Fall 10-23-2009

Kindling SPARC: The Emergence of Social Perceiving-Acting Reciprocal Conversations

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Paper presented at the Northeast Educational Research Association Conference
Rocky Hill, CT
October 22, 2009

Abstract

Based on an ecological theory of knowing (see Barab & Plucker, 2002; Barab & Roth, 2006; Gibson, 1986; Young, 2004), Social Perceiving-Acting Reciprocal Conversations (SPARC) is an emerging discussion approach designed to tune agents' perceptions to the affordances of discussion interactions and to develop their effectivities to act on these affordances. This paper discusses the creation and subsequent iterations of SPARC that emerged in my undergraduate Educational Psychology class between January and May of 2009. Educational implications and future research directions are discussed.

Introduction and Rationale

It has been argued that experience is the best teacher (Brown, Collins, & Duguid, 1989, Dewey, 1938; Greeno et al, 1998; Lave & Wenger, 1991). Small and large group discussions are one means of engaging students in discourse around course content, yet traditional classrooms afford much more in terms of student interaction than is often perceived and acted upon (Young, Barab, & Garrett, 2000). I am interested in learning how to increase the frequency and quality of interactions within communities of learners (Brown & Campione, 1990) and communities of practice (Wenger, 1998), once the pedagogical choice to engage students in intellectual discourse around academic content has been made.

Research into group discussion has identified that dialogic interaction leads to more productive discussion than monologic interaction (Daniel et al, 2005; Echabe & Castro, 1999; Fay et al, 2000; Soter et al, 2008; Westerhof-Schulz & Weisner, 2004). It has also been shown that instances of dialogic interaction emerge more often within small groups of 5 or fewer participants than it does in larger groups (Barnard, Mason & Ceynar 1993; Fay et al, 2000).

Another area of the group discussion literature has identified individual and environmental constraints that may inhibit successful discussion interaction, including issues of positioning and power (Broughton, 2002; Clarke, 2006; Westerhof-Schulz & Weisner 2004), and voice and identity (Bausch 2007; Broughton, 2002).

A gap in the existing literature is the specific exploration into *how* to increase participants' fluency with dialogic discussion interaction. SPARC has emerged out of the need to address the inconsistencies of group discussion performance that has been found in the group discussion literature.

Theoretical Framework

Barab and Plucker (2002) stated, "the central challenge for educators is to develop participatory structures that bring together the individual, environment, and sociocultural relations" (p. 176). Sociocultural Theory (Vygotsky, 1978) has often been cited in research on group discussions; however, viewing SPARC from an ecological perspective may be beneficial to perceiving *how* participant interactions might lead to "smarter contexts" (Barab & Plucker, 2002), because beyond focusing on interactions between people, it is also inclusive of interactions with the environment and across situations. This shift in epistemology serves to change the focus from an analysis of individual performance within a group to the group's performance over time.

Purpose of the Study

Educators aim to bring their students into an increased state of knowing over time. Operating under the assumption that knowing emerges in situations through social interactions, my overarching goal as the instructor of an undergraduate Educational Psychology course, was to increase the frequency and quality of student discussion interactions in an attempt to increase knowing and to avoid the problem of "inert"

knowledge that has been discussed and debated for nearly a century in education (see Bransford, Brown, Cocking, 1999, Determan & Sternberg, 1993; Whitehead, 1929). The major outcome of these efforts was the emergence of a new approach to group discussions, called Social Perceiving-Acting Reciprocal Conversations (SPARC).

The purpose of this paper is to describe and interpret the generative process that took place as SPARC emerged and transformed to fit the dynamic needs of its participants. There are two distinct areas of inquiry in this study: the emergence of the SPARC process, and an investigation into its efficacy for moving the group towards reciprocal discussion interaction over time. In addition, the inquiry resulted in the testing of one post hoc hypothesis related to a correlation between two rubric categories, *Reference to Notes & Literature* and *Real-time Discussion Notes*.

I begin with a description of the SPARC process and then move towards analysis of its emergence and outcomes, followed by analysis of the post hoc hypothesis. Three rubric iterations are reported that reflect significant revisions to the discussion process over time, which were influenced by participant feedback and participant and instructor goals and intentions. A quantitative analysis of rubric data is presented, which is supported with qualitative data from student reflection journal and teacher log transcripts. Finally, I end with a discussion of the educational implications of SPARC, and future directions for this research.

What Is SPARC?

My students and I contributed to the generation of SPARC through our engagement with it approximately once per week, from the beginning to the end of one academic semester. Participants were asked to read articles in various topics in the field of Educational Psychology and then came together to discuss these articles in an iterative

fishbowl discussion format, which has developed into Social Perceiving-Acting Reciprocal Conversations (SPARC). (See *Figure 1*). In addition, participants were asked to respond to both content and process of the discussions in online reflection journals within 24 hours of the end of each discussion.

