

Collaborative Inquiry in Digital Information Environments: Cognitive, Personal and Interpersonal Dynamics

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Introduction

This paper presents selected findings from current research that examines the research and writing processes of high school students undertaking a group research task in a New Jersey High school library to produce a co-constructed product that represents the group's understanding of their chosen curriculum topic. In particular, it examined the group dynamics in terms of cognitive, personal and interpersonal attributes, and provides insights into how collaborative learning of a research task can be supported through instructional interventions.

In many subject curriculums around the world, students are required to produce some form of a research product through engaging with information sources, and to demonstrate capacity to critically examine a range of resources and construct their own deep knowledge of the topic. It is recognised that resource-based inquiry tasks may take different forms depending on the design of the task and specific objectives established by the classroom teacher and the collaborating school librarian. (Kuhlthau, Maniotes & Caspari, 2012; Loertscher, Koechlin, & Zwann, 2005). The focus of the research task was for students to search and use a range of print and digital information sources to construct a product or artefact that represented their knowledge of the topic. Research by Todd (2006) and Kuhlthau, Heinstrom & Todd (2008) shows that the construction of knowledge through research tasks is a complex interaction of task design, instructional interventions, resource use, affective dimensions, and assessment expectations. However, little research to date has investigated how students working in teams or groups learn together through an assigned research task and produce knowledge together, and particularly in a digital learning environment. Understanding the group process is seen as an important part of this research, and this involves understanding the interactions of the cognitive, personal and interpersonal dimensions of student learning as they work together in a research task to build knowledge.

Literature review

School libraries have played a central role in developing the research capacity of students for many decades now, both through both the provision of diverse curriculum sources to support student research tasks, and through information literacy instruction to enable students to connect with, interact with, and utilise information to build their topical knowledge. A recent study undertaken by Todd, Gordon & Lu (2010, 2011) based on data from 765 participants, predominantly certified school librarians in public schools across New Jersey, showed that the development of students' research capacity is core work for school librarians. This study identified six key learning outcomes of this core instructional role. These were: contribution to development of curriculum standards and contribution to test score achievement, mastery of a diverse range of information literacy competencies, development of research process and learning management competencies, development of thinking-based competencies in using information, development of positive and ethical values in relation to the use of information, and increased interest in reading increased participation in reading, the development of wider reading interests and becoming more discriminating readers.

Such outcomes are important, particularly in the context of emerging educational concerns about academic integrity, particularly in digital environments. According to McCabe (2005) of the Center for Academic Integrity, plagiarism is a substantial and pervasive problem, especially in high schools and colleges. McCabe cites 2005 research of 50,000 undergraduates at more than 60 colleges in America that showed that 'on most campuses, 70% of students admit to some cheating'. In addition, it reported that close to 25% of the participating students admitted to serious test cheating in the past year and half admitted to one or more instances of serious cheating on written assignments' (McCabe, 2005). Williamson & McGregor (2011) sought to identify teaching strategies that helped students learn to avoid plagiarism. Their review identified a range of teaching strategies as part of the research task process that centered on: 'raising awareness of the problem of plagiarism and increasing students' ability to

recognise it; teaching students to synthesise information, including through note taking and paraphrasing; and teaching attribution of sources of information (citation and referencing methods) in all contexts (for quotations, paraphrases, and acknowledgement of ideas) Williamson & McGregor (2011, p. 2).

Against this backdrop, there is increasing attention being given to team-based inquiry and team-based research tasks.

The broader context for this emergence is the learning affordances provided by developments in the networked digital environment for collaborative participation in diverse ways, as well as in career directions, particularly the

emergence of team working and team working mechanisms as increasing features of organisational life internationally. In the USA, the Common Core State Standards, now adopted by 45 states, identify collaboration and teamwork as a 21st century skill to be taught for university and career readiness, and one where research tasks provide one of a number of explicit learning environment to enable this (<http://www.corestandards.org>). In Australia, the Australian Curriculum's official opening statement identifies the notion of participatory communities directed to active participation in the Australian community. Its general capabilities identify aspects such as 'working harmoniously with others'; 'work collaboratively in all learning areas at school, and in their lives beyond school'; 'working independently and in collaboration with others'; 'collaborate and communicate with others electronically'; and 'collaboratively construct knowledge and digital solutions' (<http://www.australiancurriculum.edu.au>).

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The emphasis on collaborative learning is also connected to using information technology to collaboratively and purposefully construct knowledge. As mentioned in the introduction, there is a gap in the formal research on how students working in teams or groups learn together through an assigned inquiry task and produce knowledge together, and particularly in a digital learning environment. The challenge is to understand group-based inquiry and identify the value of shared learning in terms of the integration of diverse expertise to create a richer whole, especially through the application of collaborative tools afforded through social media. Central to this discourse are discussions surrounding 'collaborative learning' and 'cooperative learning'.

The terms 'collaborative learning' and 'cooperative learning' are often used interchangeably, and often mixed with similar terms such as 'problem-based learning', 'group learning', 'peer-assisted learning', 'team learning', and 'learning circles'. Cooperative and collaborative learning have been conceptualised in the literature in terms of the amount of interdependence each approach provides. Where collaborative learning has been characterised as involving a higher level of interdependence between group members, cooperative learning has been shown to involve a more 'divide and conquer' type of approach (Graham & Misanchuk, 2004, p.184). Dillenbourg (1999) makes a further distinction between cooperative and collaborative learning. In collaborative learning, the group works together from start to finish. In cooperative learning, the learning task is divided into a set of subtasks that are undertaken individually, sometimes based on negotiation of who will complete individual parts, and then the final product is assembled by bringing together the subparts.

