SOCIAL COMPETENCE AND COLLABORATIVE GUIDED INQUIRY
SCIENCE ACTIVITIES: EXPERIENCES OF STUDENTS WITH
LEARNING DISABILITIES

by

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ABSTRACT

This thesis presents a qualitative investigation of the effects of social competence on the participation of students with learning disabilities (LD) in the science learning processes associated with collaborative, guided inquiry learning. An inclusive Grade 2 classroom provided the setting for the study. Detailed classroom observations were the primary source of data. In addition, the researcher conducted two interviews with the teacher, and collected samples of students’ written work.

The purpose of the research was to investigate: (a) How do teachers and peers mediate the participation of students with LD in collaborative, guided inquiry science activities, (b) What learning processes do students with LD participate in during collaborative, guided inquiry science activities, and (c) What components of social competence support and constrain the participation of students with LD during collaborative, guided inquiry science activities?

The findings of the study suggest five key ideas for research and teaching in collaborative, guided inquiry science in inclusive classrooms. First, using a variety of collaborative learning formats (whole-class, small-group, and pairs) creates more opportunities for the successful participation of diverse students with LD. Second, creating an inclusive community where students feel accepted and valued may enhance the academic and social success of students with LD. Third, careful selection of partners for students with LD is important for a positive learning experience. Students with LD should be partnered with academically successful, socially competent peers; also, this study suggested that students with LD experience more success working collaboratively in pairs rather than in small groups. Fourth, a variety of strategies are needed to promote active participation and positive social interactions for students with and without LD during collaborative, guided inquiry learning. Fifth, adopting a general approach to teaching collaborative inquiry that crosses curriculum borders may enhance success of inclusive teaching practices.
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CHAPTER 1: INTRODUCTION

This thesis presents a qualitative study of the participation of students with learning disabilities (LD) in collaborative, guided inquiry science activities in an inclusive, Grade 2 classroom. The study developed from the researcher’s interests in collaborative learning in elementary science and the social aspects of LD. The current LD and science education research literature support the potential of collaborative learning activities in science education to enhance science concept learning and social skills for all students, and particularly for students with LD. However, these research literatures also suggest that, across subject areas, the majority of students with LD do not achieve this potential. This thesis is an in-depth exploration of the effects of social competence on participation of students with LD in the science learning processes associated with collaborative, guided inquiry learning; it is also an exploration of how teachers and peers might support students whose participation is constrained by various social competence factors.

This chapter begins with a definition of the terms used in this thesis, and then describes the purpose and rationale of the research, including the primary research questions. The final section describes the organization of the thesis.

Definition of Terms

*Collaborative Learning Activities*

In this study, any learning activity that involved communication of ideas or cooperation to complete a task, between two or more students, was labeled as collaborative. The teacher used three main collaborative formats: whole-class, small-group, and pairs. Sometimes the collaborative activities were planned, for example, a small-group investigation (four to five students) or a whole-class discussion of a teacher-led demonstration. Sometimes the collaborative activities were spontaneous—in the middle of a faltering whole-class discussion, the teacher
would tell the students to break into pairs to discuss the question at hand. According to the research literature, the essential element of collaboration is convergence of ideas (Webb & Palincsar, 1996). In collaborative learning activities, learning is an active process in which students distribute thinking amongst group members, construct shared meanings and interpretations of concepts and experiences, and work toward both a common learning result and individual understanding (van der Linden, Erkens, Schmidt, & Renshaw, 2000; Webb & Palincsar, 1996). In this dissertation, the terms “cooperative learning” and “group work” will be used synonymously with “collaborative learning” (although this is not always the case in the research literature). Collaborative learning, cooperative learning and group work will be described in more detail in chapter 2.

*Guided Inquiry Learning*

Both the Council of Ministers of Education Canada (1997) and the Ontario Ministry of Education and Training (1998) have called for learning activities in elementary science and technology that include inquiry and design processes and emphasize the importance of communication skills. The teacher in this study used an inquiry-based teaching approach that most closely resembled “guided inquiry.” Educational research supports the use of the “guided inquiry” approach for inquiry-based learning in elementary science education (Brown & Campione, 1994; Magnusson & Palincsar, 1995). The guided inquiry approach offers opportunities for authentic, hands-on, inquiry-based experiences facilitated by guidance from the teacher to avoid/confront misconceptions and to introduce students to knowledge and processes that are part of the culture of the scientific community. A guided inquiry approach uses overlapping phases of learning to organize and understand the learning processes involved. The names and numbers of the phases vary across researchers and models, but typically include an engagement phase where students are introduced to and review the topic; an investigation phase where students explore ideas and materials through hands-on experiences such as experiments; an
explanation phase where children propose explanations for the phenomena they encounter, and are guided towards the intended concepts, skills, and vocabulary by the teacher; and a reporting phase where students present their work or apply their thinking to new situations (e.g., BSCS, 1992; Dalton, Morocco, Tivnan, & Mead, 1997; Palincsar, Magnusson, Collins, & Cutter, 2001). All the models share a cyclical, recursive nature, and any phase may lead back to an earlier phase. Each of these phases affords opportunities to use collaborative learning structures (whole-class, small-group, or pairs) as a means for acquiring knowledge about science.

**Social Competence**

Social competence is defined using the framework developed by Vaughn and Hogan (1990). They conceptualized social competence as a higher order construct made up of many components, organized into four categories, that combine for effective social competence: positive relations with others, accurate/age appropriate social cognition, absence of maladaptive behaviour, and effective social behaviour. For the purposes of observation and reporting, the researcher re-named the categories, in order, as: relationships with others, social cognition, behaviour, and social skills. More detail about the categories of social competence is presented in chapter 2.

**Students with LD**

LD come in many forms and affects people with varying levels of severity. According to Canadian estimates, five to ten percent of all Canadians, and two to four percent of the school age population, have LD. Since it is the policy of the Ontario Ministry of Education and Training that integration in regular classrooms is to be the placement norm for all students with exceptionalities (Royal Commission on Learning, 1995), it is unusual for teachers to find themselves in charge of a classroom that does not include students with LD. The Learning Disabilities Association of Ontario (LDAO) (http://www.ldao.ca/index.php) officially defines “Learning Disabilities” as:
A variety of disorders that affect the acquisition, retention, understanding, organization or use of verbal and/or non-verbal information. These disorders result from impairments in one or more psychological processes related to learning, in combination with otherwise average abilities essential for thinking and reasoning. Learning disabilities are specific not global impairments and as such are distinct from intellectual disabilities. (http://www.ldao.ca/what_are_lds/definitions.php)

Under provincial and local school board policies, LD are indicated by a number of criteria, but predominately by unexpectedly low academic achievement or achievement that is sustainable only by extremely high levels of effort and support (Ontario Ministry of Education, 2008; 1982). In the Grade 2 classroom that provided the setting for this study, the teacher, Tracy (a pseudonym), had flagged a number of students as at-risk for LD, four of whom were selected as focal students for observations. However, by the end of the data collection period only one of the four students had been tested and formally identified with LD. Although exceptions are made in extreme cases, it is rare that students under the age of eight (prior to Grade 3) are tested for LD in the school board in which the study was conducted (Tracy, personal communication, July 26, 2007). There is not a written policy that guides this practice, but Tracy explained that the reason are two-fold: First, once a student has been identified as exceptional, this identity follows the student throughout his or her school career. Therefore, educators want to give the student enough time to allow for simple time differences in development prior to labeling; second, when teachers submit a list of students at-risk for exceptionalities, a prioritized list for student assessment is developed collaboratively with school and clinical staff. Among other considerations, criteria for assessment priority include age of the student, severity of the exceptionality, and advocacy of the parents (Tracy, personal communication, July 26, 2007).

Recently, Response to intervention (RTI) has received considerable attention as a mechanism for identifying and teaching students with LD (Glover, DiPerna, & Vaughn, 2007). The term RTI represents various models characterized by multiple layers of research-based interventions, ongoing progress monitoring, and systematic screening points for special education evaluation (Zirkel & Krohn, 2008). In the United States, RTI has replaced the use of the severe
discrepancy approach to identify students with LD (Zirkel & Krohn, 2008) and discussion of the research and implementation of RTI models has begun in Ontario (Barnes, 2008).

Although three out of the four at-risk focal students were not formally identified with LD at the time of the study, the researcher interpreted data connected with these students under the assumption that they would be identified with LD at some point in their school careers. Gaines and Davis (1990) conducted studies examining whether teachers, in the absence of standardized tests, might accurately identify students in need of special education services. The findings indicated that teachers made accurate predictions in over 60% of cases, and that teachers were most accurate at identifying students in the lower percentiles (however, they found differential accuracy rates for subgroups of students, e.g., low socioeconomic status and previous retention).

Salvesen and Undheim (1994) found a high correlation between teachers’ predictions of low achievement and the results of standardized tests in reading, spelling, and intelligence. Tracy proved her predictions correct with one of the four at-risk students by the end of the study.

A fifth focal student, identified with Asperger syndrome, was selected for close observation by the researcher. Students with Asperger syndrome have mild to severe impairments in social interaction and understanding, restricted and repetitive activities and interests, and deficits in communication. However, language and cognitive development are not delayed (Austism Society of Canada, http://www.autismsocietycanada.ca/understanding_autism/what_are_asds/index_e.html). A student with Asperger syndrome was included in this study of students with LD because there is some consensus in the research literature that the cognitive profile of many people with Asperger syndrome includes a non-verbal LD. For example, Cederlund and Gillberg (2004) investigated the background and associated factors of 100 young males (age 5 years, 6 months to 24 years, 6 months). They reported a 51% rate of non-verbal LD in the population. However, in a study of 27 adults with Asperger syndrome who presented without a history of language delay, no significant
difference was found between the test and control population for non-verbal LD (Ambery, Perry, Russell, Morris, & Murphy, 2006).

More details about the academic and social challenges of each of the focal students are provided in chapter 3.

Inclusive Classrooms

Inclusive classrooms, such as the classroom observed in this study, include both exceptional and non-exceptional students, and operate under a philosophy called “inclusion.” The British Columbia Ministry of Education offers the following definition of inclusion, which includes both academic and social aspects of inclusion:

The value system which holds that all students are entitled to equitable access to learning, achievement and the pursuit of excellence in all aspects of their education. The practice of inclusion transcends the idea of physical location and incorporates basic values that promote participation, friendship and interaction.
(http://www.bced.gov.bc.ca/specialed/sid/6.htm)

Purpose

The purpose of this research was to investigate the participation of students with LD in collaborative, guided inquiry science learning activities by examining the role of social competence in supporting and constraining interactions in collaborative learning formats. Each phase of guided inquiry learning in science presents both academic and social challenges for students with LD (Palincsar et al., 2001). For example, at the engagement phase, students must direct and sustain their attention to the concept introduced. At the investigation phase, social competence challenges may prevent some students from gaining access to the activity and taking on roles during group investigation. The explanation and report phases present cognitive, linguistic, and social challenges as students express, defend, negotiate, and extend their ideas and knowledge. Specifically, the research asked:
1. How do teachers mediate the participation of students with LD in collaborative, guided inquiry science activities?

2. How do peers mediate the participation of students with LD in guided, collaborative inquiry science activities?

3. What learning processes do students with LD participate in during collaborative, guided inquiry science activities, and what is the extent of the participation?

4. What components of social competence support and constrain the participation of students with LD during collaborative, guided inquiry science activities?

Rationale

As discussed in chapter 2, the current research literature on collaborative and cooperative learning demonstrates the potential of collaborative learning in science education to enhance the academic and social skills of all students, and particularly of students with LD. However, it also suggests that, across subject areas, the majority of students with LD do not achieve this potential even when appropriate academic supports are in place. Identifying aspects of social competence that support or constrain meaningful participation in collaborative activities may help to create interventions for students with LD, the students they work with, and their teachers, that will enhance the success of students with LD as they engage in collaborative activities. While this study, conducted by a single researcher, focuses on only a small sample of students with LD, it presents a launching point for a more extensive study of the experiences of a larger population of students with LD as they work collaboratively during science activities.

Overview of the Thesis

The first chapter of this thesis presented an introduction to the study, including definitions of terms, and an explanation of the purpose and rationale behind the research. Chapter
2 presents the theoretical framework used for the study, social constructivism, and reviews areas of the literature in both science education and educational psychology that support the analysis and discussion of the data. The literature review topics include: guided inquiry learning, communities of inquiry, collaborative learning, students with LD and collaborative learning, and social competence. The third chapter describes the methods used to collect and analyze the data. In addition, the reader is introduced in detail to the setting and participants involved in the study.

Due to the extensive amount of data collected, the results of the study are presented over four chapters. Chapter 4 presents data about Tracy’s teaching that pertained to all students in the class and all areas of the curriculum. The data in chapters 5, 6, and 7 are divided according to the three guided inquiry science learning cycle phases observed in Tracy’s classroom: chapter 5 presents the data for the “Engage” phase; chapter 6 presents the results for the “Investigate” phase; and chapter 7 presents data for the “Explain/Report” phase. Within each chapter, the data are organized by the actions/experiences of the teacher and each focal student. Chapter 8 includes the discussion of the results in two sections: mediation strategies and a summary of social competence factors, and ends with a summary of the key findings, an exploration of the strengths and limitations of the study, and recommendations for research and practice.
CHAPTER 2: THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Introduction

This chapter presents the theoretical framework for the research and reviews the literature that supports the importance of studying the social context of students with LD during collaborative, guided inquiry science activities. The first section presents an overview of social constructivism and provides the underlying framework for the second section, the literature review. The literature review is organized into four sections: teaching and learning in guided inquiry science, communities of inquiry, collaborative learning, and social competence. The final section summarizes the chapter, and describes the relevance of each section to the study.

Theoretical Framework: Social Constructivism

Social constructivism is a theoretical framework widely used in contemporary science education. According to Scott, Asoko, and Leach (2007), social constructivist perspectives share the following tenets:

1. Learning scientific knowledge involves a passage from social to personal planes.
2. The process of learning is consequent upon individual sense-making by the learner.
3. Learning is mediated by various semiotic resources, the most important of which is language.
4. Learning science involves learning the social language of the scientific community, which must be introduced to the learner by a teacher or some other knowledgeable figure. (p. 44)

Social constructivism draws directly on the work of Vygotsky (1986). Vygotsky viewed learning as moving from a social context to individual knowledge construction (Vygotsky, 1978). We are introduced to new ideas in a social context or “social plane” through our interactions with other people, including talking, gestures, writing, drawings/photographs, and exploration. In an educational setting, the social plane might consist of a teacher working with students, or peers of varying abilities working together. Interactions (talk, gestures, etc.) become the tools for individual student’s sense-making and “internalization” of the ideas explored in the social context.
(Scott et al., 2007). Students are responsible for their own learning in the sense that they must direct their attention to learning tasks and draw on their present knowledge to construct meaning from them (Driver, 1989).

Vygotsky (1978) described the disparity between what students are able to do independently and what they are potentially able to accomplish with the help of a more expert mentor (either a higher-ability peer or a teacher) at key points during problem solving the “zone of proximal development.” Therefore, the role of the teacher is to introduce scientific knowledge into the social plane of the classroom, and then to support students’ thinking as they attempt to make sense of it. From this perspective, the students’ learning is “directly connected to, and dependent upon, the supporting activity of the teacher, on the social plane” (Scott et al., 2007, p. 40).

Driver, Asoko, Leach, Mortimer, and Scott (1994) stated that a “social constructivist perspective recognizes that learning involves being introduced into a symbolic world” (p. 7). This tenet of social constructivism originated with the Vygotskian notion of “enculturation.” Scott et al. (2007) explained:

The concepts and models of conventional science embody practices, conventions, and modes of expression that are socially and institutionally agreed upon. Because scientific knowledge is the product of the scientific community, it cannot be learned through interactions with the material world alone. (p. 41)

This suggests that students cannot be expected to “discover” scientific concepts through free exploration without direct intervention and guidance from a teacher.

As Scott et al. (2007) summarized, social constructivism accounts for the social nature of science learning in school in two ways. First, learning is “social” in that students begin their learning through interactions on the social plane; second, learning science involves being introduced to the social context of the scientific community for the construction of individual scientific knowledge.
According to Magnusson and Palincsar (1995), guided inquiry blends the emphases of three education reform efforts of the past: the learning cycle, constructivism, and conceptual understandings of science (including conceptual change theory). The learning cycle approach was developed in the late 1950s and 60s from two sources: the research of Karplus in the Science Curriculum Improvement Study (SCIS) and the work of Lawson in U.S. secondary and post-secondary biology education that led to the development of the Biological Science Curriculum Study (BSCS) (Treagust, 2007). According to Abraham (1998), the important contributions of the inquiry-based learning cycle approach were twofold: the opportunity for construction of knowledge using personal experience, and the opportunity to apply constructed knowledge to new situations.

Based heavily on Piagetian theory, “the learning cycle approach focused on individual learning more than group learning and more on personal construction than social construction of knowledge” (Treagust, 2007). Over the years, the learning cycle approach has been modified to incorporate constructivist and social constructivist ideas of learning (Appleton, 2007). A guided inquiry approach acknowledges that:

It is important to use whatever knowledge students have in the process of building new understandings and that the process of building scientific knowledge will be facilitated by having many opportunities for learners to discuss and compare their understandings with others. (Magnusson & Palincsar, 1995, p. 44)

From conceptual change approaches, guided inquiry recognizes that learners bring their own ideas and understandings of the physical world to science classrooms. Some of these ideas may be contradictory to accepted scientific knowledge and therefore science instruction should provide students with opportunities to confront and resolve these differences (Magnusson & Palinscar, 1995).
A guided inquiry approach to science teaching offers students opportunities for: hands-on exploration of new ideas and materials; proposing explanations for the phenomena they encounter (with guidance from the teacher towards the intended concepts, skills, and vocabulary); and applying their new understandings of concepts to novel problem solving activities (e.g., Blake, 2002; BSCS, 1999; Dalton et al., 1997; Palincsar et al., 2001). In collaborative formats, students present and explain ideas to peers, think and talk about individual or shared experiences, ask questions, suggest and test new ideas, reflect on changing ideas, help peers to clarify their thoughts, and advance current understanding by making sense of new ideas (Lazarowitz & Hertz-Lazarowitz, 1998).

One example of a guided inquiry model currently in use is the 5Es model—engagement, exploration, explanation, elaboration, and evaluation (BSCS, 1992). This model was used in the curriculum project *Science for Life and Living* (BSCS, 1992). *Science for Life and Living* involved collaborative learning activities (pairs, small-groups and whole-class) and integrated social learning skills with science content in the curriculum. A second example of a current guided inquiry model was created by Palincsar and the GIsML Community and entitled, *Guided Inquiry supporting Multiple Literacies* (GIsML) for teaching science in inclusive classrooms in elementary schools (Magnusson & Palincsar, 1995; Palincsar, Collins, Marano, & Magnusson, 2000; Palincsar et al., 2001; Palincsar, Magnusson, Cutter, & Vincent, 2002). Their cycling heuristic, set within a problem space, included the phases: engage, investigate, explain, and report. The researchers claimed that the creation of a community of inquiry involving the use of collaborative learning structures, where students work in pairs and small-groups for investigation and documentation of data was integral to their approach (Palincsar et al., 2001; Palincsar et al., 2002).
In guided inquiry learning, the teacher acts as a facilitator, monitoring the students’ zone of proximal development, and guiding the learning of his or her students as their understandings grow and change:

Guided discovery places a great deal of responsibility in the hands of the teacher, who must model, foster, and guide the “discovery” process into forms of disciplined inquiry that may not be reached without expert guidance. (Brown & Campione, 1994, p. 230)

Anderson (2007) summarized the role of the teacher in collaborative, guided inquiry teaching as “coach and facilitator.” As coach and facilitator, the teacher helps students to process information, communicates with small-groups and pairs, coaches student actions (social and academic), facilitates student thinking, models the learning process, and is flexible in the use of materials.

*Communities of Inquiry*

“The most compelling justification for social learning environments is their similarity to communities of practice for expert scientists” (Linn, Songer, & Eylon, 1996). Lave and Wenger (1991) first described how experienced community members or members with expertise socialize new or less accomplished members. They proposed that learning environments that involved novices learning from experts might be beneficial to all community members. Wenger (1998) defined a number of indicators of community of practice, including:

(a) sustained mutual relationships – harmonious or conflictual
(b) shared ways of engaging in doing things together
(c) the rapid flow of information and propagation of innovation
(d) very quick setup of a problem to be discussed
(e) substantial overlap in participants’ descriptions of who belongs
(f) knowing what others know, what they can do, and how they can contribute to an enterprise
(g) specific tools, representations, and other artefacts
(h) local lore, shared stories, inside jokes, knowing laughter” (pp. 125-126)

Rogoff (1995) defined learning as participation in social exchange. Therefore, it is important for learners to have access to social activity (Lave & Wenger, 1991). For novices or less skilled community members, initial access to collaborative learning activities may take the
form of more limited or peripheral participation, such as observation. “Legitimate peripheral participation,” as termed by Lave and Wenger (1991) is still a valuable part of the learning process; peripheral participation still allows learners to develop an overall understanding of the topic under study. However, as Berry (2006) stated:

For educators who work with students with LD, the notion of learning rising from participation is challenging, because these students are generally less involved in academic and social exchanges and participate less in whole-group instruction than do their general education counterparts. (p. 212)

For example, McIntosh, Vaughn, Schumm, Haager, and Lee (1993) observed students with LD in 60, Grades K-12 general education classrooms. They concluded that students with LD adopted a more passive participation style, and interacted less frequently with teachers, peers, and classroom activities than did students without LD. However, in a literature review studying various ways that teachers effectively included students with LD, Nind and Wearmouth (2006) reported that, “a sense of belonging to, and participation in, the learning community has an important effect on young people’s learning in schools” (p. 119).

Brown and Campione’s (1994) work with communities of learners generated five features they deemed essential for the ideal classroom environment for collaborative learning. The first feature is “Individual Responsibility Coupled with Community Sharing.” This means “students and teachers each have ‘ownership’ of certain forms of expertise, but no one has it all” (p. 234). Members of the community share their expertise in skills and knowledge. Diversity is recognized, encouraged, and considered to be the essence of teamwork. Second, “Ritual, Familiar Participant Structures” are established and repeated. These structures might include common classroom routines, regular formats for collaboration, and familiar, expected ways of interacting within the collaborative formats. Brown and Campione (1994) argued that the repetitive nature of these activities is essential to the smooth running of a learning community, because it enables children to make the transition from one format to another quickly and effortlessly. Because students recognize the structure, they understand the role expected of them.
Effort is then placed on science learning rather than classroom management. Third, a “Community of Discourse” is established. In a community of discourse, ideas, questions, and criticism are discussed in a constructive mode. Scientific language and ways of thinking become part of the voice of the community and constitute enculturation into the community. Ideas, such as terms and definitions, continually change and evolve as the community works towards consensus. Fourth, “Multiple Zones of Proximal Development” are present. Within an inclusive classroom, “participants can navigate via different routes and at different rates” (p. 236), supported by teachers and peers with expertise. Finally, there is “Seeding, Migration, and Appropriation of Ideas.” Brown and Campione (1994) described this feature:

Teachers and students create zones of proximal development by seeding the environment with ideas and concepts they value and by harvesting those which “take” in the community. Ideas seeded by community members migrate to other participants and persist over time. Participants in the classroom are free to appropriate vocabulary, ideas, methods, etc. that appear initially as part of the shared discourse, and by appropriation, transform these ideas via personal interpretation. (pp. 236-237).

Through stories, interviews, and action research, Zembylas and Isengarger (2002) described and analyzed the importance of combining caring relationships with a guided inquiry science curriculum when teaching science to students with LD. The teacher involved in the study provided a nurturing community for her students with LD through modeling caring behaviours, encouraging self-affirmation, and sharing her own interests in science while encouraging all students to do the same:

Her approach is directed in creating, maintaining, and enhancing relations of care and trust. Students are encouraged to support each other and, as she explains, activities and group work may enhance achievement scores in science, but they can also provide caring occasions. (p. 69)

The major component associated with caring teaching is the idea of “confirmation” from the work of Noddings (1984). In Zembylas and Isenbarger (2002), confirmation occurred through the provision of opportunities for students with LD to interact with peers while pursuing their interests in science. They defined caring as building relationships, honouring each other’s gifts,
and helping to develop talents. The findings of the study also suggested that creating a caring community decreases the incidence of inappropriate behaviour in students with LD.

**Collaborative Learning**

Like guided inquiry approaches and community of practice theory, collaborative learning approaches also have their roots in social constructivism, reflecting the changing views, from traditional to progressive, held by researchers in education on learning and the nature of knowledge (van der Linden et al., 2000; Webb & Palincsar, 1996). The social nature of learning requires collaboration amongst peers engaged in a common task. Group members are interdependent in the performance of their task and must interact in order to complete it. The essential element that defines true collaborative learning is the generation of shared meaning amongst pair or group members through an iterative discussion process (Webb & Palincsar, 1996). Research has shown that, together, students are able to solve problems and construct knowledge they would be unable to independently (van der Linden et al., 2000). Based on their review of research on collaborative learning, van der Linden et al. (2000) offered the following working definition:

> Learning in cooperation with others offers opportunities for an active learning process; it entails that one has to come to a mutual agreement as to the interpretation of what is to be learned and how to go about it. The aim is to work towards a shared meaning as a result of the negotiation process and towards a common learning result, a result that also serves as the basis for individual understanding, a personal viewpoint and identity. (p. 39)

Because students bring to the classroom their own social, cultural, and historical experiences, negotiation and reaching consensus with others are necessary parts of the construction of mutual understanding (Driver et al., 1994). This requires all individuals in the classroom to learn to discuss effectively and to negotiate shared meaning and common knowledge, including the teacher.

Many of the research articles described in this review refer to cooperative learning rather than collaborative learning, as considerably less has been written about collaboration, especially
outside science education. Cooperative learning refers to “the instructional use of small groups so that students work together to maximize their own and each other’s learning” (Johnson, Johnson, & Holubec, 1993, p. 6). A number of specific instructional approaches have been developed with varying features in terms of group organization and reward structures, for example, jigsaw, Co-op Co-op, group investigation, student teams achievement divisions (STAD), and teams games tournaments (TGT) (Webb & Palinscsar, 1996). Webb and Palinscar (1996) explained: “although certain forms of cooperative learning can occur without collaboration, collaborative learning is generally assumed to subsume cooperation” (p. 848).

Current research in education also suggests that bringing school-based learning more in line with work-based learning facilitates the transition between school and work, and to adult functioning in society (Munby, Chin, & Hutchinson, 2003). Collaboration in school provides an opportunity for students to acquire and practice social skills needed for interaction in society and in the workplace (Lazarowitz & Hertz-Lazarowitz, 1998). Social skills such as active listening, talking, offering compliments and constructive criticism, taking turns, reaching consensus and conflict resolution are essential to the effective functioning of collaborative groups (Korinek & Popp, 1997; Webb & Palinscar, 1996). Peer group activities that facilitate cognitive knowledge construction include: presenting and explaining ideas to peers, thinking and talking about individual or shared experiences, asking questions, suggesting and trying out new ideas, reflecting on changing ideas, helping peers to clarify their thoughts, and advancing current understanding by making sense of new ideas (Lazarowitz & Hertz-Lazarowitz, 1998).

All students need explicit instruction about collaborative processes to learn effectively in a social context. In a study of exemplary science teaching, Blake (2002) documented a teacher’s explicit process of coaching students in the use of social skills as part of the science curriculum while she guided students toward successful group work and collaborative and individual problem solving. Collaborative learning activities provide an authentic context in which to learn
and practice academic social skills, an essential element for improving social competence (Korinek & Popp, 1997; Sheridan, Hungelmann, & Maughan, 1999). In addition, Salend (1999) proposed that interventions to improve the social experiences of students with LD must also be directed at students without LD. For example, interventions directed at students without LD might help them to interpret and accommodate the behaviours of students with LD that fall outside age appropriate norms. Hutchinson, Freeman, and Berg (2004) emphasized the importance of supporting the development of friendships as a fundamental component of any social intervention.

Research has shown that, with effective academic adaptations, students with LD have much to gain from and contribute to academic learning in the context of guided inquiry science activities (Dalton et al., 1997; Palincsar et al., 2000; Palincsar et al., 2001). In other areas of the curriculum (particularly reading and writing), researchers have espoused both the academic and social benefits of cooperative learning (a specific form of collaborative learning) processes for students with and without disabilities (Baird, Lazarowitz, & Hertz-Lazarowitz, 1992; Johnson & Johnson, 1986; Slavin, Stevens, & Madden, 1988). Cooperative learning is also recommended as a tool for managing academic heterogeneity in inclusive classrooms (Cohen, 1994; Jenkins, Antil, Wayne, & Vadasy, 2003; Jenkins & O’Connor, 2003; Johnson & Johnson, 1986; Slavin et al., 1988). Jenkins and O’Connor (2003) explained:

The peer support inherent in cooperative learning serves as a compensatory mechanism, enabling struggling learners to overcome obstacles they might not overcome working alone. Peer support can materialize in a variety of forms, as when more capable or better-informed peers clarify the nature of an assignment, interpret complex instructions, model performance, explain ideas, give feedback and corrections, take responsibility for difficult parts of the assignment, scaffold problem-solving efforts, and provide encouragement. (p. 418)

In fact, Jenkins et al. (2003) reported that classroom teachers claimed they would be at a loss to effectively manage academic heterogeneity without the use of cooperative learning.
Students with LD and Collaborative Learning

Reviews of research. Reviews of research on collaborative and cooperative learning are difficult because of the range of structures and approaches that fall under the umbrella of these terms. Therefore, reviews tend to be qualitative and highly descriptive in order to help the reader understand the types of studies reviewed and their differences. Tateyama-Sniezek (1990) conducted a qualitative review of studies in which separate analyses were conducted on the academic achievement of students with disabilities. Only 50% of these studies reported significant positive results favouring cooperative learning over independent learning conditions for students with LD. In 2002, McMaster and Fuchs conducted a follow-up study including fifteen studies published between 1990 and 2000. As in Tateyama-Sniezek’s study, achievement results were mixed. However, cooperative structures that incorporated individual accountability and group rewards were found to be more likely to improve the performance of students with LD. This finding is similar to the results of reviews of research on the academic benefits of cooperative learning in science education for students without disabilities (Lazarowitz & Hertz-Lazarowitz, 1998; Slavin, 1984; 1996). It should be noted that collaborative learning in science education does not often include a reward structure; however, the kind of group investigation used in guided inquiry is also described by Slavin (1996) as a condition where rewards are not necessary because students are motivated by their interest in the topic and their interdependence on each other for developing their understanding of the phenomenon being studied. McMaster and Fuchs (2002) concluded that more research is necessary before cooperative learning can be viewed as an effective learning strategy for all students with LD.

Nind and Wearmouth’s (2006) literature review provided an overview of the various ways that teachers are effectively including students with LD. The review supported the potential of peer group interactive/cooperative learning approaches for supporting the achievement and progress of students with LD. Their findings suggested a number of considerations for successful inclusion of students with LD in collaborative learning activities: (a) the relationship between
academic and social dimensions is not always clear, but significant learning depends on both social and cognitive supports being in place, (b) careful planning of group work, including delineation of the roles of group members is needed, (c) group work skills are taught in a holistic way, e.g., embedded in classroom activity and subject knowledge, (d) teachers act as models for learning, and (e) teachers who effectively include students with LD demonstrate a concern for participation in the learning community, cooperation, and collaboration.

Jenkins and O’Connor (2003) reviewed research on the use and effectiveness of cooperative learning for students with LD. The scope of their review included: (a) experimental studies comparing academic learning with and without cooperative learning, (b) classroom observational studies of students’ and teachers’ behaviour during cooperative learning, and (c) interviews with teachers who used cooperative learning activities in their classrooms. From the experimental studies, Jenkins and O’Connor were unable to draw firm conclusions about the extent to which cooperative learning supports the achievement of students with LD for a number of reasons. The results of the studies examined were inconsistent—some results were positive, some negative, some positive but not significant, and many were confounded by the presence of instructional strategies that were integral parts of the studies. Jenkins and O’Connor also called for more studies that attend to the effect of cooperative learning from the perspective of constructivist learning theories.

Two long-term observational studies reviewed by Jenkins and O’Connor (2003) rated the successful participation of students with LD in cooperative learning structures as only 40 to 44%. A third observational study reported that students with LD experienced more group involvement in cooperative conditions where students were given instruction on how to cooperate with their peers.

In their review of interview studies with teachers about their use of cooperative learning, Jenkins and O’Connor (2003) briefly cited a number of studies to establish that a very high percentage of teachers in the U.S. use cooperative learning in a number of subject areas.
However, they also emphasized that teacher conceptions of cooperative learning did not always match cooperative learning as defined in the research literature. The remainder of the literature review on teacher interviews focused on one study—Jenkins, Antil, Wayne, and Vadas (2003). In-depth interviews with 21 teachers across two school boards revealed that general education teachers saw cooperative learning as one of the best strategies for teaching students with disabilities. However, many teachers also acknowledged that cooperative learning did not always work well for students with LD and that they sometimes had to make changes to their cooperative learning strategies to accommodate these students academically (and which often undermined the student’s collaboration in the group). Teachers also considered outcomes other than academic achievement in their positive reviews of cooperative learning—they included benefits such as “self-esteem, a safe learning environment, higher success rates, and better classroom products and participation levels” (p. 427).

In a general summary of their findings, Jenkins and O’Connor (2003) highlighted how individual characteristics of students with LD play a role in their success, as well as how they are perceived by their classmates, and called for more research in this area.

*Individual studies.* Although the current study is primarily concerned with the social aspects of collaborative learning, this literature review also examines academic challenges faced by students with LD when engaged in collaborative learning. The gap between students’ abilities and the academic skills required of them in a collaborative learning activity has a bearing on the student’s success and on how their value is perceived by other group members, judged by the contribution they believe he or she can make (Jenkins & O’Connor, 2003). As Nind and Wearmouth (1996) discussed:

The evidence indicates that peer group interactive approaches that are effective in academic terms are also often effective in terms of social participation and children’s attitudes to learning. Teasing out the elements of the approaches that are functionally related with each outcome…is difficult and probably unnecessary in professional rather than research terms. (p. 122)
The science curriculum requires students to use all the processes typically associated with LD—speaking, reading, writing, reasoning, and math (Scruggs & Mastropieri, 1994). The reading, writing, and speaking of the language of science is challenging for many students without LD; much more energy and effort must be expended by students with LD in this context. Palincsar et al. (2001) reported one identified student as saying, “I am thinking so hard in science that my head hurts. I need to sleep for the rest of the day” (p. 23). If students are using all their cognitive space to learn basic vocabulary or laboratory skills, they will have little capacity for abstract thinking and reasoning (Palinscar et al., 2001). In addition, if the social skills of a student with a learning disability prevent him or her from interacting fully with group members during collaborative learning, he or she will not receive the academic help intended by the collaborative approach.

Blake’s (2002) study of an exemplary teacher who used guided inquiry instruction combined with explicit collaborative learning skills instruction did not specifically address students with LD. However, a personal communication with the author (R. Blake, January 21, 2005) confirmed that the class contained a number of students with LD who successfully participated in collaborative groups without extra support or instruction.

Dalton et al. (1997) examined the experiences of students with LD in guided inquiry science (called supported inquiry in this study) versus activity-based science, where the teacher does not take an active role in directing student learning. In their literature review they argued that students with LD experience challenges at each phase of the learning cycle: At the exploration phase, they may fail to activate prior knowledge, be reluctant to take risks by posing questions, and have difficulty with planning, using feedback, and making adaptations; at the explain phase students with LD may be challenged by language and literacy tasks, have difficulty making connections between various ideas, and have trouble reconciling conflicting results; at the apply phase, they may have difficulty transferring their knowledge to new contexts. Dalton et al.’s results indicated that both students with and without LD demonstrated greater concept
learning in the guided inquiry environment with guidance from a teacher-coach. Students with LD performed on par with students without LD on diagrammatical tests, but their results were not as high on written tests. Dalton et al. attributed the success of students with LD to frequent informal assessments that helped teachers to understand their misconceptions, the chance to demonstrate their understanding through multiple modalities, and many opportunities for students with LD to co-construct knowledge with peers through recursive, experience-based discussions (guided by a skillful teacher).

But several other studies showed challenges for students with or without LD in collaborative learning groups. Hutchinson, Freeman, and Steiner-Bell (2002) suggested that:

Students with learning disabilities who are not accepted by their peers may face obstacles in participating fully in a collaborative process, obstacles that are not necessarily made explicit in class-wide discussions. Even if peer acceptance is present, and even if students are willing tutors and co-participants in inclusive classrooms…peers may not be equipped to provide the kind of specific instruction that students with learning disabilities require. (p. 6)

Scruggs and Mastropieri (1994) examined the scientific knowledge construction of students with LD in both teacher-led and group inquiry-oriented activities in both mainstream and special education classrooms. Their findings indicated that while students with LD benefited from active, inquiry-oriented learning, many aspects were challenging to them, and special education settings, with intensive coaching and scaffolding from the teacher better facilitated learning.

In Phase I of their research on group inquiry-based instruction in inclusive classrooms, Palincsar et al. (2001) reported that students with LD struggled with language/cognition, print literacy, attention, and social relations challenges. They described students with LD having difficulty gaining access to ongoing group work. Video recordings captured “group members removing materials from the hands of identified students and precluding their involvement; others show students with LD roaming away from their groups, often in search of other identified children, in the apparent hope that they will find a partner with whom to work” (p. 23).
Based on their work in classrooms that included students with LD, Palincsar et al. (2001) recommended two main interventions to support the academic learning of these students. First, rehearsing and mini-conferencing were used to monitor/facilitate students’ thinking. Students were given the opportunity to rehearse the presentation they were preparing for their classmates. Mini-conferences were highly mediated by the teacher and involved discussion about possible questions peers might ask during the presentation. Second, teachers supported print literacy through: (a) providing a glossary of terms that would help to support students’ writing, (b) providing specific prompts for lab book entries (to reduce conflation of descriptions and explanations), and (c) where necessary, transcribing of students’ ideas by a peer or paraprofessional. These strategies were implemented with a high degree of success in Phase II of the study. Hutchinson (1996) similarly recommended the use of learning materials such as illustrations, videotapes, audiotapes, and personally relevant stories and examples that do not entirely depend on reading.

Scruggs and Mastropieri (1994) showed positive results in their work with students with LD through inquiry oriented active knowledge construction and by coaching scientific reasoning. However, they noted that:

Although students with mild disabilities actively engaged in the construction of scientific knowledge, such knowledge did not seem to come easily. Difficulties were observed at all phases of the learning process; these were overcome by intensive efforts of highly skilled special education teachers. Additionally, further research is needed to uncover the most appropriate teaching strategies for achieving different learning outcomes. (p. 316)

The teachers in Palincsar et al.’s (2001) study were successful in providing intense support for their students with LD through the interventions co-constructed with the researchers. However, these teachers were in turn highly supported by the research project through long-term professional development and researcher involvement in their classrooms.

O’Connor and Jenkins (1995, 1996a) conducted a two-year observational study of students with LD as they engaged in cooperative reading lessons with their non-disabled peers. In the first year their observations focused on 12 students with LD in one class and in the second
year they focused on 10 students across two classes. Students were observed for a total of 2 to 6 hours over several months. The same cooperative reading program was used in all three classrooms. As part of the Year 1 phase, teachers were also interviewed about their rationale for using cooperative learning and their perceptions of cooperative activities as a strategy for the inclusion of students with LD in regular classrooms. Observations were assessed in terms of help received from peers, contributions to group products, and progress on assigned tasks. Based on this analysis, only 40% of cases in the first year were classified as successful and 44% in the second year (with ambiguous cases classified as successful). In successful cases of cooperative learning, the researchers described the formation of positive partnerships, teaching cooperative behaviours and an ethic of cooperation, teacher monitoring of group functioning, and scaffolded instruction as supporting factors.

In a follow-up article where they reflected on their choice to make individual students with LD the focus of their studies, O’Connor and Jenkins (1996b) discussed the role that characteristics of individual children might play in their participation in cooperative learning. In addition to cognitive abilities and academic skill level, individual differences like social competence and temperament were proposed as important factors in the success or failure of students with disabilities, and the attitude and temperament of the student(s) without LD with whom they were grouped. O’Connor and Jenkins hoped to further explore the influence of individual characteristics in a future post hoc analysis, but the size of the data set did not allow for it (J. R. Jenkins, personal communication, January 23, 2005).

Berry (2006) examined strategies to support the participation of students with LD during whole-class lessons. Berry described one of the challenges of conducting whole-class lessons as “actively engaging all students, including those with LD, who often have difficulty with attending and responding” (p. 212). For example, limited occasions for interacting and participating may provoke inattention and constrain learning opportunities. However, Berry’s review of collaborative lessons in a teacher-led, whole-class format also revealed potential benefits for
students with LD who experience attention problems. Whole-class discussions provide public confirmation and review of key knowledge. The teacher controls the pace and complexity of the lesson in order to accommodate varying needs of students. Asking questions with known-answers may provide a predictable way of experiencing both social interaction and the academic routines of the classroom. Finally, a skillful teacher can promote deeper thinking by asking challenging questions.

