

Group Processing: Students Reflections on the Experience and Impact of Group Processing

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ABSTRACT

Problem-based or Enquiry-based learning is recognized as a transformative pedagogy, but there is a paucity of research examining group processing, a critical component of this pedagogy. Group processing is a structured approach to peer- and self-assessment that encourages learning that is both self-reflective and collaborative. Students develop the skills of peer and self-assessment, they learn to receive and deliver constructive feedback, and they benefit from continuous assessment. This article presents a mixed method study that asked former students, who had taken an enquiry-based learning seminar within the past 10 years, to reflect on their experience of group processing. Participants concluded that, based on their own experience, group processing is a skill transferable to other contexts and had a significant effect on their university experience.

Keywords: Problem-based learning, enquiry-based learning, group processing, peer review, student experience

INTRODUCTION

For almost twenty years, various proponents of collaborative learning and problem-based learning have advocated the use of group processing as an integral aspect of both student learning and student assessment (Johnson & Johnson, 1999; Johnson, Johnson & Smith, 1998; Johnson, Johnson, Stanne & Garabaldi 1990). Group processing is a crucial element of cooperative learning (e.g., problem-based learning) that stimulates student engagement. During group processing, students evaluate the effectiveness of the learning process by (1) describing helpful and unhelpful strategies among group members, (2) deciding which behaviors require change, and (3) acknowledging group members'

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success (Johnson & Johnson, 2018). Group processing is intended to create a safe space for group members to provide continuous, constructive feedback to each other in order to build a sense of community and encourage realistic evaluations of individual strengths and weaknesses relevant for group learning (Murray & Summerlee, 2007). Thus, group processing can be more than a simple strategy to manage a collaborative classroom or assess students.

There are multiple manifestations of collective or collaborative learning in post-secondary education. These can range from ill-defined “group work” to various team-driven assignments and projects, to a wide variety of activities that organize how students approach problem-solving. Collaborative learning, more than a set of techniques, is a social constructivist philosophical orientation that considers learning as the emergent quality of organic interactions between members of a learning community. It focuses on the role that social relationships play in creating community-specific learning processes and meaning out of reflective enquiry (Johnson & Johnson, 2018; Oxford, 1997). Relatedly, cooperative learning is the technique-oriented foundation of multiple active learning pedagogies that centers interaction within small groups as the main catalyst for learning (Johnson & Johnson, 2018). Cooperative learning strategies foster the development of cognitive and social skills via principles of positive interdependence between group members and accountability for others’ learning (Oxford, 1997). Group processing is a core element of cooperative learning techniques (e.g., problem-based learning) aimed at identifying and implementing ways to improve the group learning process (Johnson & Johnson, 2018).

One of the more structured pedagogies to incorporate group processing is closed-loop reiterative problem-based learning (Barrows, 1986). To avoid confusion with other pedagogies that are centered on problem analysis or problem solving, the term closed-loop, reiterative, enquiry-based learning (EBL) has evolved to distinguish this mode of learning from courses that use problems in their teaching, lectures or group assignments. In contrast, enquiry-based learning adheres faithfully to the structure and components of Barrows’ closed loop reiterative problem-based learning (Summerlee & Murray, 2010). For this pedagogy, closed-loop refers to the process by which students first identify learning issues that emerge from the “problem” and then engage in researching those issues. The loop is closed when the students bring back their individual research findings and integrate them with the problem and each other’s research. Reiterative alludes to the fact that the initial research might not fully address all the learning issues or, indeed, might raise others that require research. Thus, the process begins again and can be reiterated until the case is satisfactorily explored (see Figure 1 in Murray, Giesbrecht, Mosonyi, 2013). In terms of the present study, Barrows’ (1986) original pedagogy for

medical education was implemented in small, interdisciplinary first-year seminars, which are described in greater detail below.

There is a broad and deep literature that assesses problem-based or enquiry-based learning from the perspective of learning experience and outcomes (Hmelo-Silver, 2004; Murray & Lachowsky, 2017; Murray & Summerlee, 2007; Summerlee & Murray, 2010). In one important study, researchers found that group processing enhanced both individual achievement and group productivity (Johnson et al., 1990). Another study compared individualistic learning, collaborative learning without group processing, and collaborative learning with group processing. The results showed that the group processing students exceeded the other groups in terms of problem-solving success and achievement. Perhaps more significantly, the study found that students of all abilities and levels of academic achievement benefited from group processing (Yager et al., 1986). Another study examined the impact of four different types of problem-based learning according to how group processing was implemented. These were cooperative learning without group processing, cooperative learning with teacher-led group processing, cooperative learning with teacher-and student-led group processing, and individual learning (Johnson et al., 2000). The results reveal considerable variation across the groups using different modes of group processing. The researchers concluded that the teacher-and-student-led group processing had the most significant impact on student learning. Thus, learning strategies that include group processing, when compared with other approaches, may contribute most to enhance student learning. There are, however, few studies about group processing and its efficacy, and what little research has been done is now dated (Johnson, 1990; Yager et al., 1986).

