INTERDEPARTMENTAL COLLABORATION: WORKING TOWARDS IMPROVED
LITERACY INSTRUCTION IN THE CONTENT AREAS

By

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B.Ed./B.A. The University of Lethbridge, 2002

A GRADUATING PAPER SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF EDUCATION

in

THE FACULTY OF GRADUATE STUDIES

Department of Language and Literacy Education

We accept this major paper as conforming
to the required standard

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November 2010

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Abstract

The purpose of my research is to explore whether a collaborative working relationship between an English teacher and content area teachers can improve literacy instruction in the content area classroom. This focus emerged from my observation that students, who demonstrated strong literacy skills in my English classroom did not, according to my content area colleagues, demonstrate these same skills in other subject areas. At the time of the study, staff at my school were discussing the possibility of incorporating scheduled collaborative time for teachers to work together to improve teaching practice and I began to wonder if a collaboration between content area teachers and an English teacher might be an effective method of improving student use of literacy strategies in their content area classes. The literature regarding both content area literacy and collaboration as a tool for affecting teaching practice indicates that this would be an effective method to address this problem. This qualitative study explores the nature of a collaboration involving three biology teachers and me in our attempt to improve content area literacy instruction. Data collected include questionnaire responses, field notes, email communications and artifacts created during the collaborative process. Data were coded and analyzed for major themes based on the literature regarding both content area literacy and collaboration. Findings of this study indicate that a collaborative working relationship between an English teacher and content area teachers can have a positive impact on content area literacy instruction and can be beneficial to all teachers involved.
# TABLE OF CONTENTS

ABSTRACT ........................................................................................................................................... ii

TABLE OF CONTENTS................................................................................................................................ iii

ACKNOWLEDGEMENTS ...................................................................................................................... v

Collaborative Inspiration .................................................................................................................. 1
Background and Rationale .................................................................................................................. 2

REVIEW OF RELATED RESEARCH ............................................................................................... 3
  Content Area Literacy ...................................................................................................................... 3
  Collaboration .................................................................................................................................... 6

METHODS ........................................................................................................................................... 12
  Research Design ............................................................................................................................. 12
  Research Site and Context ................................................................................................................ 12
  Participants ..................................................................................................................................... 13
  Procedures ...................................................................................................................................... 15
  Data Sources .................................................................................................................................. 15
  Data Analysis ................................................................................................................................ 17

FINDINGS ............................................................................................................................................ 18
  Literacy Concerns ............................................................................................................................ 19
  Changes to Literacy Instruction ........................................................................................................ 20
  Motivation for Participation ............................................................................................................... 21
  Kinds of Support Needed during Collaboration .............................................................................. 21
  Outcomes of Collaboration ............................................................................................................... 22

DISCUSSION ...................................................................................................................................... 23
  Summary ........................................................................................................................................ 23
  Significance ..................................................................................................................................... 23
  Limitations ...................................................................................................................................... 28
  Suggestions for Further Research .................................................................................................... 29

Collaborative Futures? ....................................................................................................................... 30

REFERENCES ..................................................................................................................................... 31

APPENDIXES ..................................................................................................................................... 33
  Appendix A: Initial Questionnaire .................................................................................................... 33
Appendix B: Collaboratively Developed Lesson Plan..........................35
Appendix C: Final Questionnaire..........................................................40
Appendix D: Teaching Resource for The Log from the Sea of Cortez........42
Acknowledgements

Thank you to my three biology teaching colleagues who so generously gave of their time and of themselves to help me conduct this research. Working with you proved to me how valuable and fulfilling cross-curricular collaboration can be. Thank you to my English teaching colleagues for demonstrating every day the immense power of open conversation and collaboration. Our collegial and supportive professional relationships were the inspiration for my research. Thank you to my graduate advisor, Dr. Theresa Rogers, and to all of my professors at the University of British Columbia for your expertise and guidance during my educational journey. My experiences throughout this program have impacted me deeply as an educator and I am a better teacher as a result of being your student. Thank you to my cohort colleagues, who for the past two and a half years, have traveled this path with me. Our conversations about education are some of the richest and professionally significant of my teaching career. Thank you to my entire support network for listening to me talk endlessly about educational research methods, early childhood literacy development, adolescent literacy concerns, genre-based approaches to writing, content area literacy, collaborative processes and many other topics which I am sure you never thought you would discuss. I could not have made it through this process without you cheering me on, encouraging me when I needed it, and celebrating every academic victory with me. Thank you to my husband, Richard. I would not have taken even the first step on this journey without you insisting that I take a risk and go for it. And I never would have managed to finish without your support. Finally, thank you to my mom. You were my first teacher and from you I learned not only what good teaching looks, sounds and feels like, but also how fulfilling it can be. You instilled in me a deep appreciation for education as both a teacher and as a student and your support made it possible for me to pursue my educational goals. I dedicate this paper to you.
Sitting at my desk at the end of a long day of teaching, I stare at the blank space that makes up tomorrow's day plan; I have no idea what I should teach the next day. I know that I will be teaching my grade 11s. I know that we are working on the concept of the inherent nature of humankind and that I want to connect two stories we recently read to this theme. I know that I need to work with these students on finding evidence to support claims they wish to make about the thematic messages of literature. But what I don't know is HOW to go about doing this. I am tired and I am out of ideas. I head next door to another teacher's classroom and flop down in one of the student desks and ask if she has a few minutes to talk. Does she have any ideas about what I could work on with my students? She hands me a sheet of paper outlining an assignment she has recently completed with one of her classes and begins to explain how she uses this particular activity. I begin to formulate a lesson in my head; if I just adapt this one section of the assignment, this will work well with my grade 11 English classes. Soon another teacher pops her head in and asks what we are talking about. We tell her and she gets excited, running back to her classroom to pull a sample of a final product from a similar assignment. Maybe I could use this to introduce the lesson? Before I know it, I am revitalized and excited about tomorrow's lesson. Not only do I have a plan for tomorrow; I also have a clear vision of the direction I want to take my grade 11 class for the next several weeks. This brief meeting of the minds has inspired me...
Background and Rationale

Reading is an essential part of learning. Textbooks and other written forms of information are the touchstones of teachers and are at the core of most courses. Although more and more teachers are turning away from the tradition of “read the chapter and answer the questions,” text is still and will continue to be a major part of how we teach and, because of this, “strategic reading is very important in the learning process,” (Forget, 2004, p. 4) and is essential to effective and lasting learning in all subject areas.

In my secondary English classroom, my students generally look like what educators generically describe as “good readers”: they predict, they ask questions and make connections to the text, they highlight without covering the page in a sea of yellow, they can recognize main ideas and can identify the supporting details for those main ideas, they use dictionaries to look up unfamiliar words. My students are all good readers when I am there guiding them.

My students are good readers in my classroom because they have been taught to be good readers in my classroom. At the beginning of the school year I model reading skills. I exclaim over an unknown word and send a student to the dictionary to look it up for me. I think aloud, pondering my own questions and connections to text. I show them what it looks like to be a good reader. And then we practice. “We never just read,” a grade eight student once mumbled to me, exasperated. I asked what he meant and he told me that we are always thinking and reading. “We have to do all this work while we read,” he said and I thought, “Exactly!” That is precisely what I want my students to be doing: thinking while they read.

