

**Project Title:** Genre-based approach to enhancing secondary students' English writing ability in science subjects

**Organisation:** Department of English, City University of Hong Kong

1. **Goals:** This project will aim to improve Hong Kong secondary school science students' English writing skills through a structured genre-based pedagogy.

**Objectives:**

- i. to develop a genre-based pedagogical approach that will involve interactive, structured methods for enhancing the students' writing abilities in performing their scientific writing
- ii. to enhance the students' capacities to become self-directed English language learners through genre-based pedagogy in the context of science, paving the road for them in English-medium science classrooms to improve their English communication skills, and to support their future career aspirations
- iii. to contribute to the development of English language curricula, particularly in terms of addressing the need for English training across science or STEM subjects

1. **Targets:** This project will benefit all English-medium secondary schools, by providing useful teaching resources for both English and Science teachers, which will help them to enhance their students' ability to use English as a tool for inquiry, learning, thinking, and communicating with specialists within Science.

**Expected number of beneficiaries:** The immediate beneficiaries will be approximately 600 students in secondary grades 7,8,9 from 9 secondary schools (60 to 100 students/school). The writing workshop will be tailored to cater for the different learning needs across levels.

2. **Implementation Plan: i) Process/schedule:** 1 April 2019 to 31 March 2022 (duration: 36 months). We plan to accomplish the 7 stages: 1) Preparation: producing genre-based teaching/learning materials; 2) Implementation: providing training to teachers for delivering writing workshops; 3) Pre-tests: measuring participants' general English language abilities; 4) Intervention: 12-week writing workshops; 5) Post-tests; 6) Analysis of the data, and reporting preliminary findings; 7) Creation of a teaching manual and a website for use by all secondary schools in Hong Kong.

**ii) Collaboration with other partners:** The nine local secondary schools have agreed to participate in this project: 1) TWGHs Wong Fut Nam College, 2) Concordia Lutheran School, 3) CCC Kei Chi Secondary School, 4) TWGHs Chang Ming Thien College, 5) Lok Sin Tong Leung Chik Wai Memorial School, 6) Maryknoll Fathers' School, 7) Carmel Alison Lam Foundation Secondary School, 8) STFA Seaward Woo College, 9) Kwun Tong Government Secondary School.

3. **Products: a. Deliverables/outcomes:** Students in the genre-based pedagogy programme will enhance their ability to write English as appropriate for scientific subjects. In particular, they will master the science-related conventions (including the standards for citations, referencing, and avoidance of plagiarism) that are associated with communicating in English in particular scientific fields. They will develop their abilities for critical and evaluative thinking within their science disciplines. The genre-based pedagogy will allow students to become self-directed English language learners in the context of science. There will be two kinds of assessment tasks (language tests and scientific reports) and pre- & post tests for evaluating the programme and the participants' English language abilities.

**b. Dissemination of deliverables/outcomes:** This project will result in two or three journal publications on the topic of developing English writing skills and genre-awareness among Hong Kong secondary students. Based on the materials developed and the feedback obtained from this project, a teaching manual and a website will be created and made publicly available. At least three professional teacher workshops will be organised to inform local school English and Science teachers to the key finding from this project. The copyrights of the deliverables/materials developed should be vested with the QEF.

**c. Commercialisation potential of deliverables/outcomes:** Four hundred copies of the manual will be produced and delivered to secondary schools across Hong Kong. In addition, a website will be designed and made available to schools and the general public. Ultimately, all secondary schools in HK will benefit from the teaching materials, manuals, and website developed in this project. These resources will offer comprehensive information about the development of students' scientific writing and language skills, and about the methods that local schools can use for increasing their students' abilities in writing scientific texts, including texts suited to specific subgenres of school science.

4. **Budget:** The total cost of this project will be \$1,022,700, including \$860,094 for staff costs, \$22,800 for equipment, \$68,000 for service, \$67,072 for general expenses, and \$4,734 for contingencies.

5. **Evaluation: i. Performance indicators:** This project will use a rigorous experimental approach and apply standardised tests to evaluate the effectiveness of genre-based pedagogy for enhancing students' abilities in writing English scientific texts. It compares a baseline with the students' performances in the control and experiential groups.

**ii. Outcome measurements:** After the 12-week writing intervention, the students will be measured by post-tests based on the same measures used in the pre-test (e.g. students' general English language abilities, writing skills (in science), motivations for learning English, and awareness of English). Any improvements in the students' writing performance between the pre- and post-tests will be compared across the three groups, as a means for measuring the effectiveness of the programme.

Key theme: effective learning and teaching of languages

Project Title: **Genre-based approach to enhancing secondary students' English writing ability in science subjects** 以文體教學法提高中學生科學英語寫作能力的研究

Name of Organisation: Department of English, City University of Hong Kong

Hong Kong students performed well in science, technology, engineering and mathematics (STEM) over the years as indicated by the international assessments (e.g. PISA, TIMSS) and international competitions (e.g. International Junior Science Olympiad). The Hong Kong (HK) SAR government has launched a policy document to promote of STEM education in 2015. STEM education is a key emphasis under the ongoing renewal of the school curriculum. Students in Hong Kong generally performed well in science, technology and mathematics at the international level and they actively participate STEM related learning activities inside and outside of schools. However, recent studies have shown the pitfall of the science teaching and criticised science students have limited English skills in communicating, presenting and writing science ideas. (e.g. Yip et al, 2003; Lo & Macaro, 2012). It is a real concern for us that these gifted HK students with high achievements in STEM but fail to express their brilliant science ideas or communicate at the international competitions. There is a need to strengthen students' ability to integrate and apply their knowledge and skills through English. In the literature, there is limited number of studies have been looked at the required English skill for successful STEM teaching and the effective way to teach the English for effective writing in STEM education, particularly in Science (Pun, 2018).

The proposed pedagogical approach will focus on Science, and a common school genre such as scientific report. This approach will make the genre-specific conventions more explicit and accessible to students. We aim to pave the road for students in English medium science classrooms to improve their English communication skills with regard to science disciplines, and to support the students' future career aspirations. Our goal is to develop an effective, innovative English instruction method that will enhance the students' capacities to become self-directed English language learners within the context of science.