Berry (2006) cited the work of Goldenberg on “instructional conversation” as a basis for her work. An instructional conversation is defined as:

Interesting and engaging…It has a focus that, while it might shift as the discussion evolves, remains discernible through-out. There is a high level of participation…Students engage in extended discussion—conversations—with the teacher and among themselves…Topics are picked up, developed, elaborated. Both teacher and students present provocative ideas or experiences, to which others respond…The teacher knows when to bear down to draw out a student’s idea and when to ease up, allowing thought and reflection to take over. Perhaps most important, he or she manages to keep everyone engaged in a substantive and extended conversation, weaving individual participants’ comments into a larger tapestry of meaning. (Goldenberg’s study, as quoted in Berry, 2006, p. 212)

In whole-class lessons involving instructional conversations, the teacher follows the theme, connects with background knowledge and previous lessons, and directly teaches skills and concepts at the appropriate time, while simultaneously supporting general discussion and participation, and remaining open and flexible to student interests and ideas.

Berry (2006) organized the strategies described in the literature pertaining to access to class discussions into two broad groups: (a) procedural strategies designed to make lessons easier to follow and topics more transparent, and (b) involvement strategies that ensure participation of all students. Procedural strategies involved identifying materials, techniques and processes, and modeling learning processes and concepts; in addition, procedural strategies provided repetition and feedback, and management of transitions and behaviour (including attention). Involvement strategies included four categories: Encouraging strategies to create a comfortable and inviting atmosphere for participation; orchestrating strategies to facilitate participation and the
incorporation of student contributions; *sharing ownership* strategies to transfer some control/ownership of the learning processes to the students; and *scaffolding* strategies, to support the participation of individual students who need support to participate and communicate in the activity.

Berry’s (2006) study supported the important role that teachers play in whole-class lessons/discussions, especially in inclusive classrooms. “A greater teacher presence in and scaffolding of discussions is particularly important with younger students, for whom sustained discussions and knowledge building is difficult” (p. 228). Berry’s analysis identified and described a range of strategies used by two elementary teachers to support the verbal participation of young students with LD during whole-class text composition lessons. First, both teachers used strategies that helped to plan next steps, monitored content and progress, and eased transitions. Second, both teachers modeled the steps in the learning processes (e.g., selecting ideas, text construction, sequencing). Third, both teachers repeated and paraphrased student contributions so that their ideas were clearly understood by their peers and to help with memory. Fourth, the teachers respected and included all students’ ideas, and gave credit for contributions to encourage participation and ownership. Fifth, both teachers issued both general calls for responses and also direct calls to individuals to ensure participation opportunities for all students.

**Social Competence**

The LD literature organizes and defines the concepts of social skills and social competence in numerous ways. For this study, the researcher chose to use Vaughn and Hogan’s (1990) conceptualization of social competence as a basis for presenting the research on social interactions of students with LD. Vaughn and Hogan view social competence as a higher order construct made up of many components that combine for effective social behaviour. These components are organized into four categories: positive relations with others, accurate/age appropriate social cognition, absence of maladaptive behaviour, and effective social behaviour.
These categories evolved new headings during data collection and analysis, and are discussed as: Relationships with Others, Social Cognition, Behaviour, and Social Skills in this document. Each of the following sections of the literature review presents research documenting the experiences of students with LD within each of these categories.

**Relationships with Others**

Within the context of school, the “relationships with others” component includes social status, friendship patterns, and relationships with teachers. Unfortunately, for students with LD, school is often a hostile environment due to the negative attitudes others have towards them.

**Social status.** In the studies reviewed for this section of the paper, the social status of children with LD was measured in two ways: ratings by significant others (e.g., peers, teachers) using nomination or rating-scale procedures, and direct observation of behaviour in classrooms and other school settings. These measures produced results along three separate factors: acceptance, neglect, and rejection (Wiener, 1987). While the results of the studies indicate generally lower social status and acceptance of students with LD, it is important to note that there is considerable variation among students with LD, and that some students with LD, as many as half, are accepted by their peers (Hutchinson, Freeman, & Berg, 2004).

T. Bryan (1974a, 1974b, 1976) published a series of groundbreaking studies that drew the attention of the field to the low social status of children with LD. The results of these studies indicated that students with LD, matched on the variables of gender, race, and classroom, were significantly less accepted, and significantly more rejected than comparison students without LD across time and classrooms. Over the last 30 years, reviews of the literature and meta-analyses examining the wealth of studies addressing the social status of students with LD have overwhelmingly supported these initial findings. Wiener (1987) reviewed 19 studies, 15 of which reported lower peer status for students with LD—methodological issues accounted for the discrepant findings in the remaining four studies. Swanson and Malone (1992) conducted a meta-
analysis of 39 studies published between 1974 and 1990 that directly compared LD students to average achieving (AA) students. Results indicated that children with LD are less likely to be accepted, and more likely to be rejected than AA peers. Kavale and Forness (1996) conducted a meta-analysis of 152 studies. Quantitative synthesis showed that eight out of ten students with LD appeared to be rejected by their peers without LD, and that seven out of ten students with LD would not be considered “friends” by their peers.

Numerous studies have found gender and race differences with respect to children’s social status. White girls with LD appear to be more rejected and less accepted than any other group (and in some cases, there were no rate of acceptance differences for boys) (T. Bryan, 1974a, 1974b; T. Bryan & J. H. Bryan, 1990; LaGreca & Stone, 1990a; Stiliadis & Wiener, 1989; Swanson & Malone, 1992; Wiener, 1987). For example, LaGreca and Stone (1990a) found that: LD boys were not rejected more than average achieving (AA) boys, but were the most neglected group; girls with LD were more rejected and neglected than AA girls; and low achieving (LA) girls were also rejected. Researchers hypothesize that because society has the highest expectations for academic success for white, elementary school-age girls, discrepant behaviour on their part is more rejected (T. Bryan, 1974b; LaGreca & Stone, 1990a; Wiener, 1987).

Conclusions on this finding tend to be tentative because of the smaller sample sizes available for girls with LD. Girls with LD may be at still more of a disadvantage in science, as they are typically not allowed by peers to participate to the same extent as boys in mixed gender groups (Webb & Palincsar, 1996).

Friendship patterns. Despite low social status, many children with LD do have friendships (Farmer, van Acker, Pearl, & Rodkin, 1999; Pearl, 2002, Wiener, 2002). However, boys with LD tend to have fewer mutually nominated friends at school (Wiener, 2002). Wiener also found that children with LD have more friends with learning problems than children without LD, more friends that were two or more years younger than them, friendships that were less stable, and that in pairs of students with LD and students without LD, the students with LD
placed a higher value and quality rating on the friendship than did the student without LD. Regardless of these findings, having even one friend at school appears to act as a buffer for the feelings of low self-esteem, loneliness, and depression that frequently affect students with LD.

*Relationships with teachers.* Observational research suggests that students with LD interact more with their teachers than students without LD; however, the interactions tend to be negative. T. Bryan (1974a) used an interaction process analysis to document and analyze the ongoing interactions of five LD boys and five boys without LD in grade 3, matched for grade, sex, and race. The results showed that while both groups of students spent similar proportions of time interacting with teachers in the regular classroom, there were significant differences in the patterns of interactions. The teacher was almost three times as likely to ignore the verbal initiations of students with LD compared to the students without LD. In addition, half of the time spent in interactions with LD students was devoted to helping with academic work, compared to one quarter for students without LD. Students with LD and students without LD received similar numbers of positive comments from their teachers, but the students with LD also received more negative feedback than the comparison students.

Pearl, Donahue, and T. Bryan (1986) reviewed three separate studies documenting the negative attitude of teachers towards students with LD. Especially in comparison to students without LD, teachers considered students with LD to possess many negative and bothersome characteristics, such as disruptiveness, hyperactivity, attention problems, aggression, poor tact, immaturity, and irresponsibility. Kavale and Forness (1996) found that teacher ratings of behaviour were not always supported by other data sources.

T. Bryan and J. H. Bryan (1977) described the negative treatment of students with LD by teachers as subtle (in comparison to the overt rejection received from peers). Rejection by teachers is communicated through body language and tone of voice, and by ignoring verbal initiations and by not interfering in negative interactions between students. LaGreca and Vaughn (1992) reviewed a number of studies that suggested that even this subtle rejection of students with
LD by their teachers is communicated to classmates without LD. In classrooms where students with LD were highly accepted by their teachers, students with LD were as well liked and no more rejected by their classmates than students from other achievement groups.

**Social Cognition**

The social cognition component of social competence encompasses the internal processes of social interactions: social perception (nonverbal communications of emotion and intent), understanding the perspective of others, social problem solving, and self-perceptions.

**Social perception.** LD researchers used drawings, photographs, videotapes and audiotapes, vignettes, and teacher ratings to study the social perception abilities of students with LD. Gerber and Zinkgraf (1982) and Stiliadis and Wiener (1989) showed students with and without LD a series of unambiguous pictures showing various social situations. When asked a series of questions about each picture, students with LD were consistently less competent at making inferences from the pictures. In addition, Stiliadis and Wiener asked teachers to rate students on various social perception skills (e.g., misinterprets facial expressions or gestures, misses nonverbal cues). Students with LD scored higher on the teacher rating scale (indicating poorer social perception) than their peers without LD. Weiss (1984) determined that boys with LD perceived ambiguous videotaped scenes and verbal descriptions of horseplay as more “unfriendly” than comparison students without LD. T. Bryan and J. H. Bryan (1977) found that students with LD were less accurate at understanding facial expressions and tone of voice than peers. However, Stone and LaGreca (1984) found no significant differences between groups when they replicated this study with incentives to help focus the attention of LD students on videotaped clips. Pearl and Cosden (1982) showed children a series of clips depicting subtle relationships between characters taken from soap operas and asked them to select descriptions of
what was happening in a multiple-choice format. Students with LD were consistently less accurate than their peers without LD at interpreting social scenarios.

*Social perspective taking.* Social perspective taking refers to an individual’s ability to understand another person’s thoughts and feelings (Tur-Kaspa, 2002). T. Bryan (1991) reviewed nine studies that compared students with LD to students without LD on various measures of perspective taking. A number of measures involved the subject re-telling stories based on pictorial cues from the perspective of different characters in the story, through the eyes of characters introduced at various points in the story (i.e., would have different information about the causes and effects of a chain of events), or from the perspective of someone else telling the story if pictures were removed. In other measures, a conflict was introduced between information the subject possessed and the information a character in the story possessed. Other studies asked students to identify what a simple scene would look like from different visual perspectives, or what emotions a person might feel when faced with a specific event. While T. Bryan’s critical evaluation of the methodologies revealed several weaknesses in the studies (including a concern that these tests were actually capturing nonverbal communication deficits), and the results of the studies were mixed, her overall conclusion was that students with LD appear to be at-risk for poor social perspective taking, with less improvement over time.

*Social problem solving.* Based on their meta-analysis of the social competence literature, Kavale and Forness (1996) reported that 80% of students without LD are better at social problem solving than students with LD. Toro, Weissberg, Guare, and Liebenstein (1990) determined that students with LD were less able to generate alternate solutions to problem situations (e.g., you want to take home the class pet that another child also wants to take home) than students without LD. Boys with LD were found to generate less sophisticated and specific goals when presented with social problems than boys without LD, though when presented with multiple-choice solutions to the problems, there were no significant differences between groups (Ollva & LaGreca, 1988). Based on a review of the social problem solving literature, Pearl, Donahue, and
T. Bryan (1986) reported that students with LD performed similarly to students without LD at recognizing appropriate responses to social problems, but when asked to choose which one they would use, they selected less socially acceptable actions.

Tur-Kaspa and T. Bryan (1994) examined the social problem solving skills of students with LD, low-achieving (LA), and average achieving (AA) students as a five-step process, and found that students with LD were less skilled than AA classmates at each step. Students with LD performed poorly at the encoding phase, and tended to insert extraneous information not presented in the original problem situation. While there were no significant differences at the interpretation step, AA students were more likely to generate multiple interpretations of the problem situation than the comparison groups—students with LD and LA students tended to view the situations as positive or negative, with no possibility of “grey” areas. At the next step, AA students generated more possible solutions to the problem situation than the other groups. Fourth, at the response decision step, AA and LA students selected more competent self-generated solutions than students with LD. Finally, AA students were better at role-playing the enactment process of their problem solution than students with LD or LA students.

Self-perceptions. “Self-perceptions” refer to “attributes or characteristics of the self that are consciously acknowledged by the individual through language—that is, how one describes oneself” (Harter, 1999, p. 3). One’s overall sense of self-worth is defined as “self-esteem” (Cosden, Brown, & Elliot, 2002). To measure academic self-perceptions of students with LD, Harter (1999) developed a scale that acknowledged LD students’ ability to differentiate their general intelligence from their performance in specific subject areas (e.g., reading, writing, math). That children are able to differentiate these factors indicates that they are as capable of evaluating their academic competencies as their non-disabled peers (Cosden et al., 2002). A review by Elbaum and Vaughn (2003) concluded that students with LD in inclusive classrooms had lower academic self-perceptions than students with LD in special education classrooms, reflecting the effect of to whom the students were comparing themselves. They reviewed three meta-analyses
that all revealed significantly lower academic self-perceptions among students with LD than among students without LD. Similarly, LaGreca and Stone’s (1990b) literature review reported that most students with LD have more negative academic self-perceptions than students without LD. Vaughn and Hogan (1990) reported that the self-perceptions of students with LD were remarkably accurate—high for overall intelligence, low for academic achievement. Many studies report lower global self-esteem for students with LD than for other populations, including LA students (e.g., Elbaum & Vaughn, 2003; Gresham, 1988; LaGreca & Stone, 1990b; Swanson & Malone, 1992). This may be explained by the finding that the personal worth of students with LD is strongly tied to academic performance (Vaughn & Hogan, 1990). However, T. Bryan and Pearl (1982) failed to find a difference between students with LD and students without LD on a self-esteem scale.

Results from the research about the social self-perceptions of students with LD are mixed. Some researchers report that students with LD have high self-perceptions of social acceptance relative to reality (e.g., T. Bryan, 1997; Vaughn & Hogan, 1990), perhaps as a defense mechanism (Cosden et al., 2002). Others report that the social self-perceptions of LD students are as accurate, and, in most cases, lower than students without LD (e.g., LaGreca & Stone, 1990a). Finally, some studies found there to be no difference in the social self-perceptions of students with and without LD (e.g., Bursuck, 1989).

Kavale and Forness (1996) reported that two thirds of all students with LD included in their meta-analysis had an external locus of control—that is, they attributed academic success to luck, and failure to a lack of ability or effort. Tur-Kaspa and T. Bryan (1993) studied the beliefs of students with LD and students without LD about their social successes and failures. They found that students with LD are more likely to use external factors in explaining social successes and failure, though they also attributed successes to internal factors. Attributing academic and social outcomes to factors beyond one’s control is thought to lead to the condition of “learned
helplessness,” where a child believes that his or her behaviour and its outcomes are independent (Gresham, 1988).

**Behaviour**

A socially competent child is partially defined by the absence of behaviour problems and by the presence of age appropriate self-control (Vaughn & Hogan, 1990). Thompson and Kronenberger (1990) identified two patterns of behaviour problems in children: (a) externalizing behaviours, including aggressive, acting out, conduct disordered, and under-controlled behaviours; and (b) internalizing behaviours, including inhibited, shy-anxious, personality disordered, and over-controlled behaviours. In a series of studies of preschool and elementary school aged children, Thompson and Kronenberger compared samples of a number of populations. While data revealed higher rates of behaviour problems in children with LD than in a general population sample, children with LD displayed lower rates of behaviour problems than children with identified emotional or behaviour disorders. Based on their meta-analysis of the LD literature on social competence, Swanson and Malone (1992) reported that students with LD evidenced more maladaptive problem behaviours than did 78% of students without LD. Similarly, Vaughn and Hogan’s (1990) review of the literature concluded that the presence of behaviour problems appeared higher in populations with LD than populations without LD, but emphasized that students with LD are not *markedly* deviant in behaviour or emotional expression compared to students without LD within a school setting—i.e., the problem behaviour of students with LD, though high, typically falls within the “normal” range.

In a review of the literature on the social relationships of children with LD, Pearl et al. (1986) identified several specific behaviours considered to be maladaptive in the classroom context. Most consistently, peers and teachers reported that students with LD are as much as 80% more likely to be off-task than peers without LD (Swanson & Malone, 1992), and are easily distracted. Other maladaptive behaviours attributed by teachers and peers to students with LD
included: hyperactivity, disruptiveness, inattentiveness, aggression, uncooperativeness, and withdrawal (T. Bryan, 1974a, Bursuck, 1989; Kavale & Forness, 1996; Pearl et al., 1986), though these traits were not found consistently across studies.

Farmer et al. (1999) examined peer-assessed problem behaviour in relation to peer group membership, social status, and LD. The results indicated that while most students with LD were not high in problem behaviour, and most high problem behaviour students were students without LD, students with LD were disproportionately nominated to the highest level of problem behaviour (especially “starts fights”).

LaGreca and Stone (1990a;1990b) theorized that some of the inconsistency across studies of the behaviour of LD students might be explained by gender differences and by examining the role of achievement in students with and without LD. Participants in grades four through six were matched for reading achievement, gender, age, classroom, and race. Teachers rated students on conduct disorder, attention problems, and anxiety-withdrawal items. The results suggested significant group differences for attention problems. LaGreca and Stone concluded that in comparison to other LA students, high attention problems are a distinguishing trait for boys with LD and lower conduct problems and higher anxiety-withdrawal ratings distinguished girls with LD.

Social Skills

Social behaviour constitutes a range of pragmatic skills often targeted for behavioural observation or intervention, due to their overt nature (as opposed to social cognition, though the two components greatly overlap) (Vaughn & Hogan, 1990). According to the meta-analysis conducted by Kavale and Forness (1996), 75% of students with LD are challenged by social skills deficits. These skills primarily refer to the social use of language, including spontaneous use of language, adapting language and tone of voice to the listener’s characteristics, communicating effectively, and listening skills (Dudley-Marling, 1985).
Spontaneous use of language. In two separate studies, T. Bryan, Wheeler, Felcan, and Henek (1976) and Pearl et al. (1986) found the number of verbal interactions between students with LD and students without LD to be quantitatively similar to interactions between students without LD, but to be qualitatively different. In general, LD-without LD interactions were more negative in tone—students with LD directed more “nasty” and “competitive” comments, and fewer “consideration” statements to peers. In return, they received more “rejection” and fewer “consideration” statements.

Adapting language. Investigations of the ability of students with LD to adapt their language to listeners of various ages and status have included studies of requesting strategies (e.g., Donahue, 1980), ingratiating strategies (e.g., J. H. Bryan, Sonnefeld, & Greenberg, 1981) and teaching games or tasks (Dudley-Marling, 1985). Donahue (1980) found that boys and girls with LD were very polite with all imaginary listeners when instructed to make a request of each, but did not vary requesting strategies as effectively as comparison students without LD. J. H. Bryan et al. (1981) reported that adults found the ingratiating strategies of children with LD to be less appealing than those of their peers. Dudley-Marling (1985) reviewed a number of studies in which students with and without LD were instructed in a game or task, then asked to teach the game or task to peers or younger children. He reported mixed results across studies and between genders.

Communicating. In a small-group decision-making task, children were asked to rank order a list of gift items for their class (T. Bryan, Donahue, & Pearl, 1981). Each small group was composed of one student with LD and two peers without LD. Group interaction was videotaped and later coded. Students with LD students were found to be less persuasive than their group members without LD—they disagreed less frequently and agreed more frequently, and they were less likely to argue for their choices (children independently ranked the items prior to group discussion). Children with LD were less likely to make an effort to direct the conversation and keep it on track. Overall, they assumed a submissive, deferential role.
In order to determine whether LD students’ conversational unassertiveness was a result of communication deficits or low status, T. Bryan, Donahue, Pearl, and Sturm (1981) placed students with LD in a dominant social position, that of a TV talk show host interviewing a student without LD. Though co-operative partners, hosts with LD asked fewer questions than hosts without LD, and were less likely to ask process questions (open-ended questions eliciting extended responses) and offer comments to encourage further elaboration by the listener. In a follow-up study, T. Bryan and Donahue (1982) tested the effects of modelling open-ended questions, conversational devices, and sample responses. Modelling increased the generation of process questions and comments among hosts with LD, but these attempts appeared more difficult for their listeners to understand and build on.

*Listening.* Donahue (1997) reported findings on beliefs about listening in students with LD gathered through a series of investigations. In the first study, children were asked to select one of four similar pictures based on descriptions given by an adult researcher. Most of the descriptions did not provide enough information to specify only one picture. Students with LD were less likely than their peers to request clarification or to ask for more information. Further tests showed that students did in fact realize the messages were ambiguous, that they did have the skills to ask for more information, and that they did realize that they were allowed to ask questions. Donahue concluded that children with LD assume that the adult has given them all the information that is required to make a selection, and that the fault must be theirs in misunderstanding the task. Further, students with LD desire to mask their comprehension difficulties from adults and peers—this prevents them from requesting help. Further studies were designed to test this hypothesis. Students were given three brief stories in which a child became confused by a teacher’s or other adult’s directions, or examples of communication breakdowns and asked to assign blame. For each case, students with LD were more likely to attribute the cause of the confusion to the listener, and when offered a choice of solutions, were more likely to pick “low-profile” strategies.
Chapter Summary

This chapter described the theoretical framework and the literature review. Social constructivism provided the theoretical framework for this study, and also for many topics explored in the literature review, including teaching and learning in guided inquiry science, communities of learning, and collaborative learning. The literature on guided inquiry science and communities of learning provided information about the learning context in which the study was conducted. Literature about the learning cycle associated with guided inquiry science, the literature describing the aspects of social competence, and community of practice theory helped guide the organization and interpretation of the data.

Social constructivist theory, and research on guided inquiry science, communities of learning, and collaborative learning provide a strong argument that learning is truly a social process and that the social nature of collaboration and negotiation of meaning is essential for learning. Viewing the research on the components of social competence and the challenges students with LD face in each of the components, suggests a number of ways in which social competence might act to support or constrain participation in collaborative, guided inquiry science activities: (a) low peer and teacher acceptance may prevent students with LD from gaining access to activities completed in small-group or pairs, (b) social cognition deficits may hamper the ability of students with LD to understand and negotiate the subtleties of group processes and interactions, (c) maladaptive behaviour makes it difficult to conform to the behaviour requirements of hands-on, student directed learning, and (d) poor social skills make it difficult to perform the tasks required for contributing to group discussion and work.

Through the research literature, it becomes clear that an understanding of how social competence affects the participation of students with LD in collaborative learning formats, and how their participation might be supported through social competence, may be crucial in understanding science learning.
CHAPTER 3: METHOD

Introduction

This study of the experiences of students with LD during collaborative science inquiry was conducted using teacher interviews, classroom observations, and examples of students’ written work. Observations focused on five focal students who were either formally identified with LD or who were identified by the teacher as at-risk for LD. The researcher selected a qualitative approach because qualitative inquiry involves the detailed description required for studying learning processes from the perspective of the participants—the teacher and the students (McMillan & Schumacher, 2006; Patton, 2002). The reliability of the data were supported through accuracy and comprehensiveness (Bogden & Biklen, 2003). Accuracy was ensured through highly detailed “Classroom Observation Notes” (Appendix A) that were created using handwritten field notes and audio recordings, verbatim transcripts of audio-taped interviews, and exact photocopies of written work. Comprehensiveness was supported through the use of three different data sources. The researcher’s own experience as an elementary teacher, and deep and long-term immersion in the setting may help to make the descriptions of the data resonate with the readers (Eisner, 1991).

Detailed classroom observations were the primary source of data. The researcher conducted two interviews with the teacher that provided insight into the teacher’s instructional approaches, classroom management strategies, and students’ characteristics, and a means for enriching and validating classroom observations. The first interview was conducted prior to classroom data collection. The second interview was conducted after, and informed by, the initial analysis of the data from the classroom observations and the first interview. Students’ written work provided evidence of learning and the worksheets provided insight into the teacher’s science teaching methods.
The methods used for this research study are outlined in two sections below. The first section describes the procedures used for participant recruitment, data collection, data labeling, and data analysis. The second section provides detailed information about the setting and the participants.

Procedures

Recruitment

After receiving approval from the university Research Ethics Board and the local school board to begin research, the researcher sent emails to school principals asking permission to recruit teachers for a research study from their schools, but received few responses. Next, the researcher distributed a brief survey (Appendix B) to Grades 2, 3, and 4 classroom teachers in the school board with a self-addressed, stamped envelope attached. Approximately 100 teachers in 20 schools received surveys. At each school, the researcher met briefly with an administrator to explain the purpose of the research and the data collection process. If an administrator was not available, the researcher left a detailed letter about the study and followed up with a telephone call to the school at a later date. The survey asked teachers to indicate their grade level and class composition, their use of guided inquiry and collaborative learning in science, and their willingness to participate in the study. The researcher received two surveys declining participation, and one survey from a Grade 2 teacher expressing interest in participating. The researcher provided the teacher with a Letter of Information and a Consent Form (Appendix C), and obtained the teacher’s consent to participate. The teacher distributed Letters of Information and Consent Forms to her students (Appendix C). However, not enough consent forms were returned by the students (and none from students with LD) to warrant data collection in the classroom.

Next, the researcher made contact by telephone with a Grade 5 teacher she knew to be interested in participating. The researcher sought and received permission from the Research
Ethics Board to extend the study to Grade 5 classrooms, and the process of obtaining consent from the teacher and students began again. For a second time, not enough consent forms were returned by the students to warrant data collection. However, the Grade 5 teacher introduced the researcher to a Grade 2 teacher in the same school who expressed interest in the study. The researcher obtained consent to participate from both the teacher and the majority of students in the class, including all of the students the teacher believed to be at-risk for LD.

Data Collection

Classroom Observations

The researcher spent approximately 34 hours in the classroom over a period of two months, observing the teacher and the students and taking detailed field notes. Data were collected primarily during science periods, but observations included Sharing and Calendar times, as well as Physical Education, Math, Art, and Language Arts lessons. Science periods were usually scheduled for the afternoons, but in the last two weeks of data collection (late June), the teacher moved science periods to the morning because students were too hot to concentrate by the afternoon. Table 1 shows a log of the observation periods, along with a brief description of the activities observed each day.

For each classroom observation period, the researcher kept a running record of the ongoing activities of the students and teacher during whole-class, small-group, paired, and independent work. The researcher usually sat in the teacher’s desk during whole-class activities, and moved around the room during small-group, paired, and independent activities, selecting positions to see and hear without being intrusive. The researcher used a small tape recorder to capture as much speech as possible during the observation periods. Observations focused on the teacher, four focal students at-risk for LD, and one focal student formally identified with Asperger syndrome. However, as a single observer, the researcher found it difficult to spread observations.
TABLE 1: Activities Observed During Classroom Observations

<table>
<thead>
<tr>
<th>Date (mm/dd)</th>
<th>Arrive (hr:min)</th>
<th>Depart (hr:min)</th>
<th>Time (hr:min)</th>
<th>Observed Activities</th>
<th>Brief Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>05/07</td>
<td>13:00</td>
<td>14:20</td>
<td>1:20</td>
<td>Science, Sharing</td>
<td>“Power from Moving Water” (moving a floating object without touching it)</td>
</tr>
<tr>
<td>05/09</td>
<td>09:30</td>
<td>11:05</td>
<td>1:35</td>
<td>Science, Calendar</td>
<td>“Comparing Still and Moving Water”</td>
</tr>
<tr>
<td>05/10</td>
<td>13:00</td>
<td>14:10</td>
<td>1:10</td>
<td>Science</td>
<td>“Exploring Gravity”</td>
</tr>
<tr>
<td>05/14</td>
<td>13:00</td>
<td>14:50</td>
<td>1:50</td>
<td>Science</td>
<td>“The Gravity Cup” (exploring the effect of gravity on water)</td>
</tr>
<tr>
<td>05/16</td>
<td>13:00</td>
<td>15:15</td>
<td>2:15</td>
<td>Science, Art</td>
<td>“Waterwheels” (making waterwheels); writing about watercolour paintings</td>
</tr>
<tr>
<td>05/17</td>
<td>13:30</td>
<td>15:00</td>
<td>1:30</td>
<td>Science, Sharing</td>
<td>“Hydroelectric Power”</td>
</tr>
<tr>
<td>05/22</td>
<td>13:30</td>
<td>15:25</td>
<td>1:55</td>
<td>Math, Science</td>
<td>Fractions (quarters); “DMA” (culminating activity: design &amp; make a wind or moving water- powered object)</td>
</tr>
<tr>
<td>05/23</td>
<td>13:00</td>
<td>15:25</td>
<td>2:25</td>
<td>Science, Sharing, PE</td>
<td>“DMA” (continued); Dance</td>
</tr>
<tr>
<td>05/24</td>
<td>10:40</td>
<td>11:55</td>
<td>1:15</td>
<td>Science</td>
<td>“DMA” (continued)</td>
</tr>
<tr>
<td>05/31</td>
<td>13:00</td>
<td>15:10</td>
<td>2:10</td>
<td>Science, PE</td>
<td>“Introduction to Simple Machines”; Games and dance</td>
</tr>
<tr>
<td>06/04</td>
<td>13:00</td>
<td>15:10</td>
<td>2:10</td>
<td>Science, Sharing</td>
<td>“Inclined Plane Expt. #1” (inclined plane or no inclined plane)</td>
</tr>
<tr>
<td>06/06</td>
<td>13:00</td>
<td>14:20</td>
<td>1:20</td>
<td>Science</td>
<td>“Inclined Plane Expt. #2” (varying the slope of inclined plane)</td>
</tr>
<tr>
<td>06/07</td>
<td>10:40</td>
<td>11:45</td>
<td>1:05</td>
<td>Science</td>
<td>“Introduction to Levers”; “Lever Experiment” (balancing loads by adjusting the fulcrum point)</td>
</tr>
<tr>
<td>06/11</td>
<td>13:00</td>
<td>15:25</td>
<td>2:25</td>
<td>Science, Sharing, Art</td>
<td>“Wedge Experiment” (block the door); Drawing Faces</td>
</tr>
<tr>
<td>06/12</td>
<td>09:00</td>
<td>11:05</td>
<td>2:05</td>
<td>Math, Calendar</td>
<td>“Probability Experiment #1” (rising and falling temperatures)</td>
</tr>
<tr>
<td>06/13</td>
<td>09:25</td>
<td>12:00</td>
<td>2:35</td>
<td>LA, Math, Science</td>
<td>Father’s Day writing piece; “Probability Experiment #2” (coin toss); “Exploring Screws and Bolts”; “Screw Experiment”</td>
</tr>
<tr>
<td>06/14</td>
<td>10:40</td>
<td>12:05</td>
<td>1:25</td>
<td>Calendar, Science</td>
<td>“Screw Experiment” (continued); “Simple Machine Hunt” (around school and yard)</td>
</tr>
<tr>
<td>06/18</td>
<td>10:40</td>
<td>12:00</td>
<td>1:20</td>
<td>Science</td>
<td>“Introductions to Wheels and Axles”; “Exploring Gears”</td>
</tr>
<tr>
<td>06/19</td>
<td>09:00</td>
<td>10:20</td>
<td>1:20</td>
<td>Science</td>
<td>“Exploring Pulley Systems”</td>
</tr>
<tr>
<td>06/20</td>
<td>10:40</td>
<td>12:00</td>
<td>1:20</td>
<td>Science</td>
<td>“Compound Machines” (finding simple machines in compound machines)</td>
</tr>
</tbody>
</table>

**TOTAL:** 34:05

PE=Physical Education; LA=Language Arts; DMA=Design and Make Activity
across five students. Because there is disagreement amongst researchers about whether Asperger syndrome should be considered an LD, the researcher chose to collect less data on the focal student with Asperger syndrome when observation time was limited. The researcher also recorded information about the students with whom the focal students interacted. As much as possible, the researcher attempted to rotate her attention from one focal student to the next in equal time periods, especially during small-group or paired activities. If the researcher found a focal student to be totally disengaged from the activity for more than a two minute period, she intervened for the purpose of exploring procedures for re-engaging the students, using low-level interventions (e.g., asking the students to explain what he or she was doing) (Palincsar et al., 2001; Perry, 1998). The nature of the support as well as the student’s response was recorded in the field notes. The researcher took the opportunity whenever possible to speak informally with the teacher about her observations during recesses.

After the classroom observations periods, the researcher typed up the field notes as Classroom Observation Notes, using a word processing program, adding details from memory. Next, the researcher listened to the audiotape, and added further details to the Classroom Observation notes, especially in the form of verbatim speech of the teacher and the students (Appendix A).

Written Work

The researcher made notes about students’ written work (e.g., progress, quality) in the Classroom Observation Notes. In addition, the researcher obtained photocopies of the worksheets completed by the focal students.

Interviews

The teacher was interviewed twice, using a semi-structured protocol. The initial, 60-minute interview sought information about the teacher’s (a) current use of guided inquiry and
collaborative learning in science, (b) goals and rationale for using these instructional methods, and (c) judgments about their efficacy for students with LD (Appendix D). Interview questions were developed using Antil, Jenkins, Wayne, and Vadasy (1998) as a model. A second, 90 minute confirmatory interview was conducted after transcription and initial analysis of the first interview and the Classroom Observation Notes. During the second interview, the researcher sought more detail about data from the first interview and further information about the focal students and the teacher, and asked questions that arose from classroom observations about teaching, classroom management, and collaborative learning (Appendix D).

Labeling and Pseudonyms

Observational data were organized by Classroom Observation Notes and labeled according to date (month and day), page (P), and line numbers (L). For example, May 7, page 1, lines 13 through 18 was coded as: May 7, P1L13-18. If the observational data were from a subject other than science, the name of the subject/activity preceded the date (e.g., SHARING, May 17, P3L8-16). During three science periods, the researcher observed a culminating Design and Make Activity (DMA). Observations from these periods are indicated by “DMA” preceding the date (e.g., DMA, May 23, P2L5-9). Interview data were labeled in the form of the transcribed interview document according to interview number (I) and teacher response number (T), e.g., I1, T86 (interview 1, teacher response 86).

The teacher and the students with consent to participate were given pseudonyms. The students without consent to participate were simply identified as “NC” (no consent) as necessary in the data. The teacher was given the pseudonym “Tracy,” and the focal students were given pseudonyms corresponding to the first five letters of the alphabet—Andy, Beth, Cindy, Doug, and Elena—to facilitate identification by the reader. The pseudonyms of the remainder of the students with consent to participate are: Faith, Ginny, Henry, Isabelle, John, Kelly, Leo, Mary, Ned, and Oliver.
Analysis

The classroom observation notes were analyzed qualitatively, first using codes arising from the research literature, for example, engage, explore, explain, and apply from the science literature; and social status, social skills, behaviour, and social perception from the LD literature. Many codes arose from the data itself, such as classroom management, classroom community, support for learning, forming groups, worksheets, and learning formats. After much coding and re-coding, sorting and re-sorting, the data were organized by category into two large groups. The first group contained information that pertained to all students in the class and all areas of the curriculum as well as data that focused on the teacher and general information about the focal students. These categories included: training and experience, classroom management, classroom community, classroom layout, worksheets and workbooks, format of collaborative learning, rationale for collaborative learning, teaching philosophy, assessment practices, forming groups, teaching group-work, and focal students’ LD. The data from these categories were then combined with some of the interview data, a process described in the next section.

The second group of data contained information specifically on collaborative, guided inquiry learning in science classrooms. These data were organized first by the phases of the learning cycle: Engage, Investigate, Explain/Report. The learning cycle phases used for analysis, and the processes associated with each phase, were originally based on the GIsML orientation of engage, investigate, explain, and report (Magnusson & Palincsar, 1995; Palincsar et al., 2000; Palinscar et al., 2001; Palinscar et al., 2002), but were modified by the researcher to reflect the activities of the classroom. These categories and their subcategories are outlined in Table 2. Next, the data were organized by the actions/experiences of the teacher and each focal student. The data were then further coded using the learning processes that accompany each phase of the learning cycle and the four components of social competence. The social competence categories used were Behaviour, Relationships with Peers, Social Cognition, and Social Skills. These categories and their sub-categories are outlined in Table 3. The main categories for coding by Social
TABLE 2: Learning Cycle Categories and Sub-Categories

<table>
<thead>
<tr>
<th>ENGAGE</th>
<th>INVESTIGATE</th>
<th>EXPLAIN/REPORT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Review of unit topic</td>
<td>• Manipulate materials and tools</td>
<td>• Express ideas</td>
</tr>
<tr>
<td>• Connect new lesson with previous learning</td>
<td>• Make observations</td>
<td>• Use scientific vocabulary</td>
</tr>
<tr>
<td>• Introduction of daily topic and activity/experiment</td>
<td>• Ask questions</td>
<td>• Defend ideas</td>
</tr>
<tr>
<td>• Preparation for the Investigate phase (learning instructions for activity/experiment via worksheet)</td>
<td>• Test ideas</td>
<td>• Consider other’s ideas</td>
</tr>
<tr>
<td></td>
<td>• Design and make</td>
<td>• Negotiate meanings/come to consensus</td>
</tr>
</tbody>
</table>

TABLE 3: Social Competence Categories and Sub-Categories

<table>
<thead>
<tr>
<th>BEHAVIOUR</th>
<th>RELATIONSHIPS WITH PEERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Attentiveness</td>
<td>• Popularity (high, medium, low)*</td>
</tr>
<tr>
<td>• Cooperativeness*</td>
<td>• Social Status (accepted, ignored, rejected)</td>
</tr>
<tr>
<td>• Joining in*</td>
<td>• Inclusion* (in group activity)</td>
</tr>
<tr>
<td>• Task initiative*</td>
<td></td>
</tr>
<tr>
<td>• Activity level/self-control</td>
<td></td>
</tr>
<tr>
<td>• Taking turns/Sharing</td>
<td></td>
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<tr>
<td>• Assuming responsibility for one’s actions*</td>
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<table>
<thead>
<tr>
<th>SOCIAL COGNITION</th>
<th>SOCIAL SKILLS</th>
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<tbody>
<tr>
<td>• Social perception</td>
<td>• Language use</td>
</tr>
<tr>
<td>• Understanding the perspective of others</td>
<td>• Communication skills</td>
</tr>
<tr>
<td>• Social problem solving (e.g., making compromises)</td>
<td>• Listening skills</td>
</tr>
<tr>
<td>• Self-perceptions</td>
<td>• Asking for help*</td>
</tr>
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<td></td>
<td>• Manners*</td>
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</table>

* sub-categories from data (all others from research literature)
Competence factors were derived from Vaughn’s and Hogan’s (1990) conceptualization of social competence, but were modified by the researcher to reflect the data.

The researcher observed two math lessons that involved probability experiments. Because the data from these activities fit the pattern of the learning cycle used in science lessons, they are presented with the science data (but are indicated with MATH in the data label). The coded data were sorted by hand (using “cut and paste” in a word processing program) into separate documents according to category.

Transcribed interview data were analyzed qualitatively. Initially, the data were coded for examination and interpretation using categories that stemmed from the interview questions, for example, frequency, rationale, strategies, efficacy, problems, LD, qualifications. The data were then further coded and sub-coded using labels that arose from both the interview and classroom data, for example, teaching philosophy, classroom community, forming groups, and teaching group work. The interview data were sorted by hand (using “cut and paste” in a word processing program) into separate documents by categories developed from the codes. Where codes overlapped with codes from the classroom observation analysis, interview and classroom observation data were combined into one document (this occurred only with categories from group one of the observational data described above).

Finally, all data were then re-examined and organized within categories, and then written up in the form presented in the thesis. Samples of students’ written work were used to support and clarify the findings from the observations and interviews.

Participants and Setting

The School and Classroom

Data collection took place in a Grade 2 classroom at a medium-sized (336 students), rural, Grades K to 8, public school in southeastern Ontario. Tracy’s classroom was large and rectangular with generous windows lining one side of the room. The desks were arranged in two
large groups, with the exception of a single desk at the front of the room by the teacher’s desk for Cindy, and a single desk at the back of the room for an NC student initially, and then Doug towards the end of the data collection period. The single desks helped to focus those students with attention and/or behaviour challenges during independent work; they frequently moved to join the larger groupings of desks during whole-class, small-group, and pairs learning activities. Figure 1 shows a diagram of the classroom. Tracy arranged the desks in this pattern because: (a) she believed that it’s natural for students of this age group to work collaboratively, and (b) the desks took up less floor space overall, leaving “lots of little pockets where groups could work” (I2, T148).

Data collection occurred during the months of May and June. The weather was hot and humid, although Tracy’s classroom stayed relatively cool. She left the lights off whenever possible and turned a fan on during independent, pairs, and small-group work—there was no air conditioning. There was a drinking fountain just outside the classroom in the hallway that the students used frequently, and Tracy allowed them to keep water bottles on their desks. Occasionally Tracy would play quiet background music while students worked independently.