My goal in all of this is, of course, for the students to start to use and apply all these skills while reading without my guidance. Eventually I want them to automatically reach for a dictionary, to be aware of their own thought processes without me there reminding them that staring blankly at a page running words through one’s head is not really reading. And I have
found some success in this endeavor. By the end of the year, most of my English students are reading the questions before the text itself, preparing themselves to look for the answers before they ever read. They are using titles and text features, hunting for clues that will enhance their understanding. They are proficient at these skills, proving their ability to me with their annotated and highlighted exams. Their test booklets, returned to me covered in their scrawl, are the mark of my success.

Yet despite this apparent success, I am repeatedly baffled by the fact that these students, according to my content area teaching colleagues, do not demonstrate these skills in their studies of science, math, social studies or any of the other subject areas. So why is it that these “good readers” whom I teach every year do not seem to be the same students who are present in other classrooms? Why are students not transferring the array of reading skills they have learned in my English classroom to other subject areas? How can I, a secondary English teacher, help my students to transfer these skills and become truly strategic and thinking readers? These queries lead me to my research question: can a collaborative working relationship between content area teachers and an English teacher improve literacy instruction in the content area classroom?

The literature in both areas of concern, improving content area literacy and the effectiveness of collaborative relationships, would indicate that yes, indeed, a collaborative working relationship between a content area teacher and an English teacher could result in improved literacy instruction in the content area.

Review of Related Research

Content Area Literacy

The ideal and the reality. There seems to be consensus in the realm of research related to reading in the content areas that “the English teachers cannot assume responsibility for the overall literacy progress of adolescents and that every teacher has a role to play in the overall
development of students' literacy” (Fisher & Ivey, 2005, p.6). The premise of most of the research in this area is that the ideal situation for our students to fully realize their potential and to get the most out of content area instruction is when all teachers are reading teachers. The current research, however, does not focus on whether the concept of “every teacher is a reading teacher” (Fisher & Ivey, 2005, p.3) is valid or not. In fact, it seems to be widely accepted that research has already shown the effectiveness of this model and most current research concentrates on how teachers can implement this ideal into the education system.

The picture of this ideal is clear: a school where reading permeates all subject areas and literacy strategies are taught and implemented by every teacher so that the skills learned in one subject area are reinforced in another. Despite the clarity of this goal, the other theme which seems to be prevalent in the research is that this ideal is not yet a reality and specifically that “content area instruction, whether in upper elementary grades or secondary schools, tends to be devoid of literacy instruction” (Alvermann & Moore, 1991; Stewart & O’Brien, 1989, as cited in Draper, Smith, Hall, & Siebert, 2005, p.12). As Donna Ogle, a past president of the International Reading Association stated, “we’re still struggling to make reading across the curriculum a reality, particularly at the middle and high school levels” (D’Arcangelo, 2002, p.12) and the focus of much of the content area literacy research is on how educators can achieve this goal.

Much of the research logically points to the training and education of preservice teachers and the use of professional development to help inservice teachers (Draper, Smith, Hall, & Siebert, 2005; Fisher & Ivey, 2005; Ivey, 2002) as the best way to encourage content area teachers to integrate reading and reading instruction into their lessons. The focus on these two approaches as the method of achieving the goal of literacy across the content areas makes this a long term endeavor that depends greatly on the “buy in” of content area teachers.
In a school where teachers are willing and enthusiastic about implementing reading across the curriculum, there can be great success. This was evidenced at Herbet Hoover High School in San Diego where the staff and administration “identified seven instructional strategies that would permeate the school at every level” (Fisher, Frey, & Williams, 2002, p.70). When they implemented a school wide reading regime based on these strategies, they found improvement in student achievement based on performance on several standardized tests as well as qualitative teacher observation.

Unfortunately, the reality in our education system is that this is not the case in every school. Many content area teachers “think of themselves as content experts” (D'Arcangelo, 2002, p.13) and “say that they don’t have time to teach both the content and reading strategies” (D'Arcangelo, 2002, p.14). Fisher and Ivey’s (2005) description of teachers’ eyes rolling and arms crossing during a math department meeting, when the topic of literacy in math is raised, demonstrates that many content area teachers are frustrated by the constant emphasis placed on reading and “feel discredited, like [their] subject doesn’t matter as much” (Fisher & Ivey, 2005, p.4). This realistic description stands in stark contrast to the ideal situation where all teachers are working together in reading across the content areas.

**The next question.** The dichotomy between what research shows to be best teaching practice and the reality of what is going on in our classrooms leaves educators who are concerned about reading across the content areas with a dilemma: if the impetus needed to cause a shift towards everyone teaching reading strategies is the result of training and education (which may take years) and not all content area teachers are willing to participate in the change, what can we do right now to help students become better readers across the content areas?

The research suggests that teaching reading in isolation and separate from content is not effective at improving content area literacy (Alvermann, 2001; Draper et al., 2005; Ivey, 2002;
D'Arcangelo, 2002) and that “to be effective, [reading] instruction must be embedded in the regular curriculum” (Alvermann, 2001, p.2). Thus it would seem that “literacy educators might consider collaborating with content area educators to create instruction that supports the acquisition of literacy processes and remain true to content learning simultaneously” (Draper et al., 2005, p.17). Is it possible that a literacy educator, such as a secondary English teacher, could collaborate with a group of specific content area teachers to improve literacy in the content areas?

Collaboration

Assumptions of goodness. Much like it is widely recognized that students benefit from content area literacy instruction, there is a general assumption in the literature about collaboration that there exists a fundamental goodness in this endeavor. Little, if any dissent, is articulated to the notion that a culture of collaboration is superior to a culture of isolation (Hargreaves & Dawe, 1990; Dufour, 2004; Johnson, 2003). In “the lonely business of teaching” (Joyce & Showers, 1982, p. 6) collaboration among educators is regarded as a successful way to promote effective teaching and learning. It seems to be generally accepted that, in teaching, two heads really are better than one and that “collaborative cultures foster teacher and curriculum development” (Hargreaves & Dawe, 1990, p. 227). Several studies of different forms of collaboration have indeed shown this to be true (Thibodeau, 2008; Corrie, 1995; Johnson, 2003). But like any “other well-intentioned school reform efforts” (Johnson, 2003, p. 6) it is necessary to examine the roots, intentions, effects and future of collaboration as a means for improving practice. Simply assuming that collaboration, in any form, is good, and should therefore be promoted is a careless mistake that can result in unproductive “pseudo-collaboration” (Corrie, 1995, p. 89) and ineffectual “contrived collegiality” (Hargreaves & Dawe, p. 227). A richer
understanding of the nature of collaboration can be achieved through an examination of the origins of formal teacher collaboration and how the concept has evolved over time.

**Origins: teachers coaching teachers.** The initial work done in the 1980s on teacher collaboration was Joyce and Showers’ (1982) model of coaching. “Coaching is essentially a method of transferring skill and expertise from more experienced and knowledgeable practitioners of such skill to less experienced ones” (Hargreaves & Dawe, 1990, p. 230) and in this model “teachers should coach each other” (Showers, 1985, p. 45) with all members of a team acting as both coach and student. Like the term coaching implies, this initial model of collaboration was based on the concept of athletic training. Proponents of this model embraced the metaphor of teacher collaboration and participation in “coaching teams” (Joyce & Showers, 1982, p. 6) as being similar to athletes learning and practicing a skill before transferring it to a game situation.

