf1" class="actionverb">$1</span>/ig;
  } elsif ($staverbs{$verb}) {
    $data =~ s/\b($n)\b/<span id="\sf1" class="stativeverb">$1</span>/ig;
  } elsif ($relverbs{$verb}) {
    $data =~ s/\b($n)\b/<span id="\sf1" class="relativeverb">$1</span>/ig;
  }
  $data =~ s/\b($n)\b/<span id="\sf1" class="verb">$1</span>/ig;
}
foreach my $n (@ads) {
  $data =~ s/\b($n)\b/<span id="\sf1" class="ads">$1</span>/ig;
}
$data =~ s|\.\.\.\<p>\</p>/ig;
$sections[$section] = $data;
}

foreach my $section (1..7) {
  my $s = "SECTION".$section." ";
  $doc =~ s/$s/$sections[$section]/ig;
}

# anonymisation happens here
foreach my $n (keys %names) {
  $doc =~ s/$n/$names{$n}/g;
}

# output the cleansed xml
my $x = "PR-T".$1.".xml"; print "Rewriting $f -> $x\n";
open (F, ">$x"); print F "$doc"; close F;
}
}
)

```

Program Two: toHTML.xsl

```
<?xml version="1.0"?>
<xsl:stylesheet version="1.0"
  xmlns:xsl="http://www.w3.org/1999/XSL/Transform">

<xsl:output method="html" indent="yes" version="4.0"/>

<xsl:variable name="lowercase" select="'abcdefghijklmnopqrstuvwxy'" />
<xsl:variable name="uppercase" select="'ABCDEFGHIJKLMNOPQRSTUVWXYZ'" />

<xsl:template match="paperCreator">
<html>
  <head>
    <title><xsl:value-of select="metaData/title" /></title>
    <link rel="stylesheet" type="text/css" href="stylesheets/
default.css" />
  </head>
  <body>
    <div class="header">
      <div class="title"><xsl:value-of select="metaData/title" /
></div>
      <xsl:call-template name="parseWriters">
        <xsl:with-param name="writers"
          select="sections/section/writer[not(text()=../
preceding-sibling::section/writer/text())]" />
      </xsl:call-template><br />
      <span class="metadataHeading">Group Number: </
span><xsl:value-of select="metaData/id" />
      <xsl:text> </xsl:text>
      <span class="metadataHeading">Mentor: </span><xsl:value-of
select="metaData/mentor" />
    </div>
    <xsl:for-each select="sections/section">
      <xsl:apply-templates select="." />
    </xsl:for-each>
  </body>
</html>
</xsl:template>

<xsl:template match="metaData">
  <div class="header">
    <div class="title"><xsl:value-of select="title" /></div>
    <span class="metadataHeading">Group ID: </span><xsl:value-of
select="id" /><br />
    <span class="metadataHeading">Mentor: </span><xsl:value-of
select="mentor" />
  </div>
</xsl:template>

<xsl:template match="section">
  <div class="section">
    <div><span class="sectionName"><xsl:value-of select="name" /> </
span><span class="sectionWriters">
      <xsl:text> by </xsl:text>
      <xsl:call-template name="parseWriters">
        <xsl:with-param name="writers"
          select="writer[not(text()=../preceding-sibling::writer/
text())]" />
      </xsl:call-template>
    </span></div>
    <div class="sectionTimestamp"><xsl:text>(Last Updated: </
xsl:text><xsl:value-of select="lastUpdated" /><xsl:text>)</xsl:text></div>
    <div class="sectionBody"><xsl:apply-templates select="contents" /></
div>
  </div>
</xsl:template>

<xsl:template match="contents">
  <xsl:apply-templates />
</xsl:template>
```

```

<xsl:template match="span|SPAN">
  <xsl:if test="@id = 'sfl'">
    <span>
      <xsl:for-each select="@*">
        <xsl:attribute name="{name()}">
          <xsl:value-of select="." />
        </xsl:attribute>
      </xsl:for-each>
      <xsl:apply-templates />
    </span>
  </xsl:if>
  <xsl:if test="@id != 'sfl'">
    <xsl:apply-templates />
  </xsl:if>
</xsl:template>

<xsl:template name="cleanWriter">
  <xsl:param name="string" />
  <xsl:choose>
    <xsl:when test="contains($string, '_'">
      <xsl:call-template name="cleanWriter">
        <xsl:with-param name="string" select="substring-
after($string, '_)" />
      </xsl:call-template>
    </xsl:when>
    <xsl:otherwise>
      <xsl:value-of select="concat(substring-before($string, '+'),
concat('_', concat(substring(substring-after($string, '+'),
1,1),translate(substring(substring-after($string, '+'),2), $uppercase,
$lowercase)))" />
    </xsl:otherwise>
  </xsl:choose>
</xsl:template>

<xsl:template name="parseWriters">
  <xsl:param name="writers" />
  <xsl:for-each select="$writers">
    <xsl:if test="position() >= 2">
      <xsl:choose>
        <xsl:when test="position() = last()">
          <xsl:text> and </xsl:text>
        </xsl:when>
        <xsl:otherwise>
          <xsl:text>, </xsl:text>
        </xsl:otherwise>
      </xsl:choose>
      </xsl:if>
      <xsl:variable name="writer">
        <xsl:call-template name="cleanWriter">
          <xsl:with-param name="string"
select="string(.)" />
        </xsl:call-template>
      </xsl:variable>
      <xsl:value-of select="$writer" />
    </xsl:for-each>
  </xsl:template>
</xsl:stylesheet>

```

Appendix E

This appendix contains all documents related to the Intervention training sessions for the First and Second Research Studies (FRS and SRS). Documents include the following:

- EdD Student Session 00F-05F - the presentations printouts from Student Pack.
- Collaborative Activity - used in the Collaborative Working Session.
- Sample Genre (GM Foods) - in Student Pack; used in Collaborative Writing Session.
- Registration Instructions Form - on desk beside Packs.
- Team Membership Form - handed out when all were seated.
- Collaborative Writing Notes - Included in Pack (referred to this in Presentation).
- Collaborative Writing Survey - Included in Pack (used in first session).
- Student Instructions - Included in Pack.
- Sample Handout - Session Notes for Teams (Session Two, Team Two included).

Intervention Session - 0. OVERVIEW



The relationship between Teacher and Peer Dialogue and Online Collaborative Writing

Introductions, Timetable and General Information

John G. Keating

EdD Research Student
Centre for Research in Education and Ed Technology (CREET)

Supervisor: Dr. Caroline Coffin, Reader in Applied Linguistics
Faculty of Education and Language Studies, The Open University



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Some Security and Emergency Information



- ❖ You will be working in this room/building for most of today. Please wear your Badge at all times. Do not leave the room/building without permission from your teacher.
- ❖ The nearest emergency exit is on the ground level. Exit this room and take the stairs to the ground floor (immediately on your right as you exit). The Exit signs are clearly visible; I will guide you. You **MUST** leave the building if the alarm sounds.
- ❖ Do not leave personal belongings visible during the breaks; they might attract thieves. Keep all personal belongings (money, phones, music players, etc.) within sight at all times.
- ❖ You will be escorted to/from Pugin Hall for lunch. Even if you are familiar with the campus, please stay with the group at all times.

What to do if you are unwell, have an accident, etc.



- ❖ If you are unwell, have an accident, etc. please inform your Teacher and/or myself immediately. There is a Nurse, and Security personnel on campus. Ask a fellow student to contact us if you cannot!
- ❖ The Medical Centre is located quite close to this building (in the Student Services Building). They can be contacted on **(01) 708 3878**.
- ❖ Campus Security can be contacted on:
 - **(01) 708 3589** or **(01) 708 3939** from mobile phone or landline
 - **3333** from an on-campus internal telephone
- ❖ When we are finished today, please be careful crossing roads on campus; there is a lot of traffic, particularly on the North Campus.
- ❖ General rule - do not “wander off” on your own! If you need to leave the room/building please travel in pairs/threes!

3

Some Additional Information (Lab Rules, Toilet facilities)



- ❖ Toilets are situated on this level; exit the door and walk across the corridor towards the stairs leading into the foyer. Male and Female toilets are on your left, just before the exit. If you need to leave this laboratory, please inform your teacher.
- ❖ We have been generously allocated this laboratory by the Department of Computer Science, so we must adhere to their rules:
 - Please do not smoke in this building; it will activate the alarms.
 - Please do not use mobile phones or MP3 players in the laboratory.
 - Please do not bring food or drink into the laboratory.
- ❖ Please do not use the computers during the sessions unless instructed to do so; you may use the computers during the breaks if a teacher is present (ask me for the User/Password details).

4

Today's Timetable: Five 45m Sessions - A Busy day!

- ❖ There will be five key Sessions, two Breaks and a Summary session:
 - ▶ 0930-1015 **Session One:** Introduction and Project Overview
 - ▶ 1015-1100 **Session Two:** Collaboration and Collaborative Writing
 - ▶ 1100-1115 **Break (15m)**
 - ▶ 1115-1200 **Session Three:** Writing a Library Research Paper
 - ▶ 1200-1245 **Session Four:** Peer Evaluation and Assessment
 - ▶ 1245-1345 **Lunch (Pugin Hall)**
 - ▶ 1345-1430 **Session Five:** EVE Collaborative Writing Environment
 - ▶ 1430-1445 **Summary and Future Plans**
- ❖ Almost all of the sessions have some practical component!

5

Thank you ... Do you have any questions?