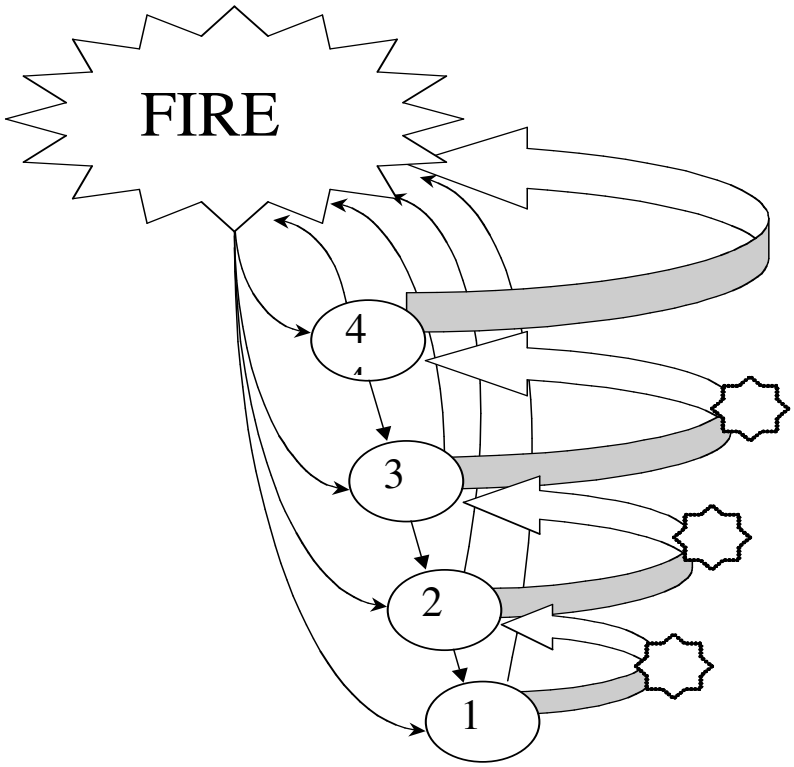

Figure 1. An illustration of the dynamics of the SPARC process. The numbers represent the different iterations, or small group fishbowl discussions; the hollow star icons represent optional between-iteration debrief sessions; and, FIRE is the final iterative reflective exchange, which is a final whole group discussion at the end of SPARC.

SPARC went through several iterations over the course of the semester; however *Figure 1* depicts my current understanding of the dynamic interactions that are alive in this

process. Our whole group, consisting of 23 students, divided into four groups of discussants, each with five to seven participants. One discussant group assembled at the center of the room, with the remainder of the class situated around them, in a fishbowl discussion format[1]. As they began to discuss the topic, the remainder of the class observed the group's conversation, and responded in real-time on note taking forms, to aspects of both content and process, to which the class had decided to pay attention. After 10 minutes, I stopped the discussion and either opened the floor to whole group discussion for 5 minutes or moved immediately to inviting the second group to the center, where they started the second discussion iteration. This cycle was repeated until all participants had taken a turn inside the fishbowl. Once all discussants participated, the entire class engaged in a final iterative reflective exchange (FIRE), which gave them the opportunity to connect once again, clarify misconceptions, and further negotiate meaning of the content.

Throughout the entire SPARC experience, participants in the observer role brought intentionality to future discussion iterations, through their note-taking procedures. These real-time notes afforded continuity across the discussion experience as well as reciprocity between groups. Schön (1991) discussed reflection-in-action, which is the noticing that happens amidst action (p.55). In SPARC, group reflection-in-action becomes a way to access the knowing-in-action (Schön, 1991, p. 50) that may not have been previously perceived within the group. For participants who had already been inside the fishbowl, the note-taking procedure afforded reflection back on their own and others' contributions to the conversation. Subsequent groups used their real-time notes to inform their own discussions,

[1] The small lecture hall structure of our classroom may not have been an optimal learning environment for SPARC participation because it did not allow participant observers to gather in a complete circle around the discussants, and it elevated the observers above the discussants, possibly contributing to a sense that the discussants were "on stage". It is recommended that SPARC participants engage in discussions in a more versatile space.

which resulted in participants revisiting topics that had already been introduced and discussing them in greater depth. SPARC also afforded participants opportunities to draw connections between all four groups as well as to previously covered course content.

The usefulness of the between-group debriefing sessions, pictured in *Figure 1* by the hollow star icons, is not known. It is likely to be situation dependent, and the scope of the current inquiry did not allow for an exploration of the ways these between-group interactions may have informed the larger discussion. Schwartz and Bransford (1998) discussed the importance of building novices' prior knowledge through differentiated knowledge structures (p. 479), and it could be these debriefing sessions afford this "time for telling" if a teachable moment is perceived.

Participants

Located in a rural community in the Northeastern United States, the university campus is a sprawling one, filled with brick buildings and steeped in history. It is a large university, composed of ten schools and colleges, with nearly 17,000 undergraduates and several thousand graduate students on its main campus. A large number of undergraduate students live on campus and there is also limited on-campus housing for graduate students.

The participants in my undergraduate Educational Psychology course consisted of 23 students; 19 of them consented to participate in the study. Participants included 17 women and 2 men. 8 participants were seniors, 8 were juniors, 1 was a sophomore, and 2 were non-degree international students at the university for a year through a Peace Scholarship program. Except for the non-degree students, all participants were enrolled in the College of Liberal Arts and Sciences in the following academic programs: History/Anthropology, Psychology, Communication Sciences, and Human Development and Family Studies. Table 1 outlines the relationships between these demographic data.

Table 1
Relationships Between Participant Gender, Academic Major, and Year in School

		College Major				
Gender	Year in School*	Communication Sciences	History/ Anthropology	Human Development & Family Studies	Psychology	Non-degree
Male	S					
	J				1	
	Sr+		1			
Female	S	1				
	J	5			2	
	Sr+	1/2**		3	1	2
Total		9	1	3	4	2

* S = Sophomore, J = Junior, Sr+ = Senior/Non-degree
** indicates number of students in this major who also have a second major in Psychology; they are counted only once, in their primary major

Self-report data indicated two international students, one from Oman, and one from Morocco. Two other students reported having lived in other countries when they were young, but have been in the United States for many years. No additional data on ethnicity is available for the participants.

Several participants shared with me experiences that are somewhat atypical of a "traditional age" undergraduate population. One participant recently became a mother, another female participant's father died unexpectedly shortly after the middle of the term, a third female participant has a diagnosis of ADHD, and finally, there was one female participant facing uncertain medical diagnosis for the majority of the semester. By the conclusion of the course, she had not received any confirmed medical diagnoses.

Methodology

The current study is an *exploratory* look at the SPARC process. As the instructor of an undergraduate Educational Psychology course I made continuous, intentional, and systematic changes to the SPARC process throughout the semester based on my classroom observations and participants' reflections on their own experiences. This dynamic approach

to research within educational settings has been referred to as design-based research (see Barab & Squire, 2004).

Limitations

There are several limitations to the current inquiry. Since SPARC is in its infancy, an experimental design was not feasible, and therefore, the findings are not generalizable beyond these participants. Further, the nature of this study, combined with my role as course instructor, prohibited the use of video or audio recording of interactions for the purposes of discourse or conversation analysis. Future work with SPARC looks to incorporate more rigorous methodological approaches.