There is a clearly defined “process of coaching” (Showers, 1985, p. 44) which must be followed in order to achieve success. It involves four stages: a study of the theoretical framework behind the teaching method being examined, observations of experts using the method, rehearsal and feedback about one’s use of the method in practice situations and support as the teacher uses the new method in his or her classroom. These stages need not occur specifically in this sequence, but all are necessary for effective coaching conditions (Joyce & Showers, 1982). It is also necessary that coaching not be “a simple additive that can be tacked on to the school with a ‘business as usual’ attitude, but rather [that it] represents a change in the conduct of business” (Showers, 1985, p. 48). When implemented correctly, the coaching model of collaboration has been effective in the “facilitation of transfer of training and development of norms of collegiality and experimentation” (p. 45).
Evolution: criticism and controversy. Although the concept of peer coaching has been embraced by many educators and must be acknowledged as "a significant intervention in the professional development of teachers and in associated processes of implementing curriculum reform and introducing new approaches to instruction" (Hargreaves & Dawe, 1990, p. 231), it has not escaped criticism and controversy. It has been criticized for problems of time, scope, balance, ideological distortion and resistance (Hargreaves & Dawe, 1990). The critics of peer coaching do not dismiss it altogether and do in fact "very much support teachers improving their skills by working closely and practically with each other" (p. 239). Additionally, the critics express concern that an understanding of collaboration not be limited to the rigid model of peer coaching and furthermore, make calls for methods of collaboration where the process is genuinely voluntary, where teachers have high control over determining and reflecting about which skills are to be coached, and where critical reflecting about the content and context of those skills is not only permitted but actively encouraged. (p. 239)

Although coaching is regarded as an important first step toward effective and meaningful collaboration, critics see that there is the potential to do more.

Despite the overwhelming assumptions of goodness in regards to collaboration, even the general concept of teachers working together to improve their practice has not avoided controversy (Johnson, 2003; Corrie 1995). Most notable among the concerns about collaboration is a failure to concretely define and understand what exactly is meant by the term collaboration, leaving educators and researchers with the feeling that "it may be easier to talk about the notion as a philosophical ideal than to achieve it in practice" (Corrie, 1995, p. 89). This failure is rooted in the fact that educators engaged in collaborative efforts have disparate understandings of what collaboration means and entails. This dissonance is revealed in Corrie’s (1995) study of six
schools in which "there was little agreement within the schools concerning the extent to which
the collaborative process occurred" (p. 93). As work in the area of collaboration moves
forward, it is important for researchers and educators to engage in further discussion about the
connotations of collaboration.

Another aspect of collaboration that has been criticized and requires further investigation
is that not all teachers have positive feelings about and experiences with collaboration. The
negative effects of collaboration can be divided into four categories: work intensification, loss of
autonomy, interpersonal conflict and factionalism (Johnson, 2003). Despite the claim that
collaboration "leads to work sharing and a reduction in the amount of duplication of work
undertaken by teachers" (p. 346) some "find that changing their work practice leads, at least
initially, to an intensification of their workloads" (p. 347). Collaboration can also, paradoxically,
be detrimental to school culture by creating conflict. Disputes can arise between those who are
actively engaged and invested in the collaborative process and those deemed "dissenters,
resistors, backstabbers, and blockers" (p. 347) and between unconnected collaborative teams
resulting in division and factionalism within a school (Johnson, 2003).

Perhaps even more concerning is that collaboration can be used by administrative
personnel to reduce teacher independence. Collaborative efforts can be hijacked and used as a
means of "enhanc[ing] administrative control" (Hargreaves & Dawe, 1990, p. 227) and as a
"mechanism designed to facilitate the smooth and uncritical adoption of preferred forms of
action (new teaching styles) introduced and imposed by experts from elsewhere" (p. 230) rather
than as an authentic opportunity for "teacher empowerment and professional enhancement,
bringing colleagues and their expertise together to generate . . . more skilled action" (p. 230).
This criticism is rooted in a disagreement about the origins of the concept of formal collaboration
between teachers. Although many believe that the concept originated from the "social
emancipation and empowerment movements of the 1970s” (Johnson, 2003, p. 339), some researchers purport that it has its “roots in the entrepreneurlism of the 1980s with its emphasis on efficiency, productivity and accountability” (p. 339). When seen as a capitalistic effort to improve teacher productivity from a top-down, managerial perspective, rather than as an authentic, teacher-driven venture, collaboration can lose its quality of essential goodness.

**New models of collaboration.** Despite the criticism of the early coaching model of collaboration, the lack of a clear understanding of the term and concerns about the nature and intentions of collaborative efforts, the concept of collaboration as a tool that has the potential to influence how collaborative participants “will instruct their students and interact with their colleagues for the rest of their teaching careers” (Thibodeau, 2008, p. 55) has persisted. As the concept has endured it has also evolved in response to the criticism it received. Contemporary models of collaboration have moved away from the notion of coaching as a “technical process” (Hargreaves & Dawe, 1990, p. 236) to become more about providing opportunities “that give teachers access to and sometimes actively encourage critical reflection about the ends and means of their work and the connections between them” (p. 239).

Contemporary forms of collaboration are much more open and flexible than the prescriptive coaching approach from the 1980s. These approaches include professional learning communities (DuFour, 2004, Protheroe, 2004) and job-embedded collaborative study groups (Thibodeau, 2008). Generally, a professional learning community is a group of educators who share an interest in a certain educational issue and work together “in collective learning and application of learning to address students’ needs” (Protheroe, 2004, p. 39), but the form that this learning takes is not established and can vary from community to community. Because of this, in the same way that a common and concrete understanding of the term collaboration has remained elusive, the phrase professional learning community has been so ubiquitously applied
to such a variety of collaborative efforts "that it is in danger of losing all meaning" (DuFour, 2004, p. 6). Our imprecise understanding of the definition of professional learning communities notwithstanding, professional learning communities are characterized by three central ideas: ensuring that students learn, a culture of collaboration, and a focus on results (DuFour) and when implemented and supported appropriately they are "a powerful new way of working together that profoundly affects the practices of schooling" (DuFour, p. 11) and can "harness the intellectual talents and energies of staff to move teaching and learning to higher levels of productivity" (Protheroe, 2004, p. 42).

Job-embedded collaborative study groups operate on the same principles as professional learning communities but have the additional facet of often including the guidance of an outside professional such as a literacy specialist (Thibodeau, 2008). This model of collaboration has been shown to be effective in spreading learning beyond the group itself, as teachers in one collaborative study group all "shared some aspect of their new learning and instructional practices with their departmental colleagues outside of the collaborative group" (p. 61). Both professional learning communities and collaborative study groups seem to be effective modes of collaboration.

The central principles, goals and benefits of these contemporary forms of collaboration align with my research question: Can a collaborative working relationship between content area teachers and an English teacher improve literacy instruction in the content area classroom? Because of this connection I decided to loosely follow these models of collaboration for the purpose of this study. The collaborative group formed during the course of the study was like a professional learning community in that it involved a group of teachers working together in an area of shared interest, in this case, content area literacy. It was like a job-embedded collaborative study group in that sometimes I acted as an outside professional with some
expertise in the area of literacy. With these two models of collaboration in mind, three biology teachers and I embarked on a journey of shared learning with the hopes of improving literacy instruction in the biology classroom.