More recent research demonstrates that peer feedback in problem-based learning has both advantages and drawbacks. On one hand, students reported that peer feedback helped them identify and reflect upon their own strengths and weaknesses, which subsequently improved their performance (Dannefer & Prayson, 2013; Geitz, Joosten-Ten Brinke, & Kirschner, 2016; Papinczak, Young, & Groves, 2007). Similarly, peer feedback improved the quality of contributions among low-engagement students and positively influenced both individual and group functioning (Kamp, Dolmans, Van Berkel, & Schmidt, 2013). Further, following peer feedback, students reported an increased sense of responsibility for the learning of others (Papinczak et al., 2007), increased engagement, team-building and analytical skills (Kritikos, Woulfe, Sukkar, & Saini, 2011), and higher levels of competence in communicating feedback (Geitz et al., 2016). However, students' perceptions of peer feedback also demonstrated several of its limitations. For example, students explained that peer feedback was not always taken seriously (Kamp et al., 2013; Papinczak et al., 2007) and questioned its fairness as an assessment process given that peers lacked confidence in peer evaluation (Kritikos et al., 2011; Papinczak et al., 2007).

Moreover, students considered that peer feedback could be biased and dishonest (Papinczak et al., 2007; Rodgers et al., 2015). In some cases, students felt that peer feedback undermined harmonious group dynamics by promoting judgement and defensiveness (Kritikos et al., 2011; Papinczak et al., 2007). For these reasons, students reported an appreciation for peer feedback that was anonymous (Kamp et al., 2013; Papinczak et al., 2007).

This study examines students' perspectives of their experience and learning in courses using a rigorous and regular form of group processing. This study emerged from our own experiences as facilitators and observations of our students. As students incorporated this form of group processing into enquiry-based learning, we observed how they went through positive changes in skills, understanding and attitudes towards learning, irrespective of their chosen disciplines or course topics. In particular, students acquired skills in giving and receiving critical feedback. They moved from the superficial to the profound and became reflective of their learning attitudes and behaviors. Groups coalesced and developed healthy dynamics that supported the learning of all members. We believe this was the result of group processing but there was no supporting data. This paper seeks to fill that lacuna by reporting student perceptions of group processing; it examines how these perceptions changed over the length of a course, and if the skills developed through group processing were transferable to other contexts.

Group processing is fundamental to the enquiry-based learning pedagogy. In contrast to traditional assessment mechanisms that focus on learning outputs, group processing opens a new means of assessment that focuses on the learning process. Further, group processing assessment is not instructor-centered because it is shared and completed by all group members, faculty facilitator and students alike. It also addresses the weaknesses of peer assessment which lacks transparency if anonymous, or lacks accountability if there are no mechanisms for mutual responsibility. Group members develop mutual trust through transparent and accountable mutual feedback. Moreover, group processing supports groups and individuals to become high functioning and successful. Without the capacity to assess a group's process, that group may begin to falter, thereby weakening their ability to address learning issues (Jones, 2002). Group processing provides a valuable means to check-in with the students, individually and collectively, throughout a course.

According to Hmelo-Silver (2004), "reflection helps students (a) relate their new knowledge to their prior understanding, (b) mindfully abstract knowledge, and (c) understand how their learning and problem-solving strategies might be reapplied" (p. 247). Thus, through group processing, students come to understand themselves as learners, knowledge producers, and team members. This form of reflection allows them

to think through their learning activities and re-access their focus and commitment (Moon, 2001). For example, when researching an issue, one student may not have found sufficient information while another might have engaged in deeper research and found a wealth of information. In the context of group processing, students have the opportunity to receive feedback, reflect upon the differences in the quality of their research, and to set goals for improvement.

Group processing reinforces positive interdependence among students and also heightens individual accountability. During the feedback session, each person sees themselves as related to every other member, as both a collective and an individual upon whom the group relies (Johnson & Johnson, 1999). Cooperation and academic improvement are enhanced as students help and encourage each other through constructive feedback and through the development of communication skills (Johnson, Johnson, & Smith, 1998).

Group processing is also a promising strategy to implement continuous feedback for students. Critical reflection provides a basis from which students can improve. It also provides a foundation for giving and receiving critical feedback in an open and transparent context (Johnson & Johnson, 1999). This allows students to learn how to receive feedback without defensiveness. Students can thus begin to recognize their strengths and areas for improvement, and use the reflective process to guide their growth as learners. Students receive individual feedback from all group members, including the faculty facilitator, after every single class meeting. This could amount to as many as twenty-four individual assessments in which students see their strengths and areas for improvement reflected back to them. This is a considerable increase in feedback compared to more conventional modes of feedback and assessment, given that numerical grades on examinations or brief comments on essays are not always self-evident to the student. Hence, the dynamic and continuous feedback inherent in group processing provides students with a body of assessment and feedback that motivates continuous improvement.