Data Collection Methods

Data collection occurred throughout the entire semester and included the following sources: participant online reflections, using the Blackboard Learning System journal application; teacher log transcripts; rubric documents; participants' scored discussion rubrics; participant and instructor real-time discussion notes; and e-mail correspondence between participants and the instructor[2].

The University of Connecticut Institutional Review Board (IRB) characterized all activities used in this study as normal educational practice. Resulting from my conflicting interests as both instructor and researcher, participant consent was sought *after* final course grades had been posted to ensure participants' freedom of choice to participate in the study.

Upon receipt of participant consent forms, I collected all journal transcript data into a single Microsoft Word document, applying a uniform format and assigning line numbers to the data. Participants' actual names were replaced with pseudonyms to protect the confidentiality of their responses. I entered data from participant discussion rubrics into a

[2] Participant and instructor real-time discussion notes and e-mail correspondence were not analyzed for this paper, but will be used to inform progress towards grounded theory about SPARC.

pivot table in a Microsoft Excel spreadsheet, and used this program to analyze the performance assessment data.

Data Analysis Methods

Analysis of the performance data began with a description of the changes to the scoring rubric across its three iterations, from the start of the semester to the end, supported by transcript data. Descriptive statistics of participant discussion performance over time as measured by these three rubric iterations were calculated, and visual analysis supported the interpretation of these results.

Rubric Process.

Studying the process changes and their effects is central to understanding the emergence of SPARC over time. The discussion rubric went through three iterations from the start to the end of the semester (see *Figure 2*). Rubric iterations were shaped by ongoing participant feedback and my own instructor reflections. The changes are presented and transcript data used to support the description of these changes.

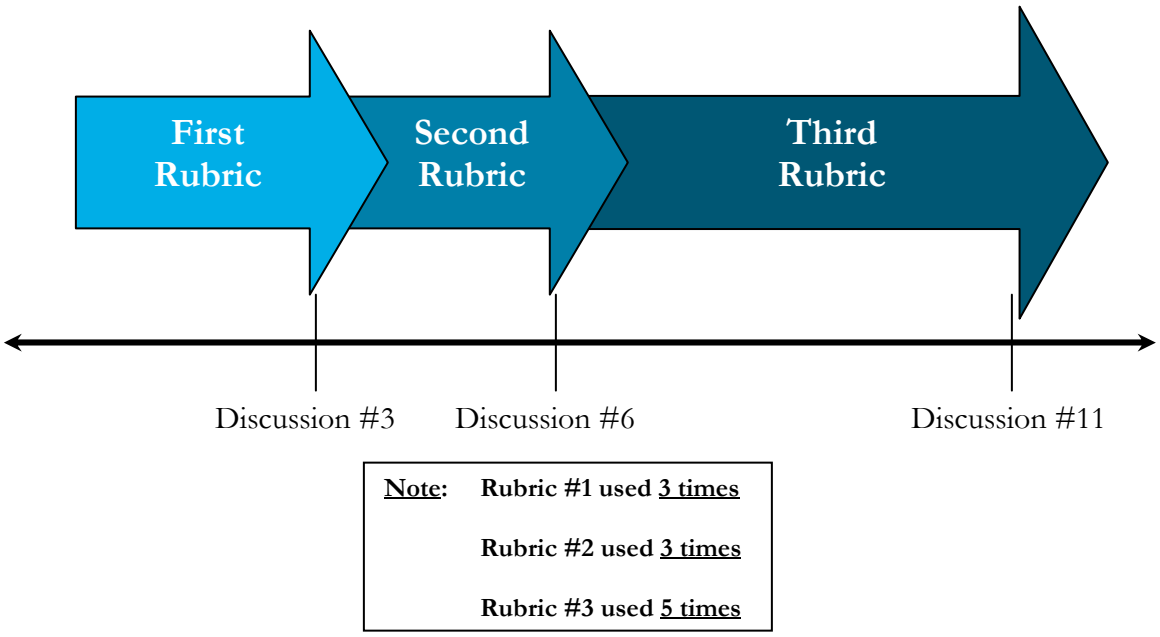

Figure 2. Timeline of discussions related to the scoring rubric iterations used for those discussions.

The first change occurred after the third formal discussion, and the second change occurred after the sixth formal discussion. These changes not only attempted to keep up with the dynamic learning process, but also reciprocally informed the development of SPARC. Table 2 outlines the Level 4 descriptors across all three rubric iterations, since this was the highest performance level assessed in each category.

Table 2
Level 4 Category Descriptions Across Three Rubric Iterations

Category	Rubric Iteration #1	Rubric Iteration #2	Rubric Iteration #3
Participation	Contributed several different times to the discussion; added to the topic at least half of the time	Contributions to the discussion reflect thoughtful understanding and questioning of the course content.*	Contributions to the discussion reflect thoughtful understanding and questioning of the course content. Personal anecdotes and/or examples from the readings are used to support claims.*
Listening	Usually responds to other group members' comments before moving on to his/her own discussion contributions (Examples: asks a clarifying question, elaborates on the topic, agrees or disagrees with what was just said)	Usually responds to other group members' comments before moving on to his/her own discussion contributions (Examples: asks a clarifying question, elaborates on the topic, agrees or disagrees with what was just said)	Usually responds to other group members' comments before moving on to his/her own discussion contributions (Examples: asks a clarifying question, elaborates on the topic, agrees or disagrees with what was just said)
Reference to Notes & Literature	All required reading materials are brought to the discussion. Frequently referred group members to specific page numbers and/or passages. Frequently read brief passages aloud to support personal claims. Frequently opened to pages/passages when directed by others.	When literature is referenced, group members are referred to a page, short passage is read aloud; the selection lends support to the speaker's point or question, and the reference moves the discussion forward.*	When literature is referenced, group members are referred to a page, short passage is read aloud; the selection lends support to the speaker's point or question, and the reference moves the discussion forward.
Preparation	Demonstrates thorough preparation for discussion: Question sheet has several page numbers listed and other notes to be referenced in the discussion. Several passages are marked in the text(s) with post-it notes and/or highlighting. Notes contain many individual thoughts, questions, and responses to the readings.	Demonstrates thorough preparation for discussion: Question sheet has several page numbers listed and other notes to be referenced in the discussion. Several passages are marked in the text(s) with post-it notes and/or highlighting. Notes contain many individual thoughts, questions, and responses to the readings.	N/A*
Materials	N/A*	All required reading materials are brought to the discussion.*	N/A*
Volume & Clarity	Could be heard and understood all of the time by everyone in the room.	Could be heard and understood all of the time by everyone in the room.	N/A*