**Methods**

**Research Design**

This study can be described as a teacher-research study in that it centered around teachers reflecting on and investigating their own teaching practice with the goal of finding "strategies to develop more principled classroom practice" (Hubbard & Power, 2003, p. xiv) and as such I acted as a participant in the study and as the researcher. This research design allowed me to include my own reflections and feelings about the collaborative working relationship in my findings and analysis, and I functioned as “the primary instrument for data collection and analysis” (Merriam, 1998, p. 7). Because the major sources of data are field notes and responses to open-ended questionnaires, the study is qualitative in nature. It was necessary to have as little interference with the organic collaborative process as possible in order to accurately reflect the nature of the collaborative relationship, so qualitative data collection methods were chosen because they seemed best to allow me “to observe behaviour in its natural setting” (Merriam, 1998, p. 7). The choice to use a qualitative teacher-research design allowed me to both participate in and observe this cross-departmental collaboration.

**Research Site and Context**

The study took place over a six month period at a school located in a suburban community in British Columbia’s lower mainland. It was a secondary level school enrolling 1255 students in grades eight through twelve. Historically, students have performed well in both areas of literacy and biology as evidenced in the 2008-2009 School Plan Summary Report where it is stated that the school community is “especially proud of the excellent trend our students
have shown over the past several years in the provincially examinable areas of Biology 12, English 12, Literature 12 and Math 12" (School District Document, 2009, p.1). At the outset of the study, the staff was in the process of exploring the possibility of incorporating collaborative time for teachers into the regular school schedule. Before the completion of the study, the school had received approval for sixteen one-hour collaborative sessions to be spaced throughout the school year. The staff’s interest in the collaborative process, and in the potential benefits of such a process, made this study particularly timely and relevant in this context.

Participants

The study centered on the collaborative working relationship between the three grade 11 and 12 biology teachers at the school and me (the researcher). The recruitment of the participant teachers was based on self-nomination. Initial contact was made in person, at which time I briefly explained the purpose of the research. The teachers who expressed interest were contacted via email and invited to attend an informational meeting. All three biology teachers at the school agreed to participate in the study. Each of the teachers had taught biology previously, though their education, teaching experience, experience with biology outside the classroom and knowledge about content area literacy varied greatly. Before the outset of the study a collegial working relationship between all participants in the study (including myself) already existed. Following is a brief description of each of the participants in the study. The source of the following information is the participant responses to the initial questionnaire.

**Teacher A.** At the time of the study, Teacher A was teaching one block of Biology 12. It was her second year of teaching biology. She graduated with a Bachelor of Human Kinetics in kinesiology with a focus on anatomy and physiology so she was comfortable with the content of the Biology 12 curriculum which focuses mainly on the human body. Teacher A had not implemented any literacy strategies in her biology class and identified inexperience and lack of
time as the reasons she had not done so. Despite this, she was eager to participate in the study because she felt that her participation would expose her to different methods of teaching and learning. Unfortunately, Teacher A did not participate in the collaborative process in any meaningful way.

**Teacher B.** At the time of the study, Teacher B was teaching one block of Biology 12 and two blocks of Biology 11. He had been teaching biology for three years. Teacher B had considerable experience in the field of biology outside the classroom as he not only graduated with a Bachelor of Science after completing five work-terms in a biology co-op program, but also spent over four years working as a field biologist before becoming a teacher. Teacher B felt very comfortable with the biology curriculum but felt he had little understanding of and experience with literacy strategies. He chose to participate in the study because he believed that the experience would “ultimately enhance the range of pedagogical tools in [his] repertoire.”

**Teacher C.** At the time of the study, Teacher C was teaching two blocks of Biology 12 and 1 block of Biology 11. She was by far the most experienced teacher with more than twenty years of biology teaching experience. She graduated with a Bachelor of Science in Human Performance with a focus on physical education and biology. With her many years of experience, Teacher C not only felt comfortable with the biology curriculum, but also with using literacy strategies in her classroom as she had used them in the past. Teacher C chose to participate in the study as a result of an ongoing interest in literacy.

**Researcher (me).** My role was to act not only as a researcher, but also as a participant, mentor and facilitator supporting the three biology teachers in their endeavours to incorporate literacy strategies into their instruction. At the time of the study I was an English teacher working on a Masters of Education in the area of Language and Literacy. I had previous
experience working as a literacy mentor to other teachers as my school's representative to the district wide literacy coach program.

**Procedures**

The study began with initial contact meetings between the participants and me during which I explained the study and gave the participants consent forms and the initial questionnaire (see Appendix A). The participants then completed the questionnaire and returned it to me. After this we met both formally and informally as needed. Some of these meetings simply involved one participant and me and others included two participants and me. We never met as a whole group due to time constraints and scheduling issues. During these meetings I recorded observations in my field notes and collected various artifacts. After our meetings I spent time processing and reflecting. I recorded these reflections in a two column note format with my initial field notes and saved all email communication between the participants and me. Our collaborative endeavour culminated with one participant teaching a lesson (see Appendix B) we developed together while another participant and I observed. The official collaboration for the purposes of this study ended when the participants filled out the final questionnaire (see Appendix C).

**Data Sources**

All of the data collected for this study were qualitative data, including two open-ended questionnaire responses, my field notes and reflections, notes and reflections from the other participants, email communications, and artifacts (such as lesson plans) developed during the course of the research. Due to varying levels of participation in the collaborative process by the three biology teachers, data was not collected from every participant in every source. This chart shows the types of data that were collected from which participants.
Table 1. Levels of Participation by Participants

<table>
<thead>
<tr>
<th>Sources of Data</th>
<th>Participants</th>
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<tbody>
<tr>
<td></td>
<td>Teacher A</td>
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<td>Initial Questionnaire</td>
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<tr>
<td>Final Questionnaire</td>
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<tr>
<td>Email Communications</td>
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<tr>
<td>Field Notes (in the midst and after the fact)</td>
<td></td>
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<tr>
<td>Artifacts (notes, reflections, documents used and created)</td>
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**Questionnaire responses.** The participants in the study completed an initial and final questionnaire that I constructed consisting of several open-ended questions. The initial questionnaire focuses on background information and teacher experience with literacy strategies; this provided a starting point. The final questionnaire concentrates on participant reflection on changes to teaching practice as a result of the collaboration and on participant feelings about the success and usefulness of the collaborative working relationship. The final questionnaire responses serve as an indicator of the growth (or lack thereof) that occurred as a result of this collaboration. Additionally, both the initial and final questionnaires act as a comparison point for my own observations and perspectives regarding the success of the collaboration, providing a means for triangulating my findings.

**Field notes.** My field notes from both planned, formal collaborative sessions and impromptu, informal conversations are a main source of data in this study. These field notes consist of in-the-midst or raw notes that I took during collaborative sessions and after-the-fact reflections on the conversations. The in-the-midst field notes are notes “gathered first hand such as jotted notes and observation notes” (Hubbard & Power, 2003, p. 92) and contain important
information about the time, place and participants in the conversation as well as the content of the conversation. The after-the-fact reflections include my thoughts, comments and questions regarding both the collaborative process and the content area literacy concerns discussed. These reflections represent my preliminary data analysis as they include my “feelings, reactions, hunches, initial interpretations and working hypotheses” (Merriam, 1998, p. 106).