### **1. Needs Assessment and Applicant's Capability**

This project aims to improve Hong Kong secondary school students' English writing skills and awareness of the requirements of English scientific writing. The project will introduce interactive writing activities that make the standards for English scientific writing explicit and accessible to students through a structured genre-based pedagogy. Our goal is to develop effective and innovative English instruction methods that enhance the students' capacity to become self-directed English language learners within the context of science. This goal supports the main areas of English language curriculum development and of teaching language-related requirements in the secondary school science curriculum (CDC & HKEAA, 2007).

Within the project period, an effective and interactive English teaching method known as "genre-based writing pedagogy" will be developed, and the effectiveness of this method for enhancing students' writing skills will be demonstrated. This method will be of immediate benefit to the 600 participating secondary Grade 7-9 students and their schools. After the project period, the methods and teaching materials developed in the project will be made available to all local secondary schools. The project's products will contribute to developing English language education curricula and facilitate the teaching of effective English writing skills in relation to science. The ultimate goal is to provide students with a genre-based writing pedagogy. This pedagogy will serve as a tool for lifelong learning by helping students to monitor and evaluate their own learning processes. That capability will help them to integrate and function as members of professional scientific communities.

The project will demonstrate how a genre-based pedagogical approach can make the language of science and scientific writing more accessible to ESL learners. It will explore how innovative pedagogy can address the challenges of academic literacy that students face when they engage with difficult, abstract, technical science texts. The teaching manual produced by this project will showcase the ways

that content-subject teachers can improve their students' academic language competence through an approach to teaching that is focused on subject-specific discourses. The students will be alerted to the issues involved in making appropriate choices of vocabulary, grammar, and language style in their science-related writing.

Learning science through a second language (L2) is a growing phenomenon around the world. Evidence has shown that science teachers and students encounter a number of language-related challenges during the process of learning science through an English medium of instruction. Among these various language-related challenges, many are related to the forms of language used in scientific writing, such as standards regarding the organisation of the text (e.g., science genre) and subject-appropriate lexico-grammatical features (e.g., nominalisation). For example, students may get frustrated with the seemingly ambiguous referents of nominalisation if they fail to grasp the subject-specific meanings of nominal phrases (Fang, 2005). Students may have difficulty presenting science knowledge or developing logical arguments in their writing if they fail to understand the role of nominalisation in scientific texts (Schleppegrell, 2004).

Research has shown that there is a need to provide explicit instructions on how science teachers can work with ESL students in Hong Kong, and how genre-based pedagogy can help in teaching the language of science (Matthessien & Pun, 2017). Science teachers with greater language awareness are more sensitive to their ESL students' language needs, and they are better able to integrate their instructions regarding scientific language with their curricular goals (Hoare, 2003). In Hong Kong, two "extremes" in the teaching of writing skills can be observed in secondary school classrooms.

1. The format approach. Students are told what sections or stages are involved in the genres of writing they are assigned to perform, and the teachers provide a rough idea of what each stage should contain. The students then write their texts. The students can, in fact, learn such formats very easily. However, although their texts may include all of the appropriate stages specified by the format, the flow of information within each stage may insufficiently coherent. There may be errors of tense, transitivity, word choice, complex sentence construction, or other problems. Such format approach does not lead to transformable outcomes. Learners find it difficult to apply the learned language formats from one text type to another text type.

2. The grammar drilling approach. Teachers often recognise that their students have a lot of problems with sentence-level grammar, and they commonly feel that they should "drill" their students in grammar before asking them to write whole texts (or conduct such drills as a way of helping the students to write their texts). In the prevailing Hong Kong context, "drilling" usually means doing written, de-contextualised, sentence-level exercises that involve operations such as filling in the blanks, transforming sentences from one grammatical form to another, or choosing between alternative solutions. However, although students may learn to successfully complete such exercises, they still fail in applying the "correct" grammar in their later writing of whole texts. Teachers in Hong Kong commonly complain that their students repeatedly make the same mistakes, despite having been taught the rules of correct grammar many times.

It has long been recognised that the most effective way to improve students' control over grammatical systems is to teach grammar in context, so that the grammatical forms are seen to be functional and meaningful rather than just arbitrary prescriptions (Halliday & Matthiessen, 2004; Christie & Derewianka, 2008). In theory, the pedagogy of genre-based writing (which was first developed in the context of first-language writing, and then more recently applied in second-language writing) ought to be capable of overcoming the gap between a focus on text structure ("organisation") and a focus on sentence-level grammar. However, this type of pedagogy is not as simple as it sounds, and in some cases a simplistic approach to genre-based pedagogy ends up being very similar to the format approach. Many teachers simply lack the resources to support effective "shunting" between macro-text and sentence-level grammatical structures.

### **What We Propose**

This project will focus on writing that is suited to the genre concerned. This approach is important for enabling both the English language and science curricula of Hong Kong secondary schools. The proposed classroom exercises and scientific report-writing assignments will help to convey the required organisation of discourse and lexico-grammatical features. These learning activities will be designed to help students write effective and accurate texts in the genre that is appropriate to each subject. The design of learning activities will follow the framework suggested by Lock & Jones (2011), which involves the three stages of **noticing**, **exploring**, and **practising**. **Noticing** activities aim to draw the students' attention to the specific features of a text. For example, these activities can involve comparing texts or parts of texts, considering alternative forms within a text, sequencing parts of a text, or transferring features of a text into a graphic mode. **Exploring** activities aim to raise the students' awareness of how specific features of language function in shaping the context. These activities typically involve sets of questions that teachers can use as frameworks to enable students to explore linguistic features. **Practising** consists of activities in which students may rewrite portions of text, compose missing sections of texts, or write whole texts themselves. These activities are designed in such a way that they can be used by both English teachers and science teachers. In our project, these activities will be trialled with a group of 600 students over a period of three months. The teachers will be trained to make use of annotated texts for stimulating their students' genre-related awareness in science writing.