For the purposes of this paper, Rockwood's conceptual distinction of these approaches is applied (Rockwood, 1995a, 1995b). Rockwood defines the differences between cooperative and collaborative learning in terms of knowledge and power. Cooperative learning is concerned with the outcome of learning as being either foundational or traditional knowledge. This approach is considered more directed, structured and controlled by the teacher with the group task focused on identifying specific answers and factual knowledge. Contrastingly, collaborative learning is conceptualised in terms of the social constructionist's perspective of knowledge as primarily a social construct. Groups are given more open-ended, complex tasks where knowledge is negotiated and constructed through collaboration by group members via engagement with the expertise, skills and insights of the group participants.

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Research on collaborative learning is particularly important because of the numerous learning outcomes these approaches can offer. From a socialising standpoint, collaborative learning can improve teamwork and increase

altruistic behaviours. Prichard, Bizo & Stratford (2006) examined the collaborative abilities of three cohorts of students (N=295) over the course of two semesters to see how previous team-building knowledge impacted performance in collaborative groups. The study found that students with previous teamwork training were more successful and that an important outcome of collaborative learning is that it supports student abilities for doing group work. In a different study, Solomon et al. (1988) created a five-year program to assess the pro-social development of a single cohort of students moving from kindergarten through 5th grade. One of the findings from this study was that a significant outcome of collaboration and group work was an increase in students' pro-social behaviours.

Collaborative/cooperative learning research has also identified some important outcomes related to student views on respect and diversity, particularly with regards to the social justice concept of equity. For example, Cohen (1994) and Cohen & Lotan (1997) analyse several pieces of research that explore how equity and access can be afforded through cooperative learning. The analysis of the previous research showed that through adjustments to the organisation of the classroom, student-teacher roles and the nature of the curriculum, cooperative learning environments can help minimise social status differences between students. Similarly, Johnson & Johnson (1981) compared the effects of cooperative experiences on the interethnic attitudes of 4th grade boys/girls over the course of a 15 day instructional period. Cooperative learning experiences were found to cause more cross-ethnic interaction than more individualistic approaches. Thus, another outcome of collaboration and group work is the fostering of respectful interactions between students of different backgrounds. It is clear, then, that research in this area can have a significant impact on different qualities of student learning.

Though there is a considerable body of empirical research on collaborative group learning in the Education, LIS and other literatures, findings have been mixed (Johnson & Johnson, 1991; Mulryan, 1992; Todd & Kuhlthau, 2004). The early research of Daiute & Dalton (1993) and Johnson & Johnson (1991) found that students learn more when cognitive work is distributed amongst a group of individuals than they do alone. Further research showed that students learn more in well-developed collaborative environments than they do individually (Barron, 2003; Slavin, 1996). However, these findings have received mixed support when explored empirically. For example, Johnson, Johnson & Stanne (1989) concluded that even though there was considerable evidence that group collaborations encourage higher individual achievement and greater group productivity than individual situations, some group conditions may work against this, such as where team members are not working towards the same goal, or where teams members are not all determined to work for higher achievements. Tudge (1992) found that the benefits were greater to those whose partner was more competent, but also acknowledged that effective collaboration was fostered when pairs understood and worked according to the nature of the rules and the shared understandings that they developed during the process. Nystrand, Gamoran, & Heck (1993) further found that providing group time for ongoing dialog and negotiation was an important dynamic in building collaboration and a shared understanding of the group task. This was also important in terms of group dynamics when disagreements occurred. In a comparative quasi-experimental study of students working alone and in groups, Teasley (1995) and Stahl (2006) found that group dialog produced richer and more interpretive insights and supported interpretive cognitive processes than working alone.

Chin & Chia (2004), for example, identified a number of problems in group dynamics, including disagreements over the next steps, delegation of work responsibilities, tasks and strategies for working together as well as what information to include in the group presentation, and time to be made available to resolve these. This is supported by Lazonder's work (2005) in the context of students undertaking web searches. Lazonder found that peer-to-peer collaboration encourages students to articulate their thoughts, which in turn facilitates the regulation of the search process as well as search outcomes. He found that pairs of students working together located the target information more often and in less time than students working individually. Pairs also employed a richer repertoire of search strategies and were more proficient in monitoring and evaluating their search behaviour (Lazonder, 2006). In contrast, Meyers' work (2010) on the effect of student group work on information seeking and problem solving found that on average, individuals achieved better search results than groups.

Building on previous work, Manlove, Lazonder & Ton (2009) found that collaboration appeared to enhance students' abilities to give more detailed accounts of products and learning processes. They identified the need to structure collaborative learning to include aspects such as positive interdependence, individual accountability, encouraging interaction, appropriate use of social skills, and group processing 'forced monitoring points within inquiry learning may be a solution to increase regulatory support use and thus regulatory activity of students during technology enhanced inquiry learning' (Manlove, Lazonder & Ton, 2009, p. 114). The need for structure to support collaborative learning was also identified by Kuiper, Volman & Terwel (2009), who found that explicit focus on the dynamics of collaborative inquiry by classroom teachers had a positive impact on the collaborative work undertaken by the group.