Other data sources. Notes and reflections from the participants in the study, email communication and artifacts created as a result of the collaboration all serve to provide a complete and detailed picture of the collaborative process as explored in the questionnaires and field notes. An example of notes and reflections from a participant is a sticky note that Teacher C gave me with some ideas about vocabulary instruction. Any such artifact was collected and analyzed. Similarly email communication between the participants in the study and me and documents generated during the collaborative process such as lesson plans, teaching tools and student worksheets were documented and analyzed.

Table 2. Instances and Descriptions of Other Data Sources

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<tr>
<th>Data Source</th>
<th>Number of instances</th>
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<tbody>
<tr>
<td>Emails</td>
<td>25</td>
<td>• Ongoing email communication between myself and the participants.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Focus on meeting dates and times</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Sharing of artifacts</td>
</tr>
<tr>
<td>Notes/Reflections from</td>
<td>3</td>
<td>• Notes and comments on resources and strategies</td>
</tr>
<tr>
<td>participants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Artifacts</td>
<td>11</td>
<td>• Graphic organizers and resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Literature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lesson plans and resources developed during the collaborative process</td>
</tr>
</tbody>
</table>

Data Analysis

The data collected during the course of this study can be divided into two distinct categories: the content area literacy and the collaborative process. All data was analyzed and
The codes I used were guided by my initial impressions, as recorded in my field notes and reflections, and informed by the literature. I then used these codes to code my data. For instance, one major theme present in the literature on collaboration is how teaching practice can be improved as a result working in collaborative groups and this is reflected in my code of the benefits of collaboration. Using this process, five major themes emerged, two in the arena of content area literacy and three in the arena of the collaborative process. The content area literacy themes were literacy concerns and changes to literacy instruction. The themes which fell under the category of the collaborative process were motivation for participating in collaboration, kinds of support needed, and outcomes of the collaboration. Each of these major themes can be further divided into sub-themes.

<table>
<thead>
<tr>
<th>Themes</th>
<th>Content area Literacy</th>
<th>Collaborative Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sub-themes</td>
<td>-reading</td>
<td>-interest in topic</td>
</tr>
<tr>
<td></td>
<td>-writing</td>
<td>-improvement to teaching</td>
</tr>
<tr>
<td></td>
<td>-higher-level thinking</td>
<td>-examples</td>
</tr>
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<td></td>
<td></td>
<td>-address teacher concerns</td>
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<td></td>
<td></td>
<td>-administrative work</td>
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</table>

The next step in my data analysis was to evaluate my field notes, email communications, notes and reflections from the participants, and artifacts created during the process in the context of these themes. This analysis served to corroborate my initial finding.

**Findings**

It is important to note that due to the nature and limitations of this study (that is, it focuses on the teachers only) findings are based on my observations of and the participants’
perceptions about their own instruction and their students’ learning and not on any formal
assessment and analysis of student work.

**Literacy Concerns**

Generally, my findings showed that the biology teacher participants had concerns about
the literacy skills of their biology students and that they were interested in addressing these
concerns through their instruction. In particular, they identified concerns regarding reading,
writing and higher-level thinking skills in the initial questionnaire. The teachers’ reading
concerns centered on students’ ability to read a variety of texts including the textbook, “authentic
documents” (Teacher C, initial questionnaire) such as labs and research reports, and tests.
Additionally, the participants were concerned about students’ use of text features in their reading
and ability to deal with “the vast amount of course specific vocabulary” (Teacher A, initial
questionnaire). The participants identified fewer concerns in the area of writing but did express
that students struggled with writing lab reports and paragraph response questions on tests and
writing creative stories in the biology context. Additionally, the participants had concerns about
their students’ higher-level thinking skills including skills such as analyzing scientific data,
applying knowledge to new structures, showing relationships, understanding metaphor and
synthesizing ideas with information gained during labs.

The concerns about literacy that the participants identified in the initial questionnaire also
became apparent our collaborative sessions as the participants discussed what teaching strategies
they had already tried in order to address these concerns. In particular, Teacher C talked about
the importance of using authentic texts like scientific articles in her teaching “because they link
learning to the real world” and about using the strategy of reading especially important
information aloud to her students so that they not only read the information but also heard it.
She had also tried to address her concerns about higher-level thinking skills by giving “bonus
marks on questions when kids are thinking outside the box”. Both the initial questionnaire and my field notes reflect that these biology teachers were aware of the importance of literacy in their subject area and had concerns about their students’ literacy skills.

**Changes to Literacy Instruction**

During the course of the collaboration, two areas of change in literacy instruction were identified. These were in the areas of reading and higher-level thinking. There was no change in the area of writing instruction. These changes to instruction were revealed in my field notes, in the artifacts collected and in the teacher responses to the final questionnaire.

The changes made in the area of reading and higher-level thinking instruction included the use of authentic texts, graphic organizers and text annotation. Both Teachers B and C were passionate about incorporating non-traditional biology texts and “not just textbooks” (Teacher C, final questionnaire) into their teaching. Such texts included *The Log from the Sea of Cortez* (Steinbeck), *The Lorax* (Dr. Seuss) and a variety of stories, articles and comic strips. They wanted to use these various texts not only to engage the students with the content being studied, but also as a way of getting them to apply their biology knowledge to new contexts. Additionally, they saw the value of using strategies such as graphic organizers and text annotation as methods to improve students’ reading and higher-level thinking skills.

All of these changes to instruction became apparent during our collaborative development and subsequent teaching of a biology lesson. Teacher B taught the lesson to his Biology 12 class while Teacher C and I observed. The lesson used a variety of non-traditional texts and a graphic organizer that we had created. Teacher B also employed the strategy of text annotation when he instructed his students to “talk to the text” and told them that if they “had a thought while [they were] reading, write it down” (Teacher B, field notes). The biology teachers’ enthusiasm for and success with using new instructional strategies that promoted both
reading and higher-level thinking skills clearly illustrated the changes they made to their instruction as a result of this collaboration.

Motivation for Participation in the Collaborative Process

The biology teachers' motivation for participation in this collaboration fell into two categories: interest in the topic and a desire to improve teaching practice. These were identified in the teacher responses to the initial questionnaire. Teacher C simply wanted to participate because she has always “had an interest” in literacy. The responses of Teachers A and B focused more on a desire to “improve [teaching] practice and help students learn better” (Teacher A, initial questionnaire) through improved pedagogy.

Kinds of Support Needed during Collaboration

Throughout the course of the collaborative process, the kinds of support that the biology teachers needed shifted. In the initial questionnaire, all three participants identified the importance of having concrete examples of what literacy instruction might look like in a biology classroom. Teacher B also pointed out that in order for the collaboration to be relevant and useful for him, the collaboration needed to directly address his concerns.

During our collaborative meetings it became apparent that another important type of support was the presence of someone (in this case, me) taking care of the administrative tasks associated with the collaboration. My field notes and the email communication between participants revealed that a substantial amount of my time was spent organizing meetings and taking care of various administrative tasks (such as photocopying) that are required for successful collaboration. Additionally, having a participant (me) with expertise in the area of literacy was a necessary and essential type of support. One specific example of the necessity of these two types of support occurred when Teacher B approached me with the novel The Log from the Sea of Cortez and told me he had been wanting to use it in his classroom for years but
had not done so because he was not sure how to use it exactly and had never had the time figure it out. My understanding of how to use literature in the classroom and my support in the administrative aspects of creating a teaching resource (see Appendix D) from his idea allowed him to incorporate literacy strategies in his instruction and finally use the novel he had wanted to use for years.