Because the class included a student with a hearing impairment (Ned), Tracy used a voice amplification system called an “FM system” (the system was assigned to Ned and will follow him from classroom to classroom during his educational career). Tracy wore a headpiece with a microphone, and one large speaker sat on a table near the front of the classroom to project her voice. Tracy said, “He [Ned] claims that it’s worked out really, really well for him, but it’s not a system that benefits just him, it benefits them all” (I2, T30). All the students (and the researcher!) could hear Tracy very well no matter where she was in the classroom or what direction she was facing without her having to raise her voice. In addition to the FM system, “hush-ups” (tennis balls with x-shaped gashes) were placed over the feet of all the chairs to cut down on background noise, another measure that benefited both Ned and his classmates.
Workbooks and Worksheets

Throughout the classroom observations, references are made to worksheets and
workbooks, so a brief explanation of what they are and how they were used is warranted. For
science, all students had green 3-tang report covers that Tracy called their “green science
workbooks.” For almost every science class, Tracy prepared a worksheet for the students to use.
The worksheet usually included a paragraph about the day’s topic with key science words, and
then an activity that reflected their discussion of the topic, or step-by-step instructions for the
day’s experiment (purpose, materials, hypothesis, procedure, observations, conclusions, space for
diagrams, group work rating). Tracy created the worksheets herself or adapted them from a
science textbook. Students collected worksheets in these workbooks over the course of a science
unit. The workbooks always included a title page and a “word-list” page, where the students
recorded science vocabulary words. At the end of the unit, Tracy took out the pages, stapled them
together, and sent them home. A sample worksheet can be found in Appendix E.

For math, all students had a 3-tang report cover where they keep loose math worksheets.
In this workbook, students kept a month’s worth of graphs that showed weather data, which they
added to every day at calendar time. The students also had a published math workbook with
exercises in it. The researcher observed them using these workbooks for a fractions lesson and for
probability lessons.

The Students

The school population was predominantly Caucasian. However, the students came from a
wide range of socio-economic backgrounds and included families from both farming and
professional communities. All the students in the Grade 2 classroom spoke English as their first
language, except for one student who spoke English as a second language fluently. Tracy thought
that none of the students in her class came from a low socio-economic background. There were
21 students in the class, 11 boys and 10 girls. Of the 21 students, the researcher obtained consent
to participate in the study from 15 students. One student (Ned) had a hearing impairment (difficulty with hearing in the upper and lower ranges, and some consonant sounds) and one student was formally identified with Asperger syndrome (Elena). Four other students (Andy, Beth, Cindy, and Doug) were identified as at-risk for LD by the teacher (Doug was formally identified with LD by the end of the data collection period). Like many school districts in Ontario, the school district involved in this study usually identified students as having LD at the end of Grade 3. The rationale for the timing is that by waiting to ensure the student’s achievement is considerably lower than his or her ability, misdiagnoses can be avoided. Approximately half of the students were in a Grade 1/2 split class together the previous year, with Tracy as their teacher (four NC students, plus Beth, Elena, Faith, Ginny, Henry, Isabelle, and Oliver).

The Teacher

At the time of data collection, Tracy was 28 years old and in her fifth year of teaching elementary school. After graduating from a one-year Bachelor of Education program at an Ontario university, she taught a Grade 3/4/5/6 split class at a small, rural school in southeastern Ontario. She then transferred to her current school, where she taught a Grade 1/2 split class for three years. This was her first time teaching a straight Grade 2 class. Tracy had her Primary, Junior, and Intermediate Basic Qualifications, a three-part specialist qualification in Computers in the Classroom, and she was qualified as a Student Support Teacher. At the end of the school year, Tracy began a one-year leave of absence from the school board to pursue graduate studies in Education.

The Focal Students

This section is intended as a brief introduction to the general academic and social characteristics of the focal students. Most of the examples are drawn from classroom observations
outside of science learning. The experiences of the focal students in science are described fully in chapters 5, 6, and 7. Table 4 contains a summary chart to help identify the focal students.

_Anda_

Tracy recommended that Andy should be assessed for LD for what she described as “non-academic” reasons. The most noticeable sign of LD was very underdeveloped gross motor skills: he did not run, gallop, skip, or balance well. The researcher observed that Andy thoroughly enjoyed the dancing unit in Physical Education, but also observed that his dance steps looked nothing like those of the other students. Tracy had concerns about Andy’s emotional development as well: “Socially Andy is easily, he’s very emotional and he’s very up and down, and he’s very easily, for a boy who is eight, he’s more easily brought to tears than others in the class” (I2, T125). Finally, he had difficulty sitting still and focusing for extended periods of time, and was quick to become over-excited and out-of-control if something exciting happened in the classroom:

An NC student is leading Calendar today. Doug and Andy sit at the back of the group…. Andy is making silly faces and watching to see if Tracy notices. Andy is also preparing to make a run for his desk when it is time to do the weather graphs in their 3-tang math workbooks…. The students go to their desks to work on the weather graphs. Tracy chooses Andy to ask a calendar graph question. Andy: “How many days has it been sunny more than partly sunny?” (CALENDAR, June 14, P1L14-24)

Tracy wondered if she was over-reacting to the final point of concern—she pointed out that he was young, and he was a boy:

And that’s the hard part with teaching primary, like I don’t really want him to have to keep it under control because he’s excited. I think it’s great that he’s excited but at the same time, you know, but when push comes to shove Andy gets his work done and does a great job, so really what am I worrying about. I kind of struggle with that with him, like he can do it. (I2, T127)

The researcher observed that Andy’s activity level seemed to register at extremes—he was usually either high energy and “on” (but not necessarily out-of-control) or dead tired (he couldn’t stop yawning) and very rarely anywhere in between.
<table>
<thead>
<tr>
<th>Focal Student</th>
<th>Status</th>
<th>Strengths</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andy</td>
<td>Identified as at-risk for LD by teacher</td>
<td>Keen interest in science; experiences academic success, good language and communication skills (oral, written, diagrams)</td>
<td>Difficulty maintaining appropriate activity level; difficulty keeping emotions under control; poor gross motor skills</td>
</tr>
<tr>
<td>Beth</td>
<td>Identified as at-risk for LD (dyslexia) by teacher</td>
<td>Good social skills, popular with peers, experiences academic success, good written communication; good oral communication with friends</td>
<td>Makes letter reversals (reading and writing); experiences anxiety attacks; difficulty maintaining attention during whole-class activities; communicates reluctantly in whole-class format</td>
</tr>
<tr>
<td>Cindy</td>
<td>Identified as at-risk for LD by teacher (scheduled for testing early in next school year)</td>
<td>Interest in science, eager to please, desire to interact socially</td>
<td>Poor social skills and social cognition (e.g., stubborn, bossy); speech impediment; difficulty with decoding words and re-numeration skills; difficulty maintaining attention during whole-class activities; needs direction for independent work; ignored/rejected by peers</td>
</tr>
<tr>
<td>Doug</td>
<td>Identified as at-risk for LD by teacher; Formally identified by end of observation period with LD (moderate receptive and expressive language disorder)</td>
<td>Making progress on social and academic strategies; interacts well with peers when toys are involved</td>
<td>Difficulty understanding and following directions; difficulty communicating (oral and written); difficulty maintaining attention on activity; difficulty keeping emotions under control; needs one on one attention to make progress on work; ignored by peers</td>
</tr>
<tr>
<td>Elena</td>
<td>Formally identified with Asperger syndrome upon entry to Kindergarten</td>
<td>Very successful academically (especially in language arts), very creative, interested in science; somewhat accepted by peers; works well independently</td>
<td>Little interest in working collaboratively; poor social skills and social cognition; difficulty maintaining attention during whole-class and small-group activities.</td>
</tr>
</tbody>
</table>
For a time at the beginning of the year, Tracy also had some concerns about Andy’s fine motor skills because he had “really huge messy printing” (I2, T142). However, his printing improved dramatically after spending time in her “picky printing group” and Andy now prides himself on his beautiful printing.

Tracy believed Andy was aware of his particular challenges—he knew that he struggled with getting his work done in the allotted amount of time and with sitting still. Tracy introduced a squeeze ball to help Andy with his need for constant motion, but since it rolled when dropped, he kept losing it. She laughed at the memory and said they should have used a beanbag instead.

Tracy reported that Andy was very bright, and she considered him to be a strong student academically. The researcher observed Andy to be very articulate: “Andy shares about an ‘attack-bot’ he has made out of Lego. He demonstrates all its features. He speaks clearly and responds well to questions” (SHARING, May 17, P3L14-16). Tracy described Andy as experiencing the most success academically when participating in something that he was excited about—for Andy, that meant hands-on learning, and science in particular. For the most part, Andy paid close attention to group discussions in science, was always quick to offer an explanation or answer a question, and wanted to be thoroughly involved in experiments and activities. His diagrams of experiments were especially detailed. When he was interested in the topic, he generally was able to focus long enough to complete seatwork.

Tracy said that when working in a group format, Andy needed specific expectations in place: “Just being in a group is not as easy for Andy as if he’s with a group and there’s something to be done and a there’s a reason for it” (I2, T130). Andy worked well with most of the students in the classroom, and especially the more mature and academically successful girls (e.g., Ginny and Isabelle). Although Andy and Doug sat close to each other and often chatted amiably, Andy also had the most trouble working with Doug, and with Cindy as well. Tracy explained that none of three had strong conflict resolution skills, and all were quick to become emotional:
Andy is angry with Cindy for pushing him. Tracy asks Andy to explain what happened. He is in tears. Tracy calls Cindy over and Cindy says she didn’t push him. Tracy sends Andy somewhere (hall?) to collect himself. (May 22, P2L42-44)

They play “Keep Them Out” next. With half the students on one side of the gym, and half on the other, they try to keep balls off of their side by throwing them across the middle line into the other group…. Cindy and Andy are really butting heads; yet gravitate towards each other each time the game resumes. (GYM, May 31, P4L32-36)

The researcher observed that Andy took on very different roles within a small group during collaborative learning depending on whom he was working with. For example, when working with Henry, a very popular, academically successful boy, Andy took the role of follower and deferred to Henry’s ideas and opinions. However, when working with less assertive personalities, Andy took on more of a leadership role. According to Tracy, Andy experienced relatively low popularity in the classroom, but was generally accepted by his peers. More details about Andy’s participation in small group work will be discussed in Chapters 5, 6, and 7.

Beth

Tracy believed Beth to be at-risk for LD, specifically dyslexia, because she consistently reversed letters while both reading and writing. Tracy said Beth’s older sister had been diagnosed with LD, making it more likely that Beth had LD as well. Tracy said that for most part, Beth experienced academic success. She was aware of her challenges, and really persevered in her attempts to minimize letter reversals:

Like she will come up to me with a book with her writing and she’d be like “Do I have reversals, like do I have any?” and I’ll say yes you have three, they’re here. “Okay,” and she’ll go right back and fix them and come back up, um she tries really, really hard to not have them, but she’s definitely aware, but she’s aware also that it’s not, it’s a normal thing, like lots of kids have them, she just has more. She doesn’t feel bad about herself because of it. (I2, T109)

During the winter term, Beth participated in the Early Literacy program, where she received extra literacy support for 40 minutes, every other day, from an Educational Assistant (EA) with specialist training in literacy. Tracy expressed regret that this program had been cancelled for the upcoming school year.
In addition to struggling with letter reversals, Beth suffered from anxiety attacks. Tracy related that since her entry into Grade 1, when the attacks happened a couple of times per day, to the final months of Grade 2, the attacks had become much less frequent. The attacks happened quite suddenly: Beth would become nervous and upset, and then start to shake and cry. By the end of the school year, Tracy was able to recognize the signs quite early—“Her face kind of crumples” (I2, T109)—and most of the time she was able to help Beth head off the attack before it became obvious to anyone else. Tracy had strict instructions from Beth’s mother about how to handle an anxiety attack. Tracy was not to baby Beth in any way: she was to say, “Beth, you’re fine, go get a drink of water.” Tracy said that sometimes Beth would resist, but that Tracy would be firm, and when Beth came back into the classroom she would be calm again. The researcher observed only one instance of the beginning of an anxiety attack during classroom observations, and was not aware of why Tracy was suddenly sending Beth out to the hall for a drink until Tracy explained at a later time.

Tracy also told the researcher that during the period of data collection, Beth’s mother was away in Alaska for three weeks. Tracy suspected Beth had not been sleeping or eating as well in her absence, which may have been affecting her behaviour at school. The researcher had observed that Beth often seemed tired or inattentive, especially during whole-group discussions, though she was usually on-task and focused at her desk.

According to Tracy, Beth was a very popular student in the classroom, and had no social challenges. She had several close friends in the class, especially Faith, Isabelle, Mary, and Kelly. Tracy thought she worked well with everyone in collaborative learning groups, except perhaps Cindy, whom Beth did not have much patience for. Beth tended to be quiet and reserved during whole-class learning activities. Although she did not often volunteer to answer questions, if Tracy asked her a question directly, Beth usually answered well, if briefly. At Sharing time, Beth spoke quietly and tended to answer questions from other students with one word answers.
Beth shares next. She says: “I am waiting for Cindy…” Cindy, who [for once] is quietly eating apples, shrugs her shoulders and makes big eyes at Tracy and myself. Beth has brought a purse given to her by her mother. Beth shows the class what she keeps inside: lip gloss, Tamagotchi, pretend cell phone, etc. She responds to questions from the class with one-word answers. (SHARING, May 23, P5L7-16)

However, during small-group activities and social times with her peers, Beth chatted easily and was not hesitant to participate in discussions (more details about Beth’s participation in small-groups and pairs in chapters 5, 6, and 7).

Cindy

Tracy had also identified Cindy as at-risk for LD and recommended her for testing for both academic and social reasons. Tracy said that Cindy is scheduled for testing early in the new school year. Cindy had a strong speech impediment that made it difficult to understand her at times. She received speech therapy once a week. In addition, the content of Cindy’s speech tended to be rambling and hard to follow. This was especially evident at Sharing times, which Cindy was always very eager to participate in:

They call students up to the front to share news from the rocking chair. Cindy goes first. She tells a rambling story about her weekend activities with her family, and then asks the students for questions and comments. No one puts up a hand. (SHARING, May 7, P4L35-37)

Cindy sits in the rocking chair. She makes a string of unconnected comments about the Tamagotchi. Tracy asks her to tell them one more thing about it and then to answer questions from the class. Cindy replies, “I don’t know, it’s not mine,” to most of the questions. (SHARING, June 11, P4L39-41)

Tracy said that there is no link between Cindy’s speech impediment and her hearing, but Tracy believed the speech impediment contributed to Cindy’s difficulty decoding new words and to sounding out words for spelling; Cindy had excellent sight-word knowledge. In addition to language-related challenges, Cindy struggled with re-numeration skills in Math. Cindy was easily distracted and that is why Tracy placed her desk at the front of the room, beside her own. Although Cindy often needed several prompts from Tracy to begin seatwork, and sometimes needed Tracy to walk her through instructions or sit with her to keep her focused, if Cindy was
interested in what she was learning about, she could be productive on her own. Often, Cindy was not allowed to use an eraser or a personal dictionary during independent seatwork. Tracy explained that Cindy wanted to be right so badly (knowing that she was often not), that she would spend all her time looking up words or erasing the few things she had managed to write.

Cindy had difficulty interacting with her peers in both social and academic settings. At various points in the interviews, Tracy described Cindy as bossy, stubborn, and loud; she insisted on having her own way; she could not resolve conflicts, which then tended to escalate; she frequently interrupted Tracy or her classmates while they were speaking; she was fanatical about things being fair to her; and the researcher observed her many times doing something specifically because Tracy had told her not to. Another habit that did not endear Cindy to her classmates, though she seemed oblivious to their reactions, was telling them what to do, that is, mimicking things that Tracy would normally tell the students. For example, pointing out things on the floor for them to pick up, telling the Calendar leader what to do next, calling out the names of students as they entered the classroom after recess; in addition, she often tattled on the actions of other students. The researcher heard Tracy say to Cindy many times “Just worry about yourself.”

However, there was something undeniably likeable about Cindy: she really wanted to please Tracy and her peers. For example, she often drew pictures or brought wildflower bouquets for Tracy. She was also surprisingly calm and forgiving when Tracy forgot to dish out an ice cream cone for her on Isabelle’s birthday, even though when the omission was discovered there was no ice cream left to give Cindy. During one of her turns at Sharing, Cindy brought in seashells to give to her classmates, though the gesture went slightly awry:

Cindy has brought a bag of shells to share. She talks about them while rooting around in the bag so it is hard to hear what she is saying. Then she lays them out one by one on the floor. Cindy says, “You can keep some of them…” and trails off. Other students start to finish her sentence. Mary: “Because you have so many?” This statement gets the class’ attention and they start to ask lots of questions. Ned and Andy want to tell about finding shells at Myrtle Beach as well…. Cindy wants to pass the shells around, but is quite bossy about the way she wants it done. Then Cindy is upset because some students are selecting bigger shells to keep—Cindy only wants to give away the little ones. This
causes some chaos! Tracy steps in to organize things a bit. (SHARING, June 4, P4L28-37)

Cindy had poor judgment about what was appropriate behaviour and often got into trouble because she blindly followed what other students were doing:

At the students’ request, Tracy leads them in the “Chicken Dance.” Cindy and Andy are way off beat, but having fun. Some of the other girls are pretending to trip the boys as they weave around the girls. Cindy joins in, but really trips Andy and he falls. (GYM, May 31, P5L32-39)

To make things worse, Cindy had difficulty taking responsibility for her actions:

Cindy: Doug was trying to pull down my pants.
Tracy: You don’t have any pants on (Cindy is wearing a dress). So I don’t think that’s true.
Cindy: He was trying to pull down on my underwear.
Tracy: His hands were up your skirt?
Cindy: um?
Tracy: You need to think carefully about what you say, Cindy. What happened at recess Cindy, start over.
Cindy: …I went over where Oliver and NC and Doug were, and after that um, Leo and ? came over and Doug tried to pull down somebody’s pants.
Tracy: What did you do Cindy? You! I’m not interested in what you saw; I’m interested in what happened to you at recess and what you did. You played soccer, then you went over to where the boys were, and then what happened?
Cindy: Um, when I came over, Doug was…
Tracy: When we came inside for recess? When recess was over? Everyone who has said they had a problem at recess has mentioned your name. And you’ve said your whole recess and you haven’t said one thing about what happened. Were you involved in pulling down people’s pants at recess, Cindy? Yes or no? Look at me and tell me, yes or no? (Cindy nods.) Yes, you were. Okay, we’ll talk about this later; it’s not fair to have us all sit here while you and Doug don’t tell what happened. (May 31, P1L18-P2L10)

Tracy described Cindy as having very low popularity in the classroom, but explained that Cindy oscillated through being rejected, neglected, and accepted by her peers. “Everyone seems to like Cindy, but it seems they can only take her in small doses” (I1, T87). Tracy also said that sometimes the other students truly mistreated her, though they were usually provoked by Cindy’s behaviour. During one classroom observation period, Isabelle handed out birthday party invitations to all the girls in the class (later Tracy informed the researcher that is very unusual for all the girls to be invited to someone’s party and that usually invitations are handed out privately).

Cindy’s reaction showed both her desire to be included and her difficulties with social perception:
Isabelle hands out birthday party invitations to all the girls in the class. The birthday party will be at a community centre with a swimming pool. Cindy is VERY excited to receive one. After reading it, Cindy says over and over worriedly that she doesn’t know where the community centre is. All the other girls put the invitations down on their desks or in their backpacks and start to pay attention to Tracy. Cindy keeps taking hers in and out of the envelope, re-reading it, and telling Isabelle over and over that she doesn’t know if she will be able to come. Isabelle half-acknowledges Cindy the first time, but she is trying to listen to what Tracy is saying and is starting to look annoyed. (GYM, May 23, P5L24-41)

Tracy named Isabelle as Cindy’s friend, but then added the caveat that Isabelle’s mom was Cindy’s babysitter. Cindy does get together with classmates outside of school, but these opportunities tend to arise through organized activities, like Brownies, or are facilitated through friendships between older siblings or between entire families (e.g., David and Ginny). Tracy said that Cindy’s parents are very good advocates for her socially.

Although working collaboratively was difficult for Cindy, Tracy felt group work was an extremely important opportunity for Cindy both socially and academically. At recess Cindy tended to play alone, and if she did play with the other girls it tended to end in conflict. Collaborative learning provided a supervised, controlled environment for social interactions, and worked best for Cindy when Tracy paired her with someone who was empathetic and who wouldn’t react to Cindy’s intensity or get frustrated with her easily (e.g., Isabelle, Ginny, or an NC). The researcher observed that while someone like Ginny worked well with Cindy one-on-one, if there were other students in the group as well, Cindy was more likely to be ignored or rejected. Academically, Tracy thought it was important for Cindy to learn to listen to and work with other students’ ideas.

Doug

Tracy believed Doug to be at-risk for LD and her recommendation for testing was acted on before the end of the school year. Tracy noted both social and academic reasons for her recommendation. Doug did not make eye contact and looked down when speaking. He shuffled his feet when he walked. Early in the year Doug showed many signs of aggression and anger, and
was brought to the point of tears very easily (this behaviour was noted in reports from previous years as well). Tracy said that both behaviours almost disappeared over the course of the school year, and she believed the aggression and anger were due to frustration that eased as he found strategies to deal with social and academic challenges. Tracy described Doug as socially awkward and as having low social ambition. She said social play did not come easily to him and often he was not on the same page as his peers. Like Cindy, Doug had difficulty taking responsibilities for his actions:

Doug: Because Oliver, John and Cindy were pulling my pants down.
Tracy: Were you pulling down anyone else’s pants, Doug?
Doug: No.
Tracy: Doug, I’m going to give you a chance to tell the truth. I know that people were pulling on your pants. Were you also pulling on people’s pants?
Doug: I don’t remember.
Tracy: Doug, you remember.
Doug: No, I don’t!
Tracy: Okay, if you can’t remember, we’re not going to talk about your situation and your feelings. It’s not fair if you only remember what you want to remember. If you change your mind and decide that you do remember, we’ll talk. (May 31, P1L18-36)

However, Tracy saw social gains and an increase in self-control over the course of the school year.

Academically, Tracy noticed that both Doug’s speech and writing were fragmented. Also, Tracy said Doug tended to become fixated on something, like “Ninja Turtles” and often during oral discussions or writing exercises about completely separate topics he ended up talking or writing about (or drawing) them. For example, an excerpt from a Classroom Observation Note said:

Doug has a graph that looks nothing like those of his group-mates. It is full of swirls and letters. He has drawn Ninja Turtles on the back of this worksheet instead of the compound machines they are examining. (June 20, P4L13-15)

In June, Doug was tested through the Identification, Placement, and Review Committee (IPRC) process, and was identified as a student with a moderate receptive and expressive language disorder. Doug’s challenges included: understanding and following directions and
instructions, reading and listening comprehension (especially understanding the main ideas of passages and making inferences), answering questions appropriately, understanding abstract information, communicating ideas effectively, using appropriate sentence structure, and writing tasks. His phonemic awareness skills and sound-symbol correspondence skills were lower than expectations for the Grade 2 curriculum. The report noted that although his responses and general comments were far off target, he had learned strategies to give himself extra time to repair communication breakdowns. The report suggested that visual support, knowledge of the framework within which information was presented, and a slower rate of presentation would help him.

When asked to name the conditions under which Doug experienced the most success academically, Tracy first listed one-on-one with herself or with a very high functioning student (like NC, Ginny, or Isabelle)—someone who could really empathize with Doug, and guide him through the activity.

They just really … break things down and are very supportive of him. Okay Doug now let’s read this, like they’re very, they almost model me…. You know, they’re very, pretending they’re the teacher and I don’t think they’re doing it in a way that is demeaning to Doug and I don’t think he feels demeaned. Like I don’t think he gets that impression at all, it’s just they’re being nice and caring. (I2, T74-T75)

Tracy said that Doug needs explicit directions and said, “when I took the time to really go through step by step with Doug he would be able to produce things that I did not necessarily think he could achieve” (I2, T66). Tracy expressed regret that this is not always possible in a classroom environment. In almost every Classroom Observation Note the researcher noted at least once that Doug needed more than one additional prompt to begin simple tasks (e.g., writing a short note in an agenda book, clearing a desk, moving to the carpet, etc.), and that Doug needed Tracy to go through instructions one-on-one with him before he could begin an independent task:

1:45 pm. Doug doesn’t understand why this is different than the previous exercise they did, which involved dividing a cookie (circle) into thirds. Tracy shows him the difference, and then moves on to someone else. Doug is working on his own, but when I check his progress, he is drawing an elaborate, non-rectangular cake in his workbook…. 1:57 pm. Doug has erased the cake he drew earlier and has written several instructions,
but they refer to thirds. His diagrams are clear. Tracy takes him to the carpet and goes through the exercise step by step, but his is still stuck on thirds…. 2:04 pm….Tracy leaves Doug at the carpet to attend to another pair of students who are not working. As soon as she leaves, Doug stops writing. (MATH, P1L26-P2L11)

The researcher observed one period of extended independent work when Doug was focused and productive without any visible support from Tracy during the period of data collection. The students were working on writing pieces called “My Dad” (a Father’s Day gift) using planning sheets with the words “My Dad” in the centre, and eight spokes leading to ideas that they wanted to include in their writing pieces.

Tracy said that Doug knows that he’s a “really smart kid” and that he has trouble saying and writing things in a way so that people can understand him. She believed he’s fairly comfortable with that, although it’s upsetting and frustrating for him sometimes when he gets misinterpreted. She also believed that although the other students in the class were aware of his communication challenges, they also respected his strengths, for example, he often won their flashcard addition and subtraction game, which she thought boosted his self-esteem.

Tracy said that Doug had low popularity in the classroom, and was usually neglected by his classmates. She emphasized that no one in the class was ever really mean to him. In general, she had observed that the girls were more accepting of Doug than the higher functioning boys. Tracy was hesitant to name anyone in the class as a real friend. She named one NC student possibly, because they were babysat together; she thought Oliver had tried to play with Doug outside of school; and John was pretty much friends with everyone:

They don’t reject him but they don’t … and in some ways they embrace him, like they enjoy his quirks, like, you know, everybody will laugh when he does things and um I think a lot of them empathize with Doug, but whether or not they are … friends with Doug, not so much. (I2, T72)

Classroom observations, especially at Sharing and Calendar time, supported Tracy’s assessment of Doug’s social status and the way he was treated by the other students. For example:

Ginny is in the sharing chair…. Doug has his hand up the entire question time but is not chosen. An NC student shares. Doug again has his hand up for the entire question time and is not chosen. The student at one point actually started to say his name, then switched
to Isabelle when she put her hand up right then. Doug looks disappointed. (SHARING, May 22, P2L27-32)

When asked under what conditions Doug experienced the most success socially, Tracy said:

Guided play, so where I would give roles to people or things like that so that Doug would have a part in the play…. social play-wise at recess he’s okay, he does okay because, like when they have their toys out, but without toys it needs to be … when there are not actual objects for them to be manipulating and playing with and the focus is on them, when the focus is on each other he needs fairly guided and scripted play. (I2, T67)

The researcher observed several times when Doug tried to bring toys to his desk (against the classroom rules) and that they often managed to appear in the midst of experiments: “Doug wants to put his Ninja Turtles under the fulcrum to help balance the ruler” (June 7, P4L40).

Tracy was enthusiastic about the benefits of collaborative learning for Doug. When I asked her about his experiences with this format, Tracy matter-of-factly said: “Doug will often times be off task even, he’s off task, he has difficulty processing auditory things so he’s off task in collaborative learning, but he’s off task in every type of learning” (I1, T76). However, she reiterated the success he experienced working with specific students in the class and said that the other students in his group help to keep him on task:

[They’ll say] “Oh Doug come on,” like they’re usually, they try and get him back on track, and they try and include him. It depends on the group, but I try and be careful, if it’s something, some task that really is going to require a lot of effort then I try and make sure he’s with students who are really helpful and empathetic. (I1, T77)

Tracy said that Doug had a lot of difficulty working with Andy and Cindy, because neither of them have strong social skills either, Elena because she is not interested in helping him, and though socially he would do fine with Oliver or John, they would not get any work done because none of them have initiative or would take a leadership role.

Elena

Elena was a student with Asperger syndrome (identified by the IPRC process on her entry into Kindergarten). Tracy described her as a “very high functioning autistic child” (I2, T189).

Elena was very successful in the classroom academically. Tracy reported that her oral language
and both oral and written communication skills were excellent. When working on a writing piece entitled, “My Dad” the researcher noted, “Elena has written quite a number of sentences in excellent printing. She has used lots of descriptive words and fairly sophisticated sentence structure” (LA, June 13, P1L40-41). Tracy said, “I have to often ask her how to spell words. It’s faster than going to the dictionary” (I2, T147). Elena was reading at a Grade 12 level. Her challenge lay in making inferences from the text—while she could easily report on the information she had read, she had difficulty answering “why” questions. However, Tracy pointed out that she was asking Elena to make inferences about text at a Grade 7 reading level, so she was not worried about Elena’s academic progress in the Grade 2 classroom. Elena’s creativity (and Tracy’s enjoyment of it), was apparent during both the classroom observations and Tracy’s descriptions of Elena during interviews:

Elena tells Tracy that she is writing a school musical called “Copa Cabana.” Tracy asks, “Who are the main characters?” Elena: “Two characters who disapprove of each other’s thoughts.” Tracy: “What are their names?” Elena: “I forget them.” Tracy: “Are there many songs in Copa Cabana?” Elena: “Well, the main title, and ‘we are united’.” Tracy tells Elena she would like to hear more about this musical (May 16, P3L45-P4L3).

Elena shares next. She sits in the rocking chair and taps her feet and stretches her arms. Tracy prompts her to start. Elena says she will be going to day camp this summer. Tracy asks if her sister will be there, where will the camp be, and who is the director? Elena answers: “Yes, my sister will be there, it is in my backyard, and my mother is the director.” Tracy laughs and says, “I thought so! You’ve gone to this day camp for several years.” (SHARING, June 11, P4L43-P5L2)

During the second teacher interview, the researcher asked Tracy about the second example above—was there really a day camp? Tracy said no, it was just Elena and her sister playing in their backyard: “That’s just Elena” (I2, T202).

On the autism spectrum, Elena ranked highly in terms of social competence. However, Tracy said she experienced social challenges in the classroom. Elena did not choose to interact socially with the other students, and even when placed in a small-group or a pair she tended to work independently, or drifted from the group:
She would choose not to be in the group... but being in a group is really good for her and it’s really important for her because at recess she plays alone always, and even when she’s in a group she’s kind of sitting looking the other way... (I1, T78)

Tracy said that Elena needed scripting to support her conversations with peers and adults. Elena memorized the scripts easily and used them in her interactions, but Tracy observed that she never made them her own, that is, Elena never adapted the language or intonation to reflect the characteristics (age, relationship to her) of the person with whom she was having a conversation, so her conversations always sounded artificial:

Yeah but with Elena—I find that with Cindy and Doug things that will come out of their mouth are just spontaneous things they would say, like we would have a conversation with you—whereas with Elena it’s very, “Elena how are you today?” “Well Miss T., I’m fine, how are you!” Like it’s very, she’s been taught to say well so and so I am fine thank you, how are you? And she does it, like she doesn’t just say, “good” like very often. So for her social skills, I don’t know, I don’t know what the answer for Elena would be... (I2, T191)

The researcher observed Elena to be capable of listening to other students’ ideas and of making compromises: “Elena asks a graph question. There is some disagreement over the answer. Tracy directs Elena to check the class graph in the calendar bulletin board. Elena does this and concedes the answer” (CALENDAR, June 13, P3L21-23).

At another time, the researcher observed Elena to be upset by a change in the expected schedule for the day:

Elena is upset because the resource teacher has not come to get her yet. Tracy: “I’m sorry, if Mrs. R. would like to see you she will come to see you.” Elena: ? Tracy: “Excuse me, Elena, she doesn’t have a regular schedule. Okay? So I would like you to do what the class does.... She will find you when she needs to find you.” (June 14, P2L20-23)

Tracy reported that Elena was “helpful, and she’s positive and the kids, uh, they’re good with her, they’re really good with her” (I1, T78). Elena’s peers respected her academic skills—during an observation of a small-group activity, Elena was working with Faith and Cindy. When the researcher questioned Elena’s reasons for assigning the label of “lever” to part of a compound machine, Faith defended Elena:

Faith: She [Elena] is sort of smarter than Miss T. She’s been doing math and science since she was 3.
Researcher: Wow.
Cindy: Miss T., we’re done!
Faith: Elena, how do you spell Mississippi?
Elena: M-I-S-S-I-P-P-I.
Cindy: How do you spell…Michelle (except it is really hard to make out the name because of Cindy’s speech impediment)?
Elena: Spell What?
Cindy: Michelle.
Elena: What?
Faith: Michelle.
Elena: Oh, M-I-C-H-E-L-L-E, Michelle.
Cindy: How do you spell tennis?
Elena: T-E-N-N-I-S [Elena seems to be quite enjoying this] (June 20, P2L22-43)

Tracy rated Elena’s popularity in the classroom as low, but felt that Elena was accepted by her peers. Ginny chose Elena as a partner at least twice during classroom observations and they worked very well together. Tracy reported that an NC had asked to have his desk beside Elena’s. When Tracy asked him why, he explained that he really liked her. Tracy reported that Elena gets together with an NC on a regular basis outside of school, and that they have been friends since Kindergarten, but she questioned the mutuality of the friendship:

It is and it isn’t, like it is, NC will invite Elena over, just Elena and they’ll do stuff together and they’ve been together since kindergarten, but Elena is really, really attached to NC, and NC isn’t overly attached to anyone I wouldn’t say, like NC is one of those students who would be friends with anyone, but Elena’s convinced that they’re best friends… (I2, T198).

Elena’s experiences of acceptance during Sharing were mixed. In one example, she was ignored by her peers:

They call students up to the front to share news from the rocking chair…. Elena goes next but there is lots of talking by the other students. Tracy asks the class how they feel if they are in the sharing chair and people aren’t listening? “Give me some words.” (SHARING, May 7, P4L35-39)

Yet in another example, she held her peers’ attention and her sharing news inspired others to participate with her: “Elena goes to the sharing chair and Cindy returns to her desk…. Elena shares about Isabelle’s birthday party. Other girls chime in with memories from the party. Elena returns to her seat” (SHARING, June 4, P4L39-42). Elena’s attention tended to wander while other students were sharing.
Chapter Summary

Chapter 3 described the methodology of the study and the main participants. Data collection methods included classroom observations focused on five students with LD, teacher interviews, and samples of students’ written work. Data were analyzed qualitatively and organized into four broad categories for reporting: teaching, and three guided inquiry learning cycle phases (engage, investigate, and explain/report). These data are reported in the next four chapters.

The main participants in the study are Tracy, the teacher, and the five focal students, Andy, Beth, Cindy, Doug, and Elena. Tracy identified Andy as at-risk for LD because of challenges in maintaining emotional and behavioural control, and poor gross motor skills. His strengths included a keen interest in science, and good language and communication skills (oral, written, and drawing). Tracy identified Beth as at-risk for LD because of letter and number reversals (in reading and writing) and anxiety attacks. Her strengths included good social skills, popularity with peers, and good written and oral communication skills (with friends). Tracy identified Cindy as being at-risk for LD because of poor social competence, difficulty with decoding words, and poor re-numeration skills. Her strengths included an eagerness to please and a desire to interact socially. Doug was formally identified with LD, a moderate receptive and expressive language disorder. He experienced difficulty with understanding and following directions, oral and written communication, attention, and emotional control. His strengths included documented progress on social and academic strategies, and the ability to interact with peers using toys as a support. Elena was formally identified with Asperger syndrome. Her challenges included a lack of interest in working collaboratively, poor social skills and social cognition, and attention. Her strengths included strong academic skills and working independently.
CHAPTER 4: RESULTS—TEACHING

Introduction

This chapter presents data from both the classroom observations and teacher interviews in two sections. The first section describes how Tracy created a close-knit community of learners within her classroom through team-building activities, good classroom management, and by taking on the role of guide and learning partner within the community. The second section presents data about Tracy’s use of collaborative learning to help the reader understand what collaborative learning looked like in Tracy’s classroom. The data includes information about why Tracy used this format, how Tracy used collaborative learning, how Tracy formed collaborative groups, how she taught students to work collaboratively, and how she assessed student learning.

Creating a Community of Learners

Tracy believed that “being in school is about being part of a community and you have to work together” (11, T22). The researcher sensed a strong feeling of community, even family, in Tracy’s classroom between Tracy and the students and between the students themselves from various occurrences during classroom observations. For example:

Tracy passes out weights of various sizes. She tells the students to feel them, and then pass them on to the person beside them. Ginny, who is sitting on the far side of the room, takes the initiative to bring a weight over to Cindy who doesn’t have one yet. (June 4, P2L28-31)

Tracy looks around and says that there are three students still without math workbooks on their desks. An NC student goes to look for his math workbook in a bin at the front of the room. He finds Elena’s book in the tub as well and unprompted, brings Elena’s workbook to her. (June 12, P1L18-21)

Other examples included unprompted sharing of personal art supplies and snacks, and taking responsibility for classroom tasks without being asked (e.g., turning of taps, lights). When the researcher shared these observations with Tracy in the second interview, Tracy’s pride in her students was evident:
I don’t know why they’re so good that way, but I know, remember at the beginning of the year we would have a lot of talks about like we are a group, like we’re together and we’re a team, and if you see something happening, like we’re kind of like a family and stuff, and then yeah we care about everybody else that’s not in our classroom too, but we really need to work together, and if you see someone outside at recess whose not having a good time it’s up to you as their classmates to go over and make sure that they’re okay, and if you see someone in the classroom that’s not, you know, can’t find their pencil or having trouble with their work it’s not just up to me to make sure they’re okay, like you can do that too, and they really, this group really did it. (I2, T215)

Tracy shared other examples of the students’ thoughtful behaviour as well. The most compelling were of students without LD, like Ginny and Isabelle, purposefully seeking out students who tended to be ignored or rejected, like Doug, Cindy, or Elena, as partners for learning activities. Tracy attributed some of the closeness amongst her students to the fact that approximately half of them were together with her last year in a Grade 1/2 class. When asked how this affected her classroom dynamics, Tracy reported a smooth transition into the new school year. Half the students were already familiar with her routines and expectations so they were able to act as leaders, and also “because they were already confident in themselves…they didn’t have to focus so much on the routines and the way things were done, they could focus more on the learning and the social aspects of learning” (I2, T18).

Team-Building Activities

Although Tracy attributed her students’ community-minded behaviour to innate qualities in the students themselves, the interviews and classroom observations suggested three main kinds of activities that nurtured this communal atmosphere: (1) talking about abilities, (2) talking about feelings and interactions, (3) creating a sense of ownership and responsibility.

Talking About Abilities

Tracy encouraged her students to be open with each other about their strengths and weaknesses. She felt they were all comfortable with talking about their abilities in front of their classmates:
We do it all the time, we start the year off like that, with what we’re really good at and what we … like um they do a lot of goal setting, like re-evaluating our goals and why, and we talk a lot about strengths and weaknesses, and they know that so and so is a really, really fast runner, and really good at math but writes their letters backwards and is trying really hard not to. Or that so and so’s a really, really awesome reader, and has trouble getting along with other people… (I1, T84)

Tracy said that she tried hard to create an environment in which students felt safe enough to be honest about what they were feeling and when they were struggling. “I try and model it for them, when I make mistakes and when I have trouble with things I let them know always…they love it” (I1, T84) Tracy also reported that if they were going around in a circle, taking turns to share something about themselves, she’d often go around twice because students may be more likely to share if they hear someone else do it first.

**Talking about Feelings and Interactions**

Often after a recess break, Tracy gathered the students around the perimeter of the carpet area for a de-briefing. She asked each student to give one or two words that described his or her recess experience, and followed up on responses that indicated a negative experience.

Tracy tells the students that before they begin science, they are going to talk about recess. She asks each student to give one or two words to describe his or her recess experience. Responses include “hurt and fall” (unknown student says “Beth helped me”), “Fun” “Soccer” “Super” “Awesome” “Basketball” Elena says, “fun, party”. (May 7, P1L23-26)

Tracy starts going around the perimeter, asking students to briefly tell her how recess was. An NC student said that he pushed Nick (a student from another class) when he wouldn’t stop teasing him and Doug. Tracy asks Doug what they could do instead of using hands. Doug says, “Victor called us babies.” Tracy reminds them about the peer mediators on the schoolyard and says they will go and apologize to Nick later. Tracy continues around the circle and several students complain about the behaviour of Walter from another class. Tracy asks for her students to name some positive things about Walter before they end the circle. (May 16, P1L15-23)

Discussions of feelings and interactions were not limited to recess de-briefings. Tracy said:

We just spend a lot of time talking about us as a class, and what’s important about us as a class and what’s good about us as a class, and how we can keep…. every day we stop at some point, it’s not really curriculum, in a specific curriculum area, but usually there’s something going on every day where we stop and evaluate how we are treating each other and why…(I1, T32)
Creating a Sense of Ownership, Responsibility, and Respect

Tracy consistently and equitably delegated classroom tasks to the students, such as keeping the floors tidy, turning on and off the lights, organizing books, distributing worksheets and materials, and running errands to other classrooms.

Some daily classroom activities, like Sharing and Calendar were student-led. At sharing time, designated sharing helpers set up the chair for Sharing and called students assigned to share on a given day of the week for his or her turn. At Calendar time each day, one student led the rest of the class through a routine of questions and tasks to establish the date, determine even and odd numbers, count days, estimate temperature, record weather, etc. Once these activities were completed, the Calendar leader dismissed the rest of the class to their desks, where they filled in data on their weather graphs (kept in 3-tang math workbooks). Then Tracy selected two students to pose questions to their classmates about the graph data (e.g., How many more days has it been sunny than rainy?).