Context

Since 2004, the University of Guelph has offered the First-Year Seminar (FYS) program. This is not a formal academic program/credential, but instead a cross-campus initiative to provide autonomous and free-standing one-off seminar courses for first-year undergraduate students taught under a single rubric. That rubric requires seminars to be interdisciplinary and provide students with the opportunity to develop both higher-order thinking and transferable skills. There are approximately 35-45 seminars offered across the Fall and Winter semesters. Any first-year student is eligible to enroll in any seminar; there are no prerequisites and seminars are not affiliated with disciplines or degree programs. Rather, all seminars qualify as credit electives in diverse programs across the

university. Faculty members submit proposals which are vetted by a committee to ensure they adhere to the program guidelines (Krometis, L.-A. H. et al., 2011; Kuh 2003; Lattuca, Voigt & Fath, 2004; Lizzio & Wilson, 2004; Youatt & Wilcox, 2008; Stebleton, Jensen & Peter 2010).

There is no mandated pedagogy in the seminars, providing each uses a form of active learning and fosters critical thinking, research, and presentation skills. Making use of the small class size (usually 18 further divided into groups of 9-10 students) and pedagogical flexibility, a number of seminars have been offered by various instructors specifically using closed-loop reiterative enquiry-based learning (EBL). While these seminars were not connected formally or informally, they all adopted the same format. Seminar groups met twice a week for one and a half hours. The EBL seminars were focused around a series of cases that address complex, intriguing, or perplexing issues. The cases were presented as scenarios that provided sufficient context for students to identify the main issues and what they needed to research in order to move forward. In the first session for each case, students analyzed the scenario by writing down what they knew and did not know, and what issues they needed to research (i.e. "learning issues"). Each student selected a learning issue to research and returned to the group at the next session to present this material and integrate everyone's information into the case. At that point, students may have encountered new pieces of the scenario and began the cycle again, or they may have brought the case to a close. No matter whether the session was devoted to scenario analysis or research presentations, they all ended with group processing. For a class session scheduled for 75 or 80 minutes, a full half hour was devoted to group processing to ensure every person's full participation. Group processing instructions required each and every participant to provide one single piece of feedback to each and every participant (including themselves) on their performance that session, and no piece of feedback should be repeated (i.e. it must be unique feedback). Participants would take turns providing this feedback until everyone had a chance to go. No specific instructions were given to document written feedback as it might arise through a session, but this practice was modelled by the instructors taking their own notes throughout each session. Early in a seminar, these group processing sessions would often be difficult, with students unprepared or unequipped to provide feedback to their peers or themselves. However, with practice and feedback their capacity to group process improved over the semester.

In the context of enquiry-based learning, facilitators were full and active participants in group processing by giving and receiving feedback from every student in every class session. Their responsibilities included modelling how to give and receive balanced constructive feedback openly and without defensiveness. It was critically important that facilitators received constructive criticism from their students without reverting to instructor privilege or authority. Virtually the only supervisory function of the facilitator

was to ensure that group processing occurred at the end of every class meeting, with sufficient time set aside for full participation by each group member. This was particularly important in the early days of a course when students were uncomfortable with the process. As the semester unfolded, that responsibility became shared as students became more comfortable, valued group processing, and assumed responsibility for it. Thus, in the initial stages of a course, the facilitator was a guiding participant with the goal to become an equal member of the group, as opposed to a moderator or authority. Facilitators also guided students to think about group processing as an essential aspect of the learning experience, one that is ongoing and extends beyond the classroom. For example, feedback and suggestions for improvement informed students' subsequent behavior. When providing feedback about themselves, students often referred back to earlier feedback and upon how they had implemented improvements.

In summary, for the purpose of this study, group processing embodied five key characteristics. First, group dynamics were non-hierarchical by granting all group members with equal voice in providing and receiving feedback. Second, students provided ongoing feedback each session to every group member in order to foster their processing skills. Third, group processing consistently lasted about one third of each session (i.e. 30 minutes of a 80 minute session). Fourth, students provided public, in-person feedback verbally to ensure mutual accountability. Last, consistent with EBL pedagogy, students were encouraged to offer novel contributions to guarantee feedback relevancy.