Intervention Session - 1. INTRODUCTION



The relationship between Teacher and Peer Dialogue and Online Collaborative Writing

Session One: Project Introduction

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Oíscail na Féirreabh Ma Nuad

Session Plan and Objectives (25m)



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Oíscail na Féirreabh Ma Nuad



- ❖ Short Presentation on the Collaborative Writing Project and the project's aims and objectives (5m)
- ❖ Overview and Purpose of the training to be provided today (5m)
- ❖ Short Survey Questionnaire completion (5m)
- ❖ Question and Answer session (5m)
- ❖ Feedback and Session Summary (5m)

Objectives

To provide background information on the project, answer any questions that you may have about the project, provide you with an overview of the sessions, and complete a survey questionnaire before the collaborative writing project begins.

Project Motivation and Background



- ❖ I have always been interested in learning and especially how children learn; I have wondered for a long time how children become scientists.
- ❖ I'm also interested in *computer mediated communication* (CMC); recently, I have developed concerns about the adoption of *virtual learning environments* (VLE) without really considering if they are appropriate, effective, and supportive of learning.
- ❖ I am supervising three PhD students engaged in research in Virtual Learning Environments, and Technology Supported Education; these mainly have a computer science and educational technology focus.
- ❖ I registered for an MEd degree with the Open University to prepare myself for an EdD (Doctorate in Education) degree. I want to study authentic scientific literacy development in a CMC/VLE environment.

3

My Research Aims



- ❖ My project aims have been produced following a critical literature review of scientific literacy, authentic learning, and technology supported learning.
- ❖ The aims of this EdD research project are threefold:
 - ▶ (i) to show the extent to which second-level (post primary) students are able to produce a scientific Library Research Paper (a genre) using an online collaborative writing environment,
 - ▶ (ii) to examine the kind of communication and collaboration engaged in before and throughout the collaborative writing,
 - ▶ (iii) to investigate possible relationships between (i) and (ii).
- ❖ The research will simulate the kind of writing and communications that scientists engage in as part of their professional activities.

4

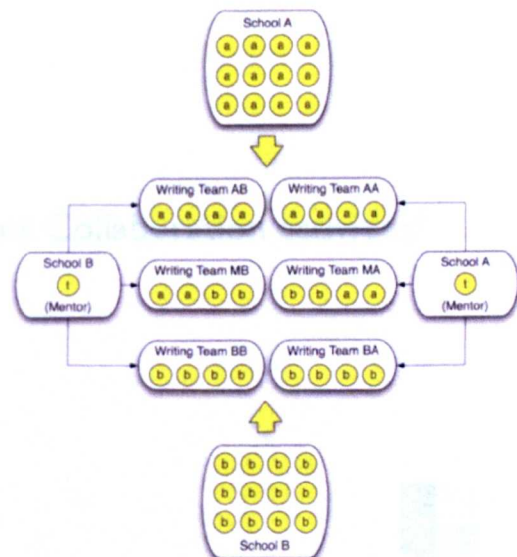
So how do I investigate my project aims?

- ❖ If we use an online collaborative writing environment and have access to all communications, the final Library Research Paper and the interim genre drafts, it will be possible to examine how student and teacher comments impact on the document revision.
- ❖ Each co-operatively written document, and associated comments and discussions derive from a small, asynchronously-communicating, writing and reviewing peer-group of four students and a single teacher.
- ❖ You, as participants, will be organised into groups (writing teams) and each group will use the same online software to collaboratively write a paper on “*The Physical Processes of Global Warming*”.
- ❖ Afterwards, I will be conducting an *anonymous* linguistic evaluation of your writing (Research Paper and your discourse) using a theoretical framework called SFL (Systemic Functional Linguistics).

5

Writing Team Construction (24 Students; 2 Teachers)

- ❖ There are a number of different ways to construct writing teams from two schools:
 - ▶ A team consists of four randomly-selected students from School A or B, mentored by an external teacher, i.e. a teacher from the collaborating school (AB, BA).
 - ▶ A team consists of four randomly-selected students from School A or B, mentored by a local teacher, i.e. a teacher from the students' own school (AA, BB).
 - ▶ A team consists of two randomly-selected School A students, and two randomly-selected School B students, mentored by a teacher local to the School A students (MA).
 - ▶ A team consists of two randomly-selected School A students, and two randomly-selected School B students, mentored by a teacher local to the School B students (MB).



6

Project Collaborative Writing (Data Collection) Phases

- ❖ I previously conducted a Pilot Study, and learned about how I could improve various aspects, e.g. student support, data collection, feedback and assessment.
- ❖ For this Case Study I will decided to provide more interventionist support which includes support for teachers and students. I'll also conduct some surveys!
- ❖ These supports include some information on scientific writing and techniques for collaboration, reviewing and assessment.
- ❖ I am also going to include an assessment framework based on teacher feedback and peer feedback (reviews). This will be more helpful than last time.
- ❖ There will be two writing phases (over three a three week period), which allows time to reflect on the reviews and make changes to your documents.



7



The Open University

Activity: A Survey on Previous Collaboration activities!



Completing the Survey!

- ❖ I'm interested in finding out about your previous collaboration and/or collaborative writing activities. They can be school or non-school based.
- ❖ If you have no experience, please leave the questions blank. There is a comment box for additional information that you might like to include.
- ❖ The Survey is the *Green Document* included in your Pack.
- ❖ This is a confidential survey; please do not discuss your answers with other students or teachers. The questionnaires will be collected at the end of the session.
- ❖ If you do not understand a question, or have difficulty reading the fonts, etc. please raise your hand for assistance!



Questions and Answers?



Intervention Session - 2. COLLABORATIVE WORKING AND WRITING



The relationship between Teacher and Peer Dialogue and Online Collaborative Writing

Session Two: Collaborative Working and Writing

John G. Keating

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Centre for Research in Education and Ed Technology (CREET)

Supervisor: Dr. Caroline Coffin, Reader in Applied Linguistics
Faculty of Education and Language Studies, The Open University



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DISCIT NA FEICHTAN MĀ NUAD

Session Plan and Objectives (25m)



- ❖ Short Presentation on Collaborative Working and Writing (5m)
- ❖ Group-based Collaborative Working and Writing Activity (10m)
- ❖ Feedback session (5m)
- ❖ Summary (5m)

Objectives

To provide you with background information on collaborative writing and collaborative problem solving, and to provide you with an opportunity to engage in a small collaborative task with new people, and to get your feedback on the activity.

- ❖ Collaborative working is ...
 - ▶ *“a method of working in which people at different locations or from different organizations work together electronically using videoconferencing, e-mail, networks, and other communication tools” (a business definition)*
 - ▶ *“a recursive process where two or more people or organisations work together intersection of common goals, for example, an intellectual endeavour” (broader definition from Wikipedia)*
- ❖ Collaborative writing (or authoring) is ...
 - ▶ *“the activities involved in the production of a document by more than one author”; “pre-draft discussions and arguments as well as post-draft analyses and debates are collaborative components.”*

- ❖ Writing is a complex , open-ended task, there are many ways of stating meaning. With multiple authors, this adds to the complexity.*
- ❖ The acts of collaboration and writing as they relate to collaborative authoring include:
 - ▶ *establishing an agenda or goal of the collaboration effort*
 - ▶ *identifying writing tasks and dividing those tasks among members*
 - ▶ *tracking individual idea generation*
 - ▶ *defining rules for document management*
 - ▶ *identifying roles for group members*
 - ▶ *communicating ideas and managing conflict*
- ❖ Collaborative authoring, therefore, requires effective communication between members of the writing group.

- ❖ Typically the communication requirements of a writing task are:
 - ▶ *task division* - relates to assigning tasks and communicating the associated requirements and deadlines.
 - ▶ *brainstorming* - is generating and recording ideas to be used in production of the text.
 - ▶ *editing* - involves members indicating their comments about and enhancements for the text (comments then used to revise text).
 - ▶ *general discussion* - include formal team meetings as well as casual, impromptu conversations.
 - ▶ *goal setting* - determining what the purpose or goal of the document is goal setting; also establishes the timeliness and activities that relate to task division.

- ❖ Besides the actual process of writing, both *language* and *written text* are important products of the group as well as the means of communication.
- ❖ When writing, the author many times makes *notes* or *comments* about the text within the text itself. To the reader, these notes may appear to be part of the actual document.
- ❖ There is need, therefore, to make the distinction between *external representation* and *actual document text*. Further, it is necessary to understand the context of these notes.
- ❖ An important part of understanding the context of these notes is knowing the *author of individual notes*. It is considered important to differentiate between actual document text, and the text produced as part of the planning and thinking phase. They are related, of course!

Collaboration doesn't just happen, you know!

- ❖ There are a number of key phases in any collaborative writing assignment; they are:
 - ▶ *Planning*
 - ▶ *Collaboration Issues*
 - ▶ *Methodology*
 - ▶ *Roles*
 - ▶ *Peer Evaluation*
- ❖ The following slides provide a brief overview of phases. The last phase “Peer Evaluation” will be discussed in detail in *Session Four!*

7

Collaborative Writing - Planning

- ❖ The key ingredients of successful group work are *leadership, planning, effective communication, equal division of labour, and equal sharing of responsibilities* for results, as well as *courtesy, thoughtfulness, and dependability*.
- ❖ For your group writing project, planning is especially important because, normally, writers tend to write in solitude using their own plans and directions.
- ❖ When a group agrees on the nature and scope of the writing project and develops an agreed-to plan or outline, responsibilities are clear. When due dates are met, the work stays on schedule.