After the programme evaluation, we will offer the proposed genre-based pedagogy to all secondary schools in Hong Kong. We will enable such pedagogy through the manuals, teaching materials, and website we develop in response to the participants' feedback from this programme. The manual and website will offer comprehensive information on genre-based pedagogy for scientific writing, and these resources will be made available to all secondary schools in Hong Kong. The long-term goal is to adapt this approach to writing skills training for helping students who are in the early stages of transition from a Chinese medium to an English medium, or for students who have limited English ability but are expected to study science in English. This project will pave the road for learning scientific English in an interactive and enjoyable manner, instead of relying on the format or grammar-drilling approaches or on the rote memorisation of material from model essays or textbooks.

Our success in meeting these goals will be evaluated through an experimental intervention. The effects of genre-based pedagogy for the writing of scientific texts will be compared with the learning outcomes of students who are not exposed to any of these writing techniques. We will administer standardised tests to students individually to measure their general English language abilities, skills in science-related writing, motivations for learning English, and overall awareness of English.

After pre-testing the students on their language and writing skills, the different classes of the nine participating schools will be randomly assigned into three groups: (a) **genre-based pedagogy with interactive activities**; (b) **genre-based pedagogy**; (c) **control**. Each condition will have three participating schools. All the teachers receive the same set of teaching materials. Those teachers in the experimental groups will be trained and supported by the research team for delivering a genre-based pedagogy. The teacher in the genre-based pedagogy with interactive activities will engage with students in a dialogic approach in helping students to express and present their scientific ideas in addition to their writing tasks. Both experimental groups will present the materials in such a way that genre-features of the scientific texts will be made explicitly to students. For the control group, the teachers will follow the conventional teaching practices. They will be provided with the same English-language science textbook that is given to the other groups, but they will be asked to read it along with the students. This group will help to determine whether our intervention yields better results than the approach that is typically used by science teachers in Hong Kong.

Having a "control" group is important, as it helps us to compare the effects of genre-based pedagogy with the results from using no new writing materials. The teachers and students in all three groups will engage in writing activities for 12 weeks, with two hours of writing sessions per week. All of the

participating groups will receive copies of the genre-based writing pedagogy materials after taking the post-test.

## **2. Goals and Objectives:**

**Goals:** This project aims to improve Hong Kong secondary school students' English writing skills through a structured genre-based pedagogy that will enhance awareness of English conventions regarding science through interactive writing activities.

### **Objectives:**

To achieve this goal, we will apply a genre-based pedagogical approach that will involve interactive, structured methods for enhancing the students' writing abilities in performing their science class assignments. This genre-based pedagogy will focus on teaching subject-specific genres of writing. The teachers will work with their students through a sequence of five steps in the teaching-and-learning cycle (c.f., Rose & Martin, 2012). These five steps will be (1) developing the students' basic understanding of their subject and of the social context in which the given genre operates; enhancing the students' capacities to become self-directed English language learners through genre-based pedagogy in the context of science; (2) carefully analysing sample texts in a way that develops understanding of their communicative purposes and of the language choices used to serve those purposes; (3) constructing texts in a joint student-teacher effort, with the teachers acting as disciplined language guides; (4) having the students construct texts individually; and (5) reviewing the students' texts to provide input for subsequent teaching and learning cycles.

In the context of science classes, students will be explicitly taught the expected conventions for English writing needed at different stages of scientific investigation. This instruction will involve the students in presenting concepts, collecting data, interpreting findings, and presenting conclusions. The project will apply a rigorous experimental design to objectively evaluate the proposed programme. The findings from the project will contribute to the development of English language curricula, particularly in terms of addressing the need for language training across subjects. The ultimate goal of this project is to prepare students for understanding how genre-appropriate English communication helps to develop the types of professional identity needed for membership in disciplinary communities or interest groups.

## **3. Audience- the target beneficiary group:**

This proposed project will benefit all English-medium secondary schools and their students. It will provide useful teaching resources for both English teachers and science teachers, which will help them to enhance their students' ability to use English as a tool for inquiry, learning, thinking, and communicating with specialists within their chosen fields or areas of interest.

The immediate beneficiaries will be 600 students in the nine participating schools. Then, based on the materials developed and the feedback obtained from this project, a teaching manual and a website will be created. Nine hundred copies of the manual will be produced and delivered to secondary schools across Hong Kong. In addition, a website will be designed and made available to schools and the general public. Ultimately, all secondary schools in Hong Kong will benefit from the teaching materials, manuals, and website developed in this project.

### **Behaviour – the targeted performance, learning outcomes, or behavioural outcomes**

It is expected that students who participate in this genre-based pedagogy programme will enhance their ability to write English as appropriate for scientific subjects. In particular, the students will master the science-related conventions (including the standards for citations, referencing, and avoidance of plagiarism) that are associated with communicating in English in particular scientific fields or areas of interest. The students will also develop their abilities for critical and evaluative thinking within their science disciplines. The students will develop their capacity to become self-directed English language learners in the context of science.

In the programme, students will learn how to assess their own language learning needs, critically reflect on their actual use of English, and identify challenges presented by texts in different school science

genres. Such reflection will allow them to understand their strengths and weaknesses in writing science, and prepare them to develop suitable strategies for meeting the demands of writing scientific texts. Throughout the 12-week intervention, students will develop strategies and skills through a range of interactive tasks specifically related to science writing (e.g. comparing text structure, analysing content, identifying writer stance (hedging), tracking text cohesion, and using recourses to check appropriacy of lexico-grammar). They will then apply the strategies and skills they have acquired to their own scientific writing. A self-checklist for effective science writing will be developed so that students can apply what they learn in the 12-week writing workshops to allow them to become self-directed English learners in the context of science beyond the programme. A post-test will also be conducted to measure the participating students' awareness of the features of science writing.

#### **Conditions – the situations under which behavioural changes are expected to occur**

The students will critically evaluate scientific texts in terms of their structure (genre, generic stage), content, writer stance (hedging), text cohesion (theme-rheme), and lexico-grammatical structure (transitivity) (c.f. Halliday & Matthiessen, 2004). They will then apply the knowledge they generate to their own scientific writing.