Group processing was an essential and integral part of every EBL class session. Instructors who engage in collaborative learning, as widely construed, have not agreed on mechanisms to assess group functioning (Johnson et al., 1998). On one hand, it appears that small groups become cohesive and high-functioning because of their size. On the other, we as instructors have observed that enquiry-based learning seminars that used this rigorous and regular form of group processing, without deviation from the structure and format, seemed to have a positive impact on students' learning outcomes and learning experience. Small groups alone are not a panacea. Rather, the specific form of group processing that we have implemented may be an effective assessment mechanism that facilitates the development of high-functioning, cohesive groups and enhances students' academic experience. Implemented in this way, group processing may be an impactful pedagogical tool, and indeed a critical component of EBL. Therefore, the aim of this study is to analyze retrospective feedback of students who experienced an enquiry-based learning seminar in the first year of university studies that incorporated regular and rigorous group processing. Our study does not attempt to isolate and evaluate specific elements of group processing; rather, this preliminary work sought to provide a global initial account of the impact of regular and rigorous group processing on students.

METHODS

Study Design

We implemented a mixed-methods study design to describe student perceptions of group processing in enquiry-based learning seminars. It examined how these perceptions changed over the length of a semester, and if the skills developed through group processing were transferable to other contexts. For this study, we used a convergent parallel design to conduct one online survey (Creswell, 2014). In other words, we collected both quantitative and qualitative data during a single data collection cycle. As part of the analyses, we synthesized both data bodies into an overarching interpretation in order to illustrate quantitative results with complementary, in-depth qualitative data (Creswell & Clark, 2007). Given that both kinds of data examined the same underlying construct (i.e., student perceptions of group processing) across time and domains, the convergent parallel design was the most appropriate fit for this preliminary and exploratory study.

Participants

To be eligible, participants must have completed an enquiry-based learning course during their undergraduate program. Recruitment methods included social media, email from instructors who were still in contact with their students, as well as snowball sampling (i.e., participants were asked to recruit others whom they knew). Forty-six individuals completed the anonymous online survey, and are described in Table 1. All of the participants had attended the university and completed an enquiry-based learning seminar between 2003 and 2016. Out of all respondents, 18 (39%) were still enrolled in higher education. Demographically, 39 respondents (85%) were women and 7 (15%) were men. Five respondents (11%) had switched academic programs while in university. A broad cross-section of programs and disciplines were represented (e.g., 35% Bachelor of Arts, 28% Bachelor of Science, 22% Bachelor of Arts and Science, 9% Bachelor of Commerce). In terms of further education, 28 participants (61%) had graduated with a baccalaureate degree, 18 of whom (64%) had proceeded to an advanced academic program, although specific programs were not identified. Some respondents were temporally near to their enquiry-based learning experience while others were further removed and had taken their seminar as many as ten years previously. This provides a crude yet initial longitudinal approach to the assessment of the impact of group processing, something that has previously been identified as a lacuna in the research (Jones, 2002).

Demographic characteristic	Participants (%)
Gender	
Men	15
Women	85
Enrolment status	
Graduated	61
Enrolled in Higher Education	39
Degree	
Bachelor of Arts (BA)	35
Bachelor of Science (BSc)	28
Bachelor of Arts and Sciences (BAS)	22
Bachelor of Communications (BComm)	9
Highest education level	
Bachelor's Degree	61
Advanced Academic Program	39

Table 1. Overall sample demographic characteristics ($N=46$).

Procedure

A link to the online questionnaire was provided to eligible participants, which contained an even mix of closed- and open-ended questions. Closed-ended questions measured participants' perceptions of value of group processing, degree of transferability of skills gained from group processing, effect of group processing on learning and overall university experiences, and self-perception of effectiveness in giving, receiving, and implementing feedback during and after the seminar. To evaluate these, a number of Likert-type questions were asked using a 10-point scale from 1 (e.g., completely disagree, totally ineffective) to 10 (e.g., completely agree, totally effective). Open-ended questions asked participants to describe their experience and perceptions of group processing and its impacts (e.g., "Describe one or two moments in the feedback process that you remember" and "Is there one anecdote or significant experience in group processing that you still remember? If so, please share.") as well as to expand qualitatively on quantitative responses (e.g. "If your view of group processing changed over time, can you explain why?" and "How did you feel delivering and receiving feedback? Did your feelings change over the course of the semester?"). Open-ended responses built on quantitative reports by inquiring about respondents' anecdotes and definitions of group processing, reasons associated with changing perceptions of group processing, experiences with group processing before and after the seminar, ways in which group processing affected university experiences, thoughts on giving and receiving feedback during and after the seminar, and experiences implementing group processing in work contexts.