8

Collaborative Writing - Planning

- ❖ Your group's writing plan (for this project) should include the following:
 - ▶ *description of your final paper*
 - ▶ *establishing criteria for a successful paper*
 - ▶ *content outline (determined, in part, by your assignment)*
 - ▶ *assignment of responsibilities for sections of content*
 - ▶ *schedule for finishing sections*
 - ▶ *editing and reviewing strategy*
- ❖ For this project, many of these issues are fixed; you have scope, however, for establishing much of your own plans.
- ❖ You will do this before, using discussion forums, before you start writing the Library Research Paper.

9

Collaborative Writing - Issues

- ❖ In addition, writing groups normally discuss and resolve ahead of time some of the following considerations:
 - ▶ *when and where to meet as a group (online) or how to meet when the participants are in different schools (doing this using software)*
 - ▶ *how to send materials between participants in the most efficient way (you can post comments, etc. using the software provided).*
 - ▶ *what to do if someone has to drop out or falls behind (please be sympathetic; always try and engage with the people that are falling behind; there may be a very good reason for lack of participation)*
 - ▶ *what the group expects to get as a grade and how they will evaluate one another (this paper will be reviewed by several teachers)*
 - ▶ *who communicates with the mentor, and how that will occur (using software messaging system); you might find it appropriate to appoint a group spokesperson.*
 - ▶ *how differences of opinion will be resolved (for example, a majority voting system, discuss with mentor/teacher, mediation).*

10

Collaborative Writing - Methodology

- ❖ When the major writing project is a collaborative writing assignment, first form a writing team and work together as a team to produce a collaborative writing project.
- ❖ Each member should plan to be responsible for at least two roles on the writing team: to write a specific section of the project and to serve as a specialist in one or more areas concerning the project.
- ❖ In addition to learning how to write this project, each member will learn to co-ordinate his or her individual effort, knowledge, schedule, and work habits with those of the other members of the group.
- ❖ This requires courtesy, thoughtful communication, and dependability on everyone's part. Remember communication will be online and asynchronous; there may be delays as students and teachers/mentors may not be working online simultaneously!

11

Collaborative Working - Roles

- ❖ Each student should take on two or more of the following roles:
 - ▶ *Writer* - everyone in the group writes and revises a specific part of the project. You may choose to revise someone else's work.
 - ▶ *Group Leader* - this person co-ordinates the team, organises the writing plan and schedule (especially for online group meetings), and picks up loose ends.
 - ▶ *Editor* - this person edits and proofreads final drafts, provides stylistic standards for the group as a whole, and guides the group in using stylistic conventions and formats.
 - ▶ *Subject Matter Specialist* - each person is responsible for research on technical topics, assisting team members with technical problems, and testing the final project for accuracy. All members must become subject matter specialists in at least one area.
 - ▶ It is a good idea for some member of the team to manage references, images, etc.

12

Collaborative Writing - Summary



- ❖ Collaborative writing is a complex, but rewarding task. It is rare, nowadays, that professional scientists work in isolation; this means that they work collaboratively on projects and write scientific papers collaboratively.
- ❖ Successful collaboration requires participants to learn new skills and methodologies in addition to the subject specific requirements!
- ❖ Many writing teams are distributed, in time and space, so it is normal that software tools are used to facilitate the writing activities.
- ❖ This project will provide you with the tools, skills and methodologies to engage in online collaborative writing; these are skills that are typically not taught explicitly at second level.
- ❖ By examining your work, I can learn about effective strategies for teaching technical collaborative writing to secondary students.

13



Collaborative Working/Writing Activity (Handout)





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Feedback Session (Team Leaders present findings)



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Questions and Answers



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Session Document - COLLABORATIVE WRITING NOTES

SOME NOTES ON COLLABORATIVE WRITING

(May 2009)

John G. Keating
An Foras Feasa, National University of Ireland, Maynooth
Maynooth, Co. Kildare, Ireland

PLANNING

Your collaborative group writing assignment is intended to be one where the entire team contributes to writing the assignment. You will be writing an online article on

You will be producing your collaboratively written paper using an online, Collaborative Writing software environment developed especially for this project.

The key ingredients of successful group work are leadership, planning, effective communication, equal division of labor, and equal sharing of responsibilities for results, as well as courtesy, thoughtfulness, and dependability.

For this group writing project, planning is especially important because, normally, writers tend to write in solitude using their own plans and directions. When a group agrees on the nature and scope of the writing project and develops an agreed-to plan or outline, responsibilities are clear. When due dates are met, the work stays on schedule.

Your group's writing plan should include the following:

- description of your final paper
- establishing criteria for a successful paper
- content outline (determined, in part, by your tutor's assignment)
- assignment of responsibilities for sections of content
- schedule for finishing sections
- editing and reviewing strategy

You can see, therefore, that the plan relies on effective group discourse! The software environment also provides a forum-like discursive environment where you can communicate with your class, privately with your group, and privately with your mentor.

ISSUES

In addition, writing groups normally discuss and resolve ahead of time some of the following considerations:

- when and where to meet as a group (online or in person) or how to meet when the participants are in a distance education class (you will be doing this electronically using software)

- how to send materials between participants in the most efficient way (you can post comments, etc. using the software provided).
- what to do if someone has to drop out or falls behind (please be sympathetic and always try and engage with the people that are falling behind; there may be a very good reason for lack of participation)
- what the group expects to get as a grade and how they will evaluate one another (this paper will be reviewed by Professor Savage)
- who communicates with the mentor, and how that will occur (all of you can do this with the software messaging system); you might find it appropriate to appoint a group spokesperson.
- how differences of opinion will be resolved (for example, a majority voting system, discuss with mentor, mediation).
- what roles the group members will assume (see below).

In the workplace (professional scientists), for example, strong group members often carry weaker members in the interest of getting the work done. Your writing project emphasizes and values both the learning and writing processes as well as the final product.

METHODOLOGY

When the major writing project is a collaborative writing assignment, first form a writing team and work together as a team to produce a collaborative writing project.

Each member should plan to be responsible for at least two roles on the writing team: to write a specific section of the project and to serve as a specialist in one or more areas concerning the project.

In addition to learning how to write this project, each member will learn to coordinate his or her individual effort, knowledge, schedule, and work habits with those of the other members of the group.

This requires courtesy, thoughtful communication, and dependability on everyone's part.

ROLES

Each student should take on two or more of the following roles:

Writer: Everyone in the group writes and revises a specific part of the project. You may choose to revise someone else's work.

Group Leader: This person coordinates the team, organizes the writing plan and schedule (especially for online group meetings), and picks up loose ends.

Editor: This person edits and proofreads final drafts, provides stylistic standards for the group as a whole, and guides the group in using stylistic conventions and formats.

Subject Matter Specialist: Each person is responsible for research on technical topics, assisting team members with technical problems, and testing the final project for accuracy. All members must become subject matter specialists in at least one area.

PEER EVALUATION

Afterwards, it is usually a good idea for your group to discuss the criteria on which you will evaluate one another and perform self-evaluation. This should be conducted, as a matter of course, for your own personal development.

Items to include might be:

- fulfillment of agreed-upon responsibilities
- dependability
- cooperation
- effort
- quality and level of work
- able to meet deadlines
- attendance at meetings
- timeliness of contributions

Good luck with the writing project!!

Session Document - COLLABORATION ACTIVITY

Collaborative Activity

- Instructions -

1. Carefully read the following piece of text, taken from an early scientific article, and establish for yourself, the meaning conveyed by the author. Make some personal notes on your conclusions for sharing with the team. Try to establish exactly how you reached this conclusion. You should try to complete this within about 5m.
2. Next, spend 5m in a collaborative discussion, listening everyone's conclusion. Did everyone come to the same conclusion as yourself? Did everyone reach the conclusion in the same way? Are there any disagreements? You should try to complete this within about 5m.
3. Finally, your team leader should summarise the team's conclusion, taking into account any agreements or disagreements. The team leader, with your help, should provide a written answer the question: **Why are there more light-coloured pepper moths than before?** You should try to complete this within about 5m.

- Scientific Text Extract -

In the years since 1850, more and more factories were built in northern England. The soot from the factory smokestacks gradually blackened the light-coloured stones and tree trunks.

Scientists continued to study the pepper moth during this time. They noticed the dark-coloured moth was becoming more common. By 1950, the dark moths were much more common than the light-coloured ones.

However, strong anti-pollution laws over the last twenty years have resulted in cleaner factories, cleaner countryside and an increase in the number of light-coloured moths.

Intervention Session - 3. WRITING A LIBRARY RESEARCH PAPER



The relationship between Teacher and Peer Dialogue and Online Collaborative Writing

Session Three: Writing a Library Research Paper

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Session Plan and Objectives (25m)



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- ❖ Short Presentation on *Writing a Scientific Library Research Paper (LRP)* (5m)
- ❖ A short group-based collaborative working/writing session. You will be given parts of a sample scientific paper, and working in groups, you will structure the components, and write a brief summary (10m)
- ❖ Feedback session (5m)
- ❖ Summary (5m)

Objectives

To provide you with some background on the structure of a scientific library research paper; experience reading and writing (summarising) a sample paper together, and providing some feedback on the activity.

Project's Collaborative Writing Assignment



- ❖ For this research, you will be using an online, collaborative writing environment to write a Library Research Paper entitled:
 - ▶ *The Physical Processes of Global Warming*
- ❖ A Library Research Paper is a critical essay based on a number of resources that will be provided by your teacher/mentor for the project. Essentially you are writing a critical review following your research of other published papers.