Some research is beginning to emerge in the context of the digital environment as the learning environment. Early work by Lakkala (2005) highlights the difficulty of moving from individualistic ways of working in a digital space, to achieving real collaborative knowledge building. Lakkala, Ilomäki & Palonen, (2007) and Johnson, Johnson & Roseth (2010) found that the web-based learning environment was used more as a coordination tool for organising the collaborative work than as a space for negotiating, debating and creating knowledge. The digital environment was seen to support groups of students in learning to work together, developing personal relationships, social skills and positive interactions with one another, developing team work skills, managing the task and individual accountability. In addition, it enabled active exchange of ideas within small groups that increased interest among the students and promoted critical thinking. They were able to capitalise on one another's resources and skills (asking one another for

information, evaluating one another's ideas, monitoring one another's work). Collectively, the research to date also highlights the difficulty and complexity of promoting real collaborative knowledge building (Scardamalia & Bereiter, 2006).

Recent research from Finland sheds some light on this complexity. Sormunen et al (2013) examined the group work strategies of 17 groups of students in an upper secondary school in Finland studying Finnish literature and history who were engaged in authoring Wikipedia articles or Wikipedia-style articles to represent their knowledge of their chosen research topic. Student interviews were conducted and analysed to identify the key activities that the students undertook, the ways the group work was conducted in these activities and how the students justified their choice of group work strategies. The study identified four group work strategies, which the students applied in the activities of their article projects.

The strategies, in the order of increasing collaboration, were: 1) delegation, 2) division, 3) pair collaboration, and 4) group collaboration. Overall, they found that division was the dominant strategy in searching, reading and writing. Division was where the activity was divided between group members into individually completed subtasks, and then brought together in the final work. The study also found that group collaboration, where students worked together to complete an activity, was commonly applied.

Research goals

Against this backdrop, the present research seeks to understand the process and outcomes of an inquiry-based project involving teams of students collaborating together for the joint creation and production of knowledge of a curriculum topic. In particular it will:

1. track the process of team work: to understand how student teams work together to build a shared representation of knowledge;
2. examine the dynamics of the co-construction of knowledge by teams of students;
3. track students' engagement with information sources and how the teams transform and co-construct text into their joint representation of knowledge;
4. track both individual learning and group learning, and to understand the relationship between individual knowledge developed in the process and the team representation of the joint product created in the process;

As this research is currently under way, his paper reports on preliminary findings emerging in relation to the cognitive, personal and interpersonal dynamics of student team processes as they undertake their group-based research task (Goal 1).

Sample and methodology

The research involved two English Accelerated classes of Grade 9 students in a New Jersey public co-educational high school engaged in a collaborative inquiry-based task in a wiki environment in the Fall of 2013. 42 students were involved and these were organised into 13 groups. The school was selected because of the high level of classroom teacher - school librarian instructional collaboration; the quality information collection available in and through the school library; the expertise of the instructional team having experience with students learning and working in a collaborative digital environments (Wikis and Google documents); and the instructional team's expertise with working within an inquiry-based instructional framework. The selection process was based on data collected as part of the New Jersey school library study (Todd, Gordon & Lu, 2010, 2011).

Grade 9 English focuses on the five elements of the language arts: reading, writing, speaking, listening, and critical viewing. The accelerated course offers a wide range of challenging literature in the genres of short story, novel, drama, nonfiction, and poetry. The course includes independent reading assignments, and stresses critical thinking and speaking skills, study skills, and research strategies. Instruction and practice in writing concentrate on a variety of writing modes. In the research task, students were assigned a novel, and given the following objective and prompt: Objective: Students will discover and develop ideas through research, prove a thesis and report on findings. Prompt: You must prove that your assigned novel is of respectable literary merit. To do so, you must also identify reasons for this merit and present to your classmates.

The assignment to the groups was random, rather than being based on student selected groups, topic selected groups or other means of assigning groups. This was undertaken by the English teacher. Students undertook their collaborative inquiry research task in a class wiki environment that was structured to meet the specific curriculum

objectives, and which enabled the students to discuss their research topics, establish working relationships, plan and manage the tasks, collect information sources, and work together through the process of co-constructing their products, which included a class presentation, visual display, and annotated bibliography. The wiki environment was developed by the school librarian for the teaching enabled the researchers to capture and track their research and writing processes, their use of information sources, their interpersonal dynamics and decision-making processes, and how they went about collaboratively creating their products. In addition, the wiki space captured interactions and feedback from the instructional team. The digital space also enabled researchers to gather data to understand how the information environment and instructional interventions helped or hindered the knowledge construction process.

As part of the learning requirements, students were to make daily journal entries during the two weeks that the classes were scheduled in the library for a range of instructional interventions led by the school librarian. Students were informed that 'Topics may include, but are not limited to, the research process and/or the material you find'. To this end, students were required as homework to input a journal response after the conclusion of each class into a networked Google document (1 for each day of the classes in the library) for a total of approximately 336 journal entries. Students were then required to read each other's journal responses and comment on at least one other student's journal response in the same networked Google document for each week of the process (referred to as the commentary stream).