Analyses

Quantitative data were analyzed using StataSE version 13.1 software. Means are included in-text below within parentheses. Paired t-tests were used to assess differences ($p < 0.05$ was considered significant) between evaluations at different times for continuous measures. Descriptive statistics for categorical variables are presented with counts and percentages. The qualitative survey data provided student respondents ample opportunity to reflect upon their experience and share their perspectives on group processing. Qualitative data were analyzed by both co-authors to identify key themes across participants. Co-authors iteratively reviewed both qualitative and quantitative findings to highlight convergences and tensions in the two data sources. Quotations from surveys are unedited and are followed by participant's graduation year or current level of study in parentheses. This research received approval from the University Research Ethics Board (status certificate: #13OC033).

RESULTS & DISCUSSION

As shown in Figure 1, most participants “vividly” remembered their group processing experiences (mean=7.4 when rated on a 10-point scale). There was strong agreement that group processing was “time well spent” (mean=8.8). This is an important perspective given that roughly one-third of each class meeting was devoted to group processing. One respondent remarked that: “Because we were a small group it made a huge difference in how we interacted, and this was showcased on how much we supported each as we got to know one another and constantly helped and provided feedback.” (4th year student). Contrary to these findings, students in other research on problem-based tutorials have perceived peer feedback as unnecessary and irrelevant (Papinczak et al., 2007; Rodgers et al., 2015).

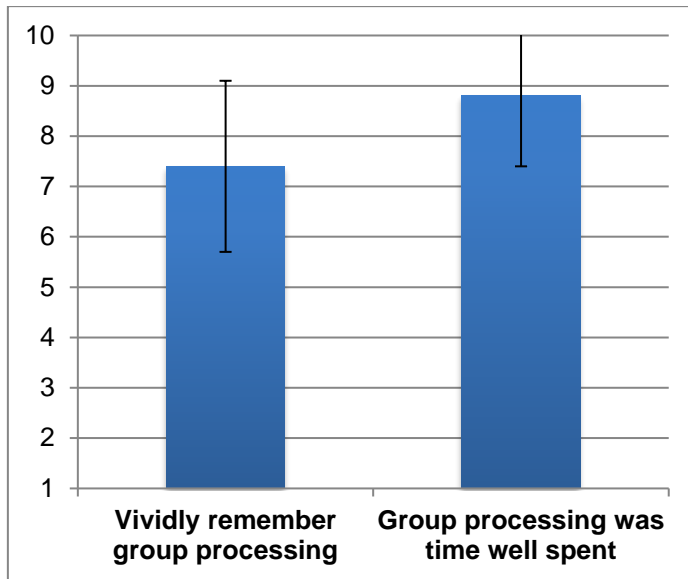


Figure 1. Students' Recollection and Perspectives on Group Processing.

Note: Responses ranged from 1 (Totally disagree) to 10 (Totally agree) for statement "Group processing was time well spent". Responses ranged from 1 (Not at all) to 10 (Completely Vivid) for statement "Vividly remember group processing".

Student participants in our current research also recognized the role group processing played in the improvement of groups and individuals. "At the end of a particularly chaotic session, one student admitted that he felt our team was unorganized. It was the first negative feedback anyone had volunteered. Since then we were more constructive about our performance, pointing out positives AND negatives." (graduated 2016). This is supported by research with other students in problem-based learning tutorials who expressed that peer feedback increased their team-building skills (Kritikos et al., 2011), group performance (Kamp et al., 2013), and confidence in delivering relevant feedback (Geitz et al., 2016). Our participants also strongly agreed that the benefits of group processing continued beyond their seminar and influenced their subsequent university experiences.

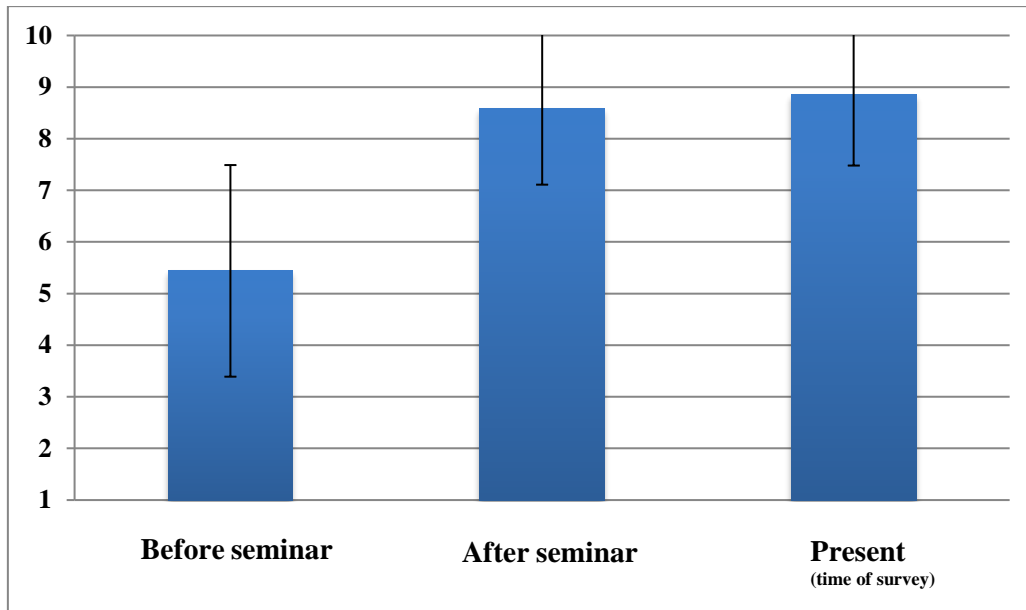


Figure 2. Temporal Comparisons of Students' Retrospective Evaluations of the Importance of Group Processing To Their Learning.