**Outcomes of Collaboration**

The outcomes of this collaboration are divided into three categories: benefits of collaboration, obstacles to collaboration and recommendations for future collaborations. These categories emerged in my field notes, in email communication and in the final questionnaire filled out by the biology teachers.

The benefits of collaboration that became apparent during the course of the study included the enjoyment of working with colleagues, the opportunity to reflect on one’s practice, the confirmation that as educators we have many of the same concerns and that there is overlap in our various subject areas and most importantly the pooling of expertise and resources to improve our practice. These benefits were noted by Teacher B, Teacher C and me at various points during the collaborative process. When asked what the least useful aspects of the collaboration were in the final questionnaire neither Teacher B or C identified any.

Time was the only major obstacle to collaboration that was identified. It was first mentioned in the initial questionnaire, and was also recorded in the field notes taken during the collaborative process, in email communication and in the final questionnaire. Although all participants noted that time was an issue, it actually prohibited Teacher A from fully participating in the collaboration as evidenced in an email from her at the end of the collaborative process in which she stated “with 5 completely different subjects to prepare and
Student Council to run, I found it very difficult to devote any extra time to creating and implementing any new curriculum."

Three recommendations for future collaborations emerged from the participants’ final questionnaires and from my field notes during the study. The first was to devote more time to the collaboration by starting earlier in the year. This was identified by Teacher C in her final questionnaire. The second recommendation, also identified by Teacher C in her final questionnaire, was to spend more time debriefing and reflecting after implementing new strategies. The final recommendation, to expand the collaboration to include more teachers, in particular the rest of the science department, was suggested by both Teachers B and C and was also noted several times in my field notes during the collaborative process.

Discussion

Summary

Generally this study supports the research done on both the benefits of content area literacy instruction and on the benefits of collaboration in that it showed that literacy instruction in the content area of biology improved student learning in the eyes of the teachers, and that collaboration was an effective method of supporting the biology teachers in their endeavours to include literacy instruction in their lessons.

Significance

Much of the research done around content area literacy indicates that content area lessons, especially at the secondary level, lack any significant literacy instruction (Alvermann & Moore, 1991). This void is often explained by a perception that content area teachers believe that “they don’t have time to teach both the content and reading strategies” (D’Arcangelo, 2002, p. 14) and that they do not see the value in incorporating literacy instruction into their repertoire. Contrary to this, the biology teachers in this study indeed recognized literacy instruction as an
effective method of improving their teaching practice and their students' learning. They identified several areas of concern regarding their students' literacy skills and expressed an enthusiasm to learn more about various literacy strategies and how these strategies could help their students. All three biology teachers indicated that they would embrace using literacy strategies once they were “made aware of them” (Teacher B, initial questionnaire) and had “more examples of how to incorporate [literacy strategies] in class” (Teacher C, initial questionnaire). The teachers still had their subject area content as their primary focus, but appreciated literacy strategies as an effective method for delivering this content.

This discrepancy between the research on content area teachers' resistance to using literacy strategies and the findings of this study is significant because it demonstrates that the challenge of and failure to reach the ideal of reading permeating all subject areas at the secondary level cannot be blamed entirely on content area teachers refusing to embrace literacy instruction. A significant component of the problem may be that content area teachers simply require some education and support in the implementation of literacy instruction. This study also indicates that collaborative working relationships among educators may be an effective way to provide this professional development.

The results of this study indicate that a collaborative working relationship between an English teacher and content area teachers can be an effective model that has the potential to be “a powerful new way of working together that affects the practices of schooling” (DuFour, 2004, p. 11). That this type of collaboration, which is similar to both a professional learning community and a job-embedded collaborative study group, was successful is evidenced by the positive responses expressed by the teachers who participated in the study. All the teachers who were able to contribute to the collaboration (Teacher B, Teacher C and myself) found several benefits to the process including a basic enjoyment of working with colleagues, the opportunity to reflect
on one's own teaching practice and to work with others to improve one's practice and a recognition of the connections and links between various subject areas.

The biology teachers' use of new strategies such as incorporating non-traditional texts, employing graphic organizers and encouraging students to annotate the text are evidence of positive changes to their teaching practice. Teacher B noted in his final questionnaire that these new methods "allowed [him] to emphasize aspects of the curriculum for which a critical thinking approach via literature rather than data was appropriate" and that the new instructional strategies he used "caught [the students'] attention and made them think more critically about the curricula." Clearly, Teacher B felt that his teaching practice was positively affected by the addition of literacy strategies that he learned during the collaborative process.

The benefits identified by Teacher C focused more on the opportunity to and advantages of working closely with colleagues. She noted in her final questionnaire that "it's great to see what's important in other teachers' classrooms" and that she appreciated the "opportunities to pick others' brains on how to approach certain teaching concepts." She also expressed regret that Teacher A was not able to participate in fully in, and therefore contribute to and benefit from, the collaboration. Of note here is that Teacher C was the most experienced teacher in general, and with literacy strategies in particular, of the three teachers. For her, the benefits of collaboration were not in learning how to use new literacy strategies; the benefits were embedded in the discussion about the literacy strategies. For Teacher C, the conversation that the collaborative process fostered was a benefit in itself.

The benefits to me, as an English teacher participating in this study, arose from recognition that what I valued as important skills in the context of my classroom was also valued in the classrooms of other subject area teachers. For example, a graphic organizer that I use to help students write effective paragraphs proved to be an effective method for organizing
information in the biology classroom as well. I also noted that just as my students struggle to analyze, explain and synthesize important information in literature, they have the same struggle with analysis and synthesis of information in biology. This reinforces the generally accepted idea in the literature regarding content area literacy that literacy skills are necessary for success in all subject areas (Fisher, D., Frey, N., & Williams, D., 2002) and that in an ideal educational setting the skills students acquire in one subject area are valuable and valued in other subject areas as well. The work completed during this collaboration represents the initial stages of moving towards the ideal of a school where “every teacher is a reading teacher” (Fisher & Ivey, 2005, p. 3) and literacy is a cross-curricular responsibility and suggests that one method to achieve this goal is to have teachers work together across curricular departments to share experience and expertise.

Despite the overall success of the collaboration, one teacher was not able to fully participate in the collaboration in any meaningful way. Teacher A was unable to attend any of the collaborative sessions with the other biology teachers, though we did share the products of our collaboration with her in the hopes that she could use the resources as well. Teacher A’s failure to contribute to the collaborative process was due to a lack of time and this proved to be the biggest obstacle to this collaboration. Time was not only an obstacle for Teacher A during the collaborative process; it was an issue for all of us as evidenced by the numerous the emails between the participants that dealt with scheduling issues. In fact, fourteen of the twenty-five emails documented dealt with scheduling and rescheduling collaborative sessions due to lack of time and conflicts with other responsibilities. Teacher A identified lack of time due to her heavy course load, being a relatively inexperienced teacher and working with the school’s student council as the chief impediments to her participation. The other teachers and I also noted that having more time to work together would have made our collaboration even more successful.
Also corroborating these findings regarding time as a considerable obstacle to effective collaboration was the importance of my role in completing time consuming administrative tasks required to move the collaboration forward. I made the time to complete these tasks as they were necessary for the completion of my study, but these tasks were in addition to my already numerous teaching duties. It was clear to me, during the course of the study, that in order for collaboration to be successful there must be at least one member of the group who can devote extra time to taking care of these tasks. My findings regarding lack of time for teachers to work collaboratively are significant as they point to the importance of creating time for teachers to work collaboratively within a school’s schedule. These findings are also significant in that one major criticism of collaboration has been that collaboration can lead “at least initially, to an intensification of [teachers’] workloads” (Johnson, 2003, p. 346). When taking this into consideration, collaboration may not be beneficial to an already overwhelmed new teacher and may in fact create additional stress for that teacher.