- ❖ There are excellent description of how to write a Library Research paper here (the first one is particularly good for this project):
 - ▶ <http://ase.tufts.edu/biology/courses/bio14/paper.htm>
 - ▶ <http://library.sasaustin.org/paperOrganizerUS.php>

3

Project's Collaborative Writing Assignment



- ❖ The actual assignment will be:
 - ▶ *Using the reference sources provided, your group should collaboratively write a library research paper on [The Physical Processes of Global Warming](#).*
 - ▶ *Please use the online environment for all communication and writing. There are two phases to the assignment: planning and writing. There is a Class Discussion Forum for general, whole class, discussions and a Project (Pre-Writing) Discussion Forum which is only visible to your team members; this forum will close once the writing phase starts.*
 - ▶ *Once the writing phase begins you can communicate with team members using the Commenting System, or use the Class Discussion Forum. You may use the Private Messaging System to communicate privately with your teacher, but there is no facility to send private messages to another student.*
 - ▶ *The structure of the Paper will be determined in conjunction with your teacher/mentor.*

4



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Have a look at the Sample Library Research Paper!



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Sample Library Research Paper



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- ❖ This is a sample Library Research Paper on *The Advantages and Disadvantages of Genetically Modified foods*, written by John Keating, and based on several reference papers.
- ❖ Have a look at the structure of this document; it contains
 - *Title and authorship details*
 - *Topic Introduction*
 - *Some Background Theory*
 - *Critical Advantages and Disadvantages*
 - *Conclusion*
 - *References (which are cited in the text)*



Collaborative Writing Activity



Collaborative Writing Activity - Writing an Abstract



- ❖ Typically, scientific articles also contain an Abstract. This is a very short summary of the complete paper, and it is used by readers to quickly establish if they are interested in the paper.
- ❖ The Abstract should be concise, accurate, informative, and stimulate interest in the reader. Typically, it does not contain references. As you will see, I neglected to provide an Abstract for my sample paper! This was poor planning; it should be there!
- ❖ Your activity is:
 - ▶ to coordinate (that's your job, Team Leader!) and write a 5-sentence Abstract for the Sample Library Research Paper on Genetically Modified foods (you have 15m)
 - ▶ Hint: Give each team member a section to summarise (1-2 sentences); then summarise the summaries and write the abstract. Watch your timing!



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Feedback Session - How did you find this task?



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Questions and Answers



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Oíscail na hÉireann Mhá Nuad

Session Document - SAMPLE GENRE (Library Research Paper)

The Advantages and Disadvantages of Genetically Modified Foods

John G. Keating

Introduction

The individual characteristics of plants such as height, flower colour and leaf shape are determined by its genetic. In nature, during pollination, the genes of two parent plants mix to produce offspring that contain the genes from each parent. In the past, farmers and other food producers selectively bred food plants to produce bigger and better crops, or crops that were resistant to certain diseases. This was achieved by deliberately cross-pollinating plants with desirable features.

Genetic modification (GM) takes selective breeding one step further. Scientists have a greater understanding of how to identify genes and recognise which genes control the development of which characteristics. It is now possible to produce offspring by transplanting the desirable genes from one plant to another using a process called Genetic Engineering (Bionet Online, 2008).

Genetic engineering has been impossible until recent times due to the complex and microscopic nature of (both plant and animal) DNA and its component nucleotides. Progressive studies, international collaborative effort, and significant research funding from industry and governments have resulted in improved understanding of chromosomes and DNA; these can now be mapped for future reference. Simplistic organisms such as fruit fly (*Drosophila*) have been chromosome mapped due to their simplistic nature. At present, a task named the Human Genome Project is mapping the human genome, and should be completed in the next ten years (Biology Online, 2008).

Background Theory

The process of genetic engineering involves splicing an area of a chromosome, a gene, that controls a certain characteristic of the organism. DNA splicing is accomplished using the enzyme endonuclease – this splits the DNA sequence and isolates the gene from the rest of the chromosome. The isolated gene may be programmed to perform some biological function, for example, produce an antiviral protein. The isolated gene is removed and can be placed into another organism, for example, into a bacterium, where it is sealed into the DNA chain using ligase (Biology Online, 2008).

When the chromosome is once again sealed, the bacterium is now effectively re-programmed to replicate this new antiviral protein. The bacterium continues to live life as it did before genetic modification. Another process involves using genetic engineering to replicate the entire genetic makeup of one organism in another, effectively cloning the original organism. There are advantages and disadvantages to these processes, and the subject area will continue to become more prominent over time.

Genetic engineering may be one of the greatest breakthroughs in recent history, however, most governments have produced legislation to control what sort of experiments are done involving genetic engineering. In the EU there are strict laws prohibiting any experiments involving the cloning of humans.

Advantages and Disadvantages

There are certainly some advantages to genetic engineering, or modification, for example:

- *Disease prevention in people/plants/animals that are genetically prone to certain hereditary diseases. Also, implanting genes that code for antiviral proteins specific to each antigen can treat infectious diseases.
- *Animals and plants can be engineered with certain desirable characteristics. Genes could also be manipulated in trees for example, to absorb more CO₂ and reduce the threat of global warming.
- *Genetic Engineering could increase genetic diversity, and produce more variant genetic coding sequences, called alleles, which could also be crossed over and implanted into other species. It is possible to alter the genetics of wheat plants to grow insulin for example. Recently, scientists have identified seven regions in the human genome that are linked to coeliac disease.

Significant disadvantages include:

- *Nature is an extremely complex inter-related chain consisting of many species linked in the food chain. Some scientists believe that introducing genetically modified genes may have an irreversible effect with consequences yet unknown.
- *Genetic engineering borderlines on many moral and ethical issues, particularly involving religion, which questions whether man has the right to manipulate the laws and course of nature.

In relation to genetically engineered foods there have been significant efforts to improve crop resistance to disease, prolong shelf life, enhance dietary properties, etc. Some examples (from BioNet Online, 2008) include:

- *Pesticide resistant rape plants, corn, sugar cane and soya beans; here scientists have transferred a gene to the rape plant which enables the plant to resist a certain pesticide. Spraying the genetically modified rape crop with pesticides destroys most of the pests without killing the plants.
- *Insecticide sweet corn, cotton and potatoes; here scientists have genetically modified crops so that it produces a poison which kills harmful insects. This means there is no requirement to fight insects with insecticides. The genetically modified corn, for example, is called Bt-corn, because the insect-killing gene in the plant comes from the bacteria *Bacillus Thuringiensis*.
- *Golden rice is genetically modified rice that now contains a large amount of A-vitamins. Or more correctly, the rice contains the element beta-carotene, which is converted in the body into Vitamin-A (eating golden rice provides you with more vitamin A). Three new genes were required for the golden rice to make beta-carotene: two from daffodils and the third from a bacterium.

*Long-lasting tomatoes, strawberries, peppers and bananas; Long-lasting, genetically modified tomatoes came on to the market in 1994 and were the first genetically modified food available to consumers. The genetically modified tomato produces less of the substance that causes tomatoes to rot, so remains firm and fresh for a long time.

These are common staple foods, which can be found in any supermarket; there are certain advantages and disadvantages to their modification, however.

(i) Advantages (from Bionet Online, 2008)

Farmers can grow larger crop quantities because it is easier to fight pests and in some cases the farmer can use a more environmentally friendly crop spray, thereby protecting the environment. As the farmer no longer has to use insecticides to kill insects, the surrounding environment is no longer exposed to large amounts of harmful insecticide. Furthermore, the farmer no longer needs to walk around with a drum of toxic spray wearing a mask and protective clothing.

Foods containing, beta-carotene, for example, may be considered advantageous to poor people in underdeveloped countries. They eat only an extremely limited diet lacking in the essential bodily vitamins. The consequences of this restricted diet causes many people to die or become blind. This is particularly true in areas of Asia, where most of the population live on rice from morning to evening.

As GM fruit remain fresh longer, they can be allowed to ripen in the sun before picking - resulting in a better tasting fruit (this is an alternative to ripening in transit). GM fruit can tolerate a lengthier transport time, which means that market gardens can avoid picking tomatoes while they are green in order that they will tolerate the transport. The producers also have the advantage that all the tomatoes can be harvested simultaneously.

(ii) Disadvantages (from Bionet Online, 2008):

Genes from the genetically modified crops could be transferred to the pests. The pests then become resistant to the crop spray and the crop spraying becomes useless.

Rape plants, for example, can pollinate weeds. When rape plants pollinate the navew their genes are transferred. The navew then acquires pesticide resistance.

This type of genetically modified corn will poison the insects over a longer period than the farmer who would spray the crops once or twice. In this way the insects can become accustomed (or resistant) to the poison. If that happens both crop spraying and the use of genetically modified Bt-corn become ineffective.

A variety of insects are at risk of being killed. It might be predatory insects that eat the harmful ones or, perhaps attractive insects such as butterflies. In the USA, where Bt-corn is used a great deal there is much debate over the harmful effects of Bt-corn on the beautiful Monarch butterfly.

Critics fear that poor people in underdeveloped countries are becoming too dependent on the rich western world. Usually, it is the large private companies in the West that have the means to develop genetically modified plants. By making the plants sterile these large companies can prevent farmers from growing plant-seed for the following year - forcing them to buy new rice from the companies.

Some opposers of genetic modification see the "golden rice" as a method of making genetic engineering more widely accepted. Opponents fear that companies will go on to develop other genetically modified plants from which they can make a profit. A situation could develop where the large companies own the rights to all the good crops.