Note: Responses ranged from 1 (Complete Waste of Time) to 10 (Completely Critical to my Learning) for all retrospective evaluations of group processing.

Research has revealed that, at the beginning of a course, students can be hesitant and resistant to group processing (Hung, Bailey & Jonassen, 2003; Johnson, Johnson & Smith, 1998). As shown in Figure 2, our research found that there was a significant increase in how students evaluated group processing as a positive contribution to their learning from the beginning to the end of the course (5.4 to 8.6, $p < 0.001$), and from the end of the course to the present (8.6 to 8.9, $p = 0.03$). As one participant observed:

At first it was a somewhat unfamiliar process, and certainly in a class setting. And because we were all new at it sometimes it felt shallow or forced. But as we got to know each other and see the value of group processing, it got much deeper and insightful (graduated 2010).

In a similar vein, another stated: "I remember early on in the course we would dread this process, but as the semester progressed it was something that we developed a deep appreciation of. It challenged us and helped shape our dynamic as a group." (graduated 2009). Another respondent reflected on the typical resistance that can occur when group processing is first introduced: "At the beginning, I felt like we were spending too much time on the group processing portion and that it took time away from the content. But as the program continued, I realized that this time was helping us work more effectively together" (graduated 2011). Similarly, another commented that: "At first I hated it. I had

no experience receiving or giving so much critical feedback before. It got better as the semester went on because I became more comfortable with it, and started to receive it as a way to improve myself/work.” (4th year student). The cumulative impact and gradual development of our student participants’ comfort and engagement in peer feedback has also been observed in problem-based learning tutorials (Kritikos et al., 2011). Through time and experience, then, even reluctant students came to appreciate the benefits of group processing.

Significantly, 70.3% of participants in the current study reported that they had experience with group processing after the end of their enquiry-based learning course. There was strong agreement that group processing was transferable to other contexts (mean=8.4), including other courses, student clubs, voluntary activities, and personal relationships. For example, one participant noted: “I try to implement group processing when working in group assignments, as I find it makes everyone more open and honest, and ultimately it creates a better final result in whatever we are working on.” (5th year student). Another respondent noted that: “Looking back I can see how much the group processing made me develop my skills which I used as a member of boards and groups throughout the following years” (graduated 2011). Another concurred: “I had a leadership position in a university campus group and used group processing to help ensure our members were happy with their roles and event planning” (graduated 2016). Overall, student feedback confirmed that group processing had applicability in multiple academic and non-academic contexts. Importantly, there was agreement that group processing affected the rest of their university experience (mean=8.1), and their experiences after university (mean=7.9). One participant reported that, “it helped me immensely with future group work, as well as living with roommates and communicating with friends” (graduated 2016).

Participants reported improvement in their assessment skills during their seminar course and they related these to their experiences in group processing. In particular, they demonstrated an improved ability to deliver effective feedback to others (mean scores from 7.1 to 8.0, $p=0.001$). One participant observed that providing feedback to peers also led to improvements in their own abilities. “I initially felt very shy and that I was being too harsh or too cliché with my comments, but with more practice I was (and am) able to more concisely and effectively communicate my feelings with other group members” (graduated 2016). Another respondent reflected on changes in the process and quality of feedback they provided.

I have moved to being much more specific and constructive with my feedback. I also work hard to give specific examples. This is a shift from giving more general and generic feedback like before. It was never really

clearly explained how to provide constructive criticism, but rather it was learned in the process (graduated 2011).

Such observations resemble students' sense of confidence and competence in delivering feedback stemming from peer feedback in problem-based learning settings (Geitz et al., 2016). Moreover, they reveal consciousness of change over time, the superiority of specific versus generic feedback, and of how these skills are learned through practice. Other participants reflected on the depth of the experience and the bonds that were forged through group processing. For example, one stated:

At first it felt a bit forced to give feedback to each person, but over time as relationships grew it came to feel like an important moment of connection and expression of gratitude. I always enjoyed receiving feedback, especially when it was something unexpected or something that shook my thinking (graduated 2010).