In looking back at the collaborative process and reflecting on its success, the participants in the study identified three suggestions for improvement. The first was to devote more time to the collaboration by starting earlier in the year. Although the initial stages of our collaboration began in October with an initial meeting to explain the study and sign consent forms, our actual collaboration focused on literacy in biology did not begin until December. With our final meeting taking place in April, our collaboration, in actuality, lasted only four months. This limited the scope of what we could achieve. Had we started the school year with the scaffolding for collaboration in place, we would have been able to achieve more.

Starting the collaboration at the beginning of the school year might have also provided for more time to debrief and reflect on how the collaboration was affecting instruction which was the second recommendation for improving the effectiveness of the collaboration. Because time
was such an obstacle for the participants in the study, often what was sacrificed to reduce the extra workload for the participants was reflection and discussion time after participants had tried something new in their classrooms. For example, after Teacher B taught the lesson that had been collaboratively developed by himself, Teacher C and me, we did not have a formal debriefing session to examine the successes and failures of that lesson. As Teacher C pointed out in her final questionnaire, more time to have these discussions would have enriched our learning. This lack of reflection time is especially important to note because effective collaborative relationships should have a focus on results (DuFour, 2004) and should “actively encourage critical reflection about the ends and means” (Hargreaves & Dawe, 1990, p. 239) of the work done by teachers as a result of the collaboration.

The third and final recommendation that emerged from this study was to expand the collaborative group to include more teachers. Both Teacher B and C suggested during various collaborative sessions that the entire science department would benefit from participating in our discussions. In his final questionnaire Teacher B pointed out that “it would have been nice to compare notes with other science teachers implementing the same strategies.” Additionally Teacher B, Teacher C and I all felt that our collaboration would have been richer had Teacher A been able to participate in a meaningful way. It would seem that because the participants felt they were benefiting from the collaborative process, they wanted to share the benefits with as many colleagues as possible. This again suggests that embedding collaborative time into a school’s schedule may be an effective way not only to encourage participation in collaboration, but also to include more teachers in the process as well.

Limitations

It is important to note, due to the nature of this study, there are several limitations to its findings. First of all, the study is limited by its number of participants as it only involved four
teachers out of an entire secondary school staff. It is also limited by the fact that all of the
participants were self-nominated for participation which would indicate that they had an interest
in and positive feelings about collaboration with colleagues. This is of particular note because
one of the criticisms of collaboration is that it can, in fact, lead to conflict among colleagues
rather than improved teaching practices (Johnson, 2003). Perhaps some of the success of this
collaboration would have been diminished if the participants had to work with other teachers
who were not as invested in and supportive of the process of collaboration. The final limitation
of this study is that all improvement to teaching practice was documented only through teacher
perception of improved student learning; no actual student work was analyzed to corroborate
these perceptions.

Suggestions for Further Research

Although much work has already done been done in both the area of improving content
area literacy and the benefits of collaborative working relationships, there is still more to
investigate especially in the sphere where these two concepts overlap. Further studies into
whether continued, long term cross-departmental collaborative groups can in fact have a
significant and lasting impact on literacy instruction in content area classrooms need to be
conducted. These studies should have a wide enough scope to include different models of
collaborative groups, a variety of content areas and teachers with differing levels of “buy in” to
the concept of content area literacy instruction. It is also important that future studies examine
student work as an indicator of the success of such collaborations. If such research occurs,
educators will have a clearer picture of how to achieve our goals of providing students with both
content and literacy rich learning environments in every classroom in our schools.
Collaborative Futures?

I sit at my desk preparing for a day of teaching. Before the students arrive today, we have a scheduled one hour collaborative session just as we do every other week. A senior biology teacher at my school is finishing a unit on ecology with his grade 12 biology classes and he wants to provide an opportunity for his students to review before their summative test. He knows that his students have a good understanding of the concepts independent from one another. He also knows that his students need to work on making connections between these concepts. What he does not know is HOW to help his students make these connections. He came to me a week ago, exasperated and looking for some guidance and I told him about a word sort strategy I have used with my grade 8 English classes for the past several years as a way to check for understanding of literary devices. I think that it will work well in the biology classroom and will accomplish both of this teacher’s goals: preparing for the upcoming test and working on helping his students to link major ideas together. He has invited several other science teachers to our meeting who have been struggling to find effective methods for review and I have invited a math teacher who I know uses several creative and fun review strategies with his struggling math students. I am excited to share my knowledge, to learn from the experiences of my colleagues and eager to see how my ideas and strategies might be transformed in the hands of another teacher.
REFERENCES


DuFour, R. (May 2004). What is a "professional learning community"? Educational Leadership, 61(8), 6-11.


Appendix A

Literacy Instruction in the Biology Classroom: Collaboration Project

Initial Questionnaire

Date: _____________________________

Teacher: _____________________________

1. How many blocks of biology do you teach? (Indicate grade 11 and grade 12)

2. For how many years have you taught biology?

3. What is your educational background/experience in the field of biology?

4. What kinds of literacy (reading and writing) are expected of students in your biology classes?

5. What general concerns do you have about your biology students’ literacy (reading and writing skills)?

6. What are your specific areas of concern about literacy (reading and writing) do you have in your biology classes?
7. Have you tried to use literacy (reading and writing) strategies in your biology classes in the past? What strategies did you try? What was the outcome? If you haven't used any strategies why not?

8. If you had more support in using literacy (reading and writing) strategies, would you do more literacy instruction in your biology classes? What kind of support would be most useful? What would this support look like?

9. Why are you interested in participating in this project?
Appendix B

Collaboratively Developed Lesson Plan

(Teacher Instructions)

Using Stories in Biology 12
Theme = the human body

Sequence of instruction:

1. Model the process using a comic or text.
2. Students will read their assigned story for homework.
3. Students will discuss the 5 questions in their story groups and prepare a presentation.
4. Each group will present to the class.
5. During the presentations all students will complete the “presentation response form”

Story List

Short texts:

"Fart Proudly” – photocopied (6 pgs)
"Colourful Wastes” – photocopied (4 pgs)
"Hot Diggety Dog” – photocopied (4 pgs)
"Chemical Witchcraft in Salem“ – photocopied (4 pgs)
"Chemistry for Zombies” – photocopied (3 pgs)
"The King of the Ferret Leggers” (Out of the Noosphere) p.115 (6 pgs)

Long texts:

"As Freezing Person Recollect the Snow- First Chill- Then Stupor- Then the Letting Go” (Outside 25) p. 438 (12 pgs)
"Thinking about Machine Man” (Outside 24) p. 265 (10 pgs)
"Across the Disappearing Finishing Line” (Outside 25) p. 265 (10 pgs)
"Chuck Jones Alone at the Edge of Human Endurance” (Out of the Noosphere) p. 62 (8 pgs)
"My Life with the Horror” (Out of the Noosphere) p. 433 (12 pgs)
The Human Body- Gaining a Deeper Understanding through Literature

As a group you are responsible for completing the follow tasks and then presenting this information to the entire class.