The students will become able to create, share, and discuss multimedia scientific texts on authentic scientific issues. These texts will be organised in a logical way, follow accepted scientific conventions, and make effective and creative use of verbal and non-verbal delivery techniques. The students will write a scientific report on an authentic scientific issue, making creative and effective use of appropriate scientific language, organisation, and academic referencing conventions. Besides, the students will gain the capacity to use genre-based pedagogical writing as a tool for lifelong learning. They will do so by monitoring and evaluating their own learning processes and by assessing the impact their learning has on their ability to relate as members of a professional scientific community.

#### **Degree- the criteria for measuring success**

This project will use a rigorous experimental approach and apply standardised tests to evaluate the effectiveness of genre-based pedagogy for enhancing students' abilities in writing English scientific texts. The results of the project will be compared with a baseline of results from the traditional instruction methods that teachers have previously used in their classrooms. The students in both the control and experiential groups will be asked to independently write scientific texts in genres appropriate to their subjects, before they have been given any instruction. These texts will be graded by their teachers using both a grading checklist and a holistic grading system. The same teachers will then grade the students' final texts at the end of the course in the same way. The teachers' grading will be checked and moderated by a panel of experienced teachers. (See more in the Evaluation section).

The criteria for measuring students' writing success: There will be two kinds of assessment tasks: language tests and scientific reports. The language learning will reinforce the students' understanding of the genres used in school science, including the structures and lexico-grammatical features (e.g., transitivity, theme-rheme progressions) (c.f. Halliday & Matthiessen, 2004) involved. The scientific report assignments will be designed to help the students to present their findings in the form of a written scientific report, which makes creative and effective use of the appropriate scientific language, organisation, and academic referencing conventions (i.e., avoidance of plagiarism).

#### **4. Targets and Expected Number of Beneficiaries:**

Collaboration with other parties/partners:

- School 1: TWGHs Wong Fut Nam College
- School 2: Concordia Lutheran School (Yau Yat Chuen)
- School 3: CCC Kei Chi Secondary School
- School 4: TWGHs Chang Ming Thien College
- School 5: Lok Sin Tong Leung Chik Wai Memorial School
- School 6: Maryknoll Fathers' School

- School 7: Cannel Alison Lam Foundation Secondary School
- School 8: STFA Seaward Woo College
- School 9: Kwun Tong Government Secondary School

This project will involve approximately 600 students in secondary grades 7–9 from the 9 secondary schools. Each school will provide approximately 60-100 students. The nine secondary schools have agreed to participate in this project (see the attached letters of support). While all three levels focus on the genre of scientific reports, each level will primarily focus on different aspects of the language uses in the texts. The writing workshop will be tailored to cater for the different learning needs across levels:

Secondary 1 students will look at the nature of English in science reports, focusing on key vocabulary and grammar at clause and sentence levels. They will work collaboratively to identify, evaluate and present aspects of scientific information although not yet in complete texts.

Secondary 2 students will focus on the development of discursial features in science reports such as generic stages, patterns of cohesion and coherence. They will produce multiple drafts of stages of science reports, making use of various language techniques including brainstorming ideas and gathering information, working with sources, prewriting and outlining, planning and drafting, reviewing, revising, editing and proofreading.

Secondary 3 students will focus on how to re-contextualise scientific information from other sources into a complete science report. Students will learn how to use different points of view and perspectives in their writing and integrate the ideas and words of others in a way that avoids plagiarism. They will work together with others to improve their reading and writing through peer review, peer conferencing, and peer review responses, collaboratively designing infographics (i.e. transferring information to visual modes) based on the gathered sources and information, evaluation their own and team members' contributions.

In the writing workshops, opportunities will be provided for English teachers and science teachers of the participating schools to work collaboratively. Short interviews will be conducted with both English and science teachers to explore their teachers' belief about collaborative process between English and Science departments at their respective schools and identify effective ways of mechanism in curriculum design and materials preparation. We will provide opportunities for English teachers and science teachers to think about and report on their existing collaboration at their schools. Both English and science teachers of the participating schools will work in collaboration in modifying and finalising the materials for their school settings. We will also present the findings of the project as well as the teaching materials for their discussion and consideration. The teaching materials will be shared with the school teachers. Both English and science teachers of the participating schools can utilize these materials for their own classrooms, with assistance of the research team, for a long-term and sustainable collaboration between the university and the participating schools in implementing genre-based science writing.

Sixteen classes in nine participating schools will be involved, with a total of 600 students. These schools will receive our annotated scientific texts and our manuals that present techniques and examples for stimulating students' genre awareness and writing skills. The teachers will also participate in workshops to enhance their understanding of how students develop their capabilities in writing scientific English. When applied in the classroom, this programme is expected to raise the students' English-writing abilities and enhance their interest in learning English. The experience of enabling such improved results will in turn enhance the efficiency of English instruction in these schools.

The immediate beneficiaries will be 600 students in the nine participating schools. In addition, based on the materials developed and the feedback obtained from this project, a teaching manual and a website will be created. Nine hundred copies of the manual will be produced and delivered to secondary schools across Hong Kong. A website will be designed and made available to schools and the general public.

Teachers and students from other secondary schools in Hong Kong may access to the developed teaching materials, manuals, online.

The impact of this proposed project will ultimately benefit all English-medium secondary schools and their students in Hong Kong. It will provide useful and sustainable teaching resources for both English teachers and science teachers, which will help them to enhance their students' ability to use English as a tool for inquiry, learning, thinking, and communicating with specialists within their chosen fields or areas of interest.

## **5. Innovation**

This project will build on a large body of scholarly work on genre-based pedagogy for teaching English writing at the secondary school level (Christie & Derewianka, 2008; Forey & Poilas, 2017; Rose & Martin, 2016; Matthessien & Pun, 2017) and in tertiary education (Lorenzo, 2013; Walker, 2011; Dreyfus et al., 2016). These studies have shown the effectiveness of genre-based pedagogy for enhancing English learning around the world.