Scientists today can genetically modify fruit without inserting genes for antibiotic resistance. However the first genetically modified tomatoes contained genes that made them resistant to antibiotics. These genes spread to animals and people, doctors would have difficulties fighting infectious diseases.

Conclusion

Genetically modified foods, without doubt, can be used to improve the food, the processes associated with their production, and the eventual consumers, I believe that we require longer timescale studies, experiments and tests, to determine the resultant impact. It may be the case that natural adaptation by pests and consumers will require further genetic modification resulting in a long complex cycle that we will never understand. Or the moment, I would be hesitant on widespread introduction of GM foods and their associated production processes.

References

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Intervention Session - 5. USING THE COLLABORATIVE WRITING ENVIRONMENT



The relationship between Teacher and Peer Dialogue and Online Collaborative Writing

Session Five: EVE Collaborative Writing Environment

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NUI MAYNOOTH
Ollscoil na hÉireann Múscraí

Session Plan and Objectives (25m)



- ❖ Presentation on The EVE Collaborative Writing Environment (10m)
- ❖ Live Demonstration of the EVE Environment (5m)
- ❖ Questions and Answers session (5m)
- ❖ Summary (5m)

Objectives

To provide an overview and live demonstration of the EVE Collaborative Writing Environment. Participants should be able to have a feel for how the software works and how it will be used in the writing project.

The EVE Collaborative Writing Environment



- ❖ We have developed a collaborative writing environment software at NUI Maynooth called EVE (Busschots et al, 2006; Raeside et al., 2007).
- ❖ The software supports group-based online asynchronous collaborative writing whereby each group member writes a previously agreed section of a scientific report/paper. The software (EVE) provides student and teacher access, group construction, section allocation, etc.
- ❖ EVE allows multiple authors to work on the same document; with everyone working on a different (pre-agreed) section. EVE handles most of the formatting, etc. for you.
- ❖ You need to use the discussion forums to co-ordinate writing, commenting and reviewing each other's work, etc.
- ❖ EVE is also a research tool; it captures all versions of your documents!

3

Some Messaging functionality included in EVE



- ❖ EVE includes global and local discussion forums that are associated with a collaborative writing project, e.g. an (global) asynchronous discussion forum intended for general comments, and a local asynchronous discussion forum intended for review comments.
- ❖ “Asynchronous discussions” is another name for forums; the turnaround for responses tends to be slower than for real-time, synchronous messaging like AIM, etc.
- ❖ EVE also provides whole-class and team discussion forums where students can exchange ideas or engage in general communication.
- ❖ EVE supports sending private messages between teachers and students (but not between team members).
- ❖ If you delete messages they are saved on the server; don't delete!

4

EVE is not perfect; Some operational rules of thumb!

- ❖ EVE is in continual development ... the version that you will use is *stable* (a computer term that is used to indicate the developers are happy for the public to use it) but sometimes things go wrong.
- ❖ **NB** Please avoid the following:
 - ▶ Do not copy material from another application (say Word) and paste it into EVE. You need to use EVE to write everything!
 - ▶ Do not upload large images for inclusion in documents via the scrapbook.
- ❖ Sometimes text in the system becomes corrupt; you can usually revert to a saved copy, however. If you lose everything, contact your mentor and mail me (john.keating@nuim.ie). I *might* be able to recover the information for you. No guarantees, however, so be careful!

5

Using an EVE colleague's overview of the software!

Using EVE for your Project

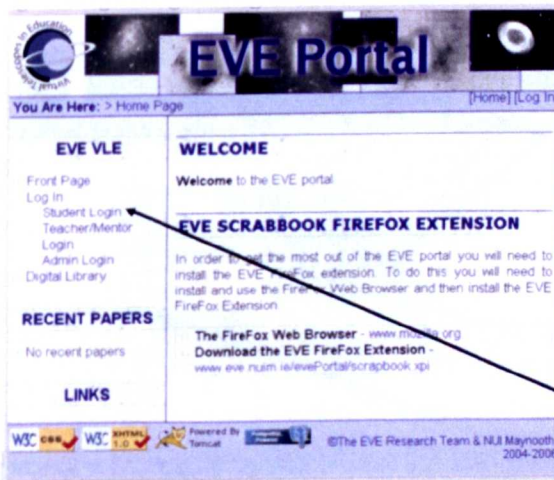
A student tutorial for using the EVE virtual learning environment

Dr. Shelagh Waddington
Department of Geography



7

Reaching EVE



1. Start up Firefox web browser

2. The EVE portal is at

<http://eve.nuim.ie/evePortal/EVE>

3. This homepage will appear

4. To log in click on <Student Login>



8

Logging in to EVE I

Teacher/Mentor: swaddington
Group/Class: Class 4
Username: Student 1
Password: *****

[Submit] [Cancel]

[Teacher/Mentor Login] [Admin Login]

1. Enter teacher/mentor name
 - This will be supplied to you in class
2. Select group/ class name
 - If you enter the correct teacher/mentor name – a list will be available to choose from – click here

Logging in to EVE II

Teacher/Mentor: swaddington
Group/Class: Class 4
Username: Student 1
Password: *****

[Submit] [Cancel]

[Teacher/Mentor Login] [Admin Login]

3. Enter your user name
 - supplied by your teacher/mentor
4. Enter your password
 - supplied by your teacher/mentor
5. Click on <Submit>

Your 'home page'


1. Select the work from the list of current projects



11

The project outline

In Project outline View you can:

- click on <Thoughts> here to see general project ideas
- click on your own section [the one with the  beside it] to begin work on the project



12

Working on your section of the project

1. Click into the dialogue box and start to type

2. Save your work regularly by clicking on <Save>



13

What happens if you make an mistake?

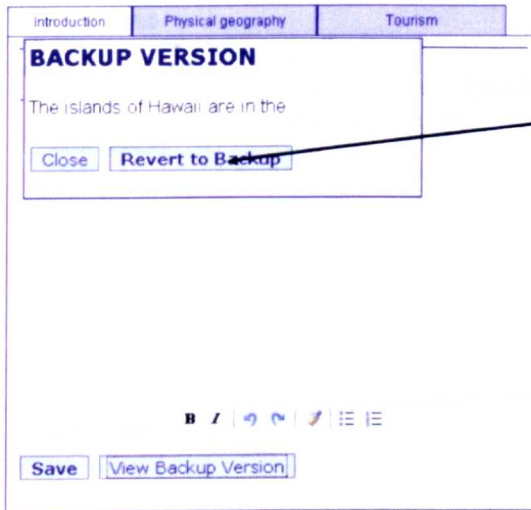
It is easy to go back to the previous version.

Click on <View backup Version>



14

Returning to the previous version



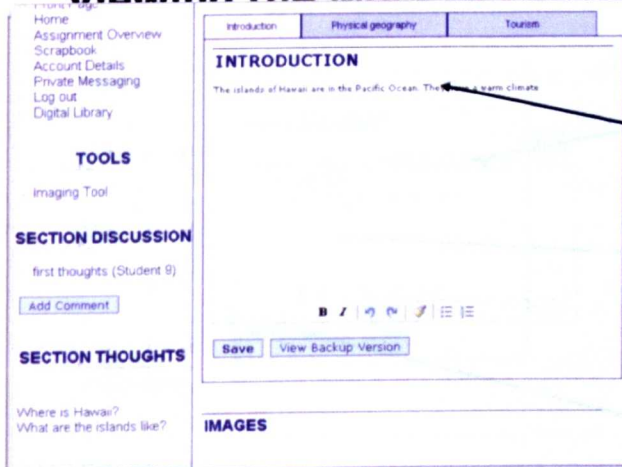
If you prefer the backup version, click on <Revert to Backup>

The previous version will be returned to your section window.