Tracy taught the students to use simple strategies like “rock, paper, scissors” and “if you take half, I’ll take half” that enabled the students to solve minor conflicts by themselves. Tracy also allowed the students to try out new seating arrangements upon request, on the condition that the students were honest with themselves and with Tracy about how it was working for them:

As students go out for recess, Beth, Faith, and Mary all come to Tracy and ask to change where they are seated in the classroom. They are all sitting together for the first time today, an arrangement they requested. Tracy gave them the option earlier to come talk to her at recess if they found it too distracting to sit together since they are friends. (May 7, P4L41-44)

Tracy consistently spoke to her students in a manner that reflected respect for their emotions and intellect. For example, she dealt promptly with all concerns the students raised during recess debriefings (even those that involved students from other classes). In another instance, she quickly deflated a potentially embarrassing situation in the middle of a science discussion: “A student passes gas and students around him giggle. Tracy says calmly, ‘That’s okay, what do you say?’ Student says, ‘Excuse me.’ There are a few more giggles and then they
have moved on” (May 7, P2L4-6). When a fairly serious accident occurred at the school she
spoke very matter-of-factly with the students about it:

When I arrive an ambulance is at the front door of the school, so I use the back entrance. I meet Tracy on the way in and she tells me that an intermediate student has been accidentally hit in the head with a baseball bat. As the students enter the classroom, the lights are off. Tracy directs them to the perimeter of the carpet. She calmly matter-of-factly describes what happened and reassures the class that the injured student is okay and is being taken care of. The Grade 2s all want to share stories about various injuries. Tracy talks about accidents and safety on the yard. (May 14, P1L13-19)

Tracy was quick to praise students publicly, and careful to criticize and correct privately (in the earlier quote about a pants-pulling-down episode, Tracy removed the students involved from the circle once the basic facts were established and resolved the issue with just the students involved). Tracy often used humour in a sensitive way to protect the dignity of her students when she did have to address behaviour. For example, when the diagrams some of her students were drawing for a science activity became somewhat inappropriate, Tracy dealt with the issue in the following way:

Grade 2s, I am more than happy to see anything you would like to draw, but if you are going to draw…ladies…please make sure that what you are drawing is appropriate to gravity and no gravity. So if you are drawing hamburgers, show me a hamburger in a world with gravity, and a hamburger in a world without gravity, don’t just draw me hamburgers. Think about what you are drawing (laughs) and how it applies to science right now. Because I know you are excellent artists. Okay. (May 10, P3L21-26)

Humour was an important part of the relationship between Tracy and her students, and it was evident how much they enjoyed each other by exchanges like this one: “Tracy says, ‘You had some really interesting thoughts and some really interesting ideas, and I can tell already that you have a pretty good sense of [a student says “humour” and Tracy laughs]…gravity’” (May 10, P3L33-35). Tracy was very good at maintaining the line between having fun and getting out of control. During an exercise to explore the uses of a wedge (as a simple machine), Tracy was encouraging her students to try to find a way to keep her from entering the classroom through the door (the FM system worked particularly well for this activity as Tracy could speak to the
students from the hall). By the end of the exploration, both Tracy and the students were laughing helplessly:

Tracy wishes the students luck, tells them to work together and shuts the door. The students are getting very excited. Someone (Isabelle?) initiates moving the big bookshelf on wheels in front of the door and lots of students jump up to help her. Tracy pretends to be very worried, “(laughing) No, no, don’t move the big bookshelf! Grade 2s (laughing) that’s not funny. Okay, okay, I’ll try it. Stand back, here I come!” Tracy opens the door; the students shriek and scream with excitement. (June 11, P1L32-37)

Classroom Management

Learning in any format was seldom interrupted to manage behaviour, and never for very long due to Tracy’s classroom management skills. The result was a collegial atmosphere, and one where Tracy’s time and attention was free to support learning activities. Though many of her strategies are likely common, they are worth describing because they facilitated smooth transitions and engaged participation between and during whole-class, small-group, pair, and independent work. The classroom management techniques are presented in two groups: strategies that managed transitions, and strategies for holding or re-capturing students’ attention.

Transitions

Tracy used a number of strategies to create smooth transitions between activities and between work areas in the classroom:

- Hands on Your Head: Tracy asked the students to put their hands on their heads after completing a task so she could tell when everyone was ready to go on. For example, “Tracy asks the students to write their names and the date on the top of the worksheet, and then to put their hands on their heads. She thanks them individually as they do this” (June 4, P1L29-30)
• Transit Question: Tracy asked each student to answer a question in transit. For example, “Each student must give an ‘energy word’ in order to leave his or her desk and move to the perimeter of the carpet” (May 10, P1L16-17)

• Reading Finger: Tracy asked the students to put their “reading fingers” (index fingers) on the first word of a sentence or paragraph before they began to read together.

• After the Task: Tracy gave students tasks or jobs to do as they finished their work, for example, reading a science book from the science book basket or helping other groups complete their activities:

  In the classroom when kids finish early they become helpers, they never go on, well sometimes they go onto something related, a game or something, but often times they become helpers to other students. So they usually still finish at the same time… (I1, T36)

• Countdowns: Tracy challenged the students to complete a clean-up or move from one place to another by the end of a countdown.

Attention

Tracy’s predominant strategy for maintaining and re-capturing students’ attention was her use of various seating formats, and most importantly, changing those formats often. The students’ desks were in two large groups, with the exception of Cindy’s desk, and towards the end of the classroom observations, Doug’s desk. These two students sat on their own at the front and back of the room respectively, to help them concentrate and avoid conflict during independent work. When desk arrangements were not working well, Tracy asked the students to help her develop a new seating arrangement.

Tracy conducted most whole-class discussions and activities at the carpet area, either with students sitting around the “perimeter” or in a large group in front of the rocking chair or chart stand. Of seating patterns Tracy said, “often times we sit in boy/girl patterns just because that gets rid of the hands-on problem with the girls and with the boys….some of them have a
special spot on the carpet where they have to sit” (I2, T59). At one point during classroom observations, the following scene occurred:

Tracy calls all the students to the carpet. “I don’t want you to stay in one place for too long!” Students groan. Tracy: “Have you been going back and forth a lot?” Students: “yes”. Tracy: “Okay, last time. This is the last time I’ll put you on the carpet. I need you on the carpet for this…. (laughing) I only wanted you to move so that you could move around a little bit. We don’t really have too much to discuss down here.” (May 31, P3L22-27)

The researcher asked Tracy about how she decided when and where to position the students around the classroom. Tracy replied that it is partly to make sure that students have a good view, and that they take turns having the best vantage point for seeing what is going on. Also:

I decide a lot of it just based on the activity that they’re doing, so whether we’re doing whole group learning or whether they’re doing independent work, but then I also um a lot of it, it happens just at the time of the activity because I’m just gauging it on how they are. Like if they’ve been sitting too long in one spot or if they are fidgeting, like if they’re uncomfortable on the carpet then we’ll move somewhere else even if it’s still…. But yeah I do try and move them around a lot because I think because I don’t sit well myself and I’m not, because I have a really hard time staying in one place for a lot of time so I just imagine that they would too, but maybe, like maybe they’d be perfectly fine, but that’s pretty much why I move them around so much. (I2, T56)

In addition to seating arrangements, Tracy used a number of other strategies to keep students focused on the activity at hand:

- **Using Names**: Tracy frequently used the students’ names in comments and instructions—she would direct comments to specific students even when addressing the whole class. For example: “I’m going to tell you that your challenge, Kelly, is to make an object move across water without touching it” (May 7, P1L37-38).

- **Criss-Cross**: Tracy asked her students to sit with their legs crossed, or their hands on their elbows, etc. to help them sit still.

- **Movement**: If students were having trouble sitting still, Tracy used movement to help settle them again. For example, she asked them to do jumping jacks, or jump up and down a number of times before sitting down again. The strategy she used most frequently involved singing, “Head, shoulders, head, shoulders, elbows, shoulders, etc.” while touching the
named body part. Students were to follow along and she kept it up until all students were focused on her again. During one classroom observation period when the students were quite restless, Tracy stopped the lesson for a “wiggle-break”:

She plays music on the stereo and asks the students to show her “the beat” on their heads, shoulders, hips, toes, etc. Next Tracy asks students to move to the centre of the carpet and teach a dance move. Tracy leads them in a few dance steps, and then they all sit down in a boy-girl pattern. (May 17, P1L16-20)

- Talk to Your Neighbour: If a number of students were talking out of turn during a whole-group discussion, Tracy went with it by asking the students to turn to their neighbour and talk for a designated amount of time about the topic at hand.
- Stand Up: If a student was really having trouble paying attention or was distracting other students, Tracy asked the student to stand up in his or her place:

  Sometimes they stand up in their spot so if they’re having a really hard time listening then I’ll, I wouldn’t, I don’t often ask them to go back to their seats, hardly ever, but I’ll have them stand up a little bit, just for a minute to see if that will fix anything. (I2, T59)

In the second interview, Tracy told me that this Grade 2 class really was exceptional in terms of behaviour and that she did not have to employ many of the classroom management techniques that she used with previous classes (such as a stop-light for behaviour warnings). Whether it was Tracy’s classroom management skills or the students’ innate tendencies towards appropriate behaviour (likely both!), the result was a classroom atmosphere in which the focus was clearly on learning, rather than behaviour management.

Teacher as Guide and Learning Partner

Although we never formally discussed Tracy’s philosophy of teaching science (or any other area of the curriculum), it was clear that Tracy established herself in the classroom as a facilitator of learning, rather than as an authority figure.

Like they always, I would say 95% of the time, no all the time, they always question me on what I’m doing and they always come up with solutions that I would have never thought of. So you have to just be, it’s kind of like you can’t be um what’s the word I’m looking for, you can’t feel like you know the answer as a teacher, and so I think maybe if
you were, if you were really feeling like uh like you knew what you were doing, and that
you had all the answers, that collaborative learning … yeah they, every, every lesson I’m
… they prove me wrong or they do something, and you just have to be, you just have to
be willing to let them … (I1, T54)

She learned alongside her students, listened carefully to and accepted their scientific
opinions, and at times, deferred to their expertise. Tracy stated that everyday, in every subject,
class discussions were the norm. “It’s really not a, it’s not a teacher-led room” (I1, T52). Tracy
wasn’t afraid to admit that she was wrong or that she did not know how to do something, and role
modeled this attitude for her students.

Tracy tries to set up a vertical double pulley system but can’t figure out how to thread the
rope. Tracy asks Ginny to read the instructions from the worksheet. The instructions are
not very clear and Tracy can’t figure out how to rig it. Oliver says he knows how to do it,
so Tracy asks Oliver to work on the double pulley system while the rest of the students
return to their seats to read through the information on the worksheets about pulley
systems (block and tackle). (June 19, P2L33-38)

There is protest when Tracy says there were no inclined planes in any of the compound
machines they examined (the students think the dustpan edge is an inclined plane and I
agree!). Tracy says she thought of it as a wedge, but that she will accept inclined plane as
the answer. (June 20, P4L22-24)

Tracy also believed that students learn best when they are given the chance to actually try
something themselves—both for science learning and social skills development:

I would say don’t underestimate your students. If you allow them, if you give them the
guidelines and you model constructive behaviour and … how to be a cooperative learner,
like how to get along with each other, and you give them the opportunity, they will rise to
the occasion. And I think the most important thing about group learning is to make sure
that you don’t have a specific outcome in mind, because usually when they get together
they will be far more creative than I would have ever thought…. they’re not going to
learn how to get along if you don’t give them the opportunity to try. And they’re not
going to learn how to work things out if you don’t let them have a conflict, because you
can’t teach conflict resolution, and you can’t teach how to appreciate each other unless
you give them the chance to do it. And if you don’t, if you stop them before they get
there then they don’t know how to work themselves out of it… (I1, T54)

In the second teacher interview, conducted after initial analysis of the classroom
observation data, the researcher asked Tracy to identify which collaborative learning activities
were the most successful during the time the researcher spent in her classroom. The researcher
had expected the teacher to identify activities that went very smoothly, but to her surprise the
teacher selected the “Waterwheels” activity, and the “Lever Experiment” as two of the most successful activities. In the waterwheel activity, the students had a lot of difficulty keeping plastic measuring cups attached to paper plates with tape, and then difficulty with the hole in the middle of the paper plate widening as it got wet while rotating a round pencil under a stream of water. Frustration developed in both students and teacher, though solutions were discovered and all the students experienced some success in the end.

In the lever experiment, students were given a ruler, a fulcrum made out of a half toilet paper roll, and Lego pieces to use as weights. They were instructed to place Lego pieces on the ends of the ruler in different numbers and then to make the lever balance. The students were supposed to figure out that they could make the lever balance by changing the location of the fulcrum along the ruler; for some reason the students were resistant to this idea and wanted to try a variety of other solutions, for example, moving the location of the Lego pieces along the ruler or turning the toilet paper roll over so the ruler rested on a flat, rather than curved edge. Some of the rulers were warped and depending on which side faced up, would balance no matter what weights were on the ends. As a consequence, Tracy was continually telling the students what not to do with the materials. The students became frustrated when they were told that the solution they were reporting on their worksheets was not correct and they had to start over again.

In the first example, the researcher had been expecting that Tracy would say that the activity would have been better had she tested the materials prior to the lesson, and completely built a water wheel of her own. Instead, Tracy said of the waterwheel activity:

Because they, the water wheels didn’t really work out in the beginning, but they all came up with ways to make the water wheels work….But that’s usually when the best stuff works is when, like they, when I do something and it doesn’t really work that, they love that, and then they love to find, they don’t love it that I don’t succeed, but they love being able, the challenge of trying to make it work…. with the water wheel one like that, then they got to figure it out, like they really, and that, they did a really good job on that one, and they could totally see the flow of the water, the wheel only turned one way, and they had to be spaced out, and it mattered how they were fastened too yeah. (I2, T155-T157)
In the second example, the researcher was expecting Tracy to say that the instructions should have been given in more detail ahead of time. However, despite the ongoing frustrations to find the balance solution, Tracy said:

I think all of the partners they really worked together and they got it, like they got that you could balance two on one end and one on the other when the fulcrum moved, and I could see … like they seemed to work at it until they figured it out, and it was a simple enough activity that they could do it, and it was, but it’s not a simple concept. I thought that went pretty well. (I2, T154)

Tracy identified activities as the least successful as ones where the students were not able to help Tracy very much with the experiment or ones where they could not solve the problem on their own, such as the “Screw Experiment” (she ended up screwing a variety of screws into a piece of wood while the students watched because the students were not strong enough). Tracy thought the experiment when they tried to move an object across a tub of water without touching it (“Power from Moving Water”) wasn’t extremely successful because they did not have a true source of moving water to experiment with (the students created moving water with their hands in tubs or by shaking the tubs) and she thought it was hard for the students to see what was really happening. In addition, she wasn’t entirely happy with the Design and Make Activity (DMA) at the end of the Power from Wind and Moving Water unit. This involved students working in small groups to design and make an object that could be moved using either wind or moving water. Tracy felt the students focused more on the objects they made rather than on how to make their objects move using power from wind or moving water.

In all the activities Tracy selected or designed for her students, she endeavoured to provide opportunities for hands-on, authentic learning. One day, while exploring a number of household tasks or objects involving levers (e.g., opening paint can with screwdriver, removing a nail from a piece of wood with hammer tines, lifting a heavy object using a see-saw lever system) Tracy commented, “I’m trying to give you examples of real life here. I could just give you worksheets but I don’t think it would be very much fun” (June 7, P2L17-20). Even if her students
did not entirely learn the concepts a lesson was intended to teach, Tracy’s philosophy supported the activity itself:

But really what did I really want them to learn, I would really rather that they learn to work together and produce something together that they get the concept kind of than have a terrible time, or me have them sit like, it’s better for them to work collaboratively and do something from beginning to end than sit by themselves at their desks and build what I give them right. (I2, T162)

Collaborative Learning

Why Does Tracy Use Collaborative Learning?

Tracy’s first experience with teaching using collaborative learning was through trial by fire in her first teaching position:

In [school name] it had to be a lot of collaborative learning because the kids were at such different levels that I often had to have the Grade 6’s working with the Grade 4’s, and the Grade 5’s working with the Grade 3’s to help them with their learning because I couldn’t possibly be teaching all four grades at the same time. (I1, T14)

In her subsequent years of teaching, collaboration became a pervasive feature of teaching and learning in Tracy’s classrooms. “To me, everything’s collaborative if you’re just not sitting there. If you sit there silently and try to do your work or you don’t ever get to like share your answers or strategies then…[shrugs as if to say ‘what’s the point?’]” (I1, T61).

Tracy never took courses, received training or mentoring, or conducted library research on her own for information about how to use collaborative learning to teach science or any other part of the curriculum (though she remembered participating in collaborative learning during her own career as an elementary, secondary and undergraduate student, and as a teacher candidate). Rather, Tracy frequently described collaborative learning as “natural” during the teacher interviews, and as something that has always just happened in her classrooms:

It’s just a really natural…maybe because it’s a primary classroom, but it’s just a very natural, it just seems to happen more often than not. I think also it’s because they’re in primary they’re oral learners because a lot of them don’t have really their strong reading and writing skills yet. It is all about talking and talking first and talking is always collaborative in discussing. (I1, T97)
Tracy observed that her students always wanted to share what they were doing and what they were learning with their classmates anyway, so it just made sense to let them do it, from both learning and classroom management perspectives:

And in science, they love doing experiments so much and doing things that they always want to share what they found with each other anyway because they’re so interested in it that they don’t, they would never want to keep what they’re doing to themselves, so it just turns into that anyway. (I1, T24)

Tracy continued to use collaborative learning because of the success all students experienced through this learning format, both academically and socially. Academically, Tracy believed that when students work together they are more creative and they learn more than if they were working independently. Socially, she believed collaborative learning created an important opportunity for students to interact with their peers and practice social skills in a predictable, structured framework:

They really benefit from it because they get to share their ideas, and they get to help other students, and they sometimes get to lead and they sometimes get to follow, but they always learn more together than they would apart. (I1, T67)

According to Tracy, even though students with LD may find aspects of collaborative learning difficult, it is even more important for them to experience it than their non-LD peers, both socially and academically:

I think the benefits outweigh the disadvantages. I think it works for them because they get to verbalize, like a lot of students that I think have LD um they can verbally articulate their ideas better than they can write it down, and so their peers, they can really feel like they’re sharing their ideas and their knowledge with each other, and they’re really helping. (I1, T68)

Tracy believed collaborative learning provided some of her students with LD with their only opportunity during the school day to share their strengths, work around their challenges, and socialize.

When asked about the disadvantages of collaborative learning, Tracy suggested that the noise level, having students frequently out of their seats, and the advance preparation needed for hands-on, collaborative learning in science might put off some teachers. Sometimes student
personalities clashed or did not complement each other in small-groups. But Tracy was quick to emphasize that as long as she was prepared (selected the student groups ahead of time and organized the materials well), she never had a negative experience with collaborative learning:

Yes, there are problems with personality differences, like students that really always want to be the leader or really always want to boss the other people around so there are issues that way. There are issues with how well I’ve planned the lesson for them to be successful, so sometimes it could just be my, I don’t have the right, I don’t have enough of something or I um … I’m not getting around to the groups fast enough or um … and sometimes what they’re doing just doesn’t work, but that kind of happens and not just in collaborative learning too….if what I’m asking them to do doesn’t work or the lesson doesn’t go very well or the experience doesn’t go very well it’s not, it’s not usually a result of the students, it’s usually a result of me. (I1, T60)

Tracy noted that students need quiet time and space in which to collect their thoughts and focus on a task; sometimes when they need to create an individual product (like a writing piece) working collaboratively creates too much social distraction. “But as far as learning and experiencing things, they’d much rather do it with their peers than on their own I think. They enjoy it a lot.” Tracy said the one exception to this statement might be Elena, who had Asperger syndrome. She preferred to work on her own, given the choice.

*How Did Tracy Use Collaborative Learning?*

Classroom observations supported Tracy’s claim of the widespread use of collaboration in her Grade 2 class. Collaboration occurred in whole-class, small-group, and pairs formats, depending on the activity, and often one science period involved all formats. Even activities that primarily involved independent seatwork were interspersed with opportunities for students to share their answers with the whole-class or with a partner in order to receive feedback or to give their classmates ideas. The following paragraphs describe how Tracy generally used collaboration as a learning strategy in each of the above formats. More details follow in the next three chapters, which examine student learning at each phase of the guided inquiry science learning cycle.
Whole-Class Format

Tracy used a whole-class format for the introduction of new topics, group discussions of observations and explanations, teacher-led experiments, and taking up written work. During the introduction of a new topic, students shared prior knowledge and reminded each other about learning from preceding lessons. Tracy used these opportunities to read through instructions for the day’s experiment or activity together. Partway through an experiment or activity, Tracy called the class together to share observations and explanations, and then sent the students back into small-groups to continue explorations using the new ideas they gleaned from classmates. She repeated this prior to asking students to record observations and explanations on worksheets. If ideas were not flowing in the large group discussion, Tracy often asked the students to turn to a partner and discuss the question at hand. Invariably, answers started to flow following these brief collaborations:

Tracy takes all the examples of levers they have used to the back of the classroom and asks the students what is similar about them. The students have difficulty answering this question…. Tracy asks them to talk to a neighbour about the similarities…. Tracy: “All right, I think we have some ideas. What is similar about these three activities we just did? John: “They lift things up.” Tracy: “They lift things up. Absolutely. We couldn’t do it by ourselves, well we could, the book, but we couldn’t do the other two by ourselves, we needed a tool. So what did we do with the tool? Beth?” Beth: “??? …pushed down so the things could go up.” Tracy: “All of these tools we pushed down to make something go up. You’re absolutely right. We pushed down to make it go up. (June 7, P2L30-P3L1)

While students were writing or drawing on their worksheets, primarily independent work, Tracy asked the students to read their answers or show each other their diagrams. This often encouraged students who were not writing or having difficulty to attempt their own work again. Tracy used a whole-class format to carry out teacher-led experiments. For example, Tracy led the class through an experiment called “The Gravity Cup”—an exploration of the effect of different numbers of holes and hole sizes on water falling out the bottom of a Styrofoam cup. Tracy asked different students to assist with each step of the experiment. Before each trial of pouring water through a cup, Tracy led the class in making a hypothesis, and then after each trial, they discussed observations as a group (Paraphrase, May 14, P1L38-P2L15). In another teacher-led experiment
observed during the study, Tracy and the students explored the effect of using inclined planes on the counter-weight needed to lift an object.

**Small-Groups and Pairs Format**

Tracy used small-groups and pairs for a number of experiments and hands-on activities during the observation period. For example, students explored how to make objects move using moving water, made pinwheels and waterwheels, designed and made objects powered by wind or moving water, and identified simple machines within complex machines. Tracy listed past activities involving small-group work as painting water cycle murals, creating load-bearing, buoyant objects, observing and caring for mealworms and amphibians, and experiments with liquids and solids.

Tracy also asked students to work in pairs for a variety of other learning activities, including brainstorming: “Tracy asks the students to brainstorm about activities involving moving water—they talk to a friend again for 10 seconds” (May 22, P3L16-18); giving and receiving feedback on writing and drawing: “Tracy asks the students to trade workbooks with the student across from them to get feedback….Tracy tells the class to make corrections and then show their work to their partner one more time” (June 4, P2L11-20); and completing science worksheets and other seatwork.

**Forming Groups**

When selecting partners for work in small-groups or pairs, Tracy used a wide variety of strategies depending on the task to be accomplished and whether the collaboration was planned or spontaneous. Sometimes Tracy decided on the partnerships, and sometimes the students were allowed to select their partners. At the point in the school year when classroom data were collected, Tracy felt that she knew her students so well that she could form groups that worked well together off the top of her head:
Sometimes I will just ask, like I might start with my four students who I know are going to be really responsible and really helpful and really strong academically, and I’ll set them up in four corners and then I’ll put kids, they don’t know what I’m doing, but they’ll, I’ll just start and then I’ll take maybe my four that I think I have the most concerns with and put each of one of them in a group, and then I’ll just keep going like that. (I1, T34)

However, there were several times during data collection when Tracy did plan the groupings of students ahead of time, especially because the researcher requested that students with consent to participate in the research be grouped together as much as possible.

In general, Tracy tried to form small-groups and pairs so that there were always students to whom success came easily working with those students to whom success may not come all the time. More specifically, Tracy explained her reasoning for when to take responsibility herself for forming groups in the following way:

It depends entirely on the expectation, because if the expectation is one that might be going through a magazine and finding all the examples, finding things that are translucent, and then another group finding things that are transparent or something, that’s not a task where there’s a lot of materials and a lot of responsibility and a lot of written work, so for that it doesn’t really matter whose working with who because if there’s going to be a personality conflict or something happening we can deal with that as a class. It’s not going to affect the outcome of the task; whereas, if it’s doing like actually testing how different solids and liquids interact with each other and using the materials properly and getting all of your materials written down and our observations written down, then I’ll always try and make sure that there’s going to be a student in the group that can help students that might require some help. (I1, T37)

Included in the students whom Tracy listed as “strong group people,” were Beth, Ginny, and Isabelle. According to Tracy they were all intelligent enough to understand the requirements of the activity, and more importantly, they were very socially aware of their peers and very good at problem solving. When the researcher asked Tracy to elaborate on her selection, Tracy explained that these students understand how other students worked and how they operated; that ability, plus problem solving skills enable them to diffuse situations well. At the other end of the spectrum, Tracy listed Cindy, Elena, John, Doug, David, and Mary as students who are not “strong group people.” Tracy said while none of them caused serious problems in groups, neither were any of them helpful at keeping people on track nor pulling people together.
At the beginning of the school year, Tracy said that she was careful to mix up those students who were all in a class with her last year with those who were new to the group during collaborative activities. This was to build social relationships amongst all the students as well as to help the new students become familiar with her routines and expectations for group work. Tracy reported that students did not seemed to mind when she assigned the pairs and groupings because, “they always pretty well know that we’ll start together, we’ll branch off, and we’ll end up together so they don’t really try and change that” (I1, T39).

For the many brief pairings that occurred, Tracy simply asked students to work with the person sitting beside or across from them (brainstorming, etc.). However, Tracy also used a number of interesting methods to group the students spontaneously into pairs, including numbering, boy-girl pairs, distribution of investigation materials and the following example:

    Tracy gives the students the option of working alone or with a partner. “If you want to work with a partner, silently, silently, point to the person you’d like to work with. If you are both pointing to the same person, go now, together. Find a spot and work. If you are not pointing to each other, don’t go together.” (May 31, P3L30-34)

Tracy frequently used boy-girl pairs and the researcher asked her if there was any self-consciousness between the boys and the girls yet. Tracy responded that self-consciousness was only just starting to appear, and just with a few of the more mature students. However, it was not enough to make her stop using boy-girl pairings at that point in the year, especially when many students, given the choice to work in pairs, chose an opposite sex partner. Also, since she has almost the same number of boys and girls it is an easy way to pair them off quickly (May 17, P2L43-P3L3).

Tracy often gave students the option of working with partners for worksheet or other seatwork activities with a warning to choose partners wisely. She said that some students always wanted a partner, some never, and the rest changed with the activity and their moods.
Teaching Group Work

This section presents strategies that Tracy used to prepare students for collaborative learning in small groups and pairs, and general strategies Tracy employed to support learning while students were working collaboratively. Strategies and teacher-student interactions specific to the focal students and to the phase of the guided inquiry science learning phases will be presented in the following three chapters.

To prepare the students for working collaboratively in small-groups and pairs, Tracy said she spent a lot of time in September and October using role play to teach her students routines, safety procedures, and how to work in groups. They also spent time talking about why each was important: “I think we all tried hard in that classroom not to have rules that didn’t make sense to them” (I2, T55). In addition, Tracy described how she would model scientific procedures and then ask the students to copy what she had done. In the first interview, Tracy warned the researcher that what she would observe in her classroom in May and June would be very different than what she would have seen at the beginning of the school year:

Often times in September and October, this is the way it is I think in primary classrooms in the beginning of the year anyway, that everything you do is very, very slow, and very step-by-step, so I would put them in groups and then I would … well it’s still this way, um it’s one step at a time, and you have the whole class stop what they’re doing and say okay now I would like group member “B” to please go to the back table and get the equipment from the back and we’ll talk about why that’s important. And the more we do that and how to be safe in the classroom and how to treat equipment, and how to treat each other, the clearer the expectations are and the reasons behind it, then the more productive and successful they are. But definitely the beginning of the year is very, very slow, and often times I will start by I will do an experiment or I will model how to do it or something, and then they will go and do it themselves with a lot of modelling. Now I don’t need to that as much because they’re, they’re very, they’re good with the scientific method, which is good. (I1, T25)

The researcher asked Tracy if there was a turning point in the year—a point in time at which she noticed a change in how the students worked together collaboratively. Tracy’s response was decisive: after the winter holiday. “They come back a little bit more focused and a little bit more mature, and now, right now they are, they’re on fire, yeah” (I1, T31).
Some of the routines and strategies that Tracy taught her students at the beginning of the year included the following:

…how to carry scissors, how to walk forward with your eyes open, watch where you’re going really completely, walking forward in the classroom, not running in the classroom, pushing your chair in so that people can get around more easily. We talked, we practiced a lot like if there is a group of four working and everyone needs a ruler, that you could choose one person to go get a ruler instead of four, and how you would go about making a selection and being fair, and why all twenty-one students don’t need to go to the back table all at once kind of thing, and then, and then just problem solving with, within like social, socially sort of things like rock, paper, scissors, and talk it out…(I2, T54).

Evidence of this early learning was heard in the classroom observations, as Tracy briefly reviewed important group learning strategies such as safety, complimenting, giving constructive criticism, and sharing answers before collaborative activities commenced:

Tracy asks what words she might hear if people are working together well as a team with their friends. “What are some words I might hear you say if you are being a good group member?” NC “Smart”; Oliver “Share”; NC “Help”; Ned “Cooperate”; Elena “using appropriate manners”; NC “Good friends”; NC “you’re a smart cookie”; Oliver “Brilliant”. (May 7, P2L3-6)

Tracy asks the students to show their diagrams to the two people closest to them. She gives them examples of positive comments they could make about each other’s drawings, “Oh I really like that or, I can tell that’s an inclined plane because…Great drawing.” (June 6, P1L20-23)

Tracy said that even though her students know who needs help with what and recognize each other’s strengths and weaknesses, sometimes she assigns very specific roles to students in small groups, especially if the task is complex:

Okay, Mary, you are the writer, Doug you are the measurer, Henry you are the project manager, you’re going to just make sure everything’s going okay, and so I sort of delegate what their responsibilities are in a big task, but sometimes I just let them … or I just say everyone needs to do like this share, and this many, or you need to put this many, you each need to do this in order for it to work, and they’ll do it. (I1, T43)

Tracy said that students were aware of her expectation that they make sure that their partners were keeping up and recording similar answers. “Normally, I would say 75% of the time the groups will make sure that everybody’s all on Part 3 together” (I1, T44). She also noted that her students were just naturally helpful.
Tracy reported that she does not modify collaborative learning activities in any way for her students at-risk for LD beyond giving them a specific role in a collaborative learning activity. She might expect a different level or form of response on their worksheets, however.

Once the students were working in small-groups or pairs, Tracy reported that the most important thing for her to do was to keep moving between all the groups, listening and watching the interactions between students and their manipulations of the materials. If things were going well, she tried not to interrupt the flow. However, if she saw something that she liked, she directed praise to the students involved using her FM system microphone so that the whole class heard. Occasionally, she stopped all the groups to share something really interesting or really creative that was happening in one group, or if “they just got it,” but that was not the norm.

If there was an isolated problem within one group, Tracy said she usually turned off her FM system microphone and worked with the group involved:

If I see…a group that’s not working very well together I will just go over with that group and we’ll talk about what’s going on, and usually by me coming over and just redirecting them they’ll get right back on task or if it’s something minor that someone’s just having a little bit of difficulty, usually just by me being there and talking to them for a minute they can get right back on track…(I1, T95)

If there was a problem within more than one group, either with understanding the task or with social functioning, Tracy said she often stopped the whole-class and asked the students to put everything down and meet on the perimeter:

We go around the circle and we start with um whoever, it doesn’t matter, and they say “I feel”, and everyone goes around with an “I feel” statement, and if we get to someone whose not, whose saying an emotion that isn’t a happy one or a positive one, then we stop and we talk about it, and the kids give strategies as to what they could, what that student could do or why they’re feeling that way, and they give, the kids give, the students give strategies to that group and that individual, and then they go back and try again and usually it’s fine. (I1, T27)

Tracy said she keeps a closer watch on her students at risk for LD while they are working in small-groups and pairs. She described what she did when she noticed one student being critical of a student at-risk for LD because she had reversed several letters while recording information for her group:
So when their face drops, usually if I’m, I try to be walking around all the time, um that’s when we stop and take a break, and as a group come back down to the carpet and work it out because we don’t want anyone not feeling good about themselves, but it … but then it also gives the students in the group without the LD a chance to recognize that, how to handle that, and how to be empathetic, and how to be a good friend and supportive, and how you can say oh I think you’ve got a reversal there, instead of saying oh my gosh, you know, and then they learn that. (I1, T70)

Tracy often asks the groups to self-evaluate their performance as a group or an individual group member. Sometimes Tracy included a spot for them to indicate a rating (and an explanation for the rating) on the worksheet that accompanied the experiment or activity, and sometimes they did it orally by closing their eyes and raising their hands to indicate a rating. Usually they did this at the end of an activity, but Tracy said that sometimes she did it as a way to get group functioning back on track in the middle of an activity. More detailed data about how Tracy supports ongoing collaborative work will be presented in the next three chapters.

Assessing Collaborative Learning

In both interviews, the researcher asked Tracy about how she assessed the success of group work, both for process and content learning. Tracy described a group of students working well together in the following way:

Oh they just feel really good about each other and themselves and they congratulate each other and they’re smiling all the time, and they like they get really excited, and they’re seven … they jump up and down, and they’re, like they’re happy, and they’re good, and they’re engaged, and they’re all writing, and they’re all successful, and they’re all, and they’re all, when a group is going really well they’re all actively engaged. No one’s looking the other way or picking at their nails or, you know, they’re all contributing. (I1, T56)

Tracy estimated that during a typical collaborative learning activity in small-group format, at any one time about 70% of the students would be actively participating in the activity. Of the students at-risk for LD, Tracy estimated that 50% would be actively participating at any one time. Tracy noted that her class was fairly diverse in abilities and interests, so that it would be unrealistic to expect all 21 students to be “on” and excited about all the activities, all the time. She also said that some students choose to watch and that is their preferred way of learning—it doesn’t mean
they are not engaged. Tracy believed that self-confidence, and providing an environment that allowed students to use their individual interests and abilities were the key to maximizing participation by all students. In a successfully working group, she expects to see that “everybody’s involved, not necessarily to the same extent, but that everyone’s involved, and that everyone got to play a part” (I2, T165).

Tracy said that spending time listening and interacting with the groups was key to assessing group success:

Just because they all have something written down doesn’t mean it was a good group. Right, like sometimes you can’t, you don’t gauge by written results, because you could have like your four strongest students altogether and trying to do everything, and then coming up with really great answers that are exactly what you want, like textbook answers, but they didn’t, they didn’t gel. (I1, T56)

Tracy explained that for official reporting purposes, collaborative learning skills are not part of science assessment, rather, they go in a general category called Learning Skills. “For actual reporting purposes, you can only report on very specific expectations, and in the Science curriculum, it says nothing about group work” (I1, T47).

Tracy relies heavily on listening in on group interactions to assess concept and content learning: “When they talk about has happened and what they’ve learned, and what they saw, it’s…they are absolutely benefiting. They get the concepts” (I1, T91). Tracy said she listens for key terms and arriving at a common ground for solving problems or explaining observations.

Although virtually all experiments and explorations are carried out in whole-class, pairs, or small-group formats and a shared product (e.g., waterwheel) may be created, students always create an individual product as well, in the form of a completed worksheet at the end of each science period. Along with activity instructions and key words and information, it provides spaces for students to write their observations and explanations with the help of sentence starters or leading questions; there are also spaces for diagrams of the materials and observations. About the role of the worksheets in learning, Tracy explained: “I hope that that makes it comfortable for them, like so that they’re not all saying, so “oh my gosh this is so much, I can’t do it,” like I hope
it helps them feel successful” (I2, T50). Tracy said she uses these worksheets for formative assessment purposes, to gauge how well the students understood the concepts presented through the lesson and activity. However, she emphasized this was more to inform her teaching than to assess students’ learning. Tracy does not use the worksheets for reporting purposes, because many students do not show their understanding fully on their worksheets. Instead, she explained:

In our education system they have to write down what they know, and they [the worksheets] serve more of the purpose of neatness, completeness, putting the data on the page, diagrams I think are really useful in Grade 2, and just the way … I also like it because it shows parents what we’re doing. It’s a way of keeping track of what we do in class so that they can … so that there is kind of like a paper trail of what we do. (I2, T46)

For summative assessments of students’ academic learning, Tracy used classroom observations, culminating projects, and conversations with students. However, Tracy believed that content learning was not as important at the Grade 2 level as simply being exposed to scientific phenomena and processes. She pointed out that all the facts and concepts in the Grade 2 science curriculum are presented again in higher grades, and simply having encountered the ideas and concepts once already will enhance students learning in the future.

Chapter Summary

The first section of this chapter presented observation and interview data about how Tracy’s cross-curricular teaching strategies created a caring community of learners within her classroom. First, talking about abilities, discussing feelings and interactions, and developing a sense of ownership and responsibility contributed to a team atmosphere. Second, effective classroom management promoted a positive atmosphere and allowed Tracy and the students to focus their attention on learning. Third, Tracy acted as a facilitator and learning partner, rather than as an authority figure. In this role, Tracy modeled and supported risk-taking, listening respectfully, admitting mistakes and not knowing the answer, and problem-solving.

The second section of this chapter described collaborative learning generally in Tracy’s classroom. Tracy strongly believed in the importance and effectiveness of collaborative learning
for all students. She used collaborative learning extensively across the curriculum, and in various formats: whole-class, small-group, and pairs. Typically, Tracy placed students in groups according to the requirements of the learning activity and the strengths and challenges of individual students. Strategies for working collaboratively were taught through modeling and scaffolding, step by step, at the beginning of the school year, and then reviewed and supported on an ongoing basis. Finally, Tracy assessed student learning and group functioning during collaborative, guided inquiry, science activities primarily through close observation and verbal interactions with groups and individuals.
CHAPTER 5: RESULTS—ENGAGE

Introduction

In practice, the phases of a guided inquiry cycle are fluid, recursive, and overlapping during periods of science activity. During data analysis, the researcher had to make decisions about where to place data that could have belonged in two or more phases. In particular, the Investigate and the Explain/Report phases overlapped and intermingled. For this reason, the data were hard to separate for the purposes of analysis and reporting, while keeping the data in context. In Tracy’s Grade 2 class, the majority of time was spent in the Engage and Investigate phases. Therefore, the data is richest and most detailed for these phases of the guided inquiry learning cycle. The amount of data collected and reported for each focal student varies between phases and collaborative learning formats. Collection of observational data was affected by group formation (if a focal student was working with an NC student), student absences, and time limitations (at the Grade 2 level, activities are usually short to accommodate a seven-year-old’s abilities for attention and self-control).

The data for the Engage phase is reported in this chapter. The chapter begins with a description of the learning and social processes associated with the Engage phase of the learning cycle. Next, Tracy’s roles in generally supporting learning and group processes are described. Then the experience of each focal student is described, including descriptions of his or her specific interactions with Tracy and his or her peers. Chapter 6 presents the data for the Investigate phase. Chapter 7 presents the data for the Explain/Report phase.

Engage

The “Engage” phase of guided inquiry learning is typically where the learning cycle begins. For Engage, Tracy always used a teacher-led, whole-class format; occasionally, students completed independent or seatwork in pairs as part of the Engage phase as well. The Engage
phase usually began with a review of the unit topic and making connections between the new lesson and previous lessons. For example:

Tracy reviews with the class that they have been talking about energy, and most recently, wind energy. She says that today they will change their focus a little bit. Instead of talking about moving air, they are going to talk about moving water. Tracy asks the class “What is so great about moving wind and moving water?” Elena answers, “It’s because…it’s renewable!” Tracy says when they think about their whale and being friendly to the earth, they are trying to come up with better ways create energy and produce electricity. (May 7, P1L29-35)

Next, Tracy introduced the day’s activity or experiment. For example:

“Two weeks ago we had a challenge where you had to move an object without touching it. Same type of challenge today, only, your groups will be slightly different and the challenge is slightly different, okay? I’m going to tell you that your challenge, Kelly, is to make an object move across water without touching it.” Students murmur, “wow” and clap. (May 7, P1L36-39)

Finally, Tracy provided instruction on the procedures and materials for the activity or experiment, especially if it was to be completed in a student-led, small-group or pairs format (if it was to be a teacher-led experiment, they worked through the instructions while carrying out the experiment). Each student was given a worksheet that included information about the topic, instructions for activity or experiment, places for writing and/or drawing observations and explanations, and follow-up questions to be answered (e.g., Appendix E). Tracy and the class read through the information and instructions (with varying levels of detail) together before commencing the activity or experiment. Occasionally, there was a short seatwork exercise about the topic to complete independently before beginning the experiment or activity (for example, circling all the wedges in a group of diagrams).