Students also reflected on the complex nature of feedback and its nuances. "I remember... How much more complicated giving constructive criticism was. One of our members was very adept at both highlighting strengths and succinctly tying in areas for improvement" (graduated 2016). This observation resembles how peer feedback in problem-based learning facilitates opportunities for reflective self-evaluation (Geitz et al., 2016; Papinczak et al., 2007) and enhances the quality of individual contributions (Kamp et al., 2013). Further, it reflects an understanding of the role and nature of feedback and assessment by appreciating the importance to balance the acknowledgement of strengths with encouragement to improve.

Receiving academic feedback from professors and teaching assistants can be stressful for students, especially in the first year of university. They have not always had the opportunity to appreciate constructive feedback as a means to help them improve rather than to diminish their abilities. Initially, group processing can elicit vulnerability; however, the transparency of feedback delivered face-to-face may build an atmosphere of trust among group members. One of the goals of group processing is to help students learn to give and receive feedback openly and without defensiveness. One student revealed a profound change in his/her understanding of feedback, "I've always struggled with feedback. The course, by normalizing the process, really helped move me to a point where I now seek feedback to improve my learning and my performance" (graduated 2011). Another participant reported: "I remember being critiqued for my resources collected. I remember it because it propelled me to be much better with source acquisition throughout the rest of my courses" (4th year student). Others noted that giving and

receiving feedback openly led to a realization that people have different evaluations of performance.

I learned that people often have different perceptions about the quality of work completed, and that my peers often have good comments about what I can improve on. Moreover, my peers' commentary on the positive aspects of my performance made me feel better about working in a team because I felt recognized for my individual contributions (graduated 2016).

Relatedly, students in other problem-based learning research consistently integrated peer feedback in self-assessments to improve their own performance (Dannefer & Prayson, 2013). However, these findings reported that peer feedback compromised harmonious group dynamics. Their participants expressed that overt, negative peer evaluations disrupted working relationships by promoting judgement (Papinczak et al., 2007), defensive reactions (Kritikos et al., 2011), and feared it could become counterproductive (Kamp et al., 2013). Students in other research complained about excessive praise without constructive comments, which led them to perceive peer feedback as unnecessary (Rodgers et al., 2015). In comparison, when rated numerically, participants in our study were more likely to agree that they were more effective at receiving feedback now than during the seminar (7.2 to 8.0, $p=0.004$), and qualitatively appreciated the variety of benefits that accrued from group processing.

Students can be perplexed about how they should receive feedback or address critiques. In our current research, participants reported that through group processing they became more effective at implementing changes that led them to improve their specific or general performance (7.7 to 8.2, $p=0.01$). This pertained to areas such as research, analysis, and presentations, or more general skills and behaviors.

I remember getting the feedback that it felt like I was jumping ahead to conclusions..., which made it hard to follow. This has stayed with me as an insight about how I'm thinking, and how others may be thinking differently, and the dangers of jumping [ahead] too fast without explanation (graduated 2010).

One of the reasons that group processing inspired improvement is that the group would acknowledge changes and recognize individual improvements which reinforced and valorized students' efforts. The students collaborated and developed a group identity that incorporated and facilitated the growth and improvement of each member.

Most participants believed that group processing had an impact not only on their enquiry-based learning experience (mean=8.3) but also on their learning more broadly (mean=8.5). As one respondent observed: “Having it so early in my university career enabled me to gain confidence giving and receiving feedback quickly to be much more cognizant of how the groups I am part of are functioning” (4th year student). Another stated:

Once we began to understand its effect on our ability to work through cases, we began to see it as a way to help people take on roles they were less comfortable with and also to balance out the either over eagerness or lack of eagerness of specific individuals. It allowed everyone to take on a leadership role in the group (graduated 2009).

Group processing also provided students with the opportunity to develop new personal insights and behaviors. Most obviously, group skills and teamwork were enhanced. The effect of group processing on developing teamwork skills was also appreciated. One participant made this link, stating succinctly: “It improved my teamwork skills and drive in learning information for knowledge’s sake” (graduated 2016). Another drew a link to how group processing bonded the students: “It was hugely critical to understanding where others were ‘at’ in the group emotionally and in terms of how they were thinking about the issue, and our process. The feedback we generated enabled our group to grow very close and function at a very high level” (graduated 2010).

Students gained significant self-knowledge through the process of self-reflection and seeing themselves reflected back by others. “It gave me a better understanding of my strengths and weaknesses” (graduated 2011). There was also evidence that participants developed greater empathy, “It profoundly informed how I understood how other people think, process information, and feel in social situations” (graduated 2010). Another respondent observed ongoing behavioral changes. “It made me process myself more often, which made for more valuable introspection” (graduated 2012). There were some experiences that linked personal experience and academic interests, “I also learned a lot about my introverted nature. I think group processing sparked my interest in introversion and my ongoing interest in evaluating it in the classroom” (graduated 2011).