Real Time Discussion Notes	N/A	N/A	Demonstrates reflective real-time interaction with the ongoing discussion: Comments are made on both sides of the note sheet, representing observations and personal reflections. Observations and reflections extend beyond the "surface" level by either offering a countering position, posing a question relating a personal example, etc. Reflections relate to previous groups within the current discussion, reference past discussions and content, or indicate a relationship between a presented idea and one you intended to discuss.*

* Indicates a change from the previous rubric iteration

Altogether seven discussion characteristics were assessed holistically on a 0-4 point scale: *Participation*, *Listening*, *Reference to Notes & Literature*, *Preparation*, *Materials*, *Volume & Clarity*, and *Real Time Discussion Notes*. Some characteristics are absent from one or more rubric iterations, and the performance expectations within some categories changed across iterations to suit the evolving needs of the class.

The performance expectations for three of the categories remained constant. *Listening* is the one category that was applied across all rubric iterations without any changes having been made to the performance expectations. The performance expectations for *Volume & Clarity* and *Preparation* also remained unchanged, however, these categories were taken out in the third rubric iteration.

Materials had been included as part of the *Reference to Notes & Literature* category in rubric iteration one, was taken out of that category and given its own category in rubric iteration two, and by rubric iteration three had been taken out altogether.

Two categories underwent meaningful changes between rubric iteration 1 and 2: *Participation* and *Reference to Notes & Literature*. The focus in both of these categories shifted

from the *frequency* of participant involvement to the *quality* of the discussion contributions. These changes were facilitated by a disturbing trend that had emerged over the first three weeks of the semester. Participants were feeling extreme pressure to contribute to the discussion within the ten-minute time frame, and a competition was emerging between them.

In the class, we came to refer to this phenomenon as "quote stealing". After the third discussion, Melissa[3] reflected on this sense of urgency to meet the rubric requirements: "For next week, I want to once again incorporate text more in my discussion. However, I want to do it in a way that it doesn't seem forced or that I am scrambling to meet the requirement." Kelly experienced similar feelings, and she wrote that she was "just trying to get facts and questions to bring up during the discussion for participation credit." Emily added, "I'm finding it hard to squeeze in quotes everytime [sic] I have a point to make and it takes the creditability away from my statement when I just sound like I'm going for the grade."

It became clear that something within the discussion environment was not allowing for the intended interactions to occur. In my teacher log after the third discussion I wrote

> When the debrief session went to the outer circle, there was a lot of discussion about quotes being 'taken' and examples being referred to as 'stolen quotes' (I find this interesting because it isn't as if anyone owns these words—except arguably the person who authored them). [A student]…suggested maybe instead of actually reading the text passages that they just refer to the page.

I continued to write in my log about suggestions from other students:

> Tracey suggested that I give out the question sheet, that all folks prepare all the questions, but that each group only discuss one. Kelly replied that she would feel "let down" … if she didn't get to answer

[3] All names are pseudonyms, assigned to protect the identity of participants.

> the question she really understood well and wanted to participate in. She said, "What if it wasn't my question?" …[Another student] replied that even in that case it would still be a good discussion. She reflected back to their first discussion (on epistemology) whre [sic] the group spent the whole time discussing concepts they didn't understand. She felt it was still a valuable discussion, so that even if you don't get the question you understood well, that it would still be a good discussion because the others could help you. Others in the room nodded in response.

I decided to take the student feedback and consider a revision to the rubric for the remaining discussions:

> I told [students] that instead of having them stop using desired discussion techniques, that I would revisit the rubric, because it could be a faulty measurement tool. And it would be silly for them to stop engaging in great discussions because of the tool.

I determined the focus on quantity of turn-taking to be an undesirable constraint on the problem space, and made the rubric changes (reflected in Rubric Iteration #2 in Table 2) that deemphasized quantity and moved toward quality of participant contributions.

Once these rubric changes were made, and participants experienced the new expectations, they responded positively. Mark commented, in the first week with the new rubric, "The changes to the rubric were well done and I feel they were appropriate. I noticed the change in the discussion as people were not forcing themselves to add quotes from the reading." Kathy agreed and wrote, "The changes to this week's grading rubric made the discussions flow much better…the new rubric combines personal statements with referencing the text but also has another section for direct quotations. I feel that this will lead students to not be so pressured to say a quote just to get the points, rather than adding to the discussion."

The final category, *Real-time Notes & Literature*, was added in week #7 as a means to scaffold participants in their attention on discussion interactions as they sat in the observer

role outside the fishbowl. Out of the 12 participants that reflected on this intentional note taking process after their first experience with it, Diane felt she "didn't benefit from the new sheets," but the other 11 participants made positive comments about the affordances of these note sheets for carrying the conversation across all SPARC iterations. Melissa wrote:

> I thought that this [note sheet] was the most effective note taking tool because it really engaged me in each discussion. I felt that it made me a more active member of the class. Before the yellow sheet was introduced, I did not pay as close of attention to the discussions. This has allowed me to take what other people are saying and respond to it. I also think that it has really added another dimension to the discussions and made them better.

Bonnie also reported positive outcomes from the note sheets: "I think that the yellow sheets were very effective this week in that I was able to use some of my notes on others' discussions in my own discussion." Luke reflected, "I like how it allows us to compare group discussion across the class period. I think the new observing format will make for a less competitive feel for discussions and unify points made in each group."