1. Record a synopsis of the story- this should be 1 or 2 sentences summarizing the events and main ideas.

2. Choose 1 or 2 short excerpts from the story to read to the class. Highlight them in your copy of the text so they will be easy to find when you present.

3. Record ___ quotes from the story that relate to what you have been learning about ____________________.

Quote How it relates to ____________________
4. Find _____ parts in the story that reveal something about "the human condition" and explain what it reveals.

Section of the story  What is revealed about "the human condition"?

5. Create a hypothesis based on what you read in the story. Use the "if ______________, then ________________" format.

Our hypothesis is . . . .

If ____________________________________________________________

______________________________________________________________, then

______________________________________________________________

______________________________________________________________.
Presentation Response Form

I learned . . .

I wonder . . .

Something that was not mentioned but I consider important is . . .

I connected . . . to . . .
**PEE - Purpose, Evidence and Explanation**

**Purpose**- what is being demonstrated?

**Evidence**- what proof do you have of the purpose?

**Explaination**- how does the evidence prove the purpose? how can this phenomenon be explained? why is this significant? how does this connect to other phenomenon?
Appendix C

Literacy Instruction in the Biology Classroom: Collaboration Project

Final Questionnaire

Date: _______________________

Teacher: _______________________

10. What were some specific literacy strategies that you tried in your classroom as a result of your participation in this collaboration?

11. Explain how this collaboration affected your instruction in your biology classes.

12. What were the most useful aspects of this collaboration?

13. What were the least useful aspects of this collaboration?
14. What would you suggest doing differently in future collaborations?

15. Would you recommend this type of collaboration to your colleagues? Why? Why not?

Additional Comments:
Sea Cucumbers
p. 77
The boulders on this beach were almost a perfect turning-over size—heavy enough to protect the animals under them from grinding by the waves, and light enough to be lifted. They were well coated with short algae and bedded in very coarse sand. The dominant species on this beach was a sulphury cucumber [*Holothuria lubrica*], a dark, almost black-green holothurian which looks as thought it were dusted with sulphur. As the tide dropped on the shallow beach, we saw literally millions of these cucumbers. They lay in clusters and piles between the rocks under the rocks, and as the tide went down and the tropical sun beat on the beach, many of them became quite dry without apparent injury. Most of these holothurians were from five to eight inches long, but there were great numbers of babies, some not more than an inch in length.

Brittle-star and starfish
p. 77
Easily the second most important animal of this shore in point of quantity was the brittle star. We had read of their numbers in the Gulf and here there were, mats and clusters of them, giants under the rocks. It was simple to pick up a hundred at a time in black, twisting, squirming knots. There were five species of them, and these we took in large numbers also, for in preservation they sometimes cast off their legs or curl up into knots, and we wished to have a number of perfect specimens. Starfish were abundant here and we took six varieties. The difference between the brittle-star and the starfish is interestingly reflected in the scientific names—
“Ophio” is a Greek root signifying “serpent” – the round compact body and long serpent-like arms of the brittle star are suggested in the generic name “ophiuran”, while the more truly star-like form of the starfish is recognizable in the Greek root “aster”, which occurs in so many of its proper names, “Heliaster,” “Astrometis,” etc.

Puget Sound
Pg. 159
The shore line here is much like that at Puget Sound: in the high littoral is a foreshore of gravel to pebbles to small rocks; in the low littoral, gravelly sand and fine sand with occasional stones below the low tide level. In this zone, with a maximum at four feet, were heavy groves of algae, presumably, *Sargassum*, lush and tall, extending to the surface. Except for the lack of eel-grass it might have been Puget Sound.

Classification
Pg. 170
Indeed, as one watches the little animals, definite words describing them are likely to grow hazy and less definite, and a species merges into species, the whole idea of definite independent species begins to waver, and scale-like concept of animal variations comes to take its place. The whole taxonomic method in biology is clumsy and unwieldy, shot through with the jokes of naturalists and the egos of men who wished to have animals named after them.

Originally the descriptive method of naming was not so bad, for every observer knew Latin and Greek well and was able to make out the descriptions. Such knowledge is fairly rare now and not even requisite.

Sponges
Pg. 182
Under the water and apparently below the ordinary tidal range were brilliant-yellow *Geodia* and many examples of another sponge of magnificent shape and size and colour. This last (erect colonies of
the cosmopolitan *cliona celata*, more familiar as a boring sponge) was reddish pink and stood high and vase-like, some of them several feet in diameter. Most of them were perfectly regular in shape.

**Jellyfish**

P. 190

The water was clear and blue, and a large swell flowed past us. About noon we moved through a great group of Zeppelin-shaped jellyfish, ctenophores or possibly siphonophores. They were six to ten inches long, and the sea was littered with them. We slowed down and tried to scoop them up, but the tension of their bodies was not sufficient to hold them together out of water. They broke up and slithered in pieces through the dip-nets.
The boulders on this beach were almost a perfect turning-over size-heavy enough to protect the animals under them from grinding by the waves, and light enough to be lifted. They were well coated with short algae and bedded in very coarse sand. The dominant species on this beach was a sulphury ______________, a dark, almost black-green ________ which looks as thought it were dusted with sulphur. As the tide dropped on the shallow beach, we saw literally millions of these ________. They lay in clusters and piles between the rocks under the rocks, and as the tide went down and the tropical sun beat on the beach, many of them became quite dry without apparent injury. Most of these ________ were from five to eight inches long, but there were great numbers of babies, some not more than an inch in length.

Easily the second most important animal of this shore in point of quantity was the _____________. We had read of their numbers in the Gulf and here there were, mats and clusters of them, giants under the rocks. It was simple to pick up a hundred at a time in black, twisting, squirming knots. There were five species of them, and these we took in large numbers also, for in preservation they sometimes cast off their legs or curl up into knots, and we wished to have a number of perfect specimens. ____________ were abundant here and we took six varieties. The difference between the ___________ and the ____________ is interestingly reflected in the scientific names- “Ophio” is a Greek root signifying “serpent”- the round compact body and long serpent-like arms of the ___________ are suggested in the generic name “ophiuran”, while the more truly
star-like form of the __________ is recognizable in the Greek root “aster”, which occurs in so many of its proper names, “Heliaster,” “Astrometis,” etc.

3. ________________________

Pg. 182
Under the water and apparently below the ordinary tidal range were brilliant-yellow __________ and many examples of another __________ of magnificent shape and size and colour. This last (erect colonies of the cosmopolitan cliona celata, more familiar as a boring sponge) was reddish pink and stood high and vase-like, some of them several feet in diameter. Most of them were perfectly regular in shape.

4. ________________________
Pg. 190
The water was clear and blue, and a large swell flowed past us. About noon we moved through a great group of Zeppelin-shaped __________, ctenophores or possibly siphonophores. They were six to ten inches long, and the sea was littered with them. We slowed down and tried to scoop them up, but the tension of their bodies was not sufficient to hold them together out of water. They broke up and slithered in pieces through the dip-nets.