The proposed project will focus on teacher-student writing in the classroom, and it will be the first attempt to apply an interactive genre-specific teaching method for helping students in second-language classrooms to learn scientific writing. First, the results will provide guidance towards developing genre-based writing materials with specific guidelines, which will be made available for language and content-subject teachers in science disciplines. These materials will help science teachers across Hong Kong to enhance their students' writing abilities. Second, the project will promote genre awareness in writing. The findings will be used to produce interactive materials for teachers and schools, which will demonstrate how teachers can enhance their students' genre-related awareness in English writing. The students will be enabled to write scientific reports on real research, making creative and effective use of the appropriate conventions regarding scientific language, organisation, and academic referencing.

## **6. Conceptual framework**

### *The relationship between science and the language of science (justifications for a focus on genre-specific language)*

According to sociocultural theory, the role of the science teacher is key to learning in science (Mortimer & Scott, 2003). This teaching role can be explained by Vygotsky's (1978) concept of learning, known as the "zone of proximal development" (ZPD). This zone is any area in which learning can only occur when a learner is assisted by a teacher, or by a peer who has better-developed skills. The study of science involves a ZPD, as scientific learning only takes place when the meaning of scientific information is constructed through social practices (i.e., a teacher's activities) in the science classroom, and these practices depend on the role of the science teacher. Language is the channel between a student who is learning to communicate regarding science and a teacher who mediates scientific thinking through a ZPD (Rollnick, 2000). Context-appropriate language is the bridge between the students (who are learning to speak the language of science) and teacher (who is mediating scientific thinking within the ZPD). Language serves as a mediating tool for both the teacher and students to interact and co-construct science-related experiences (Halliday & Matthiessen, 2006). This vital interaction suggests the important role of language in learning science. Genre-specific language is a mediator for translating scientific thought into speech or written expression. It is therefore necessary to explore how science teachers can find more effective means of explaining science concepts to students through language.

The language of science is dense, abstract, and technical (Fang, 2005). Researchers who have analysed the language used in science classrooms have suggested that the language of science has a distinctive register that differs from daily language (Halliday & Martin, 1993). This difference in register creates a challenge for ESL learners, who are expected to learn both the L2 and the language of science, thereby operating in two language systems at the same time. We do not yet clearly know what forms of language the students need to learn, or what forms of language the teachers need to know to best help their students acquire scientific knowledge through the L2. In general, we can assume that teaching science through the L2 requires that students must learn the necessary L2 language skills in the specific science discipline before they will be able to communicate and express scientific ideas through the language of



science in their L2. Only by closely studying the language of science and the structure of scientific texts through a genre-based approach can teachers effectively enable students to learn the scientific voice. Teachers need to gradually develop their students' competence in discussing science by helping them to recognise the registers, genres, and lexico-grammatical features associated with each field of science (Rollnick, 2000).

#### Previous research analysing genres of discourse

Analysis of genres has been a popular starting point for the study of scientific texts and for lexico-grammatical analysis (Christie & Derewianka, 2008; Martin & Veel, 1998; Martin & Rose, 2008; Unsworth, 2000). In classroom discourse, genres are constituted by the semantic components of the language, and classes for learning languages can focus directly on this aspect of discourse (Martin & Rose, 2008). Genre-based pedagogy offers one possible means to improve the learner's understanding of register, and thus subsequently increasing his or her competence in genre-specific discourse (Rollnick, 2000). The discourse competence of a learner significantly affects his or her ability to read scientific texts, and to effectively write them for readers who have scientific expertise (Halliday & Martin, 1993; Martin & Veel, 1998; Schleppegrell, 2004).

To better understand the linguistic challenges faced by learners in content-subject classrooms, a number of recent studies have adopted a functional approach to examining different school-related genres. These studies have analysed texts and student writings collected from content-subject classrooms, according to their identifiable genres and communicative purposes (e.g. studies of discourses on history (Coffin, 2006), mathematics (O'Halloran, 2005), and geography (Wignell, Martin & Eggins, 1993)). In these analyses of the complexity of language used in science, three strands of activity have been identified: (1) analysing science discourse, or science talk (Lemke, 1990), analysing writing in science (Halliday & Martin, 1993), and analysing reading in science (Martin & Veel, 1998); (2) exploring how scientific meaning is represented in different institutional contexts (Halliday & Matthiessen, 2006; Martin & Veel, 1998); (3) examining how scientific knowledge is represented in non-verbal displays (Guo, 2004; J. Lenke, 1998; Unsworth, 2009); and (4) analysing how the school science genre and its associated language feature in teaching and learning school science (Christie & Derewianka, 2008; Martin & Rose, 2008; Rose & Martin, 2012). For example, the major written genres in school science have generally been divided into story- and fact-based texts. These categories have been subdivided into four commonly used ways of constructing science: enabling, explaining, documenting, and persuading. The combinations of these genres give us a total of 12 science genres (Martin & Veel, 1998). These genres have been identified as texts focused on (1) procedure (with two subgenres including procedure and procedural recount); (2) explanation (with six sub-genres including sequential, causal, theoretical, factorial, consequential, and exploration); and (3) report (with four subgenres including descriptive, taxonomic, exposition, and discussion).

In moving from secondary school science to science in a professional setting (e.g., science in a university or a workplace), Veel (1998) further schematised science genres according to their situated social or institutional functions. For example, procedures enable scientific observations or experiments. Sequential explanations give presentations of observable sequences in science. Christie and Derewianka (2008) drew on the science genre model mentioned above when examining their corpus of science writings in Australia and proposed four additional school science genres, namely procedural recounts, demonstration genres, research articles, and field studies. Martin and Rose, (2008) identified more varieties of science genres beyond the school setting, which can apply in professional or "adult" science. The four most common genres that scientists have used to generalise findings or explain processes are report, explanation, procedure, and procedural recount.