Students also completed a pre and post reflection task to provide further insights into the cognitive, affective and interpersonal aspects of the research and writing process. These were integrated into the sequence of instruction and research journey. This was based on the The SLIM 'Reflection Tasks' (Student Learning Through Inquiry Measure developed by CISSL) to track both individual learning and group learning, with emphasis on the knowledge construction process, and the cognitive, affective and behavioral dimensions. The pre-survey was administered on the first day of the library classes and asked students to first identify, via open ended answers what their research topic was, what interested them about that topic, what they already knew about the topic and what terms they might use to search for information on the topic. Students were then asked to indicate on a 5 point scale how much they felt they knew about the given topic (1 = nothing at all; 5 = a great deal). The remaining questions on the pre-survey asked students to write open-ended responses indicating what they like and dislike about research, what they find easy and hard about research and finally how they feel about working in groups. The post-survey asked students to provide open-ended responses about what they now know about research, what they found easy or difficult about their research, how they feel about working in a digital environment and how they feel about group work by the end of the project. Additionally, two Likert Style (5 point scale) questions were asked pertaining to students' perceptions of the helpfulness of the reflection journal entries (1 = no help; 5 = most helpful) as well as how much they felt they learned about their topics (1 = nothing; 5 = a great deal). The journal responses, commentary stream and the more formal pre and post measures makeup the dataset used in this study. Overall, The combination of data from the reflection tasks and the documentary record of interactions and developments recorded on the wiki site have enabled the researchers to compare changes in knowledge, resource use, the knowledge construction process, and personal and interpersonal dynamics in the production of a collaborate product. The findings presented here focus on the process of group work: to understand how student groups work together to build a shared representation of knowledge, and to identify some of the cognitive, personal and interpersonal dynamics at play during the research process.

Key findings

Each of the eight student groups was responsible for providing an analysis of the literary merit of a book of their choosing. When asked to describe in their own words what they were researching, students overwhelmingly indicated to be researching the 'merit and authenticity' of their given novels. Although the assignment was the same for all students, some students translated the prompt into their own conceptions, such as whether their novel offered 'an effective portrayal of society and human nature,' or 'different types of plot and conflict.' This may be an indicator of the uncertainty that students feel when entering the information search process, or it may show students having strong conceptions of the direction they wanted the research to go, creating potentially some challenging dynamics for the group negotiation process.

The second question of the pre-survey asked students what they would like to research about their topic. Students seem to be either goal-directed with their responses, indicating that they wanted to research just what the assignment indicates ('the literary merit of my novel'), or they were more exploratory in their responses, citing personal interests ('I like x') and preferences ('I would prefer x') or previous knowledge ('I want to know more about x').

The pre-survey also measured students' self-reported levels of knowledge of their topic, as shown in Table 1.

Table 1: Pre-Survey: How much do you know about your topic?

Response	Percentage
Nothing	7%
Not Much	78%
Some	0%
Quite a Bit	15%
A Great Deal	0%

As shown in Table 1, 85% of students knew little to nothing about their topics while 15% claimed to know quite a bit. Few students claimed to know nothing about their topic (7%) or a great deal (0%) but the majority (78%) felt that they did know something. As one of the goals of this study is to understand if students learned about their topic through the collaborative work, the fact that students mostly knew very little at the start of the study removes some of the ambiguity that previous experience of the students might have brought to the table. The same question in the post-survey showed that 92% of students felt that they knew quite a bit to a great deal about their topics and 8% of students felt they knew something. No students claimed to be on the lower end of the scale. Based on this measure, it would appear that students perceived themselves to be much better informed of their topics after going through the research exercise.

Table 2 shows students' self-reported levels of knowledge of their topic at the end of the research task:

Table 2: Post-Survey: How much do you know about your topic?

Response	Percentage
Nothing	0%
Not Much	0%
Some	8%
Quite a Bit	42%
A Great Deal	50%

The finding that 92% of the students claimed that they knew 'quite a bit' or 'a great deal' comes into play when the students' perceptions of working in groups is analysed. In this data analysis process, the researchers have used an emic, rather than etic approach. An emic approach is one where the categories emerge directly from how the students imagined and explained things: their observations, categories and interpretations. This is in contrast to an etic approach, where researchers have imposed a predetermined set of categories that they deem important to undertake the analysis.

The analysis of the students' perceptions in relation to engaging in group work at the commencement of the research task identifies four key dimensions that surround their participation and engagement. These are: (1) social justice, (2) knowledge, (3) interpersonal, and (4) project management. The majority of responses revolved around the social justice and knowledge dimensions.