Group processing has been found to have a long-lasting impact on students when it was implemented regularly, and the group dynamic was guided by a non-intrusive facilitator. Although this study did not have a control condition with students who did not participate in regular group processing, the quantitative and qualitative findings integrate to articulate strongly the multitude of benefits students clearly ascribed to group processing. The various aspects of self-understanding and transferability of skills are part of the foundation for academic success, especially for first-year students. Respondents provided

insight into the transformative nature of group processing and how it prepared them for the future: “It stands out as a significantly empowering and educational experience for me; it made me deeply respect the power of giving and receiving feedback in a genuine way” (graduated 2010). Another shared a significant memory that underscores how important group processing can be for students to understand their own academic performance and as a practical strategy for how to improve:

I remember a group processing session early on and the uncomfortable feeling I had when it came to giving my self-assessment. I remember the feeling of coming to the realization that I really had no idea how I was performing in a group setting. ... In gaining an understanding of my performance, and subsequently the ability to more critically assess myself, I gained a skill that is now obvious to me that many others never have the fortune to acquire (graduated 2011).

Finally, students underscored not only their appreciation for group processing as a fundamental learning activity and means of assessment, but also for how it opens minds and brings new levels of mutual respect that can only enhance student learning experience.

I think I had always valued feedback, but didn't recognize the value of it coming from peers. Teachers and professors were the ones with valuable things to say, but I wouldn't have sought out feedback from my own classmates. By having everyone partake in the group processing, it allowed me to change my opinion of the value of both receiving and delivering feedback from peers (graduated 2012).

Despite the reported success of group processing in the First-Year Seminar program, this approach is prone to challenges if careful consideration to implementation and pedagogical adherence are not assured. First, while the public nature of peer feedback ensured students' accountability and responsibility for each other's learning, careful and intentional facilitation is required to ensure it does not suppress constructive feedback among students concerned with hurting others with their comments. Further, if not handled appropriately, public feedback may counterproductively promote tension and disrupt relationships between peers, which are otherwise crucial to the learning process (Kamp et al., 2013; Papinczak et al., 2007). Second, the non-hierarchical nature of group processing allowed students to take ownership of their learning and hone their problem-solving skills, but this should not de-emphasize the importance of the facilitator's role in modelling how to deliver and receive feedback effectively, including on how others may deliver or receive feedback. Students' perceived inability to assess their peers

appropriately (Kritikos et al., 2011; Papinczak et al., 2007; Rodgers et al., 2015) may require appropriate facilitator intervention when necessary. Lastly, students' perceived worthiness of group processing in our current study challenges the perceptions of peer feedback as irrelevant in several other previous studies (Kamp et al., 2013; Papinczak et al., 2007; Rodgers et al., 2015). This divergence is an important area for future research, in order to reproduce our findings as well as to identify the specific components of group processing in our context contrasted with the approaches implemented in other settings that explain these differences.

Importantly, this study also has several methodological limitations. Given that several participants' seminar experiences occurred long before the time of survey completion, the retrospective nature of the questions may have compromised the reliability of temporal comparisons. However, this approach also added depth to our findings by highlighting the potential lasting impact of group processing as a pedagogical tool. Sampling bias is likely given the purposive and convenience approach to reaching study participants; those with more negative seminar experiences may be less likely to remain connected with other students or instructors. Further, our sample may have been affected by self-selection bias. That is, participants who voluntarily completed the study may have been motivated to share their positive experiences with group processing. Thus, we are unsure whether or how much negative or critical perspectives on group processing are underrepresented in our sample. Lastly, our exploratory questions and items began to assess students' ability to deliver and implement feedback; more robust measures of impact on a broader array of outcomes would more reliably assess specific dimensions of group processing that lead to impact. Hence, our results represent a preliminary overall measure of group processing's impact.

Future research should address the gaps in this study. In addition to recommendations above, the association between participants' age (or time since pedagogical exposure) and their perceptions of group processing with a more robust and representative sample should be explored. Further, future research should explore whether unique dimensions of group processing can be isolated to ascertain their associated impacts on student learning to offer a more nuanced evaluation of its components and the causal reasoning behind these changes.

CONCLUSION

Group processing can provide a transformative experience for students. Students consistently reported positive perceptions of group processing, improvement of skills over time, and transferability of skills outside of the seminar context. While an inherent aspect of enquiry-based learning pedagogy, group processing as described in this paper

could be employed in other contexts of collaborative and team-based education. If implemented regularly and not subordinated in time and priority to content-based learning, group processing can have a salutary effect on both academic achievement and the personal qualities of listening, receiving feedback, and collaborating that are increasingly demanded by public and private sectors alike.

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