Tracy

Whole-Class Format

During the whole-class parts of the Engage, Tracy acted to support attentiveness, science learning, and group processes. Tracy was quick to draw in students whose attention was flagging by inserting their names into a statement, specifically asking them to answer a question, and by
giving them jobs to do, for example, taking turns reading sentences, acting as a recorder, or
asking them to gather materials. Sometimes she would pass around manipulatives to examine
during the discussion. Tracy supported science learning in several ways. First, she often
responded to student answers with praise, and then another question to further draw out the
answer. In addition, Tracy was happy to let the discussions be guided by student questions and
interests. For example, during a whole-class discussion to introduce the wedge as a simple
machine, the following exchange took place (note that Tracy demonstrated a slight conceptual
error in labeling the blades of scissors as wedges—rather, the blades of scissors are two inclined
planes that shear the paper):

Ned says to keep the portable door open they tie it with a rope instead of using a
doorstop. Tracy asks the students to close their eyes and picture the portable door. She
says it opens out, and there is a big step up into the portable. She asks why couldn’t they
use a wedge to keep the door open? NC: “The door stopper is too little.” Tracy agrees
that you would need a very big wedge to reach the bottom of the door. Tracy shows the
students the edge of a pair of scissors and how the blades are wedges…. Ned asks why
the student scissors are not wedges like Tracy’s scissors. Tracy asks him to get a pair.
They examine them, and they are flat. Tracy says they are probably flat for safety
reasons; they are not as sharp when they are flat. (June 11, P2L22-31)

For each science lesson, Tracy provided (via the worksheet) or created a list of key words to help
students with their discussions about the topic at hand and with spelling on their worksheets.
Tracy deliberately left enough ambiguity in the instructions to allow for student creativity and
problem solving during the Investigate phase of the learning cycle.

Often during a whole-class discussion, Tracy asked the students to share a textbook or
manipulative with a neighbour, or asked the students to turn to a neighbour to discuss the answer
to a question. To support these collaborative processes, Tracy would ensure first that everyone
had a partner to talk to or share with. Next, she would make sure that talking and sharing was
actually happening, sometimes offering a script for the exchange, or assigning one partner to
speak first. After the whole-class came together again to share answers, Tracy would sometimes
ask the students, “to share something cool or great or interesting that their partner said” (May 14,
P1L28-30) to encourage respect for what their peers had to say.
Independent Format

When students worked independently on seatwork during the Engage phase, Tracy circulated around the room, talking to individual students about their work and answering questions. Sometimes she walked around with a book about the topic, showing students pictures and reading out interesting passages: “Tracy asks the students to draw a picture of an inclined plane and write a sentence about it. As the students work, Tracy walks around with a book about inclined planes, reading out loud and showing pictures” (June 4, P1L39-41).

Andy

Whole-Class Format

Andy seemed to enjoy science, and during whole-class discussions he often volunteered to answer questions, take a turn reading, or asked to share an idea: “They read the introductory paragraph together….Tracy asks for examples of inclined planes. Andy: “In the church parking lot, behind the church there is a ramp where wheelchairs can get in” (June 4, P1L32-37). However, Andy sometimes found it difficult to wait to be called on to share his answers and ideas and either spoke without being called on or started talking to whomever was sitting beside him. Also, he usually chose to sit at the back and was sometimes distracted by external happenings (e.g., baby birds in nest outside classroom window or another student):

Tracy sits on the rocking chair and shows the students two screws. Doug and Andy sit at the back, and Andy is poking and pushing the NC sitting beside him. Tracy asks Andy a question about how screws work. He stops fooling around to answer…. Tracy tells the students about the different parts of the screw. Tracy asks Andy to stand up (so he will pay attention). (June 13, P3L26-32)

Pairs Format

During the Engage phase, Tracy often asked the class to confer briefly in pairs (with whoever was sitting beside them) during whole-class discussions. If Andy was paired with a socially competent peer, he participated in these exchanges successfully (though sometimes Tracy
had to direct him to talk to a partner instead of her). If paired with another socially challenged peer (e.g., Elena, Cindy, or Doug) little interaction took place, for example: “Tracy asks the students to discuss the answer with their partner(s). Elena and Andy do not talk to each other at all” (May 9, P1L22-23). The same was true when Tracy paired the students for the purpose of providing feedback on seatwork. For the most part, Andy performed his side of the interaction well enough, but he was not able to support a partner with low social competence without help from Tracy:

Tracy asks the students to trade workbooks with the student across from them to get feedback….Cindy and Andy trade workbooks. I miss the exchange but I ask Andy if Cindy had any suggestions. He says that Cindy told him he had drawn a slide twice, but then he showed her that he had tried to erase one. I asked if he had any suggestions for Cindy. He said that he showed her that she hadn’t circled both ramps. I asked Andy if she understood the correction, but he shrugged and said she didn’t listen. I check Cindy’s workbook. Andy has drawn an arrow to the correct picture to be circled but Cindy has not corrected it. (June 4, P2L11-21)

Independent Format

During independent work at the Engage phase, Andy was usually interested and focused, especially when the task involved making diagrams. His diagrams were always detailed and creative (e.g., Figure 2 [Note slight conceptual error in worksheet shown in Figure 2: bicycles and cranes are mechanisms, not simple machines]). He completed his work quickly, neatly, and with creativity and accuracy:

Tracy asks the students to draw a picture of an inclined plane on the title page of their green science workbooks….Andy draws a slide, a skateboard ramp and several other types of simple machines. (June 6, P1L15-18)

Given the choice, Andy usually chose to work alone rather than in pairs for independent seatwork.
What Is A Machine?

Look at the objects at the bottom of the page. Did you know that they are all machines? You might think that machines are big, noisy and complicated things like lawnmowers, washing machines, computers and robots, but a machine is any device that makes work easier.

Some machines are called simple machines. Simple machines use the power of people’s muscles to work.

Scissors make it easier to cut things.
A bicycle makes it easier to move fast.
A screw helps to hold pieces of wood together.
A spade makes it easier to dig the yard.
A ramp makes it easier to move objects from one level to another.
A crane makes it easier to lift heavy weights.

In the boxes below, draw and label a diagram of a different machine that helps to:

- cut
- lift
- dig
- move objects
Summary

Andy fully participated in all the learning processes associated with the Engage phase of the learning cycle. In the whole-class format, Andy’s participation was supported by his own social competence in the categories of: Behaviour (joining in) and Social Skills (communication, listening, language use). Tracy mediated Andy’s participation by providing support for social competence in the category of Behaviour (attention, activity level/self-control). In spontaneous pairings to exchange ideas and get feedback on seatwork, Andy’s participation was mediated by a socially competent peer through support for Social Cognition (social problem solving). Andy successfully participated in independent seatwork to prepare for the Investigate phase.

Beth

Whole-Class Format

During whole-class discussions at the carpet, Beth tended to sit in the middle of the group, usually beside Faith. Although she did not often volunteer to answer Tracy’s questions or participate in discussions, she usually looked attentive and rarely needed help from Tracy to focus at the Engage phase. If Tracy asked her a question specifically, she answered briefly, but knowledgeably. Beth regularly joined in the exercise of reading aloud instructions and information from the worksheets as a class.

Pairs Format

Beth interacted well during most spontaneous partnerships for exchanging ideas or feedback; she was sought out as a partner when Tracy gave students the opportunity to choose their own partners.
Independent Format

Beth worked well independently at seatwork during the Engage phase. She remained focused and completed her work quickly and neatly. For example, during one classroom observation the researcher noted, “They read together the information about wheels and axles out loud as a class and label each diagram as they read about the object…. Beth follows along with the class and neatly labels each diagram” (June 18, P2L41-46).

Summary

Beth fully participated in all the science learning processes associated with the Engage phase of the learning cycle. In the whole-class format, Beth’s participation was facilitated by her own social competence in the categories of Behaviour (attentive, cooperative) of Social Skills (communication, listening). Tracy mediated her participation through support in the area of Behaviour (joining in). During spontaneous pairings, Beth’s participation was supported by her own social competence in the categories of Social Skills (communication) and Behaviour (joining in). Interestingly, the constraint placed on her full participation in pairs in the category of Relationships with Peers was her exclusion of others, rather than being excluded herself.

Cindy

Whole-Class Format

When at the carpet for whole-class discussions, Cindy usually sat in the middle, near the front of the group and looked attentive, with occasional prompts from Tracy. She did not often volunteer to answer questions, but answered readily enough when Tracy directed a question to her. When she did speak up without prompting, it was usually out of turn:

Students call out the materials they want spelled and Tracy writes them down….Cindy calls out “white tea things.” Tracy doesn’t know what she means but her classmates translate it into “coffee filters.” Tracy calls on Andy but Cindy starts to talk again. Tracy asks her not to interrupt. (May 24, P1L22-25)
[Tracy] asks the students to find the simple machines that are part of the stapler. She opens it up so they can see all the parts…. Cindy puts up her hand and shouts, “Oooooh!” Tracy ignores her. (June 20, P1L31-33)

The researcher also noted that Cindy took it upon herself to “shush” the students around her during whole-class discussions.

While reading information or instructions as a group, Cindy sometimes read along, but often she would begin work on the related seatwork activity before the group reading finished.

*Pairs Format*

Given the opportunity, Cindy wanted to work with a partner, and she usually chose one of the higher-functioning girls. The researcher observed two instances when Tracy asked the students to trade seatwork with the student across from them for feedback, since Cindy sat alone, she had to find someone else with out a partner: in these instances, Andy and Doug. With the former, Cindy refused to accept any of Andy’s suggestions; with the latter, Cindy had all sorts of suggestions for Doug, but Doug would not receive them:

After the students finish labeling the three diagrams, Tracy asks them to switch with the person across from them. Cindy brings her book to Doug, but Doug wants to switch with somebody else. Tracy compliments Cindy on her idea to switch with Doug (they are the only ones not in the big desk groupings)…. Cindy has lots of suggestions for Doug. She talks continually about things he should change, but also says things like, “I like your pencil,” “That looks good,” “Axle and wheel,” “Good!” “How does mine look?” Doug keeps saying, “Yes, Cindy,” “I know, Cindy,” but still does not have his diagrams labeled correctly. Doug doesn’t even look at Cindy’s work. Cindy’s is quite messy; it’s hard to tell if she has labeled the diagrams correctly. (June 18, P1L41-P2L9)

During Engage, Tracy supported Cindy during interactions with other students when problems arose:

Cindy, then get a different…trade your book for an extra book. (Cindy wants to take one instead that is on someone else’s desk and the student objects.) Put your book down…put, your, book, down…and take a book that is not being read, which would be that one. Well, that’s on NC’s desk, right? So which one is in the middle? (the middle of the group of desks) That would probably be a good choice. (May 31, P2L41-P3L4)
Transitions

During transitions from whole-class to seatwork, or carpet to desks, Tracy often had to prompt Cindy to remember her worksheet, begin moving, get out materials, or begin the task. On the other hand, Cindy wanted to prompt other students during transitions: “Tracy asks the students to move to the back of the classroom to look at the door handle on the closet. Cindy tells Oliver to start walking and Tracy asks Cindy to worry about herself” (June 18, P1L26-28)

Independent Format

Cindy often completed seatwork quickly, but with little attention to quality (or neatness). However, there were exceptions, and if it was a drawing task, Cindy put more effort into what she produced. During many observations, she began on the seatwork before Tracy had finished reading through and discussing the instructions with the whole class. As a result, Cindy’s work was incorrect:

Tracy asks the girls to put the worksheets in their science workbooks, and then go to get a drink. Cindy wants to start working on the worksheet and asks Tracy to help her read it. In response, Tracy tells the entire class NOT to fill out the worksheet; she wants to talk as a group about it, first. Tracy suggests drawing a wedge on the title page if they need something to do. Cindy starts working on the worksheet, anyway. (June 11, P2L37-42)

The researcher observed one instance where Cindy tried to show her completed work to another student without Tracy’s requesting an exchange, but she received no response.

Summary

Cindy participated successfully in most of the learning process at the Engage phase of the guided inquiry learning cycle (she usually did not participate in learning instructions for the day’s activities). Cindy’s participation was supported by her own social competence in the categories of Behaviour (attentiveness). Cindy’s participation was constrained by challenges in the category of Social Cognition (social perception). Tracy mediated Cindy’s participation by providing support in the categories of: Behaviour (joining in, turn taking, attentiveness). In spontaneous pairings to
exchange ideas and get feedback on seatwork, Cindy’s participation was mediated by a socially
cOMPETENT peer through support for Social Cognition (social problem solving) and Relationships
with Peers (inclusion).

Doug

Whole-Class Format

During whole-class discussions on the carpet at the Engage phase, Doug usually chose to
sit at the back of the group. Occasionally he volunteered to answer a question, but he did not
typically join in unless specifically asked to by Tracy (the exceptions were discussions on May 7,
May 31, June 12). However, when Tracy directed a question to Doug, he was usually able to
answer well, indicating that he was paying attention:

Tracy asks the students to name the simple machines they have studied so far and what
they help us do. The students name wedge, inclined plane, lever, and screw. Of the focus
students, Andy is the only one to raise his hand to answer a question. The others seem to
be paying attention, though—when Tracy asks Doug a question, he is able to answer
correctly…. Doug says a screw, “Helps us build things.” (June 18, P1L16-21)

Often Doug’s answers were either short and without detail, and Tracy tried to draw out his
meaning. For example, Tracy asked students for examples of what activities they enjoyed that
involved moving water. Doug answered, “swimming,” and Tracy responded, “Sure, sometimes
it’s fun to go swimming in the waves?” (May 22, P3L18-19).

When Tracy asked the whole class to read through the information or instructions on a
worksheet together, Doug did not read out loud, and usually looked inattentive—he either stared
into space or rested his head on his desk or doodled on the page unless Tracy helped him to focus
on the text, for example, “Tracy cues Doug, who is sitting beside her, to use his index finger to
follow along” (May 17, P1L32-33). When a peer was reading a book out loud to the class at the
carpet and Doug was fiddling with the carpet, Tracy asked Doug if he could see the pictures in
order to turn his attention back to the book (June 11, P2L16-20).
**Pairs Format**

During the brief, spontaneous pairings with peers that occurred within whole-class discussions, the researcher never observed Doug and his partner talking unless Tracy intervened by instructing one partner to talk, then the other. Sometimes students would complete seatwork during this phase, and Tracy would ask them to exchange their work with a partner for feedback. Again, little interaction took place unless Tracy paired Doug with a helpful partner:

Tracy asks the students to trade workbooks with the student across from them to get feedback. Doug and Ginny trade workbooks. Doug has written “slid and cherapaline” (slide and trampoline). Ginny asks Joel what “cherapaline” is. She gets out the dictionary to check the spelling. (June 4, P2L11-14)

or provided scripting for the interaction:

Tracy asks the students to show their diagrams to the two people closest to them….Tracy: “Great, Doug, what did you draw? Pardon, Doug? What have you drawn? So these are not simple machines? Oh they are? Can you look at Andy’s picture and tell him what you think about it? Doug: “?” Tracy: “What’s great about it? Where’s the inclined plane, Doug? Is a truck an inclined plane, Doug? Ask Andy. Which one do you think is an inclined plane, Doug? Great. (To Andy) Can you look at Doug’s? What do you think about Doug’s? And they’re all inclined planes?” (June 6, P1L20-28)

**Transitions**

During transitions from one activity to the next Doug needed support from Tracy. For example, she often directed him to a partner, reminded him to take out or put away a book or a worksheet, helped to solve a problem like a missing pencil, or prompted him to move from carpet to desk or vice versa:

Tracy asks the students to take out their green science workbooks. Tracy asks them to turn to their science word list. Tracy picks students to read the words one by one…. Doug is digging around in his desk looking for a pencil (he has been doing this for a while). Tracy tells him to go and get a pencil from the supply table. Doug proceeds to sharpen the pencil with his fingernails. (June 14, P1L27-38)
Independent Format

Except in rare instances, Doug needed guidance and support from Tracy to complete independent work. Without help, Doug let his attention wander, doodled on his page (he often drew Ninja Turtles), or found something else to do, like sharpen his pencil (whether it needed sharpening or not). Since Doug tended not pay attention during the reading or telling of instructions (because of either an attention or processing challenge), if he did attempt the task, he often did something wrong:

Tracy asks the students to draw a picture of an inclined plane on the title page of their green science workbooks while she goes to talk to the student’s teacher. Doug draws a ninja turtle on his. (June 6, P1L15-17)

Tracy asks them to circle the “science words” in the paragraph and then prompts Doug to do it again…. Doug starts to sharpen his pencil with the automatic pencil sharpener while the class is reading. Tracy asks him to stop. Tracy tells the students their job is to label the diagrams of the screw and the bolt at the bottom of the worksheet. She tells them that once they have finished they may look at a science book while they are waiting for everyone to finish…. Tracy has to give Doug a lot of help. He has only printed two labels and one is wrong. Tracy asks him not to use his “Shrek” pencil (the pencil is enormous). “You should not be using a Shrek pencil at school; you should know that.” Tracy stands beside Doug’s desk and helps him label by label. Doug is working very slowly and he is adding curly-cues to his letters. Tracy reminds him repeatedly that the whole class is waiting to start the experiment until everyone has completed the worksheet. (June 13, P3L38-P4L10)

Summary

Doug participated to some extent in all the learning processes associated with the Engage phase of the learning cycle (he participated least in the receiving/learning of instructions for the day’s activity). In the whole-class format, Tracy mediated Doug’s participation through support for social competence in the categories of Behaviour (joining in, attentiveness) and Social Skills (communication). During spontaneous pairings, Doug participated only with mediation from Tracy for Behaviour (joining in) and Social Skills (communication).
Whole-Class Format

During whole-class discussions at the Engage phase, Elena was usually quick to volunteer to answer Tracy’s questions, share her work with the class, or take a turn reading text or instructions. She communicated her ideas clearly. Although at times she appeared inattentive (e.g., playing with a loose thread on the carpet), Elena was able to answer Tracy’s questions and show that she was following the discussion.

Pairs Format

Elena showed little inclination to participate in spontaneous pairings for discussion of a topic. When asked to share a book with a partner, Elena seemed unaware of the need to position the book so her partner could view it as well; if her partner held the book she often ended up reading out of a book held by a student not assigned as her partner. When given the choice, Elena always chose to work independently rather than with another student. However, other students seemed quite willing to work with her, and the researcher observed that Ginny selected Elena as a partner on more than one occasion.

Independent Format

Elena worked very well independently. She focused on her work and completed detailed written answers and diagrams without support from Tracy (Figure 3). Sometimes Elena was so involved in her own work that Tracy had to prompt her several times to move on to the next activity.

The researcher noted two examples when Tracy provided social competence support for Elena. The first involved a social problem solving issue where Elena wanted to examine an object another student was holding and grabbed it rather than waiting for the other student to finish.
FIGURE 3: Sample of Elena’s Written Work (Engage)

Name:  

Date:  

Inclined Plane

An inclined plane is a sloping surface that helps objects get from one level to another with less effort than lifting. A ramp is an inclined plane. You need to push or pull the object up the incline plane. It is easier than lifting it.

Can you think of any other inclined planes? Draw them and print a sentence below.

This is a bicycle ramp. I saw it at the bike park.
Tracy discussed with Elena how she could have communicated with words rather than actions. The second example, involving manners, was an interaction between Tracy and Elena:

Elena approaches Tracy’s desk and starts looking around. Tracy asks Elena if she would like help with something. Elena starts speaking without making eye contact and Tracy asks her to turn and look at her while speaking. Elena does so and says, “I know one kind of pulley: a block and tackle.” Tracy: “You’re absolutely right, and we’ll be talking about that shortly.” (June 19, P2L13-17)

Summary

Elena participated in all the science learning processes associated with the Engage phase of the learning cycle. During whole-class discussions, Elena’s participation was mediated by her own social competence in the categories of Behaviour (joining in, attentiveness) and Social Skills (communication, listening, language use). However, she did not regularly join in during spontaneous pairings. Tracy mediated Elena’s participation through support for social competence in the category of Social Cognition (social problem solving) and Social Skills (manners). Elena worked well independently.

Chapter Summary

During the Engage phase of the learning cycle, learning activities included reviewing the unit topic, making connections to previous lessons, exploring the daily topic, and preparing for the Investigate phase. Tracy typically used a whole-class format and employed various strategies to support individual social competence, science learning, and group processes. She guided students’ preparations to investigate using a worksheet to organize information and instructions.

Andy fully participated in all the learning processes associated with the Engage phase of the learning cycle. His participation was supported through self-initiated joining in and good social skills. His challenges (attention, maintaining self-control, and social problem solving) were
effectively mediated by Tracy or by a socially competent peer. Beth also fully participated in all the science learning processes associated with the Engage phase of the learning cycle. Her participation was supported through attentiveness, cooperativeness, and good social skills. Tracy effectively mediated her challenge to participating (joining in) through invitations to contribute to whole-class discussions.

Cindy participated in most of the learning processes at the Engage phase of the guided inquiry learning cycle. Cindy’s participation was supported by her attentiveness. Her participation was challenged by poor social perception. Tracy or a socially competent peer effectively mediated further challenges to Cindy’s participation in the areas of joining in, turn taking, attentiveness and social problem solving. Doug participated to some extent in all the learning processes associated with the Engage phase of the learning cycle. Tracy partially mediated Doug’s challenges to participation in the areas of joining in, attentiveness, and communication. Elena participated in all the science learning processes associated with the Engage phase of the learning cycle. Elena’s participation was supported by her social competence at joining in, attentiveness, and communicating. Tracy mediated Elena’s challenges to participation in areas of social problem solving and manners.
CHAPTER 6: RESULTS—INVESTIGATE

Introduction

This chapter presents the results at the Investigate phase of the guided inquiry science learning cycle. The chapter begins with a brief description of the academic and social processes associated with this phase, and then reports the activities and experiences of Tracy and each of the focal students at the investigate phase.

Investigate

At the Investigate phase of the guided inquiry learning cycle, students engage in activities and experiments that allow them to investigate and explore a scientific concept or phenomenon. During this phase, learning processes include manipulating materials and tools, making observations, asking questions, testing ideas, and designing and making.

In 8 of 18 science activities observed at the investigate phase, the activities/experiments were carried out in a teacher-led, whole-class format (there was more than one activity during some lessons). For example, on June 6, Tracy led the students through an experiment that explored how the slope of an inclined plane affected the amount of counter-weight needed to drag a plastic basket (and other objects) up a ramp. After asking the students to make hypotheses about which slope (steeper or milder) would require less counter-weight, she called students up one by one to help her with various aspects of the procedure. In between trials she asked the students to make predictions about how much weight would be required for the next trial based on the results of the previous (she drew a chart on a white board to help with this). Tracy explained to the researcher that she elected to carry out investigations/explorations as a whole-class when materials and equipment were limited or potentially dangerous, and when the procedure was too long or complicated for students to carry out without a lot of teacher support.
During two lessons, the activities/experiments began in a teacher-led, whole-class format, and then moved to a student-led, pairs or small-group format, where the students would repeat or extend the same activity/experiment. For example, when exploring pulleys and pulley systems, Tracy began by setting up and testing a single pulley system with the whole-class, and then divided the students into small groups to design and test multiple-pulley systems.

Ten of the observed activities/experiments were carried out entirely in pairs or small-group formats. In these instances, Tracy would give the students instructions about materials and procedures during the Engage phase, in a whole-class format, and then divide the students into pairs or groups to begin the activity or experiment. For example, this format was used to make and test waterwheels and to explore how to use moving water to make an object move. The culminating activity for the Power from Wind and Moving Water unit was a Design and Make Activity (DMA) that required students to work in small groups to design and make objects that could be moved using wind or moving water.

**Tracy**

*Whole-Class Format*

When leading an experiment/activity in a whole-class format, Tracy actively supported students’ scientific thinking and curiosity, participation in the scientific method, and social interactions (for the purpose of science learning).

Tracy supported students’ scientific thinking and curiosity by modeling problem solving and respecting students’ ideas and interests. In several activities/experiment observed by the researcher, the procedure did not go smoothly. For example, during the inclined plane experiments, Tracy was unsure of how to set-up the materials and tried several different ways, with suggestions and help from the students (and the researcher) before finding the solution. In the first inclined plane experiment, Isabelle asked why it was taking so much weight to lift the basket from the floor when the other basket (the one holding the counter-weights) was the same.
This led to an NC student noticing that the string was caught in a crack in the desk, hindering its movement. During the exploration of pulley systems, Tracy could not figure out how to string a double pulley system and asked the students to help by reading the instructions step by step. When this did not solve the problem, she assigned two students to experiment with the set-up and report back to the larger group.

Tracy was very encouraging when students shared ideas. For example:

Tracy says they can try the experiment with one more object. Henry volunteers his shoe. Ned says they can’t use it sole side down because it won’t slide. Tracy says, “Interesting!” and asks Ned to repeat this comment. She reminds the class about “friction” and asks the students all to examine their shoe soles and compare them to neighbour’s shoes. (June 6, P3L7-10)

Tracy was flexible and followed students’ interests during activities and experiments. On May 10, Tracy had intended to explore downward moving water and gravity, but ended up exploring the effects of gravity on a balloon after a student suggested that a balloon might not fall straight to the ground when dropped. During the second inclined plane experiment (June 7), Tracy had not intended to try moving different objects up a ramp, but the students expressed interest in how that would affect the experiment.

Tracy supported students’ participation in the scientific method by involving students at each phase of the process. First, she asked individual students to help gather and set-up materials. Second, she involved the whole-class in making hypotheses and predictions about the results of the experiment. Sometimes the students would record these hypotheses individually. Sometimes they were shared with the whole-class, and sometimes Tracy would ask the students to discuss their predictions in spontaneous pairings. In cases where the experiment was repeated with variations, Tracy would encourage students to use information from previous results to inform their next hypothesis. For example, on June 6, Tracy drew a chart on a white board that tracked the results of how much counter-weight was required to drag objects up inclined planes with different slopes. Prior to each trial, Tracy discussed the previous results and then asked students to make predictions based on what they had observed to that point. The students enjoyed making
predictions and it helped to hold their attention during the procedure because they were eager to see if they were right or wrong.

Tracy asked individual students to participate at each step of the experimental procedure. She was mindful of involving as many students as possible, especially the focal students—in virtually every experiment the researcher observed, the focal students were given tasks during the experimental procedure. This also helped to hold students attention and keep them involved in the activity. For example, Tracy asked students to add weights during the inclined plane experiments, act as recorders for the results, try out different types of levers (letting them figure it out for themselves), wedge the classroom door shut, and raise and lower a flag using a pulley system.

Tracy supported students’ observations by asking questions: “What do you see? What do you feel?” (May 9, P1L33-35) and reminding them to be thorough: “Do you have your scientist eyeglasses on? You’re really going to watch, make good observations with all five senses? At least definitely what you see and hear?” (May 10, P2L23-25). Observations were shared and discussed as a group; discrepancies were tested, and then often Tracy asked students to record their observations individually on their worksheets.

During group discussions Tracy insisted that students listened respectfully to each other’s answers. Tracy also mediated if problems arose during spontaneous pairings to discuss predictions or observations:

“I’m noticing that we are having difficulty with this…I’m trying to give you the opportunity to talk with your friends. But what’s happening is that some people are not included, and that some people are having trouble when they are talking. What is something I shouldn’t be seeing when you are talking to someone about what you see? Oliver: “Not looking at them?” Tracy: “Never. Why wouldn’t you do that when someone’s talking to you?” Isabelle: “Because it’s rude.” Tracy: “Absolutely. If you were speaking to me and I did this [looks away] I wouldn’t feel very good about that. Now if you were the only person talking, what could you say to get the other people in your group or your partner to speak?” ?: “It’s your turn to talk.” NC: “Ask them a question.” Tracy: “Elena, do you agree?” (May 10, P2L8-18)
Small-Group/Pairs Format

During experiments/activities when students were working in pairs or small groups, Tracy interacted sometimes with individual groups, and sometimes with the whole class to provide procedural, social, and science learning support. In this format, Tracy was constantly on the move, circulating amongst the groups and pairings.

Tracy offered frequent reminders to the groups/pairs about procedure (e.g., making predictions, recording observations) and when she noticed more than one group having difficulty with the same thing, she would stop the whole-class to give direction:

I’d like to make the instructions more clear. The blocks must be on the end of the ruler. You may not have the blocks in the middle of the ruler, or halfway towards the fulcrum. Also, you must have your fulcrum and your ruler like the letter T. (June 7, P4L22-25)

Tracy supported social aspects of learning by encouraging students to take turns and to share their predictions and observations verbally and by exchanging written notes. In addition, periodically stopping the class to remind them to think about how they were working together as a group or partner, and how they might improve:

Out of five, what would you give yourself as a group member right now. Are you contributing? Are you helpful? Are you being a helper? Are you easy to get along with? I want you to be thinking about that right now. Are you helping to get this project going? (DMA, May 23, P3L1-4)

Often at the end of a lesson involving small-group or pairs work, Tracy asked the students to rate themselves as a group member either by a show of hands or by colouring stars on a worksheet.

Tracy worked with small-groups or pairs to support scientific thinking by listening to ongoing discussion, and then asking leading questions or providing direction for further exploration. If Tracy noticed the more than one group having difficulty with a concept, she stopped the class to provide support for continued exploration:

I would just like to remind you of the experiment we did earlier in the year involving Plasticine and whether or not we could get it to be buoyant or not. Do you remember how difficult or easy it was for you to get the Plasticine to float? Do you remember the shape the Plasticine had to be in, in order to float? You might want to take that into consideration when you are trying to design something that is buoyant and made of Plasticine. (DMA, May 23, P3L34-39)
Similarly, if an interesting idea or result was found in a small-group or pair, Tracy stopped the whole class to share the discovery and provide the other students with ideas.

**Andy**

*Whole-Class Format*

During the Investigate phase, Tracy provided opportunities for Andy to participate in science learning processes by calling on him regularly to help with experimental procedures (i.e., at least once during the investigate phase of each activity/experiment) and share observations. Andy often volunteered observations and offered suggestions to test during whole-class experiments/activities. He was able to communicate his ideas effectively. For example:

Tracy taps several nails into a piece of wood….Tracy says they need a simple machine. Andy suggests using the back of a hammer, and Tracy calls him to the table to try. Andy tries pulling up at first, and then pushes down on the handle, towards the end of the tines. He is successful and explains what he did: “I started pulling up but then I started going like that to get the nail out.” Tracy: “So you actually were moving what direction?” Andy: “Down.” Tracy: “Down, to get the nail up.” (June 7, P2L9-16)

While Andy was eager to share his thoughts with Tracy, she sometimes had to encourage him to direct his comments to his peers:

Tracy asks the class if they have any suggestions. Andy suggests that someone should hold the kite up high while the other person runs. He has directed his comment to Tracy…Tracy tells him to tell Group 2. He does. (DMA, May 24, P5L5-8)

Andy obviously enjoyed science experiments/activities and usually his attention was focused on the procedure. However, sometimes his excitement made it difficult for Andy to sit still and watch while other students took turns helping (e.g., during the inclined plane experiments), remain quiet while other students shared answers, or keep his voice at an acceptable noise level when unstructured discussion occurred (e.g., during the wedge experiment on June 11 when the students were trying to find a way to keep Tracy from opening the door to the classroom). Tracy helped Andy maintain or regain self-control with gentle reminders or by asking him to stand-up, away from the action for short periods of time, e.g., “Andy, move your chair forward, put your
hands on your knees, and don’t move your eyes. Do you understand? Do you know why I’m asking you to do this?” (June 6, P2L7-9). The researcher noted one example when Andy’s attention was not held by the activity—students were counting turns of the screw as Tracy used a screwdriver and making tally marks on their worksheets. When Tracy asked who was making tally marks, Andy was not paying attention and did not respond. Ginny, who was sitting beside him, prompted him and he raised his hand as well (June 14, P2L13-14).

Small-Group/Pairs Format

Andy’s participation level and role in the group at the Investigate phase varied with the make-up of his group. When working with Isabelle and Faith to make an object move across the water without touching it, he was attentive, but hung back and watched what the girls were doing. Similarly, when working with Henry to experiment with gears, Andy watched attentively, but did not manipulate the materials himself:

I hear Andy say, “Yes, we did it!” Henry leans over to tell a student in another group that they turned 8 gears at once. Henry goes on to the next question about big and small gears. Henry does the experiment himself and writes his answer. Andy copies what he wrote. Henry does the next task by himself as well, and then tells Andy what to write. Andy keeps fiddling with something in his pocket. Tracy comes to check that Andy understands his answers. He does really well when she asks him to explain what he has written. (June 18, P4L8-13)

When designing and making a wind-powered object with Henry and Beth, Andy joined in enthusiastically, but clearly deferred to Henry as the leader. When working in a pair with Ned to make a waterwheel, Isabelle to balance a load using a lever/fulcrum system, with Leo to test predictions of probability, with Ned to test probability during a coin tossing experiment, and in a group of three with Isabelle and Cindy to find simple machines, and Isabelle and Elena to create a multiple-pulley system, Andy participated as an equal partner. However, in the last example of grouping, it is important to note that Andy and Isabelle were functioning more as a pair—Elena was not engaging with the group. The researcher did not observe Andy taking on a leadership role in small-groups or pairs.
In addition to actively participating in activities/experiments in the small-group/pairs format, Andy also did well with other aspects of behaviour. He remained attentive to the activity/experiment (there was only one negative instance, during the search for simple machines in complex machines, when Andy’s attention was on and off and he was prompted by Tracy to focus on what his group was doing), maintained self-control, and worked cooperatively with his partner(s) during experimental procedures, making objects, testing, and recording observations:

Beth: Okay, I’m going to blow this up and tie it, okay? (referring to balloon)
Andy: Um, don’t tie it, because we’re going to need to unleash it. And make it so we can get it off? So it can go. Make it go so we can get it off, with a little bit showing. (Giggling) It will blow up in our faces! (Beth asks for help with the tape)
Andy: I’ll do it. Blow it up and I’ll put the tape on it. (May 23, P4L5-10)

Andy depended on his partner(s) to take the initiative to keep activities going and when he was not partnered with someone with strong initiative, the group needed support (from Tracy or the researcher) to keep moving forward. For example,

Andy and Leo are chatting about question 1. They have completed the first question but they are waiting to see if the temperature will fall any more…. I get them started on question 2. Andy is excited about the activity. Andy and Leo talk about their prediction. Leo holds the thermometer. Andy watches and reports that it is going up. Leo leaves to go to the washroom. Andy isn’t sure what to do after finishing question 2—he doesn’t realize there are more questions on the next page. I show him where the questions continue. (MATH, June 12, P3L17-27)

However, Henry provided direction for Andy, especially during the DMA. Andy liked to focus on details, especially esthetic details in diagrams and on the design and make object (in this instance, a car). He demonstrated a high level of creativity and worked well with Henry who was more focused on the basic construction of the object and moving them along to completion:

Henry and Andy go back and forth about construction. Andy is much more concerned about the details of decoration (windows and the body of the car), whereas Henry is focused on basic construction, especially of the wheels. Beth asks them to talk one at a time because she can’t understand what they mean. While Andy talks, Henry simply goes ahead and works on the drawing of the car. Andy, “We should make some windows to make it look more like a car.” He repeats this several times. Henry says, “We can put the windows on when we decorate.” (May 23, P1L36-42)

Although Henry’s leadership sometimes appeared domineering—he would assign the others tasks, and twice the researcher observed him forcefully taking over a task when he thought he
could do it better—but this did not seem to interfere with Andy’s joining in or enjoying the activity/experiment.

The researcher observed only one instance when a behaviour issue arose that interfered with the experiment. During the screw experiment, which involved students taking turns in two large groups to screw several different types of screws into wood, Andy and Doug began poking and pushing back and forth. Once separated, Andy continued making faces at Doug. This was also the only experiment the researcher observed where students worked in two large groups.

This experiment was not well designed—there was not a lot of opportunity for student involvement, and therefore it did not hold their attention.

Andy appeared to be accepted by his peers during small-group/pairs work and was sometimes included in the ongoing activities/experiments. The researcher observed Beth inviting Andy to help her with a task during the DMA, and other boys in the class chose Andy when students were given the opportunity to choose their own partners (e.g., by Leo for the probability experiment). When Ned and Andy were partnered, they worked well together, sharing ideas and answers. The researcher recorded only one unsuccessful partnership instance:

Ginny and an NC seem to be leading. The group has worked very quickly. Andy suggests a word for the last screw. Ginny accepts it but then the NC offers a different word and Ginny takes it instead. Andy looks disappointed. (June 13, P4L30-32)

Andy demonstrated good social skills with his peers during small-group/pairs work. For example, he was able to reach a good compromise with Ned:

Andy is working on the water flow diagram on the back of the worksheet. He completes it and tells Ned to try it. A stapler arrives and they argue over who gets to staple. Andy says that he will hold the cup and Ned can staple. They start having success as Andy positions the cup and Ned staples. (May 16, P2L37-40)

During small-group/pairs activities, Andy continued to demonstrate good communication skills and used scientific language to share his observations and ideas.

Andy successfully participated in all the learning processes associated with the Investigate phase in the small-group/pairs format (manipulating materials and tools, making
observations, asking questions, testing ideas, designing and making). While making and testing a waterwheel in partnership with Ned, Andy received support from Tracy to share observations and test ideas:

[Tracy] invites Andy and Ned to try out their waterwheel again. Andy mumbles something to Tracy. She asks him to explain to Ned his idea—he wants to put cups on both sides of the plate at the same point facing the same way to balance and collect more water. Ned points out that one cup is facing a different way and explains why it won’t work like that. Ned also explains why cups should be evenly spaced. They have five cups and are trying to decide if they need more. They decide to add a few more, but are worried about blocking the cups. The boys direct Tracy where to staple. The cups go on in parallel. Andy goes to get more cups. Tracy asks Ned if he thinks it will work this time. Ned says “yes.” Tracy asks if it will be faster than the other waterwheels. Andy says it will have double the power; it will be faster when it has more weight. (May 16, P3L31-40)

However, Andy also demonstrated his ability to engage in the learning processes without Tracy’s help. During the DMA with Henry and Beth, Andy was very involved with the making of the object, and also discussing aspects of design and what to change based on their testing:

Andy: Like this is going to move. How about we just make these bigger and then it will fit.
Henry: No, it’s because of the clay that…wait—
Andy: Yeah, it’s because of all the weight. We need to take some of the weight off.
Henry: Wait, I have an idea, oh no, it wouldn’t work. I was thinking of putting it under like that, and it would move like that—
Andy: Yeah, it would work! it will work! (May 24, P5L31-36)

In another example, he participates successfully in a lever experiment with Isabelle:

Isabelle and Andy have balanced the lever with one Lego piece on each end. They read the next step out loud together. They put two Lego pieces on one end and wonder out loud if they have to be stacked. They try moving the pieces around and then stop. Jenny: “Is it balanced?” Andy: “No” Jenny: “Hmmm, I wonder what you could try?” Andy: “I think I have an idea. Maybe we could go like this and then we could put two on this end and then one in the middle.” To Isabelle: “You had better erase that because we haven’t done it yet.” (June 7, P3L34-39)

**Summary**

Andy fully participated in all the learning processes associated with the Investigate phase of the learning cycle. Tracy and/or Andy’s peers effectively mediated constraints posed by deficits in social competence. In the whole-class format, Andy’s participation was supported by
his own social competence in the following categories: Behaviour (joining in, attentiveness) and Social Skills (effective oral communication skills). Tracy mediated Andy’s participation by supporting social competence in the category of Behaviour (keeping volume/noise level under control, encouraging and facilitating joining in with/directing comments to peers). In the small-group/pairs format, Andy’s participation was supported by his own social competence in the following categories: Behaviour (attentive, joining in, cooperative, self-control); Social Cognition (social problem solving), and Relationships with Peers (medium to low popularity but accepted by peers). Tracy mediated Andy’s participation by supporting social competence in the following categories: Behaviour (low task initiative, encouraging and facilitating joining in with/directing comments to peers). Socially competent peers mediated Andy’s participation by supporting social competence in the following categories: Behaviour (providing task initiative) and Social Cognition (supporting social problem solving).

Beth

Whole-Class Format

During the Investigate phase, Tracy provided many opportunities for Beth to participate in science learning processes by calling on her regularly to help with experimental procedures (i.e., at least once during the investigate phase of each activity/experiment) and share observations. While Beth willingly participated when asked to by Tracy, she did not demonstrate a high level of enthusiasm for the proceedings—she preferred to watch and listen rather than volunteer to answer questions. When not actively involved in helping Tracy, her attention often wandered (about half of the observation notes indicated attentiveness during whole-class investigations).
Beth displayed high social competence in all aspects of small-group/pair work. Under the category of behaviour, Beth actively participated in the group’s activities; she co-operated well with her partners in carrying out experimental procedures and in sharing observations and answering worksheet questions. She showed initiative in moving projects forward (moving to the next step, making suggestions to partners for what they could be doing to help).