Social justice

Social justice, broadly defined, centres on the belief that all people deserve equal social, political and economic rights, treatment and opportunities (Zajda et al., 2006, p.6; Rawls, 1971, p.3). From the perspective of the students, this was seen in terms of equity of contribution, with intellectual input and workload to complete the group task shared equally and fairly across the group. Students valued the affordances of group work in terms of 'the work is split up evenly' and 'work spread out among the group', and when the workload was shared amongst the group members, they believed that 'no one would be overloaded'. However, while the group saw these positive aspects of group work, their perceptions at the outset of the research task were quite negative. They were concerned about equal effort and all team members contributing their fair share of work (as opposed to social loafing), as well as team members all receiving the same assessment credit when effort was not evenly distributed. As students said:

'usually the entire group does not work together', 'members tend to slack off', and this 'leads to certain people in the group doing more work than others'. Some students saw that it was easier to work alone: 'it is easier to work by yourself so that you don't have to make sure the people that you are working with are doing their jobs', thus avoiding problems caused by 'individuals in the group that are either too lazy or take complete control of the project' and thus adding 'more variables that can lessen the grade' or create issues around work credit: to grade several students on one project is unfair'

Knowledge creation

The knowledge dimension of group work refers to the opportunities that group work provides in terms of the knowledge generation and production process, particularly in relation to quantity and diversity of viewpoints and perspectives, testing their own ideas in the group, extending their own understanding of the topic and learning together. Students largely viewed this positively. They welcomed the opportunity to 'acquire new ideas I would not have thought of previously', acquire 'so many more ideas' and 'gather the input of many people, not just me', as one student expressed: two minds are better than one, but four minds are better than two'. In particular, they saw value in the group in terms of opening up the diversity of viewpoints: 'there is more than one person's opinion on each part of the project' and 'I can say my ideas and see what they think of them'; 'their ideas could show me a different way of thinking and inspire ideas of my own'.

... 'we can learn and improve from each other's input'; and 'we become smarter together'.

Students were able to articulate some benefits in this shared knowledge building process. This was in relation to both the research task: 'it adds to my insight to improve it' and 'allows for many different influences and ideas on the topic that is being researched' and 'you get help and opinions to make

your project better'. Students recognised that the knowledge building process involved multiple perspectives and viewpoints, and that engaging with this diversity through 'bouncing my ideas off other people' added strength to the group process and overall outcome: 'we can learn and improve from each other's input'; and 'we become smarter together'. At the same time, a small number of students saw the collaborative knowledge sharing and knowledge building process as a challenge, particularly in term of reaching a consensus: 'making it hard to reach a compromise and it slows down the progress' and that it was 'tedious due to the possibility of differing ideas and conflicts'.

Interpersonal interaction

The interpersonal dimension of group tasks refers to the role of and nature of the interactions between group members to accomplish the tasks. At the outset of the research task, students predominately viewed this as a positive dimension. They appeared to recognise that the process of working together fostered both learning about one another as well as learning from one another. For example: 'a chance for members to understand one another as the closeness allows the sharing of strengths and weaknesses that are not very apparent before' and enabling the project to 'exude different personalities that make it better'. Students also saw that the group task would enable the integration of multiple skills that would strengthen the project: 'everyone has different skills that can contribute to the group' and 'it could be helpful if I am weak in a certain part that someone in my group is strong in'. They saw the outcome of this interpersonal process as 'allows us to create a stronger project through discussion and collaboration. Some students also identified limitations: 'I like working in groups when the people I am with are intelligent and hard workers'. Two students particularly noted that the positive outcomes were relational 'all depends on who is in the group' and that 'communicating ideas is difficult'.

Project management

The project management dimension intersects with the social justice dimension described above. Students positively viewed group participation in the research task in terms of project management functions including distribution of workload, mapping out and monitoring the project progress. In relation to project scoping and monitoring, students saw value in group auditing with 'more than one person checking the work; and 'helpful to have several people giving input on what should be done. This enabled them to get 'different perspectives on how you should approach the project'; 'make the work go faster and keep things organised', as well as providing opportunities so that 'group members can check your work', 'constantly looking over each other's work'. Students also value in terms of shared workload: 'we can split tasks', 'work can be divided'. The outcome of this process was expressed in terms of affective aspects of stress and coping: 'other people helping out, taking off the pressure', with the result that 'the stress of working alone is relieved'. As with the dimensions listed above, students at the outset of the research task were largely positive in relation to project management. However, several concerns were identified, centring on dealing with group issues arising during the task: 'people procrastinate' and 'too many

variables to hold accountable if something is off, or not functioning'. One student expressed the outcome of this in terms of 'making it hard to reach a compromise and slow down progress', and preferred to work alone: 'working solo gives you the control where you understand that everything is your fault and responsibility'.

Table 3 summarises the core dimensions of pre-task perceptions of the group process, and their positive and negative attributes.

Table 3: Pre-task perceptions of the group process

Dimension	Description	Positive	Negative
Social Justice	Refers to core ideas around: shared responsibility, equity of contribution, equity of treatment, division of labor and workload	Work is spread out; The work is split up evenly and workload shared; No one overloaded	Waste time in ensuring others are doing their fair share; Uneven distribution of workload; Uneven commitment and effort; Lack of group togetherness; Problem of equal assessment for unequal contribution; People procrastinate
Knowledge creation	Refers to the opportunities that group work provides in terms of the knowledge generation and production process, particularly in relation to quantity and diversity of viewpoints and perspectives, testing their own ideas in the group, extending their own understanding of the topic and learning together.	Acquisition of new ideas not thought of previously; Recognition of and engagement with multiple opinions, perspectives and viewpoints; Builds a wider range of ideas and thoughts; Learning and improving from each other's input; Opportunities to think differently about the topic that is being examined	Difficulty of consensus building; Complexity of compromise; Slowing down completion progress
Interpersonal interactions	Refers to the role of and nature of the interactions between group members to accomplish the tasks	Developing group interaction skills; Learning about and from group members; Integration of multiple skills that strengthen the project and create a stronger project;	Difficulty of communicating ideas Group characteristics
Project management	Refers to management functions including distribution of workload, mapping out and monitoring the project progress.	Project auditing and checking Planning perspectives Project timing and organisation Managing workload Project monitoring for quality	Complexity of managing process problems: control, responsibility Implementing effective compromise

Following the completion of the research task, the 42 students reflected on their learning, both individually and as a group. Included in the reflection task was their commentary on the group process. Specifically, students were asked to reflect on how they felt about their participation in the group-learning task. Utilising an emic approach again to data analysis, three key themes emerged. These are: (1) knowledge creation and learning outcomes, (2) Division of workload and learning equity, and (3) Collegiality and cooperation.