In addition, both Mark and Gloria observed the benefit of the note-taking process for later groups. Gloria wrote, "I thought that it was nice since my group went last that i [sic] had notes on all of the groups and was able to know what previous topics I wanted to comment on." Mark perceived this same affordance of group position, but also reflected on the reciprocity afforded by the note-taking process: "I think the yellow sheet is more useful for the groups who go later, I think that seeing what the groups talked about before you is more helpful for when you are discussing. However, it is also nice to reflect on how the groups carried on our conversations as well."

Discussion performance.

Analysis of quantitative data included descriptive statistics and visual analysis of participants' discussion rubric scores for targeted areas of the rubric. I used transcript data to support my interpretation of puzzling data.

performance overview.

Figure 3 displays a bar graph of the means and standard deviations of 4 of the 7 categories over the three rubric iterations[4]. Each category along the x-axis contains the mean scores of all participants for each of the three rubric iterations. Next to the bars representing group means, are bars representing the standard deviations of scores within each rubric iteration. Table 3 also outlines this data.

If the learning environment were becoming "smarter" over time, as hypothesized, group means in each rubric category would be expected to increase over time as standard deviations decrease. In other words, in order to meet the hypothesis, more participants would have needed to perform at high levels as the semester continued.

Results for the *Listening* and *Volume & Clarity* categories followed the expected pattern, thus meeting the hypothesis, while those for *Participation* and *Reference to Notes & Literature* did not. While the group means across rubric iterations for *Participation* and *Reference to Notes & Literature* increased, the standard deviations did not steadily decrease from the beginning of the semester until the end. Discussion of each category follows.

[4] Three rubric categories, *Materials, Preparation*, and *Real Time Discussion Notes* were not included in this graph and have been addressed separately.

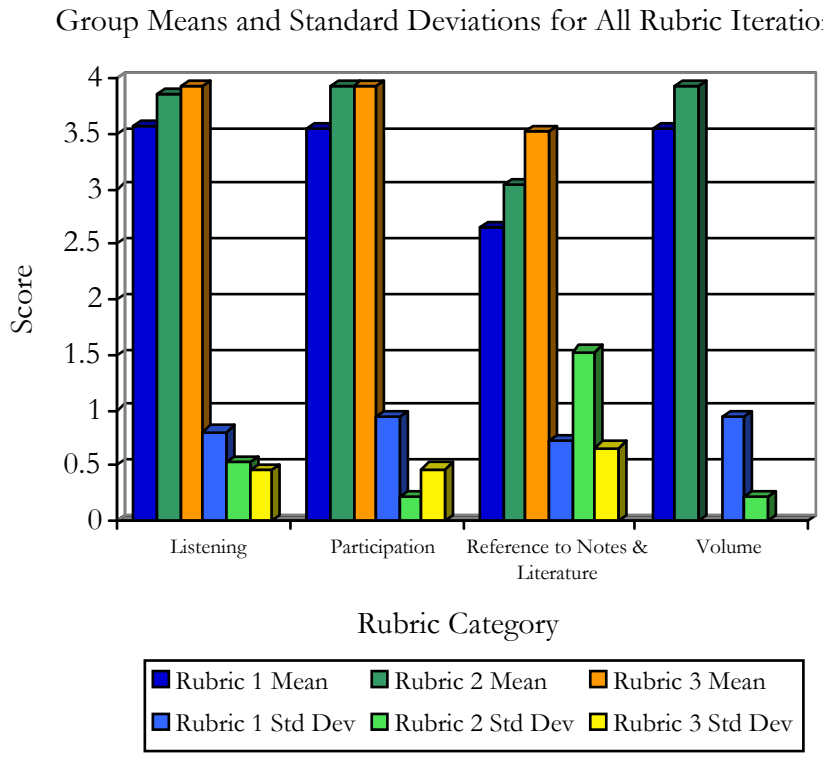

Figure 3. Group means and standard deviations for all rubric iterations.

Table 3
Means and Standard Deviations of Participant Scores across Rubric Iterations in Four Categories

	Rubric Iteration #1		Rubric Iteration #2		Rubric Iteration #3	
Category	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Listening	3.56	0.806	3.858	0.522	3.949	0.453
Participation	3.54	0.947	3.934	0.22	3.936	0.465
Reference to Notes & Literature	2.66	0.717	3.03	1.53	3.52	0.66
Volume	3.54	0.94	3.934	0.22	n/a	n/a

materials and preparation.

It became apparent very early that coming to the discussion prepared and equipped with appropriate materials was fundamental to engaging in SPARC. The overall group means for *Preparation* and *Materials* were 3.86, and 3.98, respectively. Both of these rubric categories

fell away from the assessment criteria by the third rubric iteration, as it was discovered that these behaviors were prerequisite to the other rubric categories for achieving meaningful engagement with SPARC.

volume & clarity.

Volume & Clarity was no longer assessed after week 6, having been removed from rubric iteration three. By week 6, all participants had achieved at least a level 3 in the *Volume & Clarity* category, and the mean score of participants in that week was 3.91. In addition, the last statement of an individual goal related to volume was in week 4, when Susan wrote, "…I will also try to speak up more because I saw [on the scoring rubric] that it was a little hard to hear me during the discussion".

listening.

Listening is the one rubric category that did not have its description changed across rubric iterations; nonetheless, the scores did change over time. For the purposes of the current inquiry, *listening* was defined as "Usually responds to other group members' comments before moving on to his/her own discussion contributions (Examples: asks a clarifying question, elaborates on the topic, agrees or disagrees with what was just said)". For this reason, it is important to note that without an observable behavior, it is impossible to know how well a participant has actually heard what another participant has said. In this way, the rubric may be a conservative measure of the amount of listening actually occurring within a given discussion.

A scatter plot of participant *Listening* scores across the three rubric iterations (*Figure 4*) displays *all individual scores* recorded for each rubric iteration. This means that each participant is represented up to three times for iterations one and two, and up to five times for iteration three.