These studies have identified, analysed, and described the kinds of texts that science students commonly read in science classrooms, along with the language patterns or registers used in science texts. In the European context, genre-based pedagogy has been introduced into CLIL (Content-language integrated learning) classrooms in an attempt to address the academic literacy challenges students face when they engage with different texts in their various subjects. Such pedagogy has provided ways to improve the students' academic English competence in producing subject-specific genres of writing, with

appropriate choices of vocabulary, grammar, and language style (Linares, Morton, & Whittaker, 2012; Lorenzo, 2013).

In Hong Kong, Shum (2003) identified the structures of various linguistic genres used in secondary school examination questions. His assessment showed the language features and requirements that both Chinese-medium and English-medium students were expected to master in performing public examinations. Shum analysed model essays from public examination papers in history, economics, physics, chemistry, biology, and geography, to determine how knowledge was construed through the Chinese language in these different disciplines. According to his findings, the school science texts in Hong Kong showed different features in their constructions of scientific knowledge than the texts observed in L1 classrooms. These types of features were (1) observation of a phenomenon, (2) exploration of the reason for the phenomenon, (3) suggesting a hypothesis, (4) evaluating the hypothesis through experiments, and (5) forming a conclusion.

After the new senior secondary curriculum was implemented in 2010, Pun (2011) conducted a detailed genre analysis of Hong Kong chemistry textbooks to assess the language development of ESL students in science classrooms and to understand the types of science genres science students were expected to read. His findings suggest that ESL science learners are expected to handle a number of explanations and procedures at the beginning, and to move towards highly abstract and technical texts, such as classifying and describing reports or giving theoretical explanations (Matthiessen & Pun, 2017).

#### Studies of genre-based pedagogy

This strand of work has been strongly influenced by systemic functional linguistics (SFL). According to the SFL approach to pedagogy, meaning is carried by language, which is used in particular situations or contexts in ways that are associated with its functions in those contexts (Halliday, 1993). The early work in genre-based pedagogy was grounded in the literacy projects conducted by SFL researchers (Painter, 1984). These studies examined the language-learning process in children's early years. Later, more substantial work was done on developing a teaching-and-learning cycle for writing in the different school genres applied in the Australian government's disadvantaged school programmes (Rothery, 1989; Martin & Rose, 2008). These early studies informed teaching practices and pedagogical theories regarding children's language development, and particularly the genre-based pedagogy used in teaching school genres (White, Mammone, & Caldwell, 2015).

The genre-based approach to pedagogy focuses on a particular set of school genres. The teachers work with their students through a sequence of five steps in the teaching-and-learning cycle (c.f., Rose & Martin 2012). These steps are (1) developing the students' basic understanding of their subject and of the social context in which the genre operates; (2) carefully analysing sample texts as a way of developing the students' comprehension of the communicative purposes that the texts serve, and understanding the language choices used to serve those purposes; (3) constructing texts jointly, with the teachers acting as disciplined language guides; (4) constructing texts individually, with each student demonstrating his or her capability; and (5) reviewing the students' texts to provide input for subsequent teaching and learning cycles.

To conclude, this proposed project will build on previous work to develop effective English writing activities that can be used by teachers and schools for more effectively promoting their students' abilities, interests, and motivations in writing science-related English.

#### **7. Implementation Plan with timeline**

This project will involve approximately 600 students in secondary grades 7–9 from the 9 secondary schools. Each school will provide approximately 60-100 students. The nine secondary schools have agreed to participate in this project (see the attached letters of support). The project will start from 1 April 2019 and will end by 31 March 2022 (36 months). In this period, we plan to accomplish the following:

Phases	Goals
1. Material preparation and production	Select and annotate scientific texts Develop genre-based teaching materials
2. Implementation planning	Work with science teachers on the best ways to implement the programme in their schools Provide training of genre-based writing techniques and use the developed teaching materials for delivering writing workshops
3. Pre-test	Pre-test the students' general English language abilities, writing skills (in science), motivations for learning English, and awareness of English
4. Intervention	12-week writing workshop, 2 hours per week for 3 months (intervention vs control) Intervention group: genre-based pedagogy Control group: normal English teaching
5. Post-test	Post-test on students' general language abilities, writing skills in science, motivations for learning English, and awareness of English. Interviews with science and English teachers concerning their observations on students' improvements in English and on the writing programme.
6. Analysis	Analysis of the data using a statistical package, and determination of preliminary conclusions
7. Development of teaching manual	Creation of a teaching manual and a website for use by all secondary schools in Hong Kong.

#### 8. Teachers' and Principals' Involvement in the project

The participating school principals and teachers will be a site-coordinator, in assisting the organisation of the workshops, recruiting students, and arranging the classrooms at their schools. They will also take an active role in developing the teaching and learning materials and provide comments to the research team at different stages of the project. All the teaching and development of the teaching and learning materials will be led by PI, Co-I and the research team: the language consultant, three recruited part-time teachers, and in consultation with the participating school teachers. A series of professional workshops will be organised to promote genre-based scientific writing as a teaching technique that is directly useful to the participated teachers. All the participated school principals and teachers will comment and provide advice to the development of the teaching materials, manual, and website.

#### 9. Budget

##### Staff cost, equipment, services, works, general expenses, contingencies

The total cost of this project will be \$1,022,700, including \$86,094 for staff costs, \$22,800 for equipment, \$68,000 for service, \$0 for works, \$67,072 for general expenses, and \$4,734 for contingencies.