Knowledge creation and learning outcomes

The most predominant post-task reflection theme centred on the process of creating the group representation and perception of its outcome. Students particularly valued the group process as providing opportunities for sharing of different perspectives and viewpoints, engaging with these in thoughtful and critical ways, and working with these to build a deeper representation of their knowledge, and at the same time, expanding their own repertoire of knowledge about the topic. They saw the outcome in terms of a better quality product: 'I like working in a group. When working with others, I get so many other views and ideas that I had not previously thought of. This really adds depth to the final product'; 'I really like working in groups. It gives different perspectives on the same big topic', and 'With multiple people, there are more ideas flowing and often a better train of thought'. One student reflected: working in groups allows for different ideas to come in to play creating a sharper focus for the task'. For example, 'we would have all chosen different, poorer theses than the one we chose to use if we had not been together and conversed'. The sharing of ideas also contributed to resolving confusions: 'I like working in a group because you can bounce your ideas off of the other members, and if you are confused they can always help clarify'. However, one student acknowledged that strongly held diverse views created some issues with the team meetings: 'Having two group-members with such opposing views when it came to religious topics, while working on a novel so packed with allusions to the Bible, created an unstable mix of distrust and really, chaos during the real life meetings we had'.

... 'I really like working in groups. It gives different perspectives on the same big topic',

...

Division of workload and learning equity

This theme refers to workload balances and resultant learning outcomes. The equitable division of workload, identified in the pre-survey as part of the social justice dimension was the second most recurring theme in the final reflections. One aspect of the cognitive – knowledge dimension was the perception that undertaking group-based research tasks was less individual work: 'I liked working in a group because I could bounce ideas off of my group members and did not have to do all of the work myself' and 'The best part about working in a group, which is why I prefer it over individual projects, is that the workload can be divided among the group members. For individual projects, one must do all the work by himself, but for group projects, each member needed only to do 1/3 of the actual work, making it a lot less stressful for us' and 'there is less pressure on one person because the work can be divided'. One student presented a counter voice: 'However, I felt actually finishing the project was harder in a group than it would have been if the project was individual, since I had to constantly remind my group members to work it.'

... 'I liked working in a group because I could bounce ideas off of my group members ...'

Students made reference to the division of workload both positively and negatively: 'I prefer it because it splits the work into sections that everyone wants to do and what they are best at', and 'I enjoyed having other people that I could rely on

to gather information with me, and being able to designate separate jobs needed to complete the research process to different people. This allowed us to work more efficiently and effectively. More frequently stated were concerns about the uneven contribution of work by team members, and the flow-on of that to assessment: 'I still dislike it. For our project, there was not totally participation by each person', and 'I feel that working in a group project allows for a quicker completion of the project because if everyone works together, then the productivity can be great. However, there is always the chance of having group members that are not dependable which just increases the work for the people who are actually being productive. This took effort.' Concern was also expressed in terms of fairness of assessment: 'I dislike the group project because we all get the same grade despite the amount of work that is put in by each group member and the presentation of each group member'.

Collegiality and cooperation

This theme refers to the role of group tasks in relationship formation and the benefits afforded through this. As stated earlier, students were randomly assigned to groups, and this did not emerge at all as a strong issue, apart from one pre-task reference by one student in relation to not being able to choose working partners. Having completed the group task, students identified the mutuality of working to a common goal and the stronger relationships among them that it fostered: 'I love working in group projects because you have friends who help you get to your goal'. Mutuality developed stronger collegial relationships amongst a number of the students, and taught important interpersonal skills: 'The group project was a good experience. It helped me know some students more intimately; more importantly, it taught me how to compromise and work with others'. The collegiality provided a context for supporting the learning process: 'I like it because it gives you people to talk to. You can complain to

them, help each other, and lean on each other throughout the process' and 'I really really really liked working in a group project. I needed their help a lot and could not have done it on my own'.

At the same time, there were some negative sentiments: 'The group does not work well together, it caused some friction. This made the process long and forced as opposed to an easy and fun way to learn' and 'I just think it would have been better if maybe we had gotten to choose more so that we were comfortable with whom we were working with'. One student provided this insightful conclusion: 'Sometimes it becomes difficult to work with others because of their personality/work ethic.' Another student elaborated on this idea: 'I normally like working with groups but this time I had a very difficult time. I frequently reached out to my group members but communication was an issue and I ended up doing the majority of the work, which was very stressful'.