15

Viewing the work of the rest of your team



Click on the tab for the section you wish to see, for example

connect in the text box

click on <Add Comment>



16

Working with your team mates – text based

EVE VLE

- Front Page
- Home
- Assignment Overview
- Scrapbook
- Account Details
- Private Messaging
- Log out
- Digital Library

TOOLS

- Imaging Tool

SECTION DISCUSSION

No comments for this section

[Add Comment](#)

Saved section 'Introduction'

Introduction Physical geography Tourism

PHYSICAL GEOGRAPHY

The Hawaiian Islands are made up of

IMAGES

You may want to

- share ideas
- comment on your team mate's work

To send a message click on <Add Comment>



17

EVE VLE

- Front Page
- Home
- Assignment Overview
- Scrapbook
- Account Details
- Private Messaging
- Log out
- Digital Library

TOOLS

- Imaging Tool

SECTION DISCUSSION

No comments for this section

[Add Comment](#)

Saved section 'Introduction'

ADD COMMENT

Comment Title:

Comment Text:
Have you looked at Kilauea website? This is at <http://www.nps.gov/kilauea/>

Give your comment a title

Type your comment in the text box

Click on <Add Comment>



18

Your comment will now appear in the Section Discussion area

Front Page
Home
Assignment Overview
Scrapbook
Account Details
Private Messaging
Log out
Digital Library

TOOLS

Imaging Tool

SECTION DISCUSSION

New idea for physical (Student 1)

Introduction Physical geography Tourism

PHYSICAL GEOGRAPHY

The Hawaiian Islands are made up of

IMAGES



Sharing with your team mates - images

Click on <scrapbook>

Virtual Technology EVE Portal

You Are Here: Home Page > View Assignment [No Message]

SESSION

User: swaddington [Log out]
Type: Teacher/Mentor
Assignment: Maynooth town

EVE VLE

Front Page
Home
Discussions
Scrapbook
Account Details
Private Messaging
Log out
Digital Library

TOOLS

Maynooth town (Teacher)

Thoughts

Introduction (Student 1) (0)

Resources and activities (Student 5) (0)



SESSION

User: swaddington [Log out]
 Type: Teacher/Mentor
 Assignment: Maynooth town

EVE VLE

Front Page
 Home
 Discussions
 Scrapbook
 Account Details
 Private Messaging
 Log out
 Digital Library

TOOLS

Imaging Tool

MY SCRAPS

my mum (image)
 volcano (image)

NEW IMAGE SCRAP


Scrap Name

Scrap Description
 This is my mother doing something

/

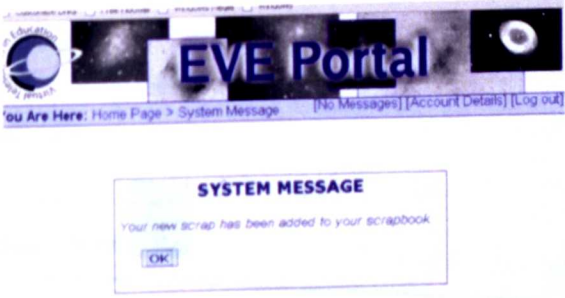
Scrap File (JPEG, PNG or GIF)

- type in appropriate <Scrap Name>
- type in brief <Scrap description>
- click on <Browse> to locate required image
- click on <Submit> to upload image



NUI MAYNOOTH
Higher Education Authority


21



SYSTEM MESSAGE

Your new scrap has been added to your scrapbook

- The message indicates that the Scrap has been added
- Click on <ok> to return to the scrap book



NUI MAYNOOTH
Higher Education Authority

22

Add the scrap to your current assignment

MY SCRAPS

happy picture (image)
japan garden (image)

NEW IMAGE SCRAP

Scrap Name
Scrap Description

Click on the image name

Click on <Add to current assignment>

Then click on <OK> to return to scrap book

HAPPY PICTURE

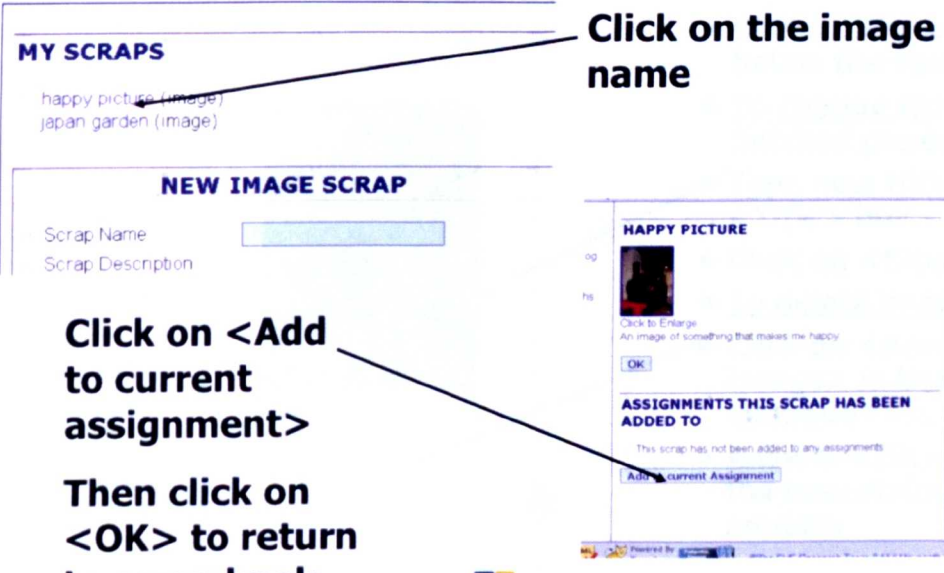
Click to Enlarge
An image of something that makes me happy

OK

ASSIGNMENTS THIS SCRAP HAS BEEN ADDED TO

This scrap has not been added to any assignments

[Add to current Assignment](#)



23

TOOLS

Imaging Tool

Save

SECTION DISCUSSION

picture (Student 1)

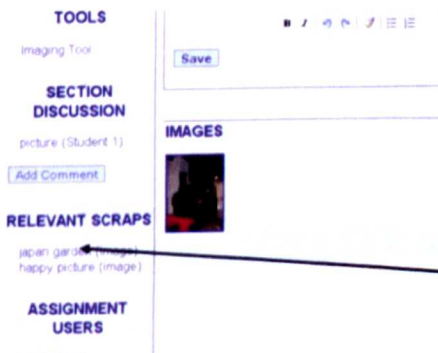
[Add Comment](#)

RELEVANT SCRAPS

japan garden (image)
happy picture (image)

ASSIGNMENT USERS

.....

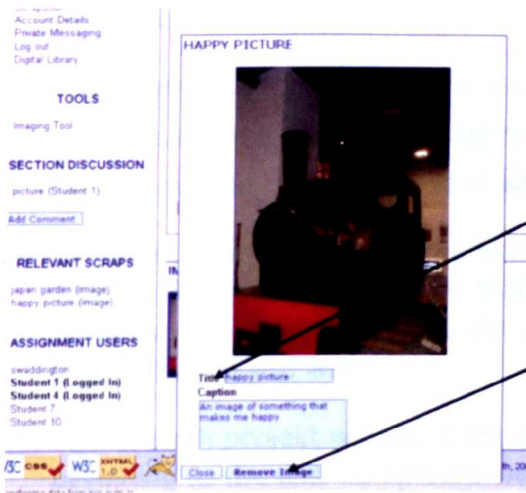


- The image is now accessible for all members of your team [including yourself]– and can be added to a section by clicking on its name
- It will then appear below the text in the relevant section



24

Changing the image title in your paper/ Deleting an image from your section/



- Click on the image below the text
- **To change title in finished paper**
- Type new title in <Title> box
- Click on <Close>
- **To delete image**
- Click on <Remove Image> in the dialogue box.
- Answer <OK> when the new dialogue box appears



Using EVE to produce a paper!

What name would you give your question?



- ❖ When the mentor/teacher agrees that the collaborative writing project is finished:
 - ▶ the mentor/teacher marks the assignment as “complete”
 - ▶ it moves to the *Completed Assignment* section of your *Home Page*
 - ▶ the document can be viewed in either PDF or HTML format
- ❖ Once the mentor/teacher *completes* the assignment it cannot be changed further. It may then be published in a Digital Library where others to see your efforts. You can download the PDF version and use it elsewhere if you wish!
- ❖ My research project will chart the evolution of your paper, from the beginning to the final completed work. I am interested in examining the impact (if any) of the comments on changes. I will also be interested in seeing how the text itself evolves.



Questions and Answers

Please give your name when you ask a question!



Appendix F

This appendix contains samples of additional research data collected during the Intervention training sessions for the First and Second Main Studies (FMS and SMS). These include the following:

- Pre- and Post-survey data on collaborative writing experiences for the FMS and SMS (4 pages).
- Sample Pre-writing planning notes (1 page).
- Samples of collaborative student writing collected during the FMS and SSS (Session Two - Collaborative Working and Writing).
- Samples of collaborative student writing collected during the FMS and SMS (Session Three - Writing a Library Research Paper).

First Main Study (FMS) Pre-Writing Survey

First Research Study (Pre-Writing Survey)		S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24		
A	Please answer the following questions about your participation in previous team-based projects:																										
	My team(s) worked effectively.	4	4	4	3	4	4	4	4	4	4	3	4	3	4	4	4	3	3	4	2	5	5	4	3		
	All team members were given the chance to fully express their ideas.	4	4	5	5	2	3	4	5	3	4	5	3	4	5	4	4	4	2	2	4	4	4	5	4	4	
	Members of my team(s) pulled their own weight.	2	4	4	3	4	3	1	4	3	3	3	0	1	3	2	4	2	2	4	4	1	4	4	3	1	
	Some team members coasted on the work of others.	4	3	1	4	2	4	5	3	3	4	4	4	4	2	4	5	4	4	4	2	4	3	5	2	4	
B	Please answer the following questions about your participation in previous team-based collaborative writing projects:																										
	My team members fully participated in the planning, evaluating, and revising of the written report.	4	2	4	3	4	3	2	4	4	5	3	2	4	2	2	2	2	3	4	4	1	3	5	3	3	
	My team(s) generally spent too little time managing the writing activities.	2	1	1	3	2	2	3	2	2	3	5	3	2	3	4	4	4	4	4	2	3	2	2	2	4	
	One or two members did more of the writing.	4	5	1	4	3	4	5	4	4	4	4	5	4	5	5	5	4	4	4	4	5	4	5	4	4	
	I felt as if I had an impact on the written report.	4	4	4	3	3	4	5	4	4	4	4	4	4	4	4	4	4	4	3	4	4	4	5	4	4	4
C	Please answer the following questions about your contribution to previous team-based collaborative writing projects:																										
	I worked hard at improving my group participation skills.	4	3	4	3	4	4	5	3	4	3	4	4	4	4	4	5	4	4	4	4	4	3	3	4		
	I typically don't put as much effort into team projects as I do into individually graded assignments.	3	2	3	3	4	2	2	2	2	2	2	4	5	3	2	4	4	4	4	2	2	2	2	2	2	
	Please answer the following questions about previous team-based projects:																										
	I learned a good deal from my team members.	5	3	5	4	4	3	4	3	4	5	2	4	5	2	4	4	5	4	1	4	2	4	4	5	3	4
D	Please answer the following questions about previous team-based projects:																										
	My team members learned a good deal about writing from each other.	5	3	4	4	4	3	2	4	5	4	5	4	5	3	4	2	1	4	4	4	4	4	4	3	4	
	I learned a good deal about what makes a group work together.	4	4	4	4	3	3	3	4	4	4	3	3	5	4	4	4	4	4	4	4	4	5	5	4	4	
	I have found working on team projects to be a valuable learning experience.	4	4	4	4	4	5	4	4	5	4	5	4	3	4	4	5	4	4	3	4	4	5	5	5	4	4
	Please enter any comments or opinions you have on collaborative writing projects in the space below:																										
S07	It is essential that equal effort is displayed by all members of the group. Otherwise, results will be flawed and inaccurate.																										