No.	items	Year 1	Year 2	Sub-total	Total (HKD\$)
<b>A) Staff cost</b>					
A1	Language consultant x 1 \$740hr x 10 hrs x 24months	\$88,800	\$88,800	\$177,600	\$860,094
A2	Part-Time teachers x 3 (\$1594 x 12 + \$1594 x 5) x3	\$81,294	/	\$ 81,294	
A3	Research Assistant x 1 \$16,000/month x 1.05 x 24 months	\$201,600	\$201,600	\$403,200	
A4	Student helpers x 3 \$55/hr x 50hr x 24 months x 3	\$99,600	\$99,600	\$198,000	

<b>B) Equipment</b>					
B1	Notebook computers \$ 5,000x3	\$15,000	/	\$15,000	\$22,800
B2	External hard disk \$1000 x 3	\$3,000	/	\$3,000	
B3	Video camera \$4000 x1	\$ 4,000	/	\$ 4,000	
B4	Audio camera \$800 x1	\$ 800	/	\$ 800	
<b>C) Service</b>					
C1	computer readable scoring sheets and standardized tests for all students in pre-test and post-test \$15 x 600 copies x2	\$9,000	\$9,000	\$18,000	\$68,000
C2	Graphic design for training materials, manuals, website	\$50,000	/	\$50,000	
<b>D) General expenses</b>					
D1	Reference materials for developing materials and manuals	\$5,000	\$5,000	\$10,000	\$67,072
D2	Postage Manuals \$10x 400 copies Other: \$500 x 2yrs	\$4,500	\$500	\$5,000	
D3	Stationery and miscellaneous items	\$2,000	\$2,072	\$4,072	
D4	Transportation	\$5000	\$5000	\$10,000	
D5	Audit fee			\$15,000	
D6	Teaching manuals for teachers \$100x 50 copies			\$5,000	
D7	Learning materials for students \$10x 600 copies			\$6,000	
D8	Training manuals for all HK schools \$30 x 400 copies			\$12,000	
<b>E) Contingency</b>					
E1	Contingency				\$4,734
				<b>Total</b>	<b>\$1,022,700</b>

### Justifications for budget items

#### A) Staff cost:

**A1) Language consultant (x1)** is needed for this project to be the Chief Trainer (10hrs/week for 24 months) to assist PI to develop teaching materials, training manuals, students' textbooks, and be a trainer to facilitate the training of the teachers to deliver the workshop for the participating schools and teachers. He or she will run regular workshops with the participating schools, teachers other than those in delivering the interventions, organise the professional development, give feedback to the schools and provide support to the team for programme evaluation. The candidate should have nearly native speaker level of English with a PhD degree plus at least 1 year of providing professional development for language teachers in Hong Kong is required.

**A2) Part-time English teachers (x3)** are needed to deliver the workshop (each teacher: 2hrs@lesson x 12 weeks= 72 hours x 3 schools) for the nine participating schools, do markings of all the students'

writing productions and involve at the pre-and post-programme evaluations. These teachers should have good English proficiency and some school-based teaching experiences.

**A3) Research assistant (x1):** The research assistant (RA, full-time 24 months) will be on site to assist PI for organising the project, arranging meetings between research team and participating schools, teachers and students. He or she will assist with ethics applications; develop fieldwork documentation, including consent forms, information sheets and project information posters; co-ordinate and maintain records of workshops and meetings; maintain contact via email with the university research office and the secretariat of QEF, and assist in preparing progress reports/updates. He/she will work with the PI for data collection for programme evaluation and later assist in disseminating the finding to the schools and QEF office.

**A4) Student helpers (x3):** The student helpers (50hrs/month x 24 months) will assist with questionnaire distribution, assist with PI to conduct semi-structured interviews with the participated teachers and students. They will also spend many hours on transcription of the recorded interview files and on translation of the data from Cantonese to English for further data analysis. They should have an English major and high standard of English writing and speaking abilities.

#### **B) Equipment**

Three notebook computers will be needed for the teachers to deliver the courses, and for the research assistants to collect data outside of the university. Three portable external hard disks for data collection are required because we will be dealing with a very large corpus, that is 600 students and their teachers. All the teaching modules (2hrs@lessons x 12 weeks x 3 groups=36 lessons x 9 schools) will be video (+/-) and audio recorded upon the consent of the participants for the purpose of programme evaluation. Therefore, at least one set of video recorder and audio-recorder will be needed throughout the entire project.

#### **C) Service**

The cost of graphic design for computer-readable scoring sheets, training materials, teaching manuals, student learning material and a project website will be needed. A contract of service for professional graphic design company is needed to ensure the quality to achieve the educational purposes.

**D) Costs for reference materials, postage and stationary:** Reference books, textbooks and downloading of academic journals related to the proposed project will be needed to develop teaching materials, training manuals, and write research reports and help with research dissemination. Postage fee will be required to post the teaching manual to the participating schools and other schools (upon request) who are interested in this project. For other schools, a website link with a summary of the project will be mailed to all schools in Hong Kong. Other miscellaneous items such as stationary for the team and teachers will be required for delivering the teaching modules. We require the transportation cost for staff to schools. Due to the amount of equipment we will need to carry to the research sites, we will need to travel there by public transportation and occasionally by taxi from nearest subway stations. In addition, as required by the QEF office, project with grant exceeding \$100,000 is required to include the audit fee.

**Printing and photocopying costs:** These will include publicity for the project, production of information brochures, A3 posters, leaflets and flyers that will inform schools around Hong Kong, so schools and the public have access to our work. In addition, 100 copies of teaching manuals for teachers in the participating schools, and 600 copies of learning materials for the participating students will be produced. The production of teaching manuals and learning materials would be published in bite-size information guides to be sent to other schools (around 400 copies). The guide would share the key findings of the study as well as annotated writing skills for teaching scientific texts.

### **10. Expected project outcomes**

After the 12-week writing intervention, the students will be measured by post-tests based on the same measures used in the pre-test (e.g. students' general English language abilities, writing skills (in science), motivations for learning English, and awareness of English). Any improvements in the students' writing performance between the pre- and post-tests will be compared across the three groups, as a means for measuring the effectiveness of the programme. The project will have several goals and predicted outcomes. First, we expect that all of the participating students will show some improvements, given their learning in each classroom environment and their natural development of knowledge over time. Second, we expect that the "typical" writing group will show greater improvements than the "control" group, as the teachers and students in the control group will engage in regular writing activities with new materials during the period. Third, the two genre-based pedagogy groups (those taking the normal genre-based instruction and those taking genre-based instruction with interactive activities) will improve their English writing skills and genre awareness more quickly than the students in the control and typical writing groups, as the genre-based approaches encourage more interaction between the teachers and students. Fourth, the group using genre-based pedagogy with interactive activities will show the greatest progress in genre awareness.