Beth was sought after as a partner, especially by her group of girlfriends (Faith, Isabelle, Mary, Kelly). Her partner(s) included her in the learning activities and discussions. For example:

Beth, Kelly, and Ginny are working together well. Ginny and Kelly are holding a meter stick while Beth tries to thread the system….Beth, Ginny, and Kelly are talking to each other a lot and continually trying new things. They all seem to be listening to each other’s suggestions. (June 19, P3L18-29)

The only negative example of inclusion observed by the researcher occurred during the designing and making of a wind- or moving water-powered object. Beth was working with Andy and Henry, and at least twice, her ideas were ignored by the two boys. In the first example, the boys were trying to figure out how to cut a Styrofoam ball and attach the pieces to their car as floats:

Beth: I have an idea.
Andy: I’m cutting.
Henry: I have an idea. Let’s see.
Beth: I have an idea…
Andy: I’m cutting it!
Beth: This fell on…
Henry: Wait, Beth! (May 24, P2L21-27)

For the next few minutes Beth tried to interject ideas, but the boys continued their discussion as if she wasn’t there. In the second example below, the researcher intervenes to encourage Andy and Henry to listen to Beth’s idea, without success:

Henry: No, it will just be like this…
Beth: We need like, something like this to cut it, and then it will move but these won’t. (Beth is trying to show that the wheel needs something to turn around—an axle that would remain still).
Henry: Let’s just try and…
Researcher: That’s a good idea, Beth. Can you explain more?
Andy: What if we just go like this and put these in like that. What if we just do this? Hey what if we just do this guys?
Andy: That’s what my idea was, take some of the weight off.
Henry: We’ll make a hole in the centre.
Andy: We’ll poke a hole in the centre. Make sure it stays on. (May 24, P5L38-P6L1)

In a third example, Beth had taken the initiative to begin a group diagram of their wind-powered object. Once Henry noticed what Beth was doing, he took over. However, Beth did not seem to mind relinquishing the task.

Beth also demonstrated good social skills during small-group and pairs work at the Investigate phase. The researcher observed her taking turns and asking for help (from her peers) when she needed it. Although reserved, Beth did communicate effectively with her partners, and used scientific language in her observations and questions.

As a member of a small-group or pair, Beth participated in all the learning processes associated with the Investigate phase. She manipulated materials and tools and made oral and written observations. She asked questions of her peers at various points during the experiments/activities. She felt comfortable sharing and testing ideas, and participated in DMAs.

An example from a probability experiment in math shows the way Beth typically participated during investigations or explorations:

Beth places the thermometer in Faith’s hands and they count together to 60. They are talking and discussing each step and interacting a lot, but keep getting mixed up in their counting. When they finish, they check the temperature. They read the Fahrenheit side instead of Celsius and are surprised at the result. I show them how to read the Celsius side so that their answers are consistent. Beth: “Oh, I get it. Then these two are wrong, because we were putting 80’s.” I show them that instead of repeating the experiments they can look at the thermometer and change their Fahrenheit readings into Celsius…. Beth and Faith move on to the last experiment. Faith: “Okay, I am estimating…I think it is unlikely.” Beth: “Yeah, me too.” They make a prediction together and then put the thermometer back into the water. Then they put the thermometer into Beth’s hands and count to 60. Beth: “It’s 20°C.” Faith: “No, it’s 80—“ Beth: “No—“ Faith: “It’s 21°C.” Beth: “Okay.” (MATH, June 12, P3L29-46)
**Summary**

Beth fully participated in all the learning processes associated with the Investigate phase of the learning cycle. Tracy effectively mediated constraints posed by challenges to social competence in the whole-class format. In the whole-class format, Tracy mediated Beth’s participation by supporting social competence in the category of Behaviour (invitation to join in, directing attention). In the small-group/pairs format, Beth’s participation was supported by her own social competence in the following categories: Behaviour (joining in, cooperativeness, task initiative, taking turns/sharing); Relationships with Peers (high popularity, accepted by peers, included); and Social Skills (asking for help, effective communication).

**Cindy**

**Whole-Class Format**

During the Investigate phase, Tracy provided many opportunities for Cindy to participate in science learning processes by calling on her regularly to help with experimental procedures (i.e., at least once during the investigate phase of each activity/experiment) and share observations. Cindy always joined in enthusiastically and usually rose to the occasion of taking on the role of helper or leader for Tracy: “Tracy asks Cindy to come up and write down the amount of each weight they add to the basket. Cindy is very excited to do this (June 4, P3L2-3); “Tracy makes the slope steeper and calls Cindy to help. Cindy does a great job adding the weights (June 6, P2L11-12). However, there were also several instances when Cindy was not entirely cooperative, though still excited to take on a task. For example:

Tracy asks Cindy to hand out a worksheet about levers. Tracy has to re-direct Cindy a minute later, and then has to ask her to speed up the task several times. Cindy continues to hand out the worksheets very slowly. (June 7, P2L21-23)

Cindy was usually interested in the science activities and attentive to the proceedings, but was easily distracted and needed occasional support from Tracy to remain focused on the
activity/experiment. Sometimes Cindy had trouble controlling her excitement and needed to be actively involved: “The last part of the experiment begins with Ginny as helper. Andy and Cindy seem very excited. They are fidgeting and moving closer and closer to the inclined plane….. Tracy asks Cindy to stop touching the inclined plane” (June 6, P3L25-30). The researcher did not observe Cindy participating in the spontaneous pairings to discuss observations or make predictions during whole-class investigations. Instead, she hung back and waited until the whole-class resumed discussion before volunteering her ideas.

The researcher observed several instances where Cindy’s actions suggested that she did not understand the perspective of other students and that she was not socially perceptive about the reactions of her peers to her behaviours. Cindy liked to correct other students’ behaviour, and Tracy had to remind her that this was the teacher’s job. In the following example, Tracy responds when Cindy points out another student’s behaviour then engages in it herself several minutes later:

“Can you worry about yourself please, Cindy? Oliver knows he shouldn’t be playing with the weights right now, but I can say that to Oliver, okay Cindy? I want you to worry about the choices you are making, not the choices other people are making.”…. Cindy is now playing with the weights not in use. Tracy points out to Cindy that this is the behaviour she was upset with Oliver about previously. “Cindy, you were just giving someone else a hard time because they were playing with the weights and now you are playing with the weights. Right? Right.” (June 6, P2L32-P3L14)

Under the category of social skills, Cindy demonstrated challenges with manners and taking turns during whole-class investigations/explorations:

Tracy passes out weights of various sizes. She tells the students to feel them, and then pass them on to the person beside them. Ginny, who is sitting on the far side of the room, takes the initiative to bring a weight over to Cindy who doesn’t have one yet. Cindy does not say thank you or acknowledge Ginny in any way. Tracy prompts Cindy to say “thank you” but Cindy just mumbles it and Ginny doesn’t hear her. Then, as more weights come to Cindy’s desk, she hoards them instead of passing them around. (June 4, P2L28-33)

In the whole-class format, Tracy facilitated many opportunities for Cindy to join in science learning processes, especially manipulating materials and tools and making observations. For example, when investigating still and moving water, Tracy stood by the sink while students
took turns placing their hands in water falling from the tap and then the still water caught in the sink: “Cindy and Doug leave their hands in the water for a long time. They seem to be concentrating on the sensation. Tracy asks them to tell her what they are seeing and feeling” (May 9, P2L19-21).

Small-Group/Pairs Format

When investigating/exploring in small groups and pairs, Cindy wanted to be involved in the learning processes, such as manipulating materials and tools and designing and making, but challenges to social competence hindered successful participation. In particular, Cindy had difficulty cooperating and compromising when her ideas were different than her partners (and sometimes it seemed her ideas differed just for the sake of differing!). During the designing and making of a wind-powered object, Cindy continually clashed with her two partners, Oliver and Ginny and would not accept the majority consensus of what to make or what materials to use.

Even when Tracy acted as mediator, Cindy carried on with her own plans:

Cindy is adamant that they will use her design, but Ginny and Oliver do not agree. Cindy: “I want it to be like this and they want it to be like that!” Tracy: “Well, how could you solve this?” Cindy: “We could put it together!” Repeats several times. Oliver and Ginny look skeptical. Tracy: “What is similar about all these designs? Ginny: “They both have balloons and little sandbags.” Tracy: “What do you disagree about?” Oliver: “The boat.” Tracy: “The bottom? Ginny, tell me what you want.” Ginny explains she wants to make a plastic cube. Cindy wants to decorate with a heart on the balloon and put plastic cars underneath in a boat. Tracy reminds them that they can’t use plastic cars. Tracy asks Oliver what he wants. Cindy interrupts to say “a tinfoil boat.” Tracy asks if it needs to be waterproof. Ginny says yes. Tracy suggests they use tinfoil to make a shape they all agree on. Ginny and Oliver agree and say they can put paper inside, but Cindy still resists. Tracy says to Cindy: “This is a team effort and your idea isn’t always going to get chosen and you need to understand that Oliver and Ginny have ideas too.” Cindy starts telling Oliver what to draw. She wants him to draw a boat. Tracy repeatedly tells Cindy to just work on her own diagram. She reminds Cindy they are using her idea for the tin foil so she can use their idea of a cube. Cindy draws a boat anyway. (DMA, May 23, P2L13-28)

The next day, the group began making the object they had designed. Ginny and Oliver worked on one object, and Cindy worked on a “decoration” by herself. Similar conflicts occurred during other investigations/explorations. For example, while drawing diagrams of screws, Cindy refused
to place the screw where her whole group could see it; in an experiment with pulleys, she insisted on choosing what they would lift with their system prior to even constructing it.

Cindy always wanted to work with a partner or group when given the choice. She often asked to work with the more popular or high functioning girls (especially Isabelle, Beth, and an NC). While the students with whom she was partnered with by Tracy did not complain aloud, the researcher observed the reactions of the other students when partnered with Cindy—Isabelle looked resigned, Mary looked sullen (this pairing happened quite often), Henry looked unhappy and hardly communicated with Cindy during the whole activity (this pairing only happened once).

The researcher observed that Cindy was often excluded from the group processes or relegated to a role such as “gopher.” For example, when working with Mary to make a waterwheel, and with Mary and John to make a pulley system, Mary consistently refused to acknowledge Cindy’s suggestions and continually tried to send her to fetch materials. Unfortunately, Cindy’s solutions tended to make the exclusion worse. In the first example, Cindy finally convinced Mary to take a turn finding a material. When she was gone, Cindy switched their places around and took over the job Mary was doing (this did not go over well with Mary!). In the second example, Cindy laughed and teased Mary when the first attempt to raise an object (not of Cindy’s choosing) did not work. While exploring gears in a group with Ginny and Kelly, Ginny was at first reluctant to believe that Cindy found a way to make two gears turn together. Later, Ginny and Kelly excluded Cindy and later gave Cindy a hard time:

11:45 am. Ginny, Kelly, and Cindy are still working together to finish the front side of the worksheet. Ginny and Kelly are lying side by side on their stomachs on the floor, giggling and writing. Cindy has gone to sharpen her pencil in the automatic pencil sharpener. She keeps looking around the classroom while her pencil is in the sharpener and her pencil keeps getting caught. Cindy comes back to the carpet and starts tracing her gear in the spot for a diagram. Kelly tells her she is cheating, and Ginny joins in. Cindy leaves again to look for another pencil…. 11:55 am. Tracy compliments Ginny and Kelly for working well together. But they are excluding Cindy, who is sitting across from them at the desks (I think Tracy forgot they are all a group). Tracy asks Cindy if she can even read her own writing, it is so messy? Tracy helps get Cindy started on the next question. Cindy stares at Ginny and Kelly. (June 18, P4L1-25)
Cindy was concerned with fairness to herself and getting her turns to such a degree that it often led to conflicts. During a probability experiment in math when she was paired with Mary, the following scene took place:

Cindy and Mary are both very concerned that they get an equal number of turns. Mary counts the tally marks to see if it is her turn (they had decided one person would do ten rolls and then switch). Cindy continues to spill the coins over and over while Mary does this. Mary doesn’t want to write down these results. She says Cindy has already had 11 turns, but Cindy disagrees. (MATH, June 13, P2L28-31)

For Cindy, having partners to help with making written observations was both a support and a challenge. She made good oral observations to make but struggled with getting them written down, so it helped her to be able to copy someone else’s work, especially when the group had made the observations together. However, she was not always polite when she asked her partners to share their written work, and sometimes it happened so often that it interfered with what her partners were doing, or began to annoy them:

Ginny, Cindy, John and Henry are all writing down ways in which they made the Lego move…. Cindy copies the written answers from John’s page and then moves to the carpet. (May 7, P3L20-22)

Kelly is covering her chart so that Cindy can’t copy. Tracy asks Kelly to share since they are working as a group. “It would be helpful if you would help your group members instead of covering up your answers. We’re working as a team, right Kelly?” (June 13, P4L34-36)

The researcher did observe one experiment in the pairs format that worked well for Cindy. In this instance, she was partnered with an academically successful, easygoing NC for the “Lever Experiment” during which the students had to find a way to balance an uneven number of Lego pieces on the ends of ruler over a half-toilet paper roll fulcrum. Cindy was taking turns placing the Lego pieces and they seemed to be discussing possible solutions, though they were frustrated with their lack of success.
Summary

Cindy participated to some extent in all the learning processes associated with the Investigate phase of the learning cycle. Tracy or Cindy’s peers mediated some constraints posed by deficits in social competence. In the whole-class format, Cindy’s participation was facilitated through her own social competence in the category of Behaviour (joining in, usually cooperative). Tracy mediated Cindy’s participation to some extent by supporting social competence in the following categories: Behaviour (turn taking/sharing, attention, activity level/self-control, encouraging joining in peer interaction); Social Skills (manners) and Social Cognition (understanding the perspective of others, social perception). In the small-group/pairs format, Cindy’s participation was supported by her own social competence in the category of behaviour (joining in, attentive, task initiative). Cindy’s participation was constrained by challenges to social competence in the categories of: Behaviour (cooperativeness, turn taking/sharing); Social Cognition (social problem solving, understanding the perspective of others, social perception); Relationships with Peers (low popularity, sometimes rejected, sometimes excluded or marginalized); and Social Skills (manners). Tracy mediated Cindy’s participation to some extent in the categories of Behaviour and Social Cognition; Some of Cindy’s peers partially mediated her participation though Social Cognition (especially social problem solving) and through Relationships with Peers (generally willing to be inclusive).

Doug

Whole-Class Format

As she did for the other focal students, Tracy provided many opportunities for Doug to participate in investigations and explorations by calling on him regularly to help with experimental procedures (i.e., at least once during the investigate phase of each activity/experiment) and to share observations:
Tracy asks, “What would happen if you let go?” Tracy asks Doug for an answer. Doug says, “It would fall to the ground.” (May 10, P1L29-30)

Tracy asks Doug to come up. Doug tries the long plane (Tracy has to show him how) and then the short plane. Doug says the shorter plane took more effort. (June 7, P1L41-42)

While Doug joined in at Tracy’s request, his participation was often without enthusiasm and it only held his attention on the procedure for as long as he was actively involved:

1:28 pm…. Then the students take turns reading out the materials list as Tracy collects them…. Doug has his head down on his desk again…. 1:38 pm. Tracy has typed out two hypotheses on the experiment worksheet (“I think the inclined plane WILL or WILL NOT make it easier to lift the box”). She hands out copies of the worksheets to the students and asks the students to circle one. Beth and Doug have their heads on their desks…. Tracy calls the students to come and sit on the carpet…. Doug is staring at the back of the classroom and laying his head on his desk…. 1:45 pm. Tracy calls Doug up to hook a weight onto the hanging plastic box…. When Doug is done he goes back to his desk and puts his head down again. (June 4, P2L23-P3L3)

Tracy asks Doug to be her helper. Doug comes up slowly…. With some guidance, Doug hooks a 10g weight on the basket and it slides immediately. Tracy asks Doug to demonstrate again. Tracy thanks Doug, then sends him back to his desk. (June 6, P2L6-11)

During whole-class investigations and explorations, Tracy frequently checked and prompted Doug’s attention towards the activity. Sometimes he was staring off into space, and at other times he was fooling around and trying to distract other students as well. Tracy focused Doug’s attention by simply asking if he was ready, by asking him a question to assess his attention, asking him to stand up and watch, or by complimenting him when she noticed him participating:

Doug is not really paying attention but he cheers with the other students when the shoe moves. Tracy asks Doug if he knows how much weight it took to move the shoe. He says, “no.” Tracy asks Doug to stand up and watch. (June 6, P3L27-29)

The students are to count and make tally marks for each time the screw goes around in their books. They have marked the screw with a piece of tape so they can count the rotations…. Doug is not counting out loud, but Beth and Cindy are counting quietly. Tracy starts working on another screw. This time Doug counts and Tracy compliments him on his counting: “Thanks for counting, Doug, that’s really well done.” (June 14, P2L2-9)
Doug had difficulty expressing his ideas so that Tracy and his peers could understand his meaning. In the whole-class format, Tracy was able to give Doug the time and encouragement he needed to make himself understood (with the help of peers):

Tracy asks the students how Beth might use the wood to lift the book…. Tracy asks Doug for an idea: “She, um, could like put the book on the wood and then lift it up.” Tracy: “Lift what up?” Doug: ? Tracy: “Okay, Beth could you come around here and lift up the wood and the book? Like that Doug?” Beth says it is harder. Doug is shaking his head. Another student (Andy?) tries to explain what Doug meant, something about moving the Lego, but I can’t hear very well. Tracy: “Okay, but what if we want to leave the big piece of Lego there? But it was a good idea, Doug, I like your idea, it was another way to lift the book for sure.” (June 7, P1L26-32)

Small-Group/Pairs Format

While the other three focal students had similar experiences whether working in small groups versus pairs, Doug’s experiences in each type of grouping, at the Investigate phase, were quite different. When working in small-groups, Doug tended to be overlooked by his partners. Most often, his attention was not on the activity/experiment and he did not show interest in joining in, so his partners engaged with other students. During the exploration of how to make a piece of Lego move across the water, Doug’s partners, Mary and Beth were activity participating, but Doug did not join in, even when prompted by Tracy:

Beth and Mary have their hands in the water. Mary is making lots of suggestions on what to do. Tracy asks all students to stop and write down one good way to move the water. Mary and Beth start writing immediately. Doug plays with his nametag, and then writes on his desk using water. Mary and Beth compare answers. Tracy prompts Doug to take out his workbook. Tracy asks Mary to share her first answer. Beth shows Tracy how she swirls her fingers in the water to make the Lego move. Mary and Beth continue to experiment with moving the water with their hands. Tracy reminds class to think about how they are working together as a group and that they will be rating themselves at the end of the experiment. (May 7, P3L9-17)

When students were assigned to small groups to create a pulley system, Doug was partnered with Oliver and Leo. Doug began by holding parts for the system. Then he tried to distract Oliver by whispering things in his ear. When this did not work, he wandered off and started fooling around with a student from another group while Oliver and Leo continued working. When Doug did
show an interest in participating, his poor communication skills and lack of confidence when asserting his ideas made it easy for his peers to ignore him.

During the culminating DMA, Doug was partnered with Isabelle, Kelly, and John. Between episodes of inattentiveness, Doug tried to become involved with the making of a kite, but his suggestions were usually ignored, despite frequent reminders from Tracy that everybody in the group should be involved in the decision making process. For example, he suggested a name for the kite, and also suggested that they attach framing sticks to both sides of the kite but received no response to either suggestion. Kelly wanted the group members to vote on the colour of ribbon that they would use to decorate the kite—Doug said his favourite colour was green, but said it so quietly that only the researcher heard him. Doug became actively involved accidentally for brief time: he was playing with a stick and a toilet paper roll when Isabelle noticed and thought it would work well for a handle for their kite. She asked Doug to hold the pieces together while she taped. After their first unsuccessful trial flight, Doug followed Isabelle and Kelly around while they discussed what changes to make. When the suggestion he made was ignored, he involved Tracy, with more success:

Then Doug says: “I have an idea. I have an idea.” He is ignored. He tries again. “What if we attach a balloon to it?” Isabelle says, “Let’s look for a balloon.” But there aren’t any balloons left. They abandon the idea and look for tape to extend the sticks. Doug goes to Tracy and tells her his idea about the balloon. Tracy asks Isabelle and Kelly what they think of Doug’s idea. Isabelle says that there are no more balloons. Tracy asks if they would like her to find them one and Isabelle says, “yes.” They work on attaching an air-filled balloon to the kite. The girls have taken over again. (DMA, May 24, P3L17-29)

When the group was ready for another trial flight, Tracy intervened and ensured that Doug was given the opportunity to participate. He did this quite happily, though he needed lots of guidance:

Tracy asks why Isabelle and Kelly always get to hold the kite. Isabelle asks Doug if he wants to hold the kite. Tracy takes the whole class outside. All the students, except for Group 2, sit on the tarmac. Doug tries running with the kite, but has most of the string wound up around the toilet paper roll and it doesn’t fly very well. Isabelle takes it from him, unwinds some of the string, and tries running. It works better. Tracy asks the class if they have any suggestions. Andy suggests that someone should hold the kite up high while the other person runs… Isabelle holds the kite up while Doug holds the toilet paper. Doug starts to run. Tracy calls, “let go!” to Isabelle, but Doug lets go too, and the kite
drops. Tracy tells Doug to try again and don’t let go this time. It works better. (DMA, May 24, P4L38-P5L11)

The researcher did observe some positive moments during small-group activities, when peer support helped Doug participate in the investigation/exploration. For example, during the DMA described above, Isabelle, Kelly, John, and Doug had reached the phase where they needed to write out their materials list in order to get the go ahead to test their creation from Tracy:

Isabelle, Kelly and John are going to write out their materials list. Doug goes to sit at a desk with the others but leaves his worksheet behind on the floor. After a minute he goes to his own desk to get a pencil (this takes a while). He goes back to his group, still without his worksheet. Isabelle says, “Doug, you haven’t even started yet. Go get your paper.” Doug gets his worksheet and starts to write. (DMA, May 24, P1L34-40)

In another example, Tracy came to check on the progress of Doug’s group while they were exploring gears. Doug had trouble communicating his ideas to Tracy, but involving the other group members facilitated their exchange:

Tracy comes to check in. She asks Leo, “What are gears?”
Leo: Some gears are like…make it go faster?
Tracy: Okay, what do gears look like, Doug?
Doug: Well, is it okay if I just draw it?
Tracy: No, it is not okay; I want you to use your words. What does a gear look like?
Doug: It ?? and it keeps on going in a pattern.
Tracy: A pattern? Like an up and down pattern? Okay, what shape is a gear? Is it a triangle?
Doug: It’s a circle.
Tracy: It’s a circle. And all around the circle is what?
Doug: Some, um, bumpy parts.
Tracy: Some bumpy parts! Do you know what they are called?
Oliver: Teeth!
Tracy: They’re called teeth. Right! (June 18, P3L16-29)

The researcher observed only one instance where inappropriate behaviour prevented Doug’s participation in the experiment/activity. During the activity that explored screwdrivers and different types of screws, Doug and Andy began pushing back and forth. Doug became very emotional when Tracy reprimanded them and Tracy sent him to get a drink to help him calm down. Later on that day, Tracy changed the desk arrangements in the classroom to separate Andy and Doug, who continued their negative interactions.
Depending on his partner, Doug had either quite successful or totally disastrous learning experiences when working in pairs. During the first probability experiment in math, Tracy gave the students the opportunity to choose their own partners. John chose to work with Doug. Both John and Doug lack initiative, and neither are highly communicative. They spent most of the math class in silence, making little to no progress on the task at hand, which was to predict whether the temperature on the thermometer would read higher or lower when changed from one situation (e.g., a cup of cold water) to another (e.g., the student’s hand). John went to Tracy to ask for help, but then he did not communicate Tracy’s suggestions to Doug. Doug fooled around and showed little interest in what John was trying to do with the thermometer. Doug occasionally tried to copy what John had written, and John did try to help Doug by erasing what he had written and correcting it. Eventually the researcher couldn’t stand watching them go in circles anymore, and worked with them to complete the experiment.

However, during the next probability experiment (involving coins), Doug was paired with Isabelle and had a completely different experience:

Isabelle and Doug are switching back and forth. Isabelle has to keep reminding Doug to take his turn. When he is done, she puts the coins back in the cup and takes her turn. Then she puts the coins back in the cup and puts it in front of Doug. She waits, and then prompts him again. Despite this, Doug is engaged and is talking about their results as they go along. Their tally marks are off by one and they have made different predictions (the different tallies agree with their different predictions!). Isabelle convinces Doug that hers is right without too much resistance. (MATH, June 13, P2L36-42)

With no other partners to focus on, Isabelle was attentive to Doug and helped him participate in the experiment (she had lots of initiative!). Doug was paired with Ginny to make and test a waterwheel. While Ginny wanted to be the one to direct the hands-on work, she did involve Doug in making decisions and encouraged his participation in the testing phase, even though his attention wandered:

Ginny has 3 cups attached to her plate and is attaching a fourth. She is talking to a student from another group about a television show. Doug mumbles that he hates it. Doug is playing with a piece of tape. Ginny takes it from him. Tracy asks if anyone wants to see if they are making good progress on their waterwheels. Ginny asks Joel if they can keep working on attaching the cups to the plate. Doug agrees. Doug is now playing with his
worksheet and laying his head on the desk. Ginny leaves to confer with another group on how they are attaching the cups. Ginny leaves the desk again and Doug tries to attach a cup. Ginny comes back and stops him. Ginny says, “Wait, I'll get more tape.” Doug wanders away. Ginny comes back and starts to attach a fifth cup to the plate. She tells Doug, “After this we are going to test ours. C’mon Doug, we’re going.” Ginny repeats this several times and Doug follows her to the sink. When they run the waterwheel under the tap the cups all fall off. Ginny says, “What if we attach 3 to one side and 3 to the other?” Doug plays with the things in his desk. (May 16, P2L9-23)

In the above quote, it is also interesting to note Doug’s challenge with social perception through his unsuccessful attempt at joining the conversation going on between Ginny and the student sitting beside her. However, after working with an NC student to explore levers, Doug completed the following positive interaction: “Tracy asks the partners to shake hands and tell each other why they were good to work with. Doug says, ‘Because you made it balance’” (June 7, P5L1-2).

Summary

Doug participated to some extent in most of the learning processes associated with the Investigate phase of the learning cycle. In the whole-class format, Tracy mediated Doug’s participation by supporting social competence in the categories of: Behaviour (joining in, attention); and Social Skills (communication). However, Tracy’s mediation did not ensure full participation during whole-class activities. In the small-group/pairs format, Doug’s participation was severely constrained by: Behaviour (joining in, task initiative, attention); Social Skills (communication); and Relationships with Peers (ignored). Tracy was able to somewhat mediate Doug’s participation in small-groups/pairs) through support in the categories of Behaviour (attention, joining in); Social Status (ignored); and Social Skills. When working with an appropriate partner (high-functioning, socially competent), peer mediation partly supported Doug’s participation in the category of Behaviour (joining in, task initiative).
Elena

Whole-Class Format

As she did for the other focal students, Tracy provided many opportunities for Elena to participate in investigations and explorations by calling on her regularly to help with experimental procedures (i.e., at least once during the investigate phase of each activity/experiment). Elena was always eager to participate in the experiment and to offer her observations and hypothesis for the phenomena being explored: “Tracy asks the students to predict which screw will go in the fastest. Elena picks one, and when Tracy asks her why, Elena says, ‘Because it’s not too fat and not too skinny!’” (June 14, P1L44-46).

Small-Group/Pairs Format

During investigations/explorations in small-groups, Elena tended to be disengaged from the activity of her group. In these instances, Tracy tried to draw her back in:

Oliver is actively trying to make the Lego move without touching the water and is talking out loud about the results. Elena is playing with her nametag with her back turned to the group activity. Tracy notices and asks Elena what she thinks about what Oliver and the other group members are doing? (May 7, P3L37-40)

Andy, Isabelle, and Elena have joined three pulleys together, but when they show Tracy she points out that they are only using one of the wheels. Isabelle is holding the system and Andy is pulling the string. Elena is staring off into space. Tracy asks Elena if she has an idea about what to do to draw her back in. Elena says she knows exactly what to do, but then looks away again. Andy starts re-threading the system and Elena says, “You are using my plan!” Isabelle asks her to hold the system. Elena does, but doesn’t pay attention to what she is doing. (June 19, P3L21-36)

At other times, Elena would just worked independently in the midst of the group:

Isabelle and Henry decide on what words they will use to describe the first screw. Elena has gone ahead and written her own words for all three screws…. Tracy tells Elena to erase what she has written and fill in the words for the first screw that the group agreed on. “Elena, I don’t know what you have done, but will you please erase that right now. You’re not working as a group at all.” Tracy goes to check on the other group who has already finished describing 2 screws, and then comes back to Group 1. “No Elena, erase everything from your columns.” (June 13, P4L21-28)
It is unfortunate that the researcher was not able to collect data on Elena during the DMA activity as she was working with the NC whom Tracy identified as Elena’s friend. This relationship may have affected Elena’s experience in a small group.

Elena seemed to experience more success working in pairs at the Investigate phase because she was more likely to remain involved in the group activity. For example, during “Probability Experiment #2” the researcher noted: “Beth and Elena are going back and forth with turns and have finished. They count up the tally marks. Elena has made the correct prediction and dances around to celebrate” (June 13, P2L33-34). During Probability Experiment #1, the researcher noted:

Ginny and Elena have worked well together and have excellent answers to all the questions in the workbook. When I ask them how they are doing, Elena says, “Excellent.” I ask Ginny how warm her hands were. She says, “26°C.” When I express surprise at how warm they are, Elena tells me hers were 27°C. Ginny asks Elena how to spell her name so she can record Elena’s hand temperature in her workbook. (June 12, P4L5-9)

Summary

Elena participated in all the learning process associated with the Investigate phase of the learning cycle. In the whole-class format, Elena’s participation was supported by her own social competence in the categories of: Behaviour (joining in, attentive); and Social Skills (communication, listening). In the small-group format, Elena’s participation was constrained by challenges to social competence in the categories of: Behaviour (joining in, attention). Tracy somewhat mediated this constraint through support for these behaviours. However, when working in a pair, Elena’s participation was once again supported by her own social competence in the areas of: Behaviour (joining in, cooperative, task initiative) and Social Skills (communication).

Chapter Summary

During the Investigate phase of the learning cycle, learning activities included manipulating materials and tools, making observations, asking questions, testing ideas, and
designing and making. Tracy used whole-class, small-group and pairs collaborative learning formats during experiments and activities. During this phase, Tracy supported students’ scientific thinking and curiosity, participation in the scientific method, and social interactions in all three formats.

Andy fully participated in all the learning processes associated with the Investigate phase of the learning cycle. In the whole-class format, Andy’s strengths were joining in, attentiveness, and effective oral communication skills. Tracy mediated challenges to Andy’s participation in the areas of self-control and interacting with peers. In the small-group and pairs formats, Andy’s strengths were joining in, attentiveness, cooperativeness, and self-control, social status and social problem solving. Challenges to Andy’s participation included difficulty with initiative, joining in with peers, and social problem solving. However, Tracy or Andy’s peers effectively mediated these challenges. Beth fully participated in all the learning processes associated with the Investigate phase of the learning cycle. In the whole-class format, Tracy effectively mediated challenges to Beth’s participation with joining in and attentiveness. In the small-group and pairs formats, Beth’s strengths were joining in, cooperativeness, task initiative, taking turns/sharing, social status, asking for help and good communication skills.

Cindy participated to some extent in all the learning processes associated with the Investigate phase of the learning cycle. In the whole-class format, her strengths were joining in and cooperativeness. Challenges to Cindy’s participation, partially mediated by Tracy, included turn taking/sharing, attentiveness, self-control, joining in with peers, understanding the perspective of others, and social perception. In the small-group and pairs format, Cindy’s strengths were joining in, attentiveness, and task initiative. Challenges to Cindy’s participation in small-groups and pairs included difficulty with social problem solving, understanding the perspective of others, social perception, social status and popularity, and manners. Tracy and Cindy’s peers partially mediated these challenges to participation. Doug participated to some extent in most of the learning processes associated with the Investigate phase of the learning
cycle. In the whole-class format, challenges to Doug’s participation included joining in, attentiveness, and communication. These challenges were mediated by Tracy but did not support full participation. In the small-group and pairs formats, Doug’s participation was severely constrained by difficulty with joining in, task initiative, attention, communication, and social status. Tracy or a socially competent peer partially mediated these challenges to Doug’s participation. Elena participated in all the learning processes associated with the Investigate phase of the learning cycle. In the whole-class format, her strengths included joining in, attentiveness, communication and listening. In the small-group and pairs formats, challenges to Elena’s participation included difficulty with joining in and attentiveness. Intervention by Tracy or working in a pair (rather than a small-group) somewhat mediated these challenges.
CHAPTER 7: RESULTS—EXPLAIN/REPORT

Introduction

This chapter presents the results at the Explain/Report phase of the classroom learning cycle. The first section describes the academic and social processes associated with the Explain/Report phase. The next section presents the experiences of Tracy and each of the focal students during this phase.

Explain/Report

In the models of guided inquiry learning described in the science research literature, the Explain and Report phases, though overlapping, remained distinct. However, in Tracy’s Grade 2 classroom, reporting was seldom a separate process from explaining. Rather, as students explained their findings and ideas to each other and to Tracy, they also recorded these findings and ideas on their worksheets. The learning processes observed at the Explain/Report Phase included: expressing and defending ideas, using scientific vocabulary, negotiating meanings and coming to consensus, considering other’s ideas, representing thinking by drawing, printing, or orating, and extending ideas to new situations.

In student-directed pairs and small groups, the most frequently observed processes were expressing ideas and considering ideas (i.e., listening to each other’s ideas); the processes of defending ideas, negotiating meanings, and coming to consensus were seen less frequently and usually only during discussions facilitated by Tracy. Most often, Tracy used a teacher-led, whole-class discussion during the Explain/Report phases, with students sometimes breaking off into small-groups or pairs to investigate or discuss new ideas, and then coming together again in a whole-class format. After or during whole-class discussions, the students in Tracy’s class almost always created an individual product in the form of a worksheet. The worksheet was designed to help the students express their ideas about scientific phenomena through written prompts.
(sentence starters) and spaces for diagrams. However, the completion of the worksheet was usually facilitated by collaborative learning in the format of whole-class discussions, and sometimes by pairs or small-group work.

Tracy

At the Explain/Report phase, Tracy continued to support students’ participation (and especially the focal students participation) by calling on them specifically to make contributions to the discussion. When students shared ideas and explanations, Tracy asked students further questions to draw out their ideas and further understanding.

Tracy: “Right, what did we learn from Experiment #1?” No one answers, so Tracy reviews the procedure in more detail and asks again. “Which way was easier? Which way took less weight?” A show of hands wins for easier with the inclined plane. Tracy: “What do you think Andy? What does a ramp help us?” Andy: “It doesn’t have wheels so it can slide up instead of pulling it up and it uses more weight if it is hanging on the floor…With an inclined plane it slides instead of lifts.” Beth: “It’s easier with an inclined plane…it doesn’t take more weight.” Tracy asks if it would be easier for an ant to climb straight up the desk leg or up the ramp. The students call out ramp, but can’t explain why. Tracy asks what about a ladder or the ramp? Henry says it would be easier to go up the ladder because you have more grip. Tracy asks what if they put grips on the ramp, then which would be easier. Henry is not sure. (June 6, P1L34-43)

Tracy closely monitored students’ attention span, and kept them active. She also used spontaneous pairing to encourage discussion:

Tracy asks, “What force is making everything fall?” An NC students answers, “Gravity.” They take turns individually clapping and saying, “grav-i-ty.”…Tracy asks, “What is gravity?” Students start asking questions about gravity…. Talking breaks out and Tracy asks the class to stand up, jump up and down 20x, and go to their desks. “We can’t sit on the carpet any longer it is not working out for us today.” She directs them to write gravity in their science workbooks on the energy wordlist page, and then put their hands on their heads. Tracy asks them to talk to the student across from them at their desks about “What does gravity mean?”… Tracy asks some of the pairs to tell the class what they talked about…. Ned: “Gravity is a power source that pulls us down. And also I have a question. Is gravity in us or just all around us?” Tracy: “I don’t know. Where could we find that out?” Cindy: “At the doctor’s!” Tracy: “We could look it up in the dictionary.” (May 10, P2L36-P3L13)

Tracy asked pairs and small-groups to agree on their answer before reporting it to the whole-class, which helped students come to a consensus.
If a student made an “inaccurate” observation or gave an explanation that differed from the accepted scientific explanation, Tracy was careful never to suggest that her students were “wrong.” Rather, she would send a student to repeat part of an experiment and report back to the group. Or she solicited a number of answers and explanations from the group, then discussed inconsistencies and tried to lead the group to a consensus close the accepted scientific explanation:

Tracy goes back to the overhead projector and leads a discussion on still water. Students say wet and cold. Tracy tries to get them to talk about pressure. When Elena says it feels “splashy” Tracy sends her back to the sink to feel it again. Isabelle: “Translucent”. They discuss transparent, translucent, opaque from previous science unit and agree it is transparent; Ginny: “hands feel stuck to the bottom of the sink.” Tracy tries to draw out a discussion about why Ginny feels like her hands are stuck to the bottom of the sink but gets sidetracked….. Ned approaches Tracy individually and tells her he feels pressure when he pushes down on the water. Tracy asks him if he would feel more or less pressure if he opened his fingers. He guesses “less.” Tracy tells him to go try it in the sink, and to take a partner. Oliver tells Tracy he feels the same force from running and still water. Tracy sends him back to the sink to feel both again. (May 9, P2L23-35)

If the students’ observations supported a different explanation she did not push the “correct” answer on them. When the researcher asked her about this outside class time, Tracy explained that she believed that since the students would encounter these scientific topics many times in their school career, it was more important for them to experience the scientific process and explore phenomena than to “know” the correct answer. They would think about their experiences and bring them to their next learning opportunity.

At the Explain/Report phase, Tracy also encouraged the students to think about how what they had learned during the day’s lessons might influence how they would approach future activities. For example, while discussing how the waterwheels worked, Tracy asked students what they might do differently if they were to build another object to be powered by wind or moving water.

In addition to reporting ideas orally, Tracy required the students to record their observations and explanations via writing or drawing. Tracy supported students’ completion of the worksheets in three ways that involved collaboration. First, she led whole-class discussions.
During the discussions, they read the worksheet questions together, shared answers as a group, and then Tracy helped students to get started on their individual written answers:

Tracy reads a worksheet question out loud, “Is moving water a source of energy?” Tracy gives suggestions on what students might write and how they might do it (use of commas, how to begin answer). (May 7, P3L42-P4L7)

Tracy writes the answers on an overhead projector. She asks students to write their own answers, but to use what she has written to help them with words…. Tracy reminds students to begin the sentence with “I felt…” (May 9, P1L45-P2L11)

Sometimes these discussions occurred at the beginning of the task; other times they arose because Tracy noticed more than one student having difficulty with the reporting task:

Tracy stops students and clarifies expectations for the last worksheet question: "How do you think the shape and the number of holes in the tap, the fountain, and the shower make them useful? Please use at least 4 of these words in your answer: more, less, water, move, flow, help, useful.” She gives an example: “Why might you prefer one medium hole or many small holes for a drinking fountain? (May 14, P2L23-27)

If time allowed, Tracy led a whole-class discussion again as students completed the task to “take-up” the answers. She asked students to share their answers, and then made suggestions to improve the answers, or to ask for suggestions from the other students. If applicable, Tracy would also try to lead the students to a consensus about the “right” answer.

Second, while students worked independently on reporting, Tracy asked them to share their answers to provide support for other students. For example, on the day when Tracy first introduced the concept of gravity and its effect on moving water, the researcher made the following observations:

Tracy walks around, talking with students and encouraging their efforts. Occasionally she asks a student to tell the rest of class what they have drawn to give other students ideas…. Tracy asks the students to leave their workbooks open on their desks and to walk around and look at each other’s work. After walking around, students go back to their own desks and add more to their own drawings…. Students are talking with each other and watching each other, trying out what other students are doing, for example, experimenting with dropping pencils. Tracy asks all students to sit around the perimeter of the carpet and hold up their books so everyone can see each other’s work. (May 10, P3L17-33)

Third, Tracy asked the students to work in pairs to complete the worksheet tasks, and then provided support for peer interactions: “Tracy assigns boy-girl partners to check each other’s
work…. Tracy checks in with the pair and reminds them what they should discuss together: what
they like about each other’s work, what to improve” (May 7, P4L10-17).

Tracy also provided individual support for students as they completed worksheets. In between teacher-whole-class interactions, Tracy circulated around the classroom or called students up to her desk to check students’ progress, to provide encouragement, and to give help as necessary:

As she walks around, Tracy re-directs Doug to his work (he is staring into space) and helps him get started on an answer. Tracy asks Elena to read her answer. “I see moving water going down. It makes waves in my hand.” She asks Cindy to read her answer, “I see moving water.” Tracy asks her which way it was moving. Cindy says “Down.” Tracy asks her to add that important detail to her answer. Tracy continues to walk around the room, giving suggestions and talking through answers as students write. (May 9, P1L46-P2L6)

Andy’s strong communication skills and keen interest in science served him well at the Explain/Report phase. He frequently volunteered to share his ideas orally and expressed himself well:

Tracy asks Ned and Andy to explain what happened with their double waterwheel. Andy explained that it still tipped but, “We’ve figured out that the pencil was making the hole bigger but if it was tighter it wouldn’t tip…and it is so wet that the pencil was making the hole bigger…and it goes faster if it doesn’t tip.” (May 26, P4L24-26)

When presenting their wind-powered device to the whole-class, Andy spoke on behalf of his group, which surprised the researcher, since Henry had taken the lead on communicating outside the group up to that point:

We were going to build to build a car that moved by moving air, but the wheels weren’t working so we took them off and then we discovered when we turned the fan on that it moved by skidding instead of traveling by wheels. (May 24, P7L4-9)

Andy also experienced success with participation when moving between pairs and whole-group discussions:

Tracy asks them to talk to the student across from them at their desks about “What does gravity mean?”…. Andy is talking excitedly with his partner and gives a great answer.
Tracy asks some of the pairs to tell the class what they talked about…. Andy: “We talked about that if there is something flying that gravity can’t pull it down unless it’s not trying to fly and if can’t fly and you’re holding it and you drop it, it just falls.” Another student says that there is no gravity in space. Andy says, “Yeah, if we jumped here we would fall back down, but if we jumped up in space we would just float.” (May 10, P2L45-P3L8)

Andy worked in a small group with Henry and Ned to find simple machines within compound machines. As in the DMA, Henry took charge, but Andy successfully asserted and defended his ideas: “Andy points out a screw. Henry says they already found one, but Andy points out that he has found a different one. Henry agrees that there are two screws” (June 20, P3L27-29).