Listening scores increased from the start to the end of the semester, with the average score for iteration one at 3.56 with a standard deviation of .806. By the middle of the semester, with iteration two, the mean increased to 3.858, and the standard deviation

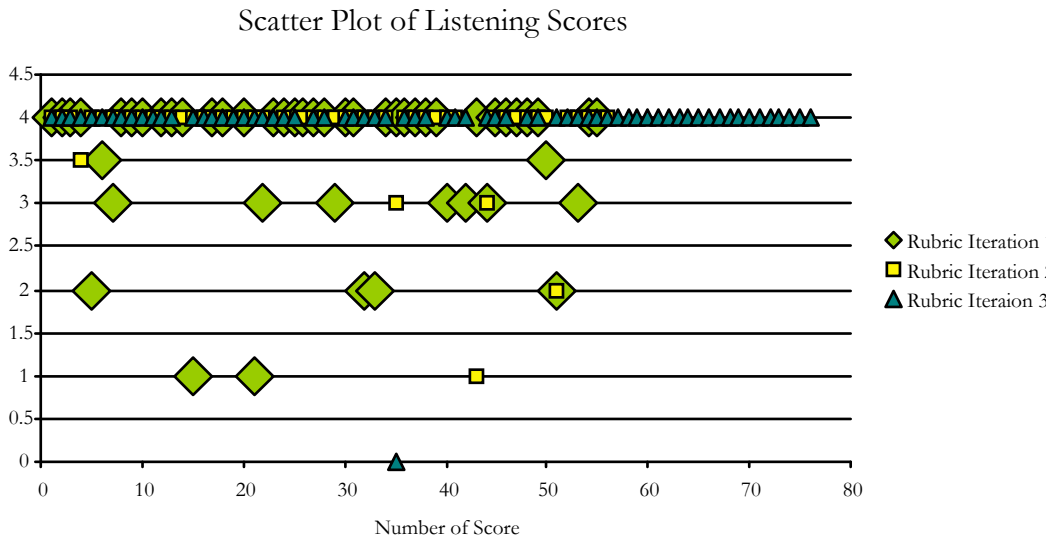

Figure 4. Scatter plot of listening scores.

decreased to .522. Finally, with iteration three, nearly everyone scored a level 4 (mean of 3.949, standard deviation of .453), with the exception of one participant who scored a zero in week 7 because she did not actively participate so there was no way to measure her listening in that discussion based on the rubric criteria.

participation.

Figure 3 showed a spike in the standard deviation in the category of *Participation* in rubric iteration three, after it had decreased between iterations one and two. A closer examination revealed week 7 as having a standard deviation of 1.014, which is very large considering the assessment utilizes a four-point scale. In contrast, the group means for the

remaining weeks in the semester in this category were all 4.0 (See *Figure 5*), which prompted me to look more closely at individual scores in week 7.

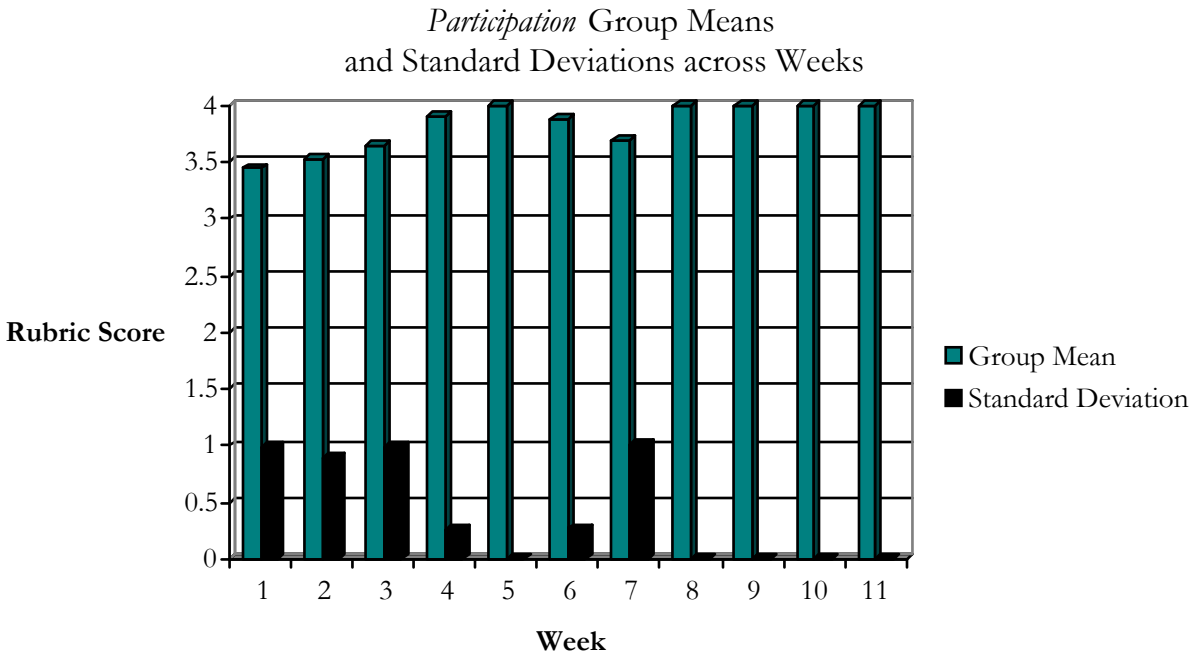

Figure 5. Group means and standard deviations in the category of participation across weeks.

In week 7, n= 16; 14 students scored a level 4; 1 student scored a level 3; and 1 participant scored a level 0. Incidentally, Hanifa, who scored "0" in week 7 proceeded to score at level 4 for the next three discussions and then was absent for the last discussion, so there is no data for her in that week. I consulted her reflection journal for clues about her lack of participation in week 7; she wrote,

> unlike the other groups we focused more on the article about the academic cheating trying to apply the concepts we have for this discussion and relate [them] to that reading. Some students comments [sic] on that and said it was [a] nice transition because many group[s] spend many long time discussing that. For me, I did not expect that and focused more on Bartholomew article to relate the concepts we have and I could not find a way to move

> smoothly to that article and I was not sure if other members [were] thinking the same way about relating the concepts to Bartholomew…

In addition to Hanifa's journal response, my week 7 rubric comments on her performance indicated, "your non-verbal cues suggested you were listening." There is evidence Hanifa was invested in this discussion, but unable to find a time to *break into* the conversation. This one discussion may not be a true reflection of her ability to participate in group discussion, especially considering her strong performance in this area in subsequent weeks.

reference to notes & literature.