It is expected that students in the genre-based pedagogy groups, indicated by their pre and post-test results, will be more successful in their science-related language learning, and that the pedagogical methods will enable teachers to perform the following specific tasks:

- i. Providing sufficient input to integrate both science and language instruction
- ii. Providing opportunities for ESL students to test their language skills in writing scientific texts
- iii. Unpacking the language of science to make it more accessible to ESL students using genre analysis
- iv. Drawing on the ESL students' daily experiences and L1 resources (vocabulary, metaphor) to guide them in moving from everyday language to scientific language
- v. Forning new connections of meaning and purpose (de Oliveira & Schleppegrell, 2015: 22-23), which will involve
- vi. setting goals and motivating students to learn and engage with texts
- vii. exploring the genre-specific language of texts and using metalanguage to place linguistic forms into meaningful contexts
- viii. maintaining a focus on the grammar to be learned while continuing to draw the students' attention to language as they encounter it
- ix. engaging the students in using the language in meaningful ways that call for context-specific uses of grammar

## **11. Project Evaluation**

This project will use a rigorous experimental approach with standardised tests to evaluate the effectiveness of genre-based pedagogy for improving the student participants' abilities to do science-related writing in English. The participants' improvements in writing ability will be measured against the outcomes of traditional instruction methods, and against the baseline of results from the methods that the students already use in their classrooms. To obtain the baseline, all of the participating students will be tested individually on their English abilities, in terms of their general English language abilities, skills in science-related writing, motivations for learning English, and overall awareness of English. The teachers and their students will then engage in a 12-week intervention.

The students in both the control and experiential groups will be asked to independently write scientific texts in a given genre before they have received any further instruction. These texts will be graded by the teachers using both a grading checklist and a holistic grading standard. The same teachers will grade the students' final texts at the end of the course in the same way. The teachers' grading will be checked and moderated by a panel of experienced teachers, language experts, and professors.

After the end of the programme, the students will be tested individually on the same tasks. These post-tests will help us to understand the extent to which each group of students has improved in terms of their performance in written English. The post-tests will also indicate the effectiveness of interactive genre-based pedagogy for promoting English learning. Our performance indicators will be the actual

test scores. The benchmarks will be the results from genre-based pedagogy, and the results from genre-based pedagogy with interactive activities. These benchmarks will show how effective each of these approaches are for enhancing the students' English science-related writing skills, motivations for learning English, and overall English awareness. In particular, we expect that the interactive mode of genre-based pedagogy will promote greater improvements in English abilities, writing interests, and awareness than will be observed in the control group members, who will learn science without the help of genre-based pedagogy.

### 12. Sustainability of Project outcomes

This project will facilitate English learning in science disciplines among secondary school English-medium students. In particular, the project will help in training these students to write on scientific topics in an interactive, interesting, motivated way. The approach we test will be a genre-based pedagogy method for enabling a more interactive English learning environment in the local classroom, especially for students with limited English ability. This innovative approach can increase the students' metalinguistic awareness in terms of understanding how scientific texts operate in communicating genre-specific information, and how the students can apply this linguistic understanding in a structured way to write effective scientific texts.

It is expected that the participating students' English writing skills will be enhanced, particularly in terms of their genre awareness and ability to use cohesive devices, achieve transitivity, and understand the lexico-grammatical features (e.g. nominalisation) associated with different structures in a scientific text (such as the linguistic expressions used for presenting scientific voices and the correct applications of scientific vocabulary). The students' interests in learning both English and science will be enhanced through this innovative and interactive genre-based pedagogy method.

### 13. Dissemination/promotion of Project outcomes

In addition to the projected immediate benefits, this project will prove useful for all local educators and parents of Hong Kong secondary school students. The project will produce materials promoting genre-based writing pedagogy, provide better techniques for writing scientific texts, and generate suggestions or hints on how best to create interactive environments that stimulate students' effective skills in scientific writing. At least 1,000 copies of the teaching manuals will be produced and sent to secondary schools in Hong Kong. A website will be made available to all schools and the general public. A series of professional workshops will be organised to promote genre-based scientific writing as a teaching technique that is directly useful to teachers. All secondary schools in Hong Kong will benefit from the teaching materials, manual, and website developed through this project.

These resources will offer comprehensive information about the development of students' scientific writing and language skills and about methods local schools can apply to increase their students' abilities to write subgenre-appropriate scientific texts. Finally, the findings of this project will be applied to produce two or three journal publications on the topics of teaching English writing skills and developing genre-awareness among Hong Kong secondary school students.

The copyrights of the deliverables/materials developed should be vested with the QEF.

### 14. Asset Usage Plan

Item/Description	No. of Units	Total Cost	Proposed Plan for Deploying
Notebook Computer	3	\$15,000	Toward the end of this project, the notebook Computers, external hard disks, and video camera will remain in the department at university for professional development workshops and future QEF projects.
External hard disk	3	\$3,000	
Video camera	1	\$4,000	

## 15. Report Submission Schedule

Project Management		Financial Management	
Type of Report and covering period	Report due day	Type of Report and covering period	Report due day
Progress Report 01/04/2019 – 30/9/2019	31/10/2019	Interim Financial Report 01/04/2019 – 30/9/2019	31/10/2019
Progress Report 01/10/2019 – 31/03/2020	30/04/2020	Interim Financial Report 01/10/2019 – 31/03/2020	30/04/2020
Progress Report 01/04/2020 – 30/9/2020	31/10/2020	Interim Financial Report 01/04/2020 – 30/9/2020	31/10/2020
Progress Report 01/10/2020 – 31/03/2021	30/04/2021	Interim Financial Report 01/10/2020 – 31/03/2021	30/04/2021
Progress Report 01/04/2021 – 30/9/2021	31/10/2021	Interim Financial Report 01/04/2021 – 30/9/2021	31/10/2021
Final Report 01/04/2019 – 31/03/2022	30/06/2022	Final Financial Report 01/10/2021 – 31/03/2022	30/06/2022

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