Except for a couple of entries in the classroom observation notes about Tracy asking Andy to sit still or stop playing with materials, Andy’s behaviour was not usually an issue at this phase. However, if Explain/Report processes occurred at the end of a lesson, Andy often seemed to have expended all of his energy and participated with less attention and enthusiasm. The following excerpt is typical of the researcher’s observations of Andy at the end of a lesson:

“Tracy re-directs Andy to his work by asking him about what he is writing. Andy and Doug are looking spaced-out and yawning. All other students are writing” (May 9, P2L12-14). When reporting activities did not occur as “wrap-up” tasks, Andy’s participation was more successful, especially when the method of reporting involved diagrams: “Andy has drawn some very detailed diagrams—some are simple, machines, some are not. But he has been focused and accomplished a lot. Andy really seems to do well it science, it captures and holds his interest” (May 31, P4L11-13).

Andy usually chose to work alone to fill out his written answers on the worksheets. When not exhausted, his attention was focused on his work and he wrote detailed explanations (e.g., Figure 4). Given the choice of working in pairs or independently, Andy usually chose to work independently. For example, Andy was reluctant to exchange worksheets with Doug after competing his report on the first inclined plane example (but perhaps is was just Doug he objected to?), and he chose to work alone to create an acrostic poem about WEDGES. When assigned to work as a pair with Isabelle to complete a diagram of a hydroelectric power plant, he
FIGURE 4: Sample of Andy’s Written Work (Explain/Report)

Inclined Plane Experiment #2

Today we did an experiment to see if the slope of an inclined plane changes the effort needed to lift an object.

Here is what we found out:

<table>
<thead>
<tr>
<th>What we lifted</th>
<th>How many grams did it take to lift the object with a less steep inclined plane?</th>
<th>How many grams did it take to lift the object with a steeper inclined plane?</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Basket</td>
<td>10g</td>
<td>40g</td>
</tr>
<tr>
<td>Conor’s Hat</td>
<td>100g</td>
<td>100g</td>
</tr>
<tr>
<td>Hughston’s Shoe</td>
<td>260g</td>
<td>500g</td>
</tr>
</tbody>
</table>

Today I learned that when the slope is steep it is hard to make things slide up.

Here is a picture of my favourite part of today’s experiment.
still worked fairly independently, and Isabelle was not responsive to Andy when he tried to interact with her. However, when I asked them about their work, they both participated in the discussion.

On the simple machine hunt, Andy worked in a group with Isabelle and Cindy. On this occasion, Isabelle also excluded Andy from interacting with her at the Explain/Report phase: “Andy is asking Isabelle which box he should write an answer in. Isabelle ignores him. Isabelle keeps leaving her group to go and talk to Beth” (June 14, P3L35-36).

Summary

Andy participated fully in all the learning processes associated with the Explain/Report phase of the learning cycle. Andy’s participation was mediated by his own social competence in the categories of: Behaviour (joining in, attentiveness), Social Skills (communication, language use), and Relationships with Others (accepted, usually included). Sometimes Andy’s participation was constrained by a low energy level at the end of a period or by Relationships with Others (sometimes excluded). Tracy mediated Andy’s participation through support for Behaviour (attentiveness).

Beth

Beth was reserved during whole-class discussions and did not often volunteer to answer Tracy’s questions. Beth often appeared inattentive, but was usually able to answer questions specifically directed to her. The researcher noted several times when Tracy asked Beth to change where she was sitting because she was chatting with a neighbour (Isabelle or Faith) rather than following the discussion.

During spontaneous pairings to discuss ideas, Beth’s participation depended on her partner (i.e., she did not talk with Cindy; she had animated conservations with Faith). Like Andy,
Beth usually chose to work alone to complete written observations. Her answers were fairly detailed and complete (e.g., Figure 5, note reversals).

When working in pairs to complete an explaining or reporting task, Beth’s interactions were also quite different depending on her partner. If she was partnered with a friend (e.g., Faith, Isabelle, or Mary) she was communicative, cooperative, and inclusive. For example, Beth and Mary worked well together on the simple machine hunt—they stayed together, took turns pointing out simple machines, and shared their written answers. When working with Faith to complete a worksheet introducing simple machines, Beth initiated work on the questions and discussed her ideas with Faith. If she was partnered with others, in one example, with an NC, or in another, with Doug, she did not participate with her partner to complete the work, but seemed to ignore the partner and complete the work independently.

Beth worked very successfully in a small group with Kelly and Ginny to find simple machines in compound machines. Both girls were part of Beth’s social group. Beth participated enthusiastically in this activity and took a leadership role. She was also very attentive to the quality of her reporting work:

Group 2 is taking turns holding the scissors. Kelly says “Wedge.” Beth says, “Screw.” Beth is engaged and closely following what is happening. They compare their answers and make sure they have marked the same things. They ask me if there is an inclined plane. Tracy overhears and repeats her message about how an inclined plane is used. I tell them there is another simple machine, one that has a long straight bar and a fulcrum. They talk about it for a minute and come up with “Lever.” Beth tells the others to erase “inclined plane” from their chart. When they are done, Beth traces the scissors. Kelly waits for her to finish so she can do it as well. Ginny draws the scissors freehand and labels the simple machines. Beth keep erasing and re-drawing her tracing of the scissors, trying to get it perfect. (June 20, P3L15-23)

In contrast, when she worked in a small group with Isabelle and Cindy to write an acrostic poem using the word WEDGES, Beth tried to withdraw from the group when Cindy became bossy. However, Beth decided to stay when Cindy protested, and then demonstrated her initiative by beginning the work on the poem—she wrote the word WEDGES down the left-hand side of the paper and began the first line. Beth responded positively when Isabelle corrected the way she
FIGURE 5: Sample of Beth’s Written Work (Explain/Report)

Name: [Redacted]

Group Challenge #2

Purpose: To make an object move across water without touching it.

Hypothesis: I think that we will or will not be able to make the object move across water without touching it.

Materials: bin filled with water buoyant object

Observations: First we ___ We blow it.

Then we ___ We cleared the hazards.

1. Is moving water a source of energy? ___ yes it is

   a source of energy

2. How many different ways can you move the object across the water?

   we could different ways

Draw a labeled diagram of what your group did today.

![Diagram]

Did you work well with your group today? ★★★★★

Why did you colour in the stars?
wrote the line: “Beth writes the first sentence but starts with a “w” even though there is already one written. Isabelle fixes it while quietly explaining to Beth what she is doing” (June 11, P4L7-9).

Summary

Beth participated fully in all the learning processes associated with the Explain/Report phase of the learning cycle. Beth experienced the most successful participation working independently on reporting tasks, or partnered with friends in pairs or small groups on reporting or application tasks. In the whole-class format, Tracy mediated Beth’s participation through support for social competence in the category of Behaviour (attentiveness, joining in). In the small-group and pairs formats, Beth’s participation was mediated by her own social competence in the categories of: Behaviour (joining in, attentiveness, task initiative) and Social Skills (communication, language use), and Relationships with Others (popular, accepted, included). Beth’s participation was constrained at times because she excluded other students.

Cindy

With Tracy’s support (by asking her questions), Cindy participated with partial success in the whole-class discussions. She shared her ideas and listened to those of other students; her attention usually remained focused on the discussion, especially if she was seated close to Tracy. Sometimes she had difficulty taking her turn speaking—she talked to the students around her while waiting for Tracy to call on her, interrupted other students or Tracy during the discussion, or called out an answer before Tracy asked her to share her ideas. In response to these behaviours, Tracy did not call on Cindy to participate.

Cindy was less successful at participating in the learning processes associated with the Explain/Report phase when working in pairs or small groups. In some cases, she was excluded by her partner(s) (e.g., Beth or Kelly), even when Tracy was directing Cindy’s participation:
Tracy asks them to talk to a neighbour about the similarities…“Cindy, go somewhere and talk to someone, please…. What were trying to do with the book, the lid and the nail? Think about it. Tell the person beside you. Tell the other person beside you. What were we trying to do to these things?” Cindy tries to talk to Kelly, but Kelly is not very responsive. (June 7, P2L30-41)

Cindy’s preference was to work with a partner or partners at the Explain/Report phase. She was eager to join in and wanted to take a leadership role in small-group activities. However, as at the Investigate phase of the guided inquiry science learning cycle, her social competence challenges, particularly in the area of social cognition and social skills, hindered her success as a group leader and constrained full participation in the exchange of ideas and coming to consensus. For example, when working with Beth and Isabelle to write an acrostic poem using the word WEDGES, Cindy first insisted they were to use the word TOOLS and only back down when she heard Tracy saying, “WEDGES” to another group; then, she insisted that there was no “D” in the word wedges and would not back down until Isabelle and Beth showed her where Tracy had written the word on chart paper. She also insisted that they start a sentence with “Our class…”—she told her partners that is did not matter that there was no “O” in “wedges.” Cindy also tried to direct her partners in who should write what line, and then constantly changed her mind; she insisted that Beth use Cindy’s eraser; and finally, she grabbed the poem out of Isabelle’s hand when Tracy asked them to return to their desks. The whole time she seemed oblivious to the effect of this behaviour on her partners.

While looking for simple machines around the school and schoolyard with Andy and Isabelle, her participation was also enthusiastic. Cindy wanted her partners to take turns finding machines, but then kept running ahead and ordering her partners to come and see what she had found.

Cindy worked with Elena and Faith to find simple machines in compound machines. Once again, she showed initiative and enthusiasm. She asserted her own ideas about simple machines, but was unwilling to consider the ideas of her partners. At one point, she flatly refused to let either of her partners have a turn holding and examining a can opener, even with
encouragement from the researcher. In addition, Cindy continually interrupted the researcher while she tried to talk to Cindy’s partners about their ideas:

Cindy is holding a can opener and saying that the piece that turns is an inclined plane. The other students are saying no. I ask her if she is actually moving something up and down with the plane, or just turning the plane around and around. She is silent for a moment, and then says, “It’s an inclined plane.” Faith says it’s a wedge. Cindy says, “No!” I ask Faith which part she means. Cindy keeps interrupting us. Cindy is talking non-stop and off-topic. I ask Cindy several times to let another group member hold the can-opener. Cindy says Faith already had a turn. Finally she gives Faith the can opener, but then asks for it back right away. (June 20, P3L34-40)

In all the above examples, though visibly annoyed by Cindy’s behaviour, her partners were surprisingly patient and polite with her. While Cindy’s behaviour constrained the success of the collaboration, it did not completely inhibit her participation.

The researcher’s observations of Cindy working in pairs at the Explain/Report phase revealed positive as well as negative experiences. For example, Cindy worked with John on a worksheet about the effect of gravity and water flow. While John was not the most responsive partner for anybody, Cindy took the initiative and tried to begin discussion of each question. Cindy worked with an NC to complete a worksheet introducing simple machines. In this task, Cindy made excellent drawings with labels with prompting from her partner. However, in the following exchange, she was less successful at working cooperatively:

Tracy assigns Oliver and Cindy as partners...Cindy gets upset because she thinks that Andy and Beth choose to sit too close to herself and Oliver. Cindy says that she has already finished the back of the worksheet. “I finished it at my desk; it was too easy!” Then she tells Oliver what to write for each answer. Oliver looks and sounds like he is getting annoyed. “I know, Cindy.” (June 11, P3L20-24).

Cindy usually completed independent seatwork quickly, but without detail in her drawings or written explanations (Figure 6). Tracy frequently checked Cindy’s work, asked her questions about what she had done so far or sent her to repeat part of an experiment, and then directed her to add what she had just told Tracy in her answers.
FIGURE 6: Sample of Cindy’s Written Work (Explain/Report)

Name: Cindy

Group Challenge #2

Purpose: To make an object move across water without touching it.

Hypothesis: I think that we will or will not be able to make the object move across water without touching it.

Materials: bin filled with water buoyant object

Observations: First we blew the lage

Then we made waves with our hands.

1. Is moving water a source of energy? Yes

2. How many different ways can you move the object across the water? 2 ways

Draw a labeled diagram of what your group did today.

[Diagram drawn by hand]

Did you work well with your group today? 4 stars

Why did you colour in the stars? Because
Summary

Cindy participated to some extent in all the learning processes associated with the Explain/Report phase of the learning cycle. In the whole-class format, Cindy’s participation was mediated by her own social competence in the categories of: Behaviour (joining in, attentiveness), and Social Skills (communication, listening). Sometimes Cindy’s participation was constrained by Behaviour (taking turns), which led to less invitations by Tracy to join in the discussion. In the small-group/pairs format, Cindy’s participation was supported by her own social competence in the category of Behaviour (joining in, task initiative). However, challenges in the categories of Social Cognition (social perception, social problem solving), Behaviour (cooperativeness, taking turns), Relationships with Peers (sometimes rejected, excluded) and Social Skills (listening, manners) constrained successful participation. These constraints were partially mediated by Tracy, and partially by patient, accepting, high-functioning peers. Cindy experienced some success at the independent reporting, where Tracy was able to help her extend and apply her thinking through short, but frequent, one on one interactions.

Doug

At the Explain/Report phase of the learning cycle, Doug’s attention was seldom focused during whole-class discussions. Even when Tracy asked Doug questions, his responses were unenthusiastic and his attention wandered as soon as the interaction ended:

Tracy asks why some of the waterwheels tilted…. Doug is not paying attention…. Tracy asks Doug why her plate is tilting. Doug says there is more weight. Tracy tries to draw out his answer a bit but Doug is done…. Tracy asks what they would do the same and differently at home if they were going to try to build waterwheels again…. Doug is drawing on his eraser. (May 16, P3, L19-28)

Like Andy, Doug appeared very tired by the end of a science class and especially struggled with participating when the Explain/Report phase occurred then:

Doug has drawn pictures of playground slides in the spaces on his worksheet where he was supposed to draw diagrams of the experiment…. Doug puts his head on his desk again. I ask him if he is okay, if he is tired? He nods. I ask him what he will write for his
sentence. He doesn’t answer, but writes, “inclined plane” on the blank line. (June 4, P4L5-14) (Figure 7)

Doug struggled with completing independent reporting via worksheets, even when supported by whole-class discussions about the answers—during the whole-class interactions Doug was inattentive. Unless he received individual support from Tracy, he made little progress on worksheet tasks:

As she walks around, Tracy re-directs Doug to his work (he is staring into space) and helps him get started on an answer. (May 9, P1L46-P2L2)

Tracy then instructs the students to make diagrams of the experiment and fill answer the questions on their worksheets. Tracy works one on one with Doug to get all the blanks filled in. (June 4, P3L44-46)

Doug had more success using drawing to represent his thinking than writing.

Doug experienced success participating during spontaneous pairings only when Tracy helped Doug to begin a conversation with a partner. The researcher observed only one positive learning experience for Doug when working in the pairs format at the Explain/Report phase.

When Doug was paired with Oliver to hunt for simple machines, they ran together from place to place, talked about what they saw, and then Oliver helped Doug with his written answers. The researcher observed four other times when Doug was assigned to work with a partner at the Explain/Report phase. When Tracy asked students to exchange their written and pictorial answers after the first inclined plane experiment, Andy refused to switch with Doug. When Tracy assigned Doug and Beth to work check each other’s work after the “Making an object move across water without touching it” experiment, Beth looked around while Doug read his answers to her. Doug was assigned a partner to work with while completing the diagram of the hydroelectric power plant, but the researcher observed him to be working alone. Finally, he had the following experience working with Faith:

Doug comes to Tracy to ask for help. Tracy asks where his partner is (Faith). Doug doesn’t know…. Faith and Doug are getting lots of direction from Tracy but are not making a lot of progress. Faith is listening to other groups. Doug shows her how he spelled “hole.” Faith takes her workbook to show Tracy. I ask Doug a few questions and he doesn’t demonstrate an understanding of what differences hole size and shape might
FIGURE 7: Sample of Doug’s Written Work (Explain/Report)

Name: Doug

Inclined Plane Experiment #1

Purpose: To find out how an inclined plane can make lifting easier.

Materials: 2 boxes
1 metre of string
1 board 1-2 metres long
weights
desk
metre stick

Hypothesis: I think the inclined plane will make it easier to lift the box.

Procedure: 1. Fasten the string to the shoe boxes. Label the boxes Box A and Box B.
2. Place Box A on the floor and hang Box B over the desk.
3. Begin to place weights into Box B until Box A begins to lift up off the ground.
4. Keep adding weights until Box A reaches the top of the desk.
5. Count the weights that it took to lift the box up to the desk.
6. Measure the height of the desk.
How far did Box A travel? 61 cm
7. Next repeat steps 1 - 4, but this time Box A should be placed on the board (an inclined plane) to begin.
8. Count the weights that it took to lift the box up to the desk.
How much weight was needed to lift Box A to the top of the desk? 40 g
9. Measure the length of the board.
How far did Box A travel this time? 68 cm

Observations: Draw what we did and what you saw.

Without the inclined plane

With the inclined plane

Conclusion: Today I learned that
make to water flow. He says, “Shower water flows faster and shower holes are bigger.” He says a waterfall would be good for swimming and that the water fountain water flows down only. Faith comes back but does not share the ideas she got from Tracy with Doug. Doug watches what she writes and starts to copy it…. Tracy calls students up to her desk one by one to check their work. When Faith leaves her desk, Doug finishes copying her answers. (May 14, P2L36-P3L6)

In all these examples Doug was ignored or excluded by his partners and did not receive peer support for applying or representing his ideas.

The researcher observed two occasions at the Explain/Report phase when Doug worked in small groups. On the first, he was assigned to a group with two NC students to complete a worksheet about simple machines. Doug wanted to interact with his partners, but not in a way that contributed to the science task:

Doug keeps repeating “wood” over and over. An NC asks him how wood helps lift? Doug starts being silly—making silly voices, then giving silly answers (e.g., speedboat!). The others want to say “me” for what helps lift, and have drawn themselves. One of the NCs starts getting off track with colour rhymes (e.g., If it’s blue, let it glue). Doug is now talking about aliens…(May 31, P3L46-P4L4)

Doug worked with Oliver, Mary, and Isabelle on the task of finding simple machines in compound machines. Doug seemed to make no effort to participate. Near the end of the task, the researcher made the following observation:

Mary is throwing around Doug’s paper. Doug has a graph that looks nothing like those of his group mates. It is full of swirls and letters. He has drawn Ninja Turtles on the back of this worksheet instead of compound machines. I ask Doug if he agrees with the simple machines that his group has found. Mary says, “Yes, he does.” Isabelle tells me that instead of machines he has drawn Ninja Turtles. (June 20, P4L13-17)

In this excerpt, it seemed as if Doug was being excluded, but in this case the behaviour of the other students toward him may have been a reaction to his own lack of interest in the group’s activities.
Summary

Doug participated in the learning processes associated with the Explain/Report phase to a limited extent. In the whole-class format Doug’s participation was constrained by social competence challenges in the category of Behaviour (attention, joining in), and not even Tracy’s support mediated sustained participation. In the small-group/pairs formats, social competence challenges in the categories of Behaviour (attention, joining in) and Relationships with Peers (ignored, sometimes excluded) constrained participation. It would have been interesting to observe Doug at this phase paired with students with whom he had more success working at other phases of the learning cycle (e.g., Ginny or Isabelle).

Elena

At the Explain/Report phase, Elena participated well in whole-class discussions, but only interacted in spontaneous pairings with support from Tracy. The only Classroom Observation Note about Elena completing reporting work in a pair during this phase describes her partner (an NC) as ignoring her and talking to Henry instead while completing a diagram of a hydroelectric power plant.

As in the other phases of the learning cycle, Elena did not participate fully as a member of a small group during explaining/reporting activities: “Tracy checks on the group’s progress. Elena is totally disengaged. Tracy directs her to look at the can opener. Tracy walks them through all the simple machines on the can opener…. Tracy needs to focus Elena several times” (June 20, P3L44-P4L4).

When working independently to report on activities via the worksheets, Elena was focused and wrote detailed answers and diagrams (e.g., Figure 8). In another example, Elena chose to work alone to create an acrostic poem about WEDGES. She finished quickly and read it to the researcher:
Comparering Still and Moving Water

Put the plug in the sink and turn the tap on. When you put your hands under the tap what do you see?

I see moving water. It was going down. It made some waves in my hands. I didn’t splash. It was cold.

When you put your hands under the tap what do you feel?

I felt cold water. It was slippery. It wet my hands. I thought when it was coming down, it made me think of Niagara Falls.

Turn off the tap and put your hands in the water. What do you feel? What do you see?

I saw my hands in the water. I saw bubbles in the water. It was wet. I felt splashy water. It felt very slippery. It was transparent.

What is the same about the water from the tap and the water in the sink?

They are both transparent. They are both cold. They are both wet. They both take the shape of the sink. They are both liquids.

What is different about the water from the tap and the water in the sink?

The tap water moves while the sink water does not. The sink water can be bumped while the tap water can’t. The tap water falls while the sink water can’t.

What do you see when you remove the plug?

_____________________________
Elena: Jenny. This poem is called Wedges.  
Researcher: Okay.  
Elena: We use wedges in all ways. Everyone needs wedges. Don’t cut without wedges…
[I can’t make out the rest on the audiotape]  
Researcher: That is an excellent poem, Elena. You know a lot about wedges now.  
Elena: Yeah! (June 11, P4L16-19)

It is interesting to note that when given the opportunity to rate herself as a member of a group, or to rate her group’s functioning, Elena’s rating was off the scale at the positive end. Her explanatory comments included, “We took turns and shared” and “We didn’t act silly.”

Summary

During the Explain/Report phase of the learning cycle, Elena participated to some extent in all the associated learning processes. While Elena’s social competence in the categories of Behaviour (joining in, attention, taking turns) and Social Skills (communication, listening, language use) supported her participation in whole-class discussions, social competence challenges in the category of behaviour (joining in, attention) constrained her participation in the small-group/pairs format. Elena excelled at representing her ideas during independent reporting involving writing and drawing.

Chapter Summary

During the Explain/Report phase of the learning cycle, learning activities included: expressing ideas, using scientific vocabulary, defending ideas, considering other’s ideas, negotiating meanings/coming to consensus, representing thinking by drawing, printing, or orating, and extending ideas to new situations. Tracy predominantly used a whole-class format during this phase, breaking the students into small-groups or pairs to begin or facilitate explanatory discussions. Reporting activities were supported through worksheets, and collaboration in a whole-class or pairs format. Tracy supported students’ participation through invitations to join in, keeping the students active, encouraging consensus, encouraging and
accepting all ideas regardless of scientific accuracy, directing students to apply their ideas to new situations, and encouraging students to share their ideas with their classmates.

Andy fully participated in all the learning processes associated with the Explain/Report phase of the learning cycle. In all formats, Andy’s strengths were joining in, attentiveness, communication, and language use. Occasionally Andy needed support from Tracy to support attentiveness when his energy level dropped. Beth fully participated in all the learning processes associated with the Explain/Report phase of the learning cycle. In the whole-class format, Tracy mediated challenges to Beth’s participation in the areas of attention and joining in. When partnered with friends in small-groups and pairs, Beth’s strengths were joining in, attentiveness, initiative, communication, language, and social status. Beth participated well independently.

Cindy participated to some extent in all the learning processes associated with the Explain/Report phase of the learning cycle. In the whole-class format, Cindy’s strengths included: joining in, attentiveness, communication, and listening. In this format, Cindy’s participation was challenged by difficulty with taking turns. In the small-group and pairs formats, Cindy’s strengths were joining in and initiative. Cindy’s participation was challenged by difficulty with social perception, social problem solving, cooperativeness, taking turns, low social status, listening, and manners. Tracy and Cindy’s peers partially mediated these challenges to participation. With support from Tracy, Cindy experienced some success at independent reporting. Doug participated in the learning processes associated with the Explain/Report phase of the learning cycle to a limited extent. In all formats, Doug’s participation was challenged by difficulty with attention and joining in that was not fully mediated even with support from Tracy. In the small-group and pairs formats, low social status further constrained Doug’s participation. Elena participated to some extent in all the learning processes associated with the Explain/Report phase of the learning cycle. In the whole-class format, Elena’s strengths included: joining in, attentiveness, taking turns, communication, listening, and language. When working in small-groups and pairs, Elena’s
participation was constrained by difficulty with joining in and attentiveness. Elena excelled at independent reporting activities.
CHAPTER 8: DISCUSSION

Introduction

The purpose of this research was to investigate the participation of students with LD in collaborative, guided inquiry science learning activities by examining the role of social competence in supporting and constraining interactions in collaborative learning formats. Data were collected in an inclusive Grade 2 classroom in a medium sized, rural school. Detailed classroom observations were the primary source of data. In addition, the researcher conducted two interviews with the teacher (Tracy), and collected samples of students’ written work. The classroom observation notes and teacher interviews were analyzed qualitatively. Written work was used to support the findings from the observations and interviews.

Participation in social interactions is a necessary component for learning in a collaborative, guided inquiry approach to learning (e.g., Palincsar et al., 2001; Scott, Asoko, & Leach, 2007; Vygotsky, 1978). Research in science education and on the social aspects of LD suggests that social competence is one gateway to participation in collaborative science learning processes and this study attempts to explain the success of students’ participation in science learning using social competence (Vaughn & Hogan, 1990) as a window for discussing the results. However, it is difficult to separate social processes from academic processes, and academic mediation from social mediation (Nind & Wearmouth, 2006). Therefore, this discussion is organized using a social perspective, but addresses academic concerns as well.

Students with LD are a diverse group, and vary greatly in academic skill level, social competence, and temperament—all of which are important factors in the success or failure of students with LD in collaborative learning processes (Jenkins & O’Connor, 1996b). Tracy employed numerous and diverse strategies to support collaborative learning for all of her students. Different strategies were important for different focal students, but it was the combination of strategies that allowed all the students with LD to participate, at least to some
extent, in all the learning processes associated with the guided inquiry approach to science used in Tracy’s Grade 2 classroom.

This chapter begins with a discussion of strategies used in Tracy’s classroom that mediated the participation of students in science learning processes through supporting social competence. Next, the components of social competence are reviewed and discussed with reference to the focal students and the mediation strategies. Third, the contributions of the research are described and the findings are summarized. The final two sections discuss limitations of the study along with recommendations for future research, and then the strengths of the study with recommendations for practice.

Mediation Strategies

The first two research questions developed for this study asked: (a) How do teachers mediate the participation of students with LD in collaborative, guided inquiry science activities, and (b) How do peers mediate the participation of students with LD in guided, collaborative inquiry science activities? This section discusses how Tracy and classmates without LD mediated the participation of students with LD in science learning processes through supporting social competence. The strategies include: creating a community for collaboration; strategies to support collaborative, guided inquiry learning; strategies to support involvement; and varying collaborative learning formats.

Creating a Community for Collaboration

Tracy’s Grade 2 classroom included many of the characteristics of Wenger’s (1998) definition of a community of practice, as seen in the data. The members varied in knowledge and skills and the social plane was the focus for learning. The following section describes the qualities of and contributors to this successful learning community: a caring atmosphere, Tracy’s philosophy, classroom management, and sharing knowledge.
From the beginning of the school year, Tracy deliberately created a community atmosphere in her classroom. She made it clear that the only acceptable behaviour in her classroom was inclusive behaviour. As a result, the researcher observed the students to be unusually thoughtful, respectful, caring towards, and accepting of each other. These behaviours were explicitly taught, and then constantly reinforced by Tracy. Tracy’s strategies for fostering inclusive relationships included: (a) encouraging students to think of their classmates as family members and to look out for each other inside and outside the classroom; (b) providing opportunities for students to disclose their strengths, interests, and challenges to each other during sharing circles; (c) asking students to talk about their feelings and how they were affected by positive and negative interactions with their peers (e.g., whole-class de-briefing after recess or talking through problems as they arise during activities); (d) helping students to create a sense of ownership and responsibility within the classroom through delegating tasks to students, facilitating student-led activities, and teaching students strategies for resolving conflicts on their own; and (e) teaching and preserving mutual respect by role modeling respectful interactions, preserving dignity through humour, and participating with students in activities. The results of this study suggest that the presence of such a nurturing atmosphere, and the sense of participation in, and belonging to, the classroom community may have supported the academic participation of the focal students (Nind & Wearmouth, 2006; Zembylas & Isenbarger, 2002). In addition, the caring atmosphere may have reduced instances of inappropriate behaviour (Zembylas & Isenbarger, 2002). For example, Tracy reported that she believed Doug’s improved behaviour was due to a reduction in his feelings of frustration at not being able to communicate his ideas to his peers.

Placing students with LD into inclusive classrooms and heterogeneous learning groups does not necessarily gain them entry into the social interactions of whole-class or small group learning, nor does it ensure equal status among group members (Palincsar et al., 2001).
results of this study also suggest that encouraging caring and respect between students may have mediated some of the constraints that can be placed on participation in small-groups and pairs by low popularity and social status, as peer acceptance is necessary for collaboration (Hutchinson et al., 2002).

The research literature on social status suggested that in classrooms where students with LD were highly accepted by their teachers, students with LD were as well liked and no more rejected by their classmates than students from other achievement groups (La Greca & Vaughn, 1992). In addition, social constructivist theory suggests that the teacher plays a crucial role in guiding the social and academic learning processes of each student in his or her classroom (Brown & Campione, 1994; Vygotsky, 1978). Tracy seemed to genuinely like, respect, and enjoy interacting with all the focal students. Her interactions with them were consistently positive and constructive, and she worked to ensure similar interactions between peers. Tracy’s positive relationship with the focal students also appeared to mediate some of the constraints placed on participation in small-groups and pairs by low popularity and social status.

Tracy taught, modeled, and then required inclusive behaviour from her students. The students without LD in Tracy’s classroom then mediated the participation of students with LD through their patience and tolerance for behaviour and academic capabilities outside of age appropriate norms.

**Philosophy**

Tracy believed that collaboration was a natural part of working within a community and essential for practicing social skills, extending science knowledge, and providing social experiences, especially for students with LD. Tracy also viewed her Grade 2 students as social creatures to whom collaboration came naturally. Nind and Wearmouth (2006) cited a concern for community and collaboration on the part of the teacher to be an essential feature in effectively including students with LD.
Tracy used collaboration, and specifically collaborative inquiry, consistently across the curriculum. It did not seem to matter whether she was teaching Art, Science, or Math. In all areas of the curriculum she emphasized problem solving and process over product and content. In this way, collaborative inquiry became a familiar and comfortable mode of learning for her students, and allowed them to direct their cognitive capacities to the subject matter at hand.

**Classroom Management**

Through effective classroom management skills, activities in Tracy’s classroom were seldom interrupted to deal with behaviour issues. Part of her classroom management involved the physical environment of the classroom: the lighting was as low as the activity allowed, “hush-ups” were in place to limit background noise, and the room was set-up to facilitate group work. Tracy orchestrated smooth transitions within and between activities. Effective classroom management and smooth transitions contributed to the positive atmosphere in the classroom, and created both the extra time that student-directed learning activities require (Blake, 2002) and left Tracy free to support the learning of students with LD. Tracy used “ritual, familiar, participant structures” for discussions, transitions, forming groups, experiments, and reporting (Brown & Campione, 1994). Students knew what to expect and were familiar with the routines for completing science activities, leaving them free to focus on science learning. Overall, Tracy’s skills with classroom management appeared to reduce constraints placed on participation by the social competence component of Behaviour.

**Sharing Knowledge**

While students in Tracy’s class were responsible for their own learning, and for demonstrating their own learning (via reporting), knowledge was considered communal and for everyone to access. In addition to knowledge, students were expected to share their skills and strengths with their peers (Brown & Campione, 1994). During investigations in small-groups,
Tracy encouraged students to observe other groups and try out the strategies and ideas of others. After investigations, all results and explanations were discussed in a whole-class format. Then while students were working independently or in pairs on reporting (through writing or diagrams), Tracy frequently stopped the class and asked students to share answers and try out each other’s ideas. In this way, “seeding, migration, and appropriation of ideas” occurred (Brown & Campione, 1994). Whole-class discussions were a frequent feature of Tracy’s guided inquiry approach, and operated as a “community of discourse” (Brown & Campione, 1994). Questions were raised, ideas were shared, and both were discussed constructively, using scientific language, with ideas evolving over the course of the lesson and unit.

Knowledge sharing mediated constraints placed on participation by challenges with task initiation (Behaviour), language use, communication, and asking for help (Social Skills). Knowledge sharing in this way also provided opportunities for “legitimate peripheral participation” (Lave & Wenger, 1991) for those students who were less involved in the hands-on activities of their own groups. In addition to mediating the participation of students with LD through sharing knowledge verbally, students without LD mediated the written communication of students with LD. Written reporting is often a significant challenge for students with LD in science education, and students without LD in Tracy’s class frequently allowed their peers with LD to copy written answers after a verbal discussion, or prompted and supported students with LD while they wrote their own answers.

**Strategies to Support Collaborative, Guided Inquiry Learning**

**Collaboration**

*Planning.* Successful collaborative, hands-on inquiry requires considerable advance planning work on the part of the teacher to organize and test procedures, materials, and the make up of groups (Blake, 2002; Nind & Wearmouth, 2006). Tracy believed that collaborative learning in guided inquiry science required much advance preparation and that she could clearly attribute
any problems with a lesson to lack of preparation rather than the students’ performance or behaviour. While Tracy emphasized the importance of advance preparation, the experiments the research observed were not thoroughly tried and tested by Tracy prior to use with her students.

Except for brief, spontaneous pairings for the purpose of generating discussion or checking written work, Tracy usually selected partners for her students. She tried to match high ability students with lower ability students, and students with high social competence with those with lower social competence. The results of the study showed vastly different learning experiences for the focal students depending on who they were partnered with. In particular, the high-achieving, socially competent girls in the class appeared to be more accepting, and more attentive to the students with LD, especially when working in pairs. In small groups, the students without LD tended to gravitate towards each other, ignoring, more than rejecting, the students with LD.

In their studies of cooperative learning, O’Connor and Jenkins (1995, 1996a) attributed successful collaboration to positive partnerships. In this study, academically and socially competent peers were observed to mediate some constraints placed on participation by challenges in the social competence factors of Behaviour (peers prompted joining in, directed attention, and supported task initiative), Social Skills (peers supported both oral and written communication of ideas), Social Cognition (peers enabled social problem solving), and Relationships with Others (inclusion).

Teaching and supporting collaborative skills. All students need explicit instruction about collaborative processes for guided inquiry learning (Blake, 2002). Collaborative learning skills are best taught in an authentic context, using a holistic approach (Blake, 2002; Korinek & Popp, 1997; Nind & Wearmouth, 2006; Sheridan, Hungelmann, & Maughan, 1999). At the beginning of the school year, Tracy repeatedly taught scientific procedures, safety practices, social skills (e.g., giving and receiving compliments and constructive criticism), and conflict resolution through role modeling (Berry, 2006) and role-playing. Over the course of the year she gradually released
responsibility for these processes to the students. However, she would conduct reminder clinics as the need arose.

Successful group-work requires constant monitoring of group functioning by the teacher (O’Connor & Jenkins, 1995; 1996a). During small-group work, Tracy was constantly on the move, listening in and interacting with students in order to assess learning and group social processes and to intervene as necessary. Support for learning processes sometimes took the form of procedural help, and sometimes support was given for the emergence and convergence of theories and ideas. Socially, Tracy insisted on respectful listening and sharing of ideas amongst group members and discussed feelings within a small-group, or sometimes with the whole-class if problems arose that the group could not solve on its own. Sometimes a social intervention took the form of Tracy asking students to stop and evaluate their performance as a group member, and often she requested that they evaluate their group processes at the end of an activity.

During spontaneous pairings in the midst of a whole-class discussion, Tracy supported the collaborative process by ensuring everyone had a partner, making sure everyone was talking to partners, modeling a script, assigning one partner to speak first, or asking students to share something interesting that his or her partner had said.

Initial teaching and ongoing support of collaborative processes appeared to mediate constraints placed on collaborative learning processes in the categories of Behaviour (cooperativeness, turn taking/sharing, task initiative), Social Cognition (understanding the perspective of others, social problem solving), and Social Skills (communication).

Worksheets

Worksheets played an integral role in guiding and supporting collaborative learning activities in a whole-class format or in small-group/pairs investigations. Tracy’s worksheets provided literacy support in the form of key information, simple instructions, sentence starters and spaces for diagrams (Dalton et al., 1997; Hutchinson, 1996; Palincsar et al., 2001). In
addition, the support provided by the worksheets made the tasks of conducting or following an experiment, generating hypotheses, reporting the results, and drawing conclusions more approachable and manageable, especially for students with LD. The worksheets may have mediated constraints placed on participation by challenges in the social competence factors of Behaviour (attention, task initiative), and Social Skills (communication).

**Strategies to Support Involvement**

Tracy used a number of strategies to get students involved, and keep students involved, in the learning process.

*Attention and Joining In*

During whole-class activities, Tracy carefully monitored attention to and participation in the discussion or experiment. Tracy encouraged attention beginning with low-level interventions e.g., using names or asking specific students questions (Berry, 2006) and moved to higher-level interventions as necessary, e.g., requiring students to stand up in place for a short time. While self-initiated joining in was ideal for participating in the learning processes, Tracy was able to effectively support the participation of the students who did not join in voluntarily by issuing direct calls to students to take part in the discussion or to take a turn helping with an experiment. Tracy involved students in each phase of the scientific method either as a whole-class or through individual participation. The results showed that Tracy called specifically on the focal students more frequently than students without LD in the class.

Other techniques Tracy used to encourage attention and joining in during whole-class lessons were brief, spontaneous pairings to discuss the topic or question at hand, a “hook” to introduce activities—by making the activity a challenge, the students were excited to meet it, offering manipulatives to stimulate interest in the discussion, connecting new lessons to previous learning, and using “real-life” examples and activities to provide a meaningful learning context,
and using “wiggle breaks” or short bursts of physical activity (e.g., jumping jacks) when students became restless.

During work in small-groups and pairs, Tracy circulated amongst the groups and redirected the attention of the focal students who were uninvolved in the group activities by asking them questions about what the group was doing, and suggesting tasks that they might perform to help. In the small-group and pairs formats, peers also played a role in promoting attention and joining in for students with LD. In particular, the high-functioning girls, while working in pairs, mediated the participation of students with LD by prompting turn taking, asking for opinions, and comparing and correcting written answers.

Communication

When students made verbal contributions to discussions, Tracy praised and acknowledged the contribution, and then drew out the students’ ideas through further, deeper questions (Berry, 2006). In addition, she would often repeat and paraphrase students’ contributions to help communicate them clearly to peers and keep the discussion cohesive and on track (Berry, 2006). At times, when Tracy was having difficulty understanding what a student with LD was trying to communicate, it was peers who mediated the participation of students with LD by translating or re-phrasing an answer.

Ownership

Tracy created a sense of ownership of the learning process for the students (Berry, 2006) in several ways. First, while she tried to facilitate whole-class discussions to reach a scientifically correct answer, she did not dictate answers to students. Second, she allowed room in her instructions for experiments and explorations for students to figure things out for themselves. Third, Tracy let the interests of the students guide discussions and explorations, especially during the Engage and Investigate phase of the learning cycle, even if those interests took them in a
direction she had not intended to pursue. Fourth, Tracy encouraged students to extend ideas to future activities. Fifth, Tracy acted as coach or a guide during science activities rather than an authority figure (Anderson, 2007). She admitted when she made mistakes or did not know how to do something, and sometimes she even deferred to her students’ expertise. When problems arose, Tracy role-modeled her problem solving process, and involved students in problem-solving processes (Nind & Wearmouth, 2006).

Tracy’s strategies to encourage involvement in the science learning processes in her classroom mediated the constraints placed on participation by social competence challenges in the areas of Behaviour (attention, activity level/self-control, joining in), and Social Skills (communication).

**Varying Collaborative Learning Formats**

Tracy used a variety of collaborative learning formats: whole-class, small-group, pairs, and brief, spontaneous pairings during the whole-class format. Each format mediated constraints on social competence in different ways for different focal students, and the variety of formats ensured that all focal students had an opportunity to participate in science learning processes.

In the whole-class format, Tracy was able to closely monitor and support the attention and joining in behaviours of the focal students in both discussions and teacher-led experiments. In addition, Tracy was able to immediately support verbal communication. These advantages greatly facilitated the participation of students like Cindy, Doug, and Elena, who had more difficulty gaining access to participation in small-groups and pairs through constraints posed by their Relationships with Others, or through Behaviour, Social Cognition, or Social Skills challenges. Finally, in the whole-class format Tracy was able to model both academic processes (e.g., making hypotheses, charting observations) as well as social competence (e.g., giving constructive feedback, social problem solving, taking turns).
However, as Berry (2006) discussed, whole-class formats can also pose disadvantages for students who have trouble sitting still and remaining focused while waiting for their next turn. In this study, Andy was much more attentive and maintained a more appropriate activity level when working in small-groups or pairs, where he had more opportunities for hands-on participation. Beth, who experienced some form of anxiety-withdrawal, also participated more actively in small-groups and pairs, perhaps because she felt more comfortable sharing her ideas with a smaller number of peers at a time, especially peers in her own social circle. The small-group/pairs format also gave students the opportunity to practice social skills and social cognition in an authentic setting. A disadvantage to the small-group/pairs format was that Tracy could not constantly monitor involvement and communication challenges.