The pattern of standard deviations across the three rubric iterations for *Reference to Notes & Literature* was also not as expected (see *Figure 3*), though it followed a different pattern than that of the *Participation* category just discussed. *Figure 6* depicts a multiple line graph, with each participant represented on the x-axis and their mean rubric iteration scores represented on the y-axis. The erratic pattern of scores in rubric iteration two is apparent. This suggests that the changes made to the rubric between iteration one and two, in the category of *Reference to Notes & Literature*, created challenges for many of the participants. With intentions moving from an emphasis on *quantity* of contributions to *quality* of contributions, 7 participants' mean scores decreased, while 10 participants' mean scores increased, and 2 participants showed no change.

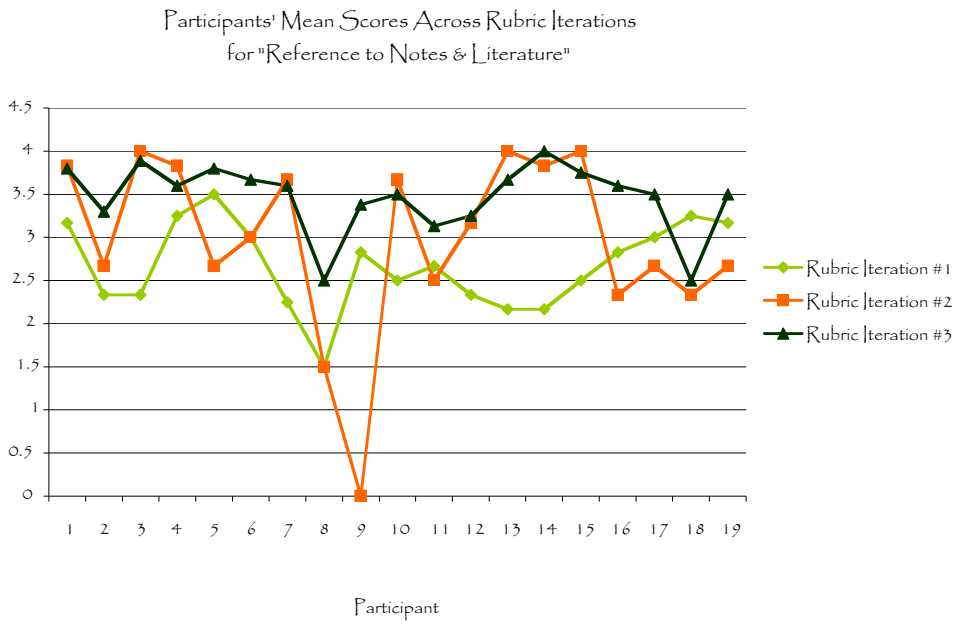

Figure 6. Participants' mean scores across rubric iterations for the category of Reference to Notes & Literature.

Then, as the rubric changed again, the pattern became more consistent across participants, with the lowest mean scores for iteration three at 2.5, for participants 8 and 18[5]. Overall, the movement towards a straighter line, situated near the top of the graph, supports the hypothesis of the emergence of a "smarter context" (Barab & Plucker, 2002) with this third rubric iteration.

What may have happened to cause such a pronounced difference in the pattern between rubric iterations two and three? As seen in Table 2, the rubric criteria in this area did *not* change between these two rubric iterations. When I compared scatter plots of *all scores* across the three rubric iterations (*Figures 7, 8, 9*), interesting patterns emerged.

[5] It may also be important to consider some extenuating circumstances that surrounded the participant represented by number 18 on the graph at the time of data collection for the third rubric iteration; she had been absent from class for four of the five discussions included in rubric iteration three, as the result of the death of a close family member. Therefore, this plot point is based on a single score, rather than an average of the five discussions that were assessed with this rubric. Further, due to the nature of her absences, it is likely this one score is not an accurate measure of her abilities.

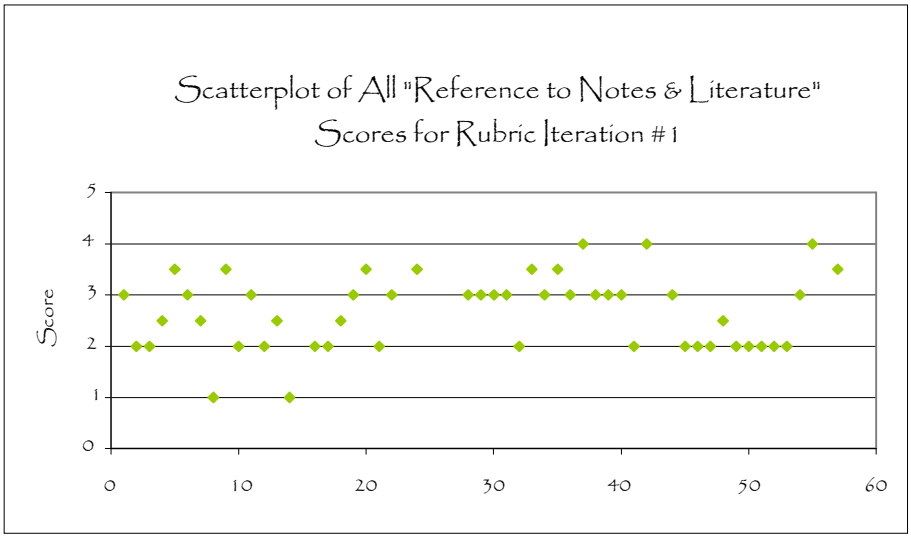

Figure 7. Scatterplot of all scores in the Reference to Notes and Literature Category for the first rubric iteration.

Figure 8. Scatterplot of all scores in the Reference to Notes and Literature Category for the second rubric iteration.