S10	I have worked on projects in L.V and found this year alot more challenging with group work with the younger students																										
S11																											
S17	Working as a group can be difficult or easy depending on the people in your team and how everyone contributes.																										
S21	Can often find team based projects to end up being the individual work of a minority of the group, while the whole team takes the credit.																										
S23	I feel it is an effective method or doing projects and it produces better projects because the people involved can use their strengths and can get help from other team members with their weaknesses.																										

First Main Study (FMS) Post-Writing Survey

First Research Study (Post-Writing Survey)

Question		S01	S02	S03	S04	S07	S12	S23	S24
A	Please answer the following questions about your participation in pervious team-based projects:								
	My team(s) worked effectively.	5	4	4	4	1	4	3	3
	All team members were given the chance to fully express their ideas.	3	2	5	5	4	4	4	5
	Members of my team(s) pulled their own weight.	5	3	3	4	1	1	2	1
	Some team members coasted on the work of others.	2	3	2	2	5	5	3	5
B	Please answer the following questions about your participation in previous team-based collaborative writing projects:								
	My team members fully participated in the planning, evaluating, and revising of the written report.	3	2	4	4	1	4	3	2
	My team(s) generally spent too little time managing the writing activities.	3	4	2	3	5	4	4	4
	One or two members did more of the writing.	4	5	3	3	5	4	4	4
	I felt as if I had an impact on the written report.	4	4	4	5	1	4	4	4
C	Please answer the following questions about your contribution to previous team-based collaborative writing projects:								
	I worked hard at improving my group participation skills.	4	3	4	4	1	3	3	4
	I typically don't put as much effort into team projects as I do into individually graded assignments.	4	2	4	3	5	5	2	4
D	Please answer the following questions about previous team-based projects:								
	I learned a good deal from my team members.	4	2	4	2	1	4	4	3
	My team members learned a good deal about writing from each other.	3	2	4	3	1	4	3	3
	I learned a good deal about what makes a group work together.	4	4	3	2	1	2	4	4
	I have found working on team projects to be a valuable learning experience.	5	4	3	3	1	3	4	4
E	Please enter any comments or opinions you have on collaborative writing projects in the space below:								
	I believe that when accepting this project we did not account for our Summer exams. This left very little time. I would recommend that								
	should you carry out any further studies you do so early in the school year								
S07	I thought it was a good idea, just bad timing with the school year.								
S24									

Second Research Study (SRS) Pre-Writing Survey

Question	S01	S02	S03	S04	S05	S06	S07	S08	S09	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22	S23	S24	S25	S26	S27	S28	S29	S30	S31	S32	S33	S34	S35	S36		
A Please answer the following questions about your participation in previous team-based projects:																																						
My team(s) worked effectively.	3	3	3	4	4	4	4	4	4	4	4	2	4	2	4	4	4	4	4	3	1	4	4	4	4	4	4	4	3	4	4	4	4	4	5	3	4	4
All team members were given the chance to fully express their ideas.	2	3	3	3	4	4	4	4	4	4	4	5	4	3	2	4	4	5	3	2	1	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Members of my team(s) valued their own weight.	4	4	2	4	2	3	4	3	4	4	5	3	2	4	3	4	4	4	4	1	2	2	4	3	3	5	4	3	2	4	4	4	4	4	4	4	4	
Some team members coasted on the work of others.	4	2	3	3	4	3	4	2	2	3	5	4	5	4	4	2	3	3	4	5	3	2	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	
B Please answer the following questions about your participation in previous team-based collaborative writing projects:																																						
My team members fully participated in the planning, brainstorming, and revising of the written report.	2	2	2	4	2	4	0	4	0	4	0	2	0	2	3	4	4	4	4	1	1	2	2	4	4	4	4	4	2	4	4	4	4	4	4	4	4	
My team(s) generally spent too little time managing the writing activities.	2	2	3	3	3	2	0	2	0	4	0	3	3	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
One or two members did most of the writing.	5	4	4	5	4	3	0	3	4	0	4	0	4	0	4	4	3	3	5	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
I felt as if I had an impact on the written report.	3	4	3	4	4	4	0	4	0	4	0	5	0	2	3	3	5	3	4	4	1	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
C Please answer the following questions about your contribution to previous team-based collaborative writing projects:																																						
I worked hard at improving my group participation skills.	3	2	3	5	4	4	0	4	3	0	4	0	2	4	3	4	4	4	4	3	1	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
Typically I don't do as much about my team projects as I do in individually graded assignments.	4	4	2	4	1	2	0	2	4	0	4	0	4	2	2	3	1	4	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
D Please answer the following questions about previous team-based projects:																																						
I learned a good deal from my team members.	3	4	2	3	4	4	3	4	4	3	4	3	3	1	4	4	4	4	4	2	1	2	5	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
My team members learned a great deal about writing from each other.	2	3	3	4	4	4	3	4	3	2	4	3	1	4	4	4	4	4	3	2	1	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	
I learned a good deal about what makes a group work together.	2	2	2	4	5	4	4	4	4	3	4	4	4	1	4	4	4	4	4	5	1	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	
I have found working on team projects to be a valuable learning experience.	3	3	3	4	4	4	4	4	4	4	4	5	4	1	4	4	4	4	5	4	1	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	
E Please enter any comments or opinions you have on collaborative writing projects in the space below:																																						
S20 Nothing to say. Sorry.																																						
S21 In my opinion I don't think they are good																																						
S22 They are good																																						
S26 If some people in the team don't like each other the whole project won't be very successful																																						
S27 Some of the people didn't communicate well with each other or didn't like each other so it didn't work well as a team																																						
S28 A lot of people in a team will not put much effort if they know someone else will. It's better if you're in a different group to your friends because you will not mess as much.																																						
S29 I feel some people have to take too much of the load and then some people just don't bother.																																						
S30 I feel that we spend more time on how we are going to write up the project instead of worrying about actually gathering the information.																																						
S32 It is easier to work in a group with people you know will work.																																						

Second Main Study (SMS) Post-Writing Survey

Second Research Study (Post-Writing Survey)		Question	S25	S26	S27	S28	S29	S30	S31	S32	S33	S34	S35	S36	S37	S39	S40		
A	Please answer the following questions about your participation in pervious team-based projects:																		
		My team(s) worked effectively.	4	4	4	2	4	4	4	4	4	3	4	3	2	2	2	3	
		All team members were given the chance to fully express their ideas.	5	3	4	4	3	4	5	4	3	3	2	3	3	4	4	4	
		Members of my team(s) pulled their own weight.	5	4	3	1	2	4	3	4	3	4	3	4	2	0	1	1	1
		Some team members coasted on the work of others.	2	4	4	5	4	2	4	3	3	2	3	2	3	5	5	1	5
B	Please answer the following questions about your participation in previous team-based collaborative writing projects:																		
		My team members fully participated in the planning, evaluating, and revising of the written report.	4	4	2	2	3	4	4	4	4	2	4	2	4	3	2	2	1
		My team(s) generally spent too little time managing the writing activities.	3	3	4	4	2	4	4	4	3	4	3	4	4	4	3	3	4
		One or two members did more of the writing.	2	2	5	4	5	2	2	2	2	4	5	4	5	4	5	4	5
		I felt as if I had an impact on the written report.	4	4	3	5	4	4	4	4	4	4	4	4	4	2	5	4	5
C	Please answer the following questions about your contribution to previous team-based collaborative writing projects:																		
		I worked hard at improving my group participation skills.	4	4	5	4	4	4	4	4	4	4	4	4	4	3	5	4	4
		I typically don't put as much effort into team projects as I do into individually graded assignments.	4	1	2	2	4	2	3	1	4	4	3	2	4	3	2	4	1
D	Please answer the following questions about previous team-based projects:																		
		I learned a good deal from my team members.	4	2	2	2	2	4	3	3	2	4	3	1	1	3	1	1	
		My team members learned a good deal about writing from each other.	5	3	2	3	2	4	3	3	3	3	3	2	1	1	3	1	
		I learned a good deal about what makes a group work together.	5	4	4	4	4	4	4	4	4	4	3	4	4	1	1	4	1
		I have found working on team projects to be a valuable learning experience.	5	4	3	4	4	4	4	4	4	5	3	2	3	1	1	5	3
E	Please enter any comments or opinions you have on collaborative writing projects in the space below:																		
	S29: The work really does need to be completed by ALL students. Also the teachers in charge need to make an effort in titles of the sections.																		
	S33: People didn't take it very serious. S37: My team never worked together! Two members never logged into the system ever and we given absolutely no assistance!!! It was an absolute Shambles. Sorry!																		