Overall, the students viewed the group task as a positive experience, both in terms of learning, and in terms of the affective dimensions of learning. As indicated in Table 2, and compared to table 1, students perceived that they had learned a considerable amount about their chosen topic, notwithstanding their views of the group experience. Embedded in 31 of the responses across the groups was the affective outcome of learning as an enjoyable experience, for example: 'I felt that working in a group project was very fun. I enjoyed it a lot'; 'I've always liked working independently, but this project was very interesting and fun in some ways.

Table 4 summarises the core dimensions of post-task perceptions of the group process, and their positive and negative attributes.

Table 4: Post-task perceptions of the group process

Dimension	Description	Positive	Negative
Knowledge creation and outcomes	refers to the opportunities that group work provides in terms of the knowledge generation and production process	sharing of different perspectives and viewpoints; depth of knowledge outcome Quality product; Resolution of confusion	Reluctance to compromise on strongly held views
Division of workload and Learning equity	refers to workload balances and resultant learning outcomes	Equitable division of workload and tasks; Reduction of stress; Strength of individual expertise; Efficiency and effectiveness	Time involved in getting team to produce; Realisation of shared responsibility; Inequity of group assessment not matched to individual input
Collegiality and cooperation	refers to the role of group tasks in relationship formation and the benefits afforded through this	Mutuality of working to common goal; Development of collegial relationships; Development of interpersonal skills; Learning support	Group tension; Interaction of personal attributes; Stress

Discussion

Students' perceptions of group work are shaped by cognitive, social and personal dimensions, in particular social justice, knowledge, and relationship dimensions. The pre- and post-survey reflections on group processes show some consistent patterns around these concepts. The social justice dimension, strongly stated in the pre-surveys, was reasserted in the post-survey reflections, particularly with reference to the division of workload and learning equity in relation to assessment. Students appeared to bring a sense of the importance of shared responsibility, shared effort and shared knowledge as key dynamics to learning in groups. The majority of the students reflected positively on their experience with the group research task. At the outset of the task, they were concerned about the potential for uneven distribution of work, and potential for uneven assessment, concerns that seem to be based on a view of group work as a process of dividing the work task evenly to distribute and even lessen the workload. The pre-survey reflections suggest that students bring with them a sense that social justice principles will be enacted in the learning environment, whether that is a classroom or a school library.

At the same time, students, both in their pre-research and post-research reflections saw the value of groups in terms of the opportunity to build richer knowledge about their chosen topic through the sharing of different perspectives, viewpoints and opinions as a basis for negotiating the knowledge to be constructed by the group. Overall this was a strongly stated positive dimension of group work, and one that appeared to be welcomed by the students at the start of their research and realised through the process, according to their post-research reflections. The conceptual framework for Guided Inquiry, as elaborated by Kuhlthau, Caspari & Maniotes (2007, 2012) centres on students constructing their understanding of a topic by building background knowledge, and establishing the focus and direction of their inquiry. At this background building stage, students explore their topic, find new information and consider different perspectives, and develop sufficient knowledge to move forward in the research process. Students acknowledged that this process enabled them to acquire new ideas not thought of previously, and afforded opportunities for them to think differently about their chosen topic, and to move forward with a wider range of ideas and thoughts. At the same time, they saw this as an opportunity to test their own ideas within the group, and to engage in a collaborative dialog of negotiation. Some students acknowledged that this was difficult particularly in finding a pathway through the diverse perspectives and reaching a compromise. It was difficulty of compromise that was reflected in both the pre- and post-reflections.

These findings also come back to core ideas in the literature surrounding cooperative and collaborative learning. As mentioned in the literature review, collaborative learning is characterised by interdependence, collaboration and co-construction in the learning process, and cooperative learning

... collaborative learning is characterised by interdependence, collaboration and co-construction in the learning process ...

is characterised by a divide-conquer approach, where the learning task is divided into a set of subtasks which are undertaken individually, sometimes based on negotiation, and then assembled by bringing together the subparts. (Graham & Misanchuk, 2004; Rockwood, 1995a; Rockwood, 1995b). In this research task, the groups were given a more open-ended task where the focus of knowledge and its central thesis is negotiated and constructed through collaboration by group members though engaging with the expertise, skills and insights of the group participants. There was evidence to suggest that the interaction of social justice aspects and knowledge building process engaged the students in aspects of both cooperative and collaborative learning. While they engaged in the knowledge building process of sharing multiple perspectives and opinions and negotiating their thesis focus, and once this was negotiated and established, the remainder of the knowledge building process was one of splitting the task into individual tasks that were to be subsequently woven together. In the collaborative process, students, in a sense, formed their own norm of equity through collective reasoning and negotiation, even though they essentially found the process of negotiating their responsibilities, input and roles to be a challenging effort but important to reducing stress, increasing efficiency and realising their collective goal. This finding supports Brufee's (1995) idea that collaborative learning leads to increased reasoning and questioning in students.

It was the cooperative process that seemed to generate the concerns with the equitable distribution of labor, time and contributions within their groups, which link back to the project management concerns identified in the pre-survey. They were concerned about each person doing their share of work so that at the outcome could be achieved, and viewed their learning somewhat negatively when this was not done. This raises implications for the design of group research tasks, as well as for determining appropriate interventions and training of students if a full collaborative approach to learning is to be realised, and one where the students engage in the co-construction of knowledge for the duration of the process. Implied in the findings is the expectation that the product would be generated by a divide-and conquer approach.