Finally, working in pairs with the right partner seemed to give the focal students with the greatest social competence challenges the best opportunity for a positive learning experience. When working in pairs, it was easier for students without LD to direct their attention towards the students with LD.

Summary of Social Competence Factors

The remaining two research questions developed for this study asked: (a) What learning processes do students with LD participate in during collaborative, guided inquiry science activities, and what is the extent of the participation, and (b) What components of social competence support and constrain the participation of students with LD during collaborative, guided inquiry science activities? This section summarizes the role of each component of social competence—Behaviour, Relationships with Others, Social Cognition, and Social Skills—in supporting or constraining the participation of the focal students during collaborative, guided inquiry science activities.
**Behaviour**

The results of this study suggest seven sub-categories associated with behaviour relevant to collaborative learning: attentiveness, cooperativeness, joining in, task initiative, activity level/self-control, taking turns/sharing, and assuming responsibility for one’s actions. The presence and importance of the sub-categories varied across learning cycle phase and collaborative learning format.

During all learning cycle phases and in all learning formats attentiveness and joining in were key behaviours for participation, and presented challenges to all the focal students at various times and in various contexts (for example, Elena was attentive and voluntarily joined in the whole-class format, but was inattentive and showed little interest in joining in during group activities; the opposite was true for Beth). However, Tracy, and sometimes peers, effectively mediated the constraints posed by challenges to attention and joining in through varying formats and involvement strategies. Challenges with activity level and self-control posed potential constraints for Andy and Cindy, primarily in the whole-class format, during the Engage and Explain/Report phases of the learning cycle. However, Tracy was able to effectively mediate these constraints as well through involvement strategies. Occasionally Doug was observed “fooling around” in the small/group format, but this was not the norm (usually he was simply uninvolved rather than disruptive). Cindy experienced particular challenges in the sub-categories of cooperativeness and turn taking/sharing at all phases of the learning cycle, and in both whole-class and small-group/pairs formats. Tracy partially mediated the constraints put on collaboration by challenges with these categories through supporting collaborative learning, but Cindy’s access to participation was still negatively affected when frustration with her behaviour caused her peers or Tracy to exclude her, or when her behaviour disrupted the activity. Task initiative posed challenges for Andy and Doug in small-group and pairs formats—however, socially competent peers effectively mediated this constraint for Andy, and to some extent for Doug. Worksheets also helped support task initiative for all students.
Relationships with Others

In the category of Relationships with Others, the sub-categories that emerged were popularity (high to low), social status (accepted, neglected, or rejected) and inclusion (whether or not a student was allowed access to the science activity by group members). When working in a whole-class format, this area of social competence did not pose any constraints to participation, except during brief, spontaneous pairings that occurred in the midst of a whole-class activity. When working in small-groups and pairs during the Investigate and Apply/Report phase, these sub-categories became more important factors in participation. Not surprisingly, focal students with higher popularity and more favourable social status were more included by their peers. Beth was a popular, accepted student who was always included in all learning processes by her group members, except for one instance of exclusion when working with Andy and Henry. This occasion may be explained by the tendency for girls to be excluded to some extent in mixed gender groups (Webb & Palincsar, 1996). Interestingly, Beth sometimes excluded other students. Andy was of middling popularity and generally accepted by his peers—he was usually included in group activities. Doug was not very popular, and he tended to be ignored by his peers. He was excluded at times, more so when working in small-groups than in pairs. Elena’s popularity was low but she was generally accepted, though it appeared she excluded herself from small-group activities. Cindy’s popularity was also low, and her status was usually rejected. However, she was not consistently excluded from group activities. Often, she was included at the start, but then as her behaviour caused frustration amongst group members, exclusion started to occur. Constraints posed by Relationships with Others were certainly present, but mediated by Tracy through use of various formats, and her development of a caring, accepting community.

Social Cognition

The sub-categories associated with social cognition were social perception, understanding the perspective of others, social problem solving, and self-perceptions. As these are internal traits,
they were the most difficult to observe and document. Social problem solving appeared to be the most important factor in supporting or constraining participation in this study. Cindy struggled with this category the most, and Doug and Andy experienced some challenges as well. When conflicts arose, these focal students were less likely to generate a solution that allowed them to continue working effectively as part of the group.

Constraints placed on participation by difficulty with social problem solving were partially mediated by partnering with a socially competent peer, and by Tracy’s strategies for supporting collaborative learning. Cindy also struggled with social perception and understanding the perspective of others. Because she was not able to “read” people, Cindy did not realize how group members were responding to her and therefore did not modify her approach, further alienating herself. Through individual interactions with Cindy, Tracy was able to partially, but not fully mediate, constraints placed on Cindy’s participation by challenges in these sub-categories.

The methodology for this study did not include effective tools for measuring self-perceptions or determining its effect on participation in collaborative, guided inquiry learning activities. Therefore, it is not discussed here, except to say that “learned helplessness” (Gresham, 1998) may have influenced Doug’s difficulty with initiating tasks.

Social Skills

Data analysis revealed the sub-categories of language use, communication skills, listening skills, asking for help, and manners as the social skills relevant to participation in Tracy’s collaborative, guided inquiry approach. The most important of the sub-categories were language use and communication skills. Andy and Elena were both highly skilled in these categories across formats and learning cycle phases, which greatly facilitated their participation. Beth needed support via involvement strategies from Tracy in the whole-class format, but was self-sufficient at communicating in small-groups and pairs. Cindy was eager to communicate and confident in expressing her ideas, but sometimes she needed help from Tracy in order to be
understood. Doug needed extensive mediation from Tracy to communicate his ideas in all formats and phases of the learning cycle (but this mediation was effective). Beth was particularly good at asking for help when she needed it; Cindy’s participation was constrained by manners in the small-group format.

Contributions

This study contributes to the current body of research on creating supportive learning environments for students with LD. As suggested by the literature review, this study was strongly influenced by the research program of Palincsar and the Guided Inquiry supporting Multiple Literacies (GIsML) Community (Magnusson & Palincsar, 1995; Palincsar, Collins, Marano, & Magnusson, 2000; Palincsar et al., 2001; Palincsar, Magnusson, Cutter, & Vincent, 2002). The GIsML team developed and facilitated a professional development program for elementary teachers to support guided inquiry teaching with an emphasis on mediating the engagement and learning of students with LD. The professional development included an out-of-class component during which case studies of students with LD were developed and examined. From these case studies, strategies emerged to provide academic and social support to students with LD. These strategies were then implemented in the classroom with on-going support from the GIsML team. Their research strongly supported the potential of using collaborative, guided inquiry learning to promote deep science learning for all students.

While the GIsML research program focused on helping teachers to adopt and implement inclusive teaching strategies, the research in the current study took a step beyond: this research focused on how teachers might educate their students about inclusive practice. The data from this study provides an example of how to create a learning community where collaboration is not just a strategy, but also an integral part of the classroom culture. In addition to describing the experiences of students with LD and the classroom teacher, this research provides detailed descriptions of the roles students without LD might play in mediating learning for students with
LD. This research is also unique in its use of social competence categories as a framework for examining the participation of students with LD in collaborative, guided inquiry science learning.

The results of this study suggest five important findings. First, using a variety of collaborative learning formats creates more opportunities for the participation of the diverse population of students with LD. Different collaborative learning formats lend themselves to different social competence strengths, as well as different strategies for mediating constraints placed on participation by challenges to social competence. Second, establishing a philosophy of inclusion, or creating a sense of community where students feel accepted and cared for, and where they feel that their contributions are valuable, may enhance the academic and social success of students with LD. Third, peers can play an important role in mediating the social and academic challenges of students with LD during collaborative, guided inquiry science learning. However, careful selection of partners for students with LD is important for a positive learning experience. Students with LD should be partnered with academically successful, socially competent peers. This study suggested that girls were better at mediating the participation of students with LD than boys. This study also suggested that students with LD experience more success working collaboratively in pairs rather than small groups. Fourth, a variety of strategies to involve students in learning (e.g., support for attention and joining in, communication, and ownership) and to support collaborative, guided inquiry learning (e.g., teaching and ongoing support for collaboration, worksheets) are needed for students with LD to experience success. Fifth, this study highlights the potential benefits of adopting a general approach to teaching collaborative inquiry that crosses curriculum borders.

Limitations and Recommendations for Future Research

The findings of this study are limited by several factors. First, only two of the children in the study were formally identified with LD. Second, the study was of limited scope in terms of participants and classrooms. This was partially due to having only one researcher involved in the
study, and partially due to the difficulty of obtaining parental consent from enough participants in potential classrooms. Third, the study took place toward the end of the school year when many collaborative processes were already in place. Fourth, the strategies used by Tracy to support collaborative, guided inquiry science learning were directed at students in Grade 2 (seven and eight year-olds). Therefore, the applicability of these specific strategies may be limited for teaching science across the elementary grades (K-8). The strategies documented in this study represent a way of teaching collaborative, guided inquiry science learning, rather than a set of generic tools for all classrooms.

These limitations may be addressed through the following recommendations for further research: (a) replication of the study in classroom(s) where children are formally identified with LD (Grade 3 or above), (b) replication of the study during the first two months of the school year, when strategies for collaborative inquiry are first being taught and routines are being established, (c) reviewing letters of information and consent with teachers and administrators prior to obtaining ethical approval to make them as understandable and inviting as possible, and (d) repetition of the study across a variety of classrooms, with a variety of teachers and across a range of grades.

Strengths and Recommendations for Practice

The major strength of this research was that the participants and classroom setting selected for the study provided the researcher with the opportunity to observe and document a context in which collaborative learning was successful for students with LD. The researcher spent an intensive period of observation in the classroom, and conducted two extensive interviews that allowed her to become immersed in the context, routines, practices, and personalities of the classroom. These data collection methods, and the openness of the teacher and students, allowed the researcher to develop a deep sense of the participants, and increased the richness of the data.
The findings of the study suggest six recommendations for practice. First, using a variety of collaborative learning formats (whole-class, small-group, and pairs) may support the participation of diverse students with LD. Second, placing students with LD in pairs with an academically successful, socially competent girl, rather than in a small groups, may maximize the success of the learning experience for students with LD. Additionally, if a student with LD is working in a small-group, assigning him or her a partner within the group may enhance opportunities for social interaction for the student with LD. Third, since peers may not be automatically equipped for helping students with LD socially or academically (Hutchinson et al., 2002), identifying students who are willing and able to support students with LD, and providing them with explicit training (e.g., how to involve a student with LD by asking questions or for an opinion, make invitations to participate, assign a task, facilitate turn-taking, check on progress, discuss answers orally, and then share written answers) may enhance the participation of students with LD. Fourth, working from the beginning of the school year to create a truly inclusive classroom—a classroom with an atmosphere of caring, respect, and collaboration—may enhance learning experiences for all students. It appears that collaborative inquiry is most successful when it is used consistently across the curriculum. Fifth, group-work appears most successful when collaborative skills are explicitly taught to all students, with and without LD, and then supported in an ongoing manner. Sixth, a variety of strategies to promote active participation in collaborative activities and to support positive social interactions amongst students during collaborative, guided inquiry learning are needed for students with LD to experience success.

In a recent paper, Palincsar (2005) argued that, “theory building is integral to the work of advancing knowledge building within a domain,” (p. 219) while recognizing the considerable challenges of “working theory into and out of design experiments” (p. 218). The research described in this dissertation clearly supports the usefulness of the social constructivist framework (Scott et al., 2007) for studying science learning in an elementary classroom. Students were observed interacting with the teacher, with peers of greater or less academic ability, with
texts and illustrations, and with explorations to develop their understanding of science concepts relating to Power from Wind and Water and to Simple Machines. There was also an expectation of and opportunity for individual sense-making by the students. In this case, the teacher (Tracy) was not always a perfectly knowledgeable mentor of science and technology concepts, but she was knowledgeable enough to support her students’ “zones of proximal development” (Vygotsky, 1978). This dissertation focused more on learning through interactions on the social plane than on being introduced to the social context of the scientific community (i.e., acquisition of scientific concepts).

The data from this study support the research literature advocating the use of collaborative, guided inquiry learning in science for students with and without LD, as each of the focal students in this study experienced successful learning, and their participation was enhanced through interactions with Tracy and with peers. Tracy took on the role of “coach and facilitator” (Anderson, 2007) described as essential to guided inquiry learning. However, Tracy could have spent more time on preparation for activities and experiments (e.g., thoroughly testing materials and procedures) and in strengthening her subject knowledge. Tracy’s interactions with her students clearly supported the challenges to learning and participation experienced by the students with LD in her classroom. So this study provides a substantial empirical base for developing theory, but the challenges suggested by Palincsar (2005) remain. Critical questions for theory development might include: (a) what constitutes a learning disability versus a learning difference, and (b) how pedagogy and classroom context (imposed by teacher, board, or government) might set students up for challenges rather than success.
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APPENDICES

Appendix A

Classroom Observation Notes

Date: May 16, 2007

Teacher: Tracy
Focus Students: Beth, Cindy, Andy, Doug (Faith, Elena)
Activity: Science and Art
Time Period: 1:00 pm to 3:15 pm

Running Record

1:00 pm. Leo is back for the first time today. Tracy introduces Leo and me, and asks the students to explain to Leo why I am here. The answers include, to write “The Buzz,” publish books, to write about the students, to watch what we learn, and science! Tracy calls the students to the carpet to talk about recess because a yard duty teacher reported a problem with Doug and another student. Tracy starts going around the perimeter, asking students to briefly tell her how recess was. An NC student said that he pushed Nick (a student from another class) when he wouldn’t stop teasing him and Doug. Tracy asks Doug what they could do instead of using hands. Doug says, “Victor called us babies.” Tracy reminds them about the peer mediators on the schoolyard and says they will go and apologize to Nick later. Tracy continues around the circle and several students complain about the behaviour of Walter from another class. Tracy asks for her students to name some positive things about Walter before they end the circle.

1:15 pm. Tracy presents the class with a challenge: In partners, they will make a waterwheel, and that she will pick the partners (this doesn’t seem to bother the students). Tracy briefly reviews with the class how they harvested wind energy using pinwheels. She tells them they must understand how waterwheels work in order to learn how to harvest energy from water. Tracy shows the students the materials they will be using: paper plates, medicine cups, tape, and a pencil. Tracy reviews the materials available and then assigns partners on the spot. (Mary + Cindy, Elena + Faith, Beth + Oliver, Ned + Andy, Ginny + Doug) She does not give them any instructions about where to put the cups or how to use the tape to attach the cups. Tracy gives each a student a worksheet. One side lists materials, instructions, and follow-up questions for creating a waterwheel. On the other side is a diagram of a hydroelectric power plant.

1:25 pm. Mary is reading the instructions on the worksheet, Cindy joins in. Mary stops and says they must answer the first question. Cindy says, “no” they have to do the experiment first. Cindy asks Mary to wait so she can copy what Mary has written. Mary corrects Cindy’s reading. The girls go to get a band-aid for Mary and materials for the experiment. Back at the desk, Mary pokes a pencil through the plate. Cindy counts out the medicine cups. There are 9 (they instructions say they need 6 to 8). Mary urges Cindy to take the extra cup back in case someone else needs it. Cindy says, “no.” Cindy also sticks her pencil through the plate. Mary wants her to go get tape for their cups. Tracy will not tell them where to put the cups.
[Tracy stops the class and asks them to think about what kind of partner they are being and how to improve on this.]

Cindy goes to get another piece of tape. Mary is trying to figure out how to attach a cup to the plate. Mary tries to send Cindy for more tape but Cindy says it is Mary’s turn. Mary suggests they play rock, paper, scissors. They play, but can’t agree who has won. Mary eventually goes to get more tape. Once Mary leaves, Cindy switches their places and takes over trying to attach the cups to the plate. Mary returns to the table. She looks upset because Cindy has switched their places.

1:35 pm. Ginny and Doug. Ginny has 3 cups attached to her plate and is attaching a fourth. She is talking to a student from another group about a television show. Doug mumbles that he hates it. Doug is playing with a piece of tape. Ginny take it from him.

[Tracy asks if anyone wants to see if they are making good progress on their waterwheels.]

Ginny asks Joel if they can keep working on attaching the cups to the plate. Doug agrees. Doug is now playing with his worksheet and laying his head on the desk. Ginny leaves to confer with another group on how they are attaching the cups. Ginny leaves the desk again and Doug tries to attach a cup. Ginny comes back and stops him. Ginny says, “Wait, I’ll get more tape.” Doug wanders away. Ginny comes back and starts to attach a fifth cup to the plate. She tells Doug, “After this we are going to test ours. C’mon Doug, we’re going.” Ginny repeats this several times and Doug follows her to the sink. When they run the waterwheel under the tap the cups all fall off. Ginny says, “What if we attach 3 to one side and 3 to the other?” Doug plays with the things in his desk.

[The students are getting frustrated with the tape because it is not sticking well, or strong enough to hold cups on under water. Tracy is getting frustrated, too. I suggest using staples. Tracy tries it and it works, so she sends students to other classrooms to get staplers.]

1:45 pm. Henry and Leo go to the sink to try their waterwheel. They have used only tape to attach their cups, but they have done an excellent job, it works really well. Ned watches, then walks around waiting for a turn with a stapler and checking out what other people have done. His partner, Andy, is sitting at his desk.

[Tracy asks students to sit at their desks while they are waiting for a stapler and to work on answering the worksheet questions.]

Andy reads a question out loud, but Ned doesn’t respond. Andy is working on the water flow diagram on the back of the worksheet. He completes it and tells Ned to try it. A stapler arrives and they argue over who gets to staple. Andy says that he will hold the cup and Ned can staple. They start having success as Andy positions the cup and Ned staples.

[Tracy reminds the class to share their answers with their partners.]

1:55 pm. Beth and Oliver are sitting at the carpet answering questions. Another student suggests that they add one more cup to their waterwheel. Beth and Oliver do this, and then go back to the sink to try it out. Beth holds the pencil, but has trouble positioning the plate under the water flow. Tracy points out that the hole is much larger than the pencil, so the plate is tilting. Oliver takes a turn with the waterwheel. Beth leaves and starts twirling on the carpet. Oliver returns to the carpet also and they start to work on the questions. Beth asks Oliver what he wrote.
Tracy is getting frustrated and flustered, and the students are losing focus. Tracy asks all the students to return to their seats and put their worksheets into their workbooks. Andy and Ned accidentally staple Tracy’s finger while she is trying to help them attach a cup to their plate. After collecting herself, Tracy reminds the students to use capitals and periods in their answers. Then she asks the students to stand up if their waterwheel spins. She says, “Ned and Andy can’t stand up yet because they are having trouble with the stapler.” Then Tracy asks them to stand up if their waterwheel spins really, really well. Then she asks students to stand if their waterwheel had a bit of trouble spinning. Tracy asks the students to check to see if their partner is giving the same answer. Next, Tracy asks the students to explain why their waterwheel worked well or did not work well. Kelly: the cups came off with tape, but worked better with staples; John: the hole was too big and the plate tilted and the pencil blocked the cups. Tracy asks why some of the waterwheels tilted. Someone suggests the plate is wet. Doug is not paying attention. Beth is listening; Andy is resting his head on his arms. Tracy asks Doug why her plate is tilting. Doug says there is more weight. Tracy tries to draw out his answer a bit but Doug is done. An NC says there is more weight on one side because all the cups are on one side. Mary suggests they could put cups on both sides. Tracy asks Ned and Andy if they would like to try that, putting cups on both sides. Henry says he and Leo didn’t have that problem because they taped their cups to the edge. Tracy shows the class their waterwheel. Tracy asks what they would do the same and differently at home if they were going to try to build waterwheels again. Beth is doodling in her workbook; Doug is drawing on his eraser. Andy is playing with some of the cups. Tracy takes up the questions on the worksheet.

2:18 pm. Tracy tells the students to get their snacks. She invites Andy and Ned to try out their waterwheel again. Andy mumbles something to Tracy. She asks him to explain to Ned his idea—he wants to put cups on both sides of the plate at the same point facing the same way to balance and collect more water. Ned points out that one cup is facing a different way and explains why it won’t work like that, putting cups on both sides. They have five cups and are trying to decide if they need more. They decide to add a few more, but are worried about blocking the cups. The boys direct Tracy where to staple. The cups go on in parallel. Andy goes to get more cups. Tracy asks Ned if he thinks it will work this time. Ned says “yes.” Tracy asks if it will be faster than the other waterwheels. Andy says it will have double the power; it will be faster when it has more weight.

[The recess bell rings but Tracy tells the students to keep eating their snacks. After a few more minutes, she tells them they can go out when they are ready.]
the flow of water. Tracy asks Andy why it is still tipping even though there are cups on both sides. He thinks it is because the plate is wet, causing the hole around the pencil to get bigger and bigger. I ask if they have learned about symmetry in math or science and point out that even with cups on both sides, the wheel is still not symmetrical. I wonder out loud about putting two plates together. Tracy and Isabelle hold two plates together to see how it looks. We return to the classroom. Ned and Andy are very excited about their experiment.

[I was skeptical when Tracy did not give the students any direction about where to place the cups on the plates, or how to attach the cups. But the students came up with lots of different and creative solutions. Some worked, some didn’t, but they all tried, and kept trying until they had some success.]

2:40 pm. The students come in from recess and sit at their desks. Tracy asks Ned and Andy to explain what happened with their double waterwheel. Andy explained that it still tipped but, “We’ve figured out that the pencil was making the hole bigger but if it was tighter it wouldn’t tip...and it is so wet that the pencil was making the hole bigger...and it goes faster if it doesn’t tip.” Tracy asked if there was another way to stop it from tipping. Isabelle repeats what I suggested about using two plates so that the wheel would be symmetrical. Tracy explores with the students different ways to put the plates together. Tracy tells the kids to keep all these ideas in their heads because next week the final challenge of their energy unit will be to design an object that can be moved with wind or water. Tracy tells the students to rock, paper, scissors with their partner to decide who gets to take the waterwheel home.

2:47 pm. The students go to the room next door to retrieve paintings they created in the morning. They bring their paintings to their desks. The paintings are beautiful wet on wet watercolour. Tracy talks with the students about primary and secondary colours and how students made the secondary colours in their paintings. Tracy asks the students to write about their paintings. Some students are finishing the worksheets from science. Tracy plays quiet music on the stereo.

2:54 pm. Cindy is working at her desk. Tracy gets Cindy’s “word book” to help her with spelling. Tracy reads over the questions to guide the writing about their paintings, and the students begin to work. Cindy is writing slowly and stopping to look around a lot—painful progress!

2:59 pm. Beth is writing quietly. Doug hasn’t written anything. Andy is doodling on his paper.

3:02 pm. Tracy helps Doug get started on writing. Andy is writing now. Tracy moves Doug to a desk at the back of the room and talks through his answers with him. Doug begins to write. Beth is making good progress. She has reversed a letter in her name.

3:14 pm. Tracy is spending time going from student to student. She is frequently checking on Cindy, Doug, and Andy. Beth brings her writing to Tracy for her to check it.
Appendix B

RECRUITMENT LETTER

Social Competence and Collaborative Science Activities:
Experiences of Students with Learning Disabilities

Dear Grade 2, 3, or 4 Teacher,

HELP, PLEASE!

My name is Jennifer Taylor. I am a doctoral student in the Faculty of Education, Queen’s University (and before entering graduate studies I worked as an elementary teacher). I am writing to request your participation in research about the role of social competence in inquiry science learning where group work is involved. The ultimate goal of my research is to help students with learning disabilities to participate fully in collaborative science learning activities.

This research has two parts. The first part is a brief interview about your experiences using collaborative learning and inquiry learning to teach science. In the second part of the research, I will be observing some of your science classes during collaborative inquiry activities that are part of your regular curriculum and classroom activities (i.e., no extra work involved!). My observations will focus on the activities of students in the class with learning disabilities. I will be documenting examples of social competence (e.g., positive relations, social skills, behaviour) and the students’ participation in inquiry learning processes (e.g., observing, explaining, exploring).

If you are interested in participating in this project, please fill out the survey on the back of this letter and return it to me using the attached envelope. The information provided on the survey will not be used for research purposes and will be destroyed after participants have been recruited. Filling out a recruitment survey does not commit you to participating in this project. If you have any questions, please contact me by email: 9jat@qlink.queensu.ca or home telephone: 613-530-2403.

Sincerely,

Jennifer Taylor
Doctoral Candidate
Faculty of Education
Queen’s University
RECRUITMENT SURVEY

Social Competence and Collaborative Science Activities: Experiences of Students with Learning Disabilities

Name: _________________________________

School: _______________________________

Grade: ______

Contact Information (email or telephone): _________________________________

Number of Students: _____________

Number of Students with Learning Disabilities: ______

Do you use “guided inquiry” or “hands-on” learning for teaching science?: ______

Give an example of a “guided inquiry” or “hands-on” learning activity that you do with your class:

________________________________________________________________________

________________________________________________________________________

Do you use collaborative learning for teaching science?: __________________________

Give an example of a collaborative science learning activity that you do with your class:

________________________________________________________________________

________________________________________________________________________

Are you interested in participating in a research study that would involve two teacher interviews and a researcher observing some of your science classes for 2 to 3 weeks?
(Yes, no, maybe with more information): ______________________________________
Appendix C

Letter of Information for Teachers
Social Competence and Collaborative Science Activities: Experiences of Students with Learning Disabilities

My name is Jennifer Taylor. I am a doctoral student in the Faculty of Education, Queen’s University. I am writing to request your participation in research about the role of social competence in inquiry science learning where group work is involved. The ultimate goal of my research is to help students with learning disabilities to participate fully in collaborative science learning activities. This research will be used in my doctoral dissertation. It may also result in publications of various types, including journal articles or other professional publications. This research has been cleared by the Queen’s University General Research Ethics Board, and also by your school board.

This research has two parts. In the first part, I will interview three teachers within Grades Two to Four about their experiences using collaborative learning and inquiry learning to teach science. In the second part of the research, I will be observing the science classes of the teachers I interview during collaborative inquiry activities that are part of your regular classroom activities. My observations will focus on the activities of students in the class with learning disabilities (identified by the teacher). I will be documenting examples of social competence (e.g., positive relations, social skills, behaviour) and the students’ participation in inquiry learning processes (e.g., observing, explaining, exploring). If I find a student with LD to be totally disengaged from the activity, I may intervene for the purpose of exploring procedures for re-engaging students. Interventions will be consistent with the curriculum and with teacher’s instructional approach.

The interviews will be conducted at your school at a time that is convenient to you. The initial interview will last a maximum of one hour and the follow-up interview will last for a maximum of 30 minutes. The interviews will be audiotaped. The taped interview will be transcribed and then the tape will be destroyed. The classroom observations will take place over a period of approximately three to four weeks, up to a maximum of 15 hours. I will take extensive written notes and I will audiotape “teacher talk,” student discussions, and informal conversations between students and myself as they work. The audiotapes will be used to clarify written notes. All electronic files will be password protected. None of the data will contain your name, or the identity of your place of work. Paper and audio data will be secured in a locked cabinet in the researcher’s home and confidentiality is absolutely guaranteed. A pseudonym will replace your name on all data that you provide to protect your identity.

I do not foresee risks in your participation in this research. Your participation is entirely voluntary. You are not obliged to answer any questions you find objectionable or uncomfortable. You may withdraw at any time without penalty, without damaging your position in your school or school board, and without damaging your relationship with Queen’s University. All of your data will be destroyed.

If you have any questions about this project, please contact me (9jat@qlink.queensu.ca or 613-530-2403); or the researcher’s supervisor, Dr. Hugh Munby (munbyh@educ.queensu.ca or 613-533-6260). If you have any questions, concerns, or complaints about the ethics of this study, please contact the Dean of Education, Dr. Rosa Bruno-Jofré, (brunojor@educ.queensu.ca or 613-
533-6210); or the Chair of the General Research Ethics Board, Dr. Joan Stevenson, (joan.stevenson@queensu.ca or 613-533-6081).

Sincerely,

Jennifer Taylor
Doctoral Candidate
Faculty of Education
Queen’s University
Teacher Consent Form
Social Competence and Collaborative Science Activities: Experiences of Students with Learning Disabilities

Teacher Name: __________________________

I have read and retained a copy of the Letter of Information and all my questions about the research have been answered to my satisfaction.

I understand that I will be participating in the research study “Social Competence and Collaborative Science Activities: Experiences of Students with Learning Disabilities”. I understand that the purpose of the study is to observe and document the role of social competence in supporting and challenging the participation of students with learning disabilities in the collaborative learning processes required for guided inquiry science teaching. I understand that a tape recorder will be used to record two interviews and some of my classroom teaching.

I am aware that I may contact the researcher, Jennifer Taylor (9jat@qlink.queensu.ca or 613-530-2403); or the researcher’s supervisor, Dr. Hugh Munby (munbyh@educ.queensu.ca or 613-533-6260). If you have any questions, concerns, or complaints about the ethics of this study, please contact the Dean of Education, Dr. Rosa Bruno-Jofré, (brunojor@educ.queensu.ca or 613-533-6210); or the Chair of the General Research Ethics Board, Dr. Joan Stevenson, (joan.stevenson@queensu.ca or 613-533-6081).

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty, without damaging my position in my school or school board, and without damaging my relationship with Queen’s University.

I have been assured that confidentiality will be maintained through the use of pseudonyms and through the protection of raw data via locked cabinets (paper data, audio data) or by password protection (electronic data).

Teacher Name: __________________________

Date: __________________________

Signature: __________________________
Letter of Information for Parents
Social Competence and Collaborative Science Activities: Experiences of Students with Learning Disabilities

My name is Jennifer Taylor. I am a doctoral student in the Faculty of Education, Queen’s University. I am writing to request permission for your child to participate in research about the role of social competence in inquiry science learning where group work is involved. The ultimate goal of my research is to help students with learning disabilities participate fully in collaborative science learning activities. This research will be used in my doctoral dissertation. It may also result in publications of various types, including journal articles or other professional publications. This research has been cleared by the Queen’s University General Research Ethics Board, and also by your school board.

My research will involve observing science classes in your child’s classroom during collaborative learning activities that are part of your child’s regular classroom activities. My observations will focus on the activities of students in the class with learning disabilities (identified by the teacher) and their interactions with the teacher and other student partners. However, students with learning disabilities will not be singled out—I will be moving from group to group and my observations will involve the whole class. I will be documenting examples of social competence (e.g., positive relations, social skills, behaviour) and the students’ participation in inquiry learning processes (e.g., observing, explaining, exploring).

The classroom observations will take place over a period of approximately three to four weeks, up to a maximum of 15 hours. I will take extensive written notes and I will audiotape “teacher talk,” student discussions, and informal conversations between students and myself as they work. The audiotapes will be used to clarify written notes. All electronic files will be password protected. None of the data will contain your child’s name, or the name of your child’s school. Paper and audio data will be secured in a locked cabinet in the researcher’s home and confidentiality is guaranteed. A pseudonym will replace your child’s name on all data about your child to protect his or her identity.

I do not foresee risks in your child’s participation in this research. Your child’s participation is entirely voluntary. Your child is not obliged to answer any questions he or she finds objectionable or uncomfortable. You may withdraw your child at any time without penalty, and without affecting your child’s standing in school. If you withdraw your child, no data provided by your child to that time will be used in the study and no further data will be collected from your child.

If you have any questions about this project, please contact me (9jat@qlink.queensu.ca or 613-530-2403); or the researcher’s supervisor, Dr. Hugh Munby (munbyh@educ.queensu.ca or 613-533-6260). If you have any questions, concerns, or complaints about the ethics of this study, please contact the Dean of Education, Dr. Rosa Bruno-Jofré, (brunojor@educ.queensu.ca or 613-533-6210); or the Chair of the General Research Ethics Board, Dr. Joan Stevenson, (joan.stevenson@queensu.ca or 613-533-6081).

Sincerely,

Jennifer Taylor
Doctoral Candidate
Faculty of Education
Queen’s University
Parental Consent Form for Student Participation

Social Competence and Collaborative Science Activities: Experiences of Students with Learning Disabilities

Student Name: ____________________________________________________________

I have read and retained a copy of the Letter of Information and all my questions about the research have been answered to my satisfaction.

I understand that my child will be participating in the research study “Social Competence and Collaborative Science Activities: Experiences of Students with Learning Disabilities.” I understand that the purpose of the study is to observe and document the role of social competence in supporting and challenging the participation of students with learning disabilities in the collaborative learning processes required for guided inquiry science teaching. I understand that a tape recorder will be used to record classroom activities and student discussions.

I am aware that I may contact the researcher, Jennifer Taylor (9jat@qlink.queensu.ca or 613-530-2403); or the researcher’s supervisor, Dr. Hugh Munby (munbyh@educ.queensu.ca or 613-533-6260). If you have any questions, concerns, or complaints about the ethics of this study, please contact the Dean of Education, Dr. Rosa Bruno-Jofré, (brunojor@educ.queensu.ca or 613-533-6210); or the Chair of the General Research Ethics Board, Dr. Joan Stevenson, (joan.stevenson@queensu.ca or 613-533-6081).

I understand that my child’s participation is voluntary and that my child is free to withdraw at any time without penalty and without affecting his or her standing in school. No data about my child will be used in the study.

I have been assured that confidentiality will be maintained through the use of pseudonyms and through the protection of raw data via locked cabinets (paper data, audio data) or by password protection (electronic data).

My child has given voluntary assent to participate in the research.

Student Signature: ________________________________

Parent/Guardian Name: ____________________________

Date: ____________________________

Parent/Guardian Signature: ____________________________
Appendix D

Teacher Interview 1: Questions and Follow-up Probes

1. How often do you use collaborative inquiry science learning?
   Days/weeks/month/year.
   Specifically in the last month of teaching, how many days would you estimate
   that you used collaborative inquiry learning?

2. In what other subjects do you use collaborative learning?

3. Why do you use collaborative learning?
   Definition of collaborative learning; rationale for goals.

4. What got you started in collaborative inquiry learning?
   How did you learn about collaborative learning?
   Did you learn a particular model?
   Do you use a particular model?

5. If a model has been described: Have you altered the model? If so, how?
   Have you altered the approach you began with? How?

6. What is it that you like about collaborative learning?
   What keeps you using it?

7. How do you get the collaborative inquiry learning system started each year?
   Do you have to do any special preteaching on group skills?
   Can you tell me more about those first days each year?

8. How do you form groups?
   Specifics (e.g., heterogeneous/self-selected).

9. Have students altered the structure of collaborative inquiry in your class?
   Have students suggested changes in the cooperative learning structure?
   How did you handle the suggestions?

10. Does collaborative inquiry in your science class usually include group or individual
    products?
    Usual use of collaborative inquiry.

11. Are individuals responsible for one another’s learning or product?
    During collaborative inquiry, what are students responsible for?

12. Do collaborative inquiry activities contribute to students’ grades? How?
    Individual and group components of grades.

13. What kinds of activities do you assign for collaborative inquiry?
    More examples?

14. Give me examples of collaborative inquiry activities you’ve recently?
    What advice might you give another teacher who is interested in starting collaborative
    science inquiry?

15. What advice might you give another teacher who is interested in starting collaborative
    science inquiry?

16. When a group is going really well, what do you see happening?

17. In a typical collaborative inquiry activity, what would you estimate is the percent of
    groups in which every member participates fully (i.e., speaks, gives ideas, manipulates
    materials, etc.)?

18. Have you had any problems with collaborative inquiry?
    Are your goals being achieved?
    Solutions?
    Any others come to mind?

19. How do you perceive the students like it?
    Is there anyone who doesn’t like it?

20. Does collaborative inquiry work better for some students than for others?
    How does it work for students with LD?
21. Do you have any students with LD in your classroom? How many?
   Specific disability?
   How do these students tend to do in collaborative inquiry groups?
   Is the activity modified for these students?
22. Of the students with LD in your class, what percent would you estimate participate (i.e.,
   speak, discuss, manipulate materials, etc.) in a typical collaborative inquiry activity?
23. What are the major benefits of collaborative inquiry to students with LD?
24. Do you have any external assistance/other adults during your collaborative inquiry
   lessons?
      What do you have them do (their role)?
25. Is there anything else that you would to tell me?

Teacher Interview 2: Questions and Probes

Teaching Experience

1. How many years have you been teaching?
2. What Additional Qualifications Courses or Specialist Courses have you taken?
3. When you studied for your B.Ed. degree, what focus courses did you take (what did you
   choose take outside of the required courses?)
4. What conferences or Professional Development activities have you attended?
5. How long have you been teaching Grade 2?
6. What other grades have you taught?
7. You’ve told me that you taught half of your Grade 2 students in Grade 1 as well. How does
   that affect classroom dynamics?
8. How would you characterize the population of Storrington P.S.?
    a. Urban/rural
    b. Socio-economic status
    c. Small, medium, large school? How many students?
9. How many students do you have in your class? What is the boy to girl ratio?

Classroom Set-up and Routines

10. Tell me about the voice amplification system that you use.
    a. What is it called?
    b. How does it work?
11. Here is a computer drawing of your classroom set-up. Will you check it and mark any
    corrections to the layout?
12. What rules do you have about toys and pop-culture items in the classroom?
    a. For example, I heard you ask one student to put away his “Shrek” pencil because it is
       not allowed in the classroom and another student to keep her Tamagotchi in her
       backpack.
    b. Are these rules school policy or your own rules?
    c. If they are your own, what prompted you to make the rules?
13. You give your students a worksheet almost every science period. What role do these
    worksheets play in science learning?
    a. How do you design the worksheets?
    b. How do you use the worksheets to assess learning?
14. In our last interview you mentioned that you taught your students safety and other routines at the beginning of the year to prepare for science and other collaborative learning. What is an example of one of those routines?
   a. How did you teach the routine?
15. I’ve noticed that the students rarely remain in one area of the classroom for long—you move them between their desks, the carpet, individual workspaces around the room; sometimes the chart stand is at the front, sometimes at the side; when they are at the carpet sometimes they sit around the perimeter, sometimes they sit in a big group. How do you decide when and where to position the students? Is there a pattern?
16. What classroom management techniques do you use when students are working in small groups or pairs?
17. What classroom management techniques do you use when students are involved in whole class discussions?
18. What classroom management techniques do you use when students are working independently?

Focus Students

I have focused my observations on four students: Doug, Cindy, Beth, and Andy. I have focused my observations to a lesser degree on Elena. I’d like to ask you some questions specifically about these students now. I’ll use the same questions, but go through each student one by one.

19. I understand that students are not formally tested for LD in Grade 2. However, based on your own observations, you have recommended _______ for testing.
   a. What academic characteristics prompted you to recommend _______ for testing?
   b. What social characteristics prompted you to recommend _______ for testing?
20. Under what conditions does _______ experience the most success academically?
21. Under what conditions does _______ experience the most success socially?
22. What does _______ understand about his/her academic and social challenges?
23. Who are _______’s friends in the class?
   a. Is he/she popular? Accepted? Ignored? Rejected?
24. How well is _______ accepted by his/her peers?
   a. What happens when they work together?
25. Who does _______ work best with?
   a. What happens when they work together?
26. Who does _______ have trouble working with?
   a. What happens when they work together?
27. What extra help does _______ receive outside of the classroom?
   a. a. How often is _______ taken out of the classroom?
   b. Who gives the help?

Collaborative Learning:

28. How do you prepare for science lessons involving a small or large group experiment?
29. What was the most successful collaborative science activity during the Power from Wind and Water and the Simple Machines units?
   a. What criteria did you use to rate its success?
   b. What made it so successful?
30. What was the least successful collaborative science activity during the “Energy from Wind and Moving Water” and the “Movement: Simple Machines” units?
   a. What criteria did you use to rate its success?
   b. What made it unsuccessful?
31. During collaborative learning, students are learning science content, and they are learning about working together.
   a. What indicators do you use to assess content learning?
   b. What indicators do you use to assess social learning?
32. Sometimes you interrupt collaborative work to address the whole class. How do you choose when to stop the activity?
   a. For example, sometimes you stop to repeat or emphasize instructions.
   b. For example, sometimes you stop to talk about group dynamics.
33. Who are the best students in the class at making groups work?
   a. What does they do?
34. Who are the least helpful students in the class at making groups work?
   a. What do they do?
35. I noticed that all the girls in the class received invitations to Isabelle’s birthday party. Is it the norm for all the students in the class to be included in events that occur outside school?
Appendix E

Sample Worksheet

Name: __________________________  Date: ____________

The Gravity Cup

Gravity is an invisible force that pulls us towards the earth. Gravity is the force that causes objects to fall when they are dropped and it also causes objects to come back to earth when they are thrown upwards.

Purpose: To see the force of gravity move water.

Materials: a cup with three holes in the bottom
water
plastic tub

Hypothesis: What do you think will happen when we pour water into the cup?

Procedure: First hold the cup over the plastic tub
Then pour some water into the cup
Finally record what happens

Observations:

<table>
<thead>
<tr>
<th>Labeled diagram</th>
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Look at the pictures.

Does gravity affect how the water falls in each picture?

What direction does the water go with the tap?

What direction does the water go with the fountain?

What direction does the water go with the shower?

How do you think the shape and the number of holes in the tap, the fountain and the shower make them useful?

Please use at least 4 of these words in your answer.
(more, less, water, move, flow, help, useful)