Sample Planning Notes (from Collaborative Writing Environment)

Team 1: Planning		
Ms Kelly	Team 1 Planning!	Please use this forum only for planning your collaborative writing project in this forum you can plan who will do what, during the project. Please refer to John Keating's document on collaborative writing, and have a look at the various roles that authors take on during collaborative writing projects. What role will everyone take on? Remember you need to have at least two roles! The Team Leader (S04 S04) should ensure that everyone has two roles before the writing starts on Thursday 14th May! Good luck with the collaborative writing project! If you have any problems please send a private message to me (Ms. Kelly)
Ms Kelly		Hey boys, no sign of any planning yet....will anyone start you off? E9 Let me know if there is anything I can do for you. Ms. Kelly
Ms Kelly_4_S01		Sorry about the delay but the reason we havnt started yet is because we didnt get our teacher/mentor names until today. We should get started on it today or tomorrow. Thanks for all the usefull links but seeing that that was a delay could we please get some extra time to get the roles sorted out?
Ms Kelly_4_S01	Essay ideas	The abstract is a brief overview of what we are going to say. And we cud put da intro as what is global warming and its effects. Has any1 got any ideas on the body of the essay. I want to do a section on why global warming is fake. that could be the last point. We have to make sure we stick to the title 'The Physical Effects of Global Warming'. Heres some ideas for the different points on the body of the essay - Increasing temperatures -Shrinking ice caps -Desertification -And why global warming is fake if anyone else has any ideas or wants one of those topics just say
Ms Kelly_4_S02	Essay ideas	Ye, ive finally gotten this yolk working -P, the ideas you have there are good and manage to cover pretty much anything, maybe we could throw in a bit on how global warming will affect us here in Ireland like under your "Shrinking ice caps" title we could have somethin about how the fresh water flowin off dem would stop the gulf stream and change our weather. ill talk 2 u more tomorrow about de
Ms Kelly	S03 and S04 anyone?	Does anyone know if S03 or S04 will be joining in the discussion? John was hoping you would start the project at the weekend but they haven't been involved in the planning of the project yet. Any ideas? Ms. Kelly
Ms Kelly_4_S04	delayed	sorry i couldn't get onto this until now because i had trouble wit my username. I think when writing the essay the main ideas that should be taken into account, in the body of the essay, are what humans have done 2 contribute 2 global warming, for eg. the overuse of fossil fuels, deforestation etc. The introduction should give a clear & understandable definition of global warming. Also, S01 is the team leader, not me.
Ms Kelly_4_S01		Mrs Kelly, I don't know what S03's problem is he never said anything in school about any trouble logging in. But now that we have 3 of us online he can get the remaining topics. Thanks for the points S04, I think that they will be perfect in the introduction. I wouldn't agree however with you when you say that our main ideas should be about what humans have done to contribute to global warming. The title of the essay is 'The Physical Effects of Global Warming'. Do you not agree that if our main points are about humans contributing to global warming then we would be straying off the point of the title? It seems that you have a clear idea of what the introduction should be like. Do you want to do the introduction? Also your points that humans contribute to global warming would be great for the first point (Physical effects of increasing temperatures) because you can then talk about how the increasing temperatures were caused by humans. Does that sound Good to you?
Ms Kelly_4_S02	Sections	S01, ill grab the section on "Shrinking Ice caps" while its open, and im cosy with whatever I get for my 2nd section, just stick up something on this forum for me to cover aswell and ill get working on it. Also, i saw S03 at lunch today and he told me he was havin some troubles with logging on, didnt hear from him after that but saw him talking to mr. andreas anyway so hopefully he'll be on over the weekend to get his "leftover" sections -P
Ms Kelly		Sounds good boys. I have trouble logging in myself at times, maybe S03 has the same problem. Each time I type my password EVE doesn't accept it, I have to copy and paste it from an email or document and then EVE will let me in. Perhaps you could pass that tip on to S03 if you see him. Ms. Kelly
Ms Kelly_4_S04		ye sounds good S01! ye ill do the intro. ye i think youre rite about our main points not being about how humans contribute 2 global warming but we should talk about the effects of global warmin and then bk the points up wit wat humans do to cause these problems??!
Ms Kelly	GW fake?	You might find this page interesting S01: http://www.realclimate.org/index.php/archives/2005/01/the-global-cooling-myth/ You will have to copy and paste the link into a new tab to view it. Ms. Kelly
Ms Kelly	GW Swindle	Found an interesting film when I searched for 'fake global warming'...It's a 1 hour film and can be found on google videos. Just do a search for 'global warming swindle' and you should find it. Just in case, here is a link to it http://video.google.com/videoplay?docid=28895268065100870
Ms Kelly	Fake GW link	Oops, don't know what happened to my post! Anyway, the link above will take you out of EVE so maybe best to copy and paste it into a new tab. Ms. Kelly
Ms Kelly_4_S03	hi	sorry bout the delay only got correct password on friday.
Ms Kelly_4_S03		i made a start on the physical effects on global warming. S01 i noticed u didnt want much about human interactions cause it strays off the point a little. i think though that in physical effects all the main reasons point to fossil fuels and greenhouse caused by humans.
Ms Kelly_4_S03		in ice cap shrinking u cud look into results in the rising sea level as lots of coutries in europe including germany are below sea level or does that go with physical effects
Ms Kelly_4_S01		Sorry about not replying I was away all day. Yes your right S04 we would need to mention what causes the physical effects. You have the intro and Humans and global warming. In that you can explain what global warming is and what humans are doing to cause physical effects. Thanks very much Mrs Kelly for the great references it will save me a lot of time scourging the internet. Also Mr Green told us what causes all that random text when you copy and paste links. To not let it happen again you paste your link into the comment box then click on the little brush (inbetween the arrows and lines) to show all the hidden text. Then delete the unwanted text. Good to see you online S03 now we can get this project done. What you could do with Physical effects is talk about desertification in Africa then talk about how Greenhouse gasses caused it and what could be done to stop it. So yes you right in saying that you will need to put in stuff about Greenhouse Gasses but i dont think that is straying from the point. Fair play in starting the project already your putting us all to shame. Also S02 is doing the section on the ice caps so i hope he will take what you said on board.
Ms Kelly		Well done S03....last in...but first off the mark with writing! Thanks for the tip to clean up messy code S01. Ms. Kelly
Ms Kelly_4_S02		thanks for the countries below sea level idea S03, that sounds like another interesting thing to mention and ill be sure to add that. just to clear things up by the way, "physical effects" isnt a title for any section, its the title of the project which we have to try and write under, so all our titles will be connected to physical effects in some way.
Ms Kelly_4_S03		ok thanks
Ms Kelly_4_S03		hey, i am going to spain on saturday for a week and i have exams during the week so i will get my piece done b4 that. i should be able to find a computer over in spain so i will check in now and again while i am over there.
Ms Kelly	holidays	Thanks for the commitment S03. Ms. Kelly

Session Two: Team 1 Notes

Student IDs: S-28

Because of the populatio pollution let out by the many factories built after 1850, many pepper moths turned darker. As strong anti-pollution laws were set in place, cleaner environments stops the colouring of these moths, and makes them lighter.

We all decided that it was the anti-pollution laws that stopped the colouring of these moths. Cleaner environments were also achieved. Also we decided that as technology improved, pollution w reduced.

Student IDs: S-25

There are more light coloured moths now than before as over the last twenty years factories have become cleaner and so has the countryside, thus leading to more light-coloured moths than before.

Student IDs: S-27

Because Anti-pollution laws came in. This has resulted in cleaner factories and reduced the amount of soot produced. And increased the number of light-coloured moths.

Student IDs: S-26

Because of all the soot from the factory smokestacks the moth's blackened but now because there are very few smokestacks today the light-coloured moth's ~~are going back to their a~~ are more common.

Sample collaborative student writing collected during the FMS and SMS
(Session Three - Writing a Library Research Paper).

Session Three: Team 1 Notes

Student IDs: S-03

Staple foods are now used more commonly, they are better for the environment and less harmful to people and insects. There are many advantages and disadvantages like; farmers can grow larger amount of crop, advantages to poor people in underdeveloped countries, A GM fruit remains fresh for longer (tolerate transport) / Disadvantages; pests can become resistant to the spray, pollinate weeds, variety of insects are at risk, poor people too dependant on the western world.

Student IDs: S-04

Genetic engineering - greatest breakthroughs in EU - strict laws involving the cloning of humans.

Most genetic engineering experiments are taken under control by the government which ~~to sort what experiments would be taken by~~. Produced legislation to control experiments undertaken.

Student IDs: S-02

Scientists have discovered a way to produce offspring by transplanting specific genes from 1 plant to another using a process called Genetic Engineering.

Student IDs: S-01

Genetically modified foods can be used to improve the food, but it requires a longer timescale, studies, experiments and tests.

Student IDs: S-25

Advantages can be that they can grow larger quantities due to being able to fight pest easier but disadvantages can be that they poison would last over a longer period of time and the pests could become accustomed to it and ~~and~~ thus crop-spraying would become ineffective.

Student IDs: S26

While Genetic engineering of food could seem to ~~be~~ have many advantages the disadvantages could cause a much bigger problem then we had originally thought such as an irreversible effect that is yet unknown.

Student IDs: S-27

Genetic engineering can ~~improve~~ prevents disease in people, plants or animals. Preserves food for longer.

Student IDs: S-28

Genetic Modification + Engineering is an advancement on selective breeding which involves splitting or splicing a gene that contains a desirable ~~as-pe~~ aspect of the organism, and then ~~placed~~ placing into another organism to give it the characteristic of the gene, within a certain limit. Eg cloning a human gene.