According to Brufee (1995), cooperative learning has historically been discussed in terms of its application to students in K-12 rather than at the college and university level due to the ability of this approach to foster the acculturation process, and that collaborative learning is more suitable to adolescents and adults than students in lower grades. The grade 9 students in this study show the transition between cooperative and collaborative learning. The introduction of technology into classrooms has the potential to providing enhanced collaborative learning opportunities that can help facilitate class discussion, increase interactions between students and teachers, foster co-construction and production of knowledge, and provide social rather than solitary learning opportunities (Looi et al., 2009; Goldberg et al., 2013; Subramaniam et al., 2012). In this study, the students' reflections on their group dynamics did not mention information technology, even though they were immersed in this, using technology to provide to search, communicate and provide input and feedback to one another as they negotiated their projects, and interacting with teacher and school librarian.

The research presented here showed that students often rely on cooperative, 'divide and conquer' types of interactions in their groups than forming truly positive dependent relationships to one another, especially at the stage of co-constructing their group knowledge. This was made evident in the groups' comments about equitable divisions of workload and stress in which the students perceived their groups as more cooperative rather than

collaborative (dividing work solely based on the structure of the assignment). This supports some of the findings presented by Sormunen et al. (2013) in which students were found to dominantly use a strategy of division, dividing tasks amongst each other, rather than collaboration. Both the pre and post surveys also showed that when asked what students found easy or difficult, the vast majority of the students had concerns which were individualised based on roles rather than collective. Similarly, Lakkala (2005) and Johnson, Johnson & Roseth (2010) similarly found that students often used collaborative environments and tools in ways that reflected an individualistic rather than collectivistic thought process. It might be that the students may have understood the group work as a matter of dividing tasks up equitably and pursuing individual goals rather than truly collaborating, particularly in the knowledge construction process. Given this finding, learning environments ought to be defined as collaborative not only by virtue of their structure but also via the perceptions of those engaging in activities in that environment. Since collaborative environments are not monitored in the way cooperative environments are, educators may need to understand and adjust student perceptions of group work prior to engaging them in a collaborative environment.

Implications for professional practice

School educators can take several important ideas from this research. Firstly, when using a collaborative environment for learning, educators may need to understand what students' perceptions of collaboration are before engaging in such a project. This might mismatch or match educator expectations. Student perceptions of collaboration may overshadow the actions they take in working with their group, thereby furthering the 'divide and conquer' mindset instead of nurturing a truer collaborative one including the co-construction of knowledge. Secondly, though the collaborative process involves students in intersubjectively constructing norms for their groups around less concrete concepts like an equitable division of labor, such projects may need to be designed in ways that are more longitudinal and that allow students to revisit and renegotiate such norms. Allowing students to experience a collaborative project over an extended period of time can provide the necessary space and opportunity for students to re-evaluate and iteratively form group norms based on shared experience. The experience of collaboration, in other words, might be better understood through a prolonged experience, allowing students enough time to be critical of their dynamic interactions and implement group changes that reflect deeper collaboration.

As part of the task design and project management process, it is worth considering building in explicit opportunities and time for talk, and where students actively and systematically record key ideas and decisions through journaling and other strategies. Students might be encouraged to develop and map out a writing plan, and time may be needed to scaffold students through these processes, and to develop teamwork skills and expected pro-social behaviours and cognitive actions that lead to the desired learning outcomes. The nature of the knowledge and the process of knowledge construction need to be made explicit, perhaps embedded in discussion of some social justice and work load equity issues and team processes that might emerge.

The findings also challenge educators to think about the assessment criteria to be used, and the place of collaborative teamwork and the co-construction of knowledge in the assessment measure. The whole arena of assigning group vs individual grades on group performances continues to be discussed in the literature (Chinn, 2011). While students might provide feedback that another student contributed very little to the process, especially the writing-up process, it may not be the fault of that student. For example, it could be possible that if the group is driven by a desire to get a high grade, members of the group might exclude someone from contributing out of fear that this might pull the grade down. In addition, research acknowledges that the most proficient students tend take over the task (Chinn, 2011). The more the group dynamics are understood by educators, and made visible through reflection, journaling and feedback loops to both educators and students, and made explicit in the assessment criteria, the greater likelihood that issues surrounding social justice, knowledge creation and project management may be reduced.

Other strategies might be used, such as public display of learning outcomes, peer review of contribution, use of information technology tools to develop collaborative writing and editing strategies, the assignment of roles such as note-takers, documentalists, search strategists, summarisers, and editors; and the posting of notes of group meetings, discussions and decisions.

Conclusion

This research reported here, with particular emphasis on group processes, indicates that developing collaborative inquiry through group research tasks in a digital information environment is a complex interplay of cognitive, social

and interpersonal dynamics. These centre on both the process and outcome of knowledge creation and representation, the interpersonal and personal dimensions that create the team dynamics, the functionality of the group, and the nature of the learning outcome. Embedded in these dynamics are core concepts such as social justice, division of labour and equity of contribution, and effective monitoring of learning processes. By identifying these dynamics, and through modelling, training and encouraging key processes such as positive interdependence, balanced participation, and group skills development, the potential for deep learning and understanding can be realised. This is particularly critical in the context of information technology, as information technology moves from being a tool to support learning, to being the socially constructed learning environment.

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