Scores across the first rubric iteration (*Figure 7*), used in weeks 1-3, showed a lot of scatter, with only three level 4 scores, and 2 level one scores, and the rest distributed fairly evenly in between. Moving into rubric iteration two (*Figure 8*), there was a polarization of

participant mean scores, with 10 out of 42, or nearly 25% of the scores at level 0. At the same time, the rest of the scores were pulled up, all at a level 3 or level 4.

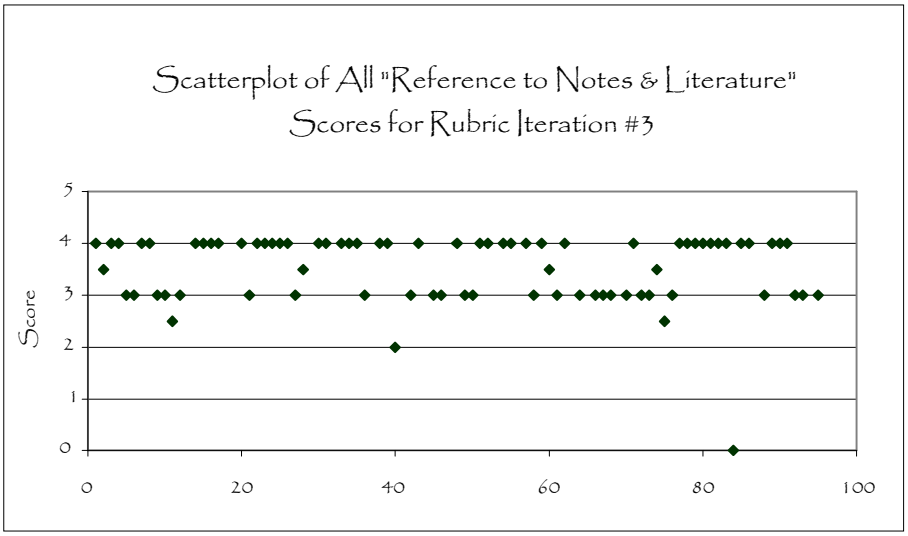

Figure 9. Scatterplot of all scores in the Reference to Notes and Literature Category for the third rubric iteration.

The change in the pattern of performance for the third rubric iteration was unexplained by a change in the rubric expectations (see Table 2) for *Reference to Notes & Literature*, because no change was made to this discussion requirement between these rubric iterations. The inability of the results to be explained by a rubric change led to a post hoc hypothesis about the relationship between the categories of *Reference to Notes & Literature* and *Real-time Discussion Notes*.

real-time discussion notes.

Once a rubric change was ruled out as an influence on the dramatic shift in the participant performance pattern in the third rubric iteration over the second in the category of *Reference to Notes & Literature* (see *Figures 8* & *9*), I analyzed the changes that had been made between these two rubric iterations to search for possible causes for the distinct

performance change represented in *Figure 6*. Four changes were made when moving from the second to the third rubric iterations. Three categories were removed entirely (*Preparation*, *Volume & Clarity*, and *Materials*) from third rubric, and the category of *Real-time Discussion Notes* was added. It seemed unlikely that the removal of categories in which participants were already demonstrating proficiency would have been related to a dramatic change in the category of *Reference to Notes and Literature*, so I developed and tested a post-hoc hypothesis around the addition of *Real-time Discussion Notes*: If participants act with intentionality in their interactions with the real-time discussions, does their level of performance in *Real-time Discussion Notes* correlate with their level of performance in *Reference to Notes and Literature*?

To test this hypothesis, I calculated correlations between participants' scores in the rubric categories of *Reference to Notes & Literature* and *Real-time Discussion Notes* for discussions 7-11 (all of the discussions scored with rubric iteration 3). The results are displayed in Table 4.

Table 4
Correlation Between "Reference to Notes & Literature" and "Real Time Discussion Notes" Across Discussions in Rubric Iteration 3

Discussion Number	Sample Size (n)	Correlation (r)	Statistical Significance (p-value) one-tailed
7	17	-.2922	0.1275
8	16	.2422	0.1831
9	16	.0355	0.4481
10	14	.7645	0.0007*
11	16	.4808	0.0297*

*results are statistically significant at $p < .05$

For discussion 10 and discussion 11, the final two discussions of the semester, the correlation between the categories of *Reference to Notes & Literature* and *Real-time Discussion Notes* were statistically significant at the $p = .0007$ and $p = .0297$, respectively. These sample sizes are small, and the correlations were statistically significant in only two of the five

discussions; however, the significant correlations were found in the final two discussions of the semester, so it cannot be known if this correlational relationship would have continued if the semester hadn't ended.

Findings

In viewing SPARC from an ecological perspective, I was interested in knowing the patterns of change within the *group* performance over time, as well as studying the evolution of SPARC over time as a result of instructor and participant feedback. Findings are discussed in relationship to the two original hypotheses and the post-hoc hypothesis.

Emergence of the SPARC Process

SPARC is an organic process, with each part reciprocally influencing the other—assessment influences participation as participation influences assessment. As a result, the scoring rubric evolved in response to the collective reflection of all participants. Findings from the use of each rubric iteration guided changes to the next iteration. Making changes to the assessment criteria that removed perceived constraints on the learning space afforded the emergence of rubric criteria that matched participant intentions and increased discussion performance over time.

Efficacy of SPARC for Increased Reciprocity of Group Interactions Over Time

Group means in all rubric areas increased over time and with continued SPARC experience. Participants' responses to the addition of the category of *Real-time Notes & Literature* in the third rubric were positive. Both participant reflection journals and analysis of rubric data supported the hypothesis that this intentional note taking helped participants interact across discussions, therefore increasing reciprocity between groups in SPARC.

Correlation between *Reference to Notes & Literature* and *Real-time Discussion Notes*

A post-hoc analysis of the correlation between two of the categories in the third rubric iteration, *Reference to Notes & Literature* and *Real-time Discussion Notes*, revealed statistically significant correlations between these rubric categories in the last two discussions of the semester. This result provided preliminary data to support a relationship between intentional observer interactions in SPARC with their referencing of notes and literature within their own small group discussions. In other words, paying careful attention to discussion interactions, through the writing of careful notes on these interactions, may be related to referencing past discussions and course materials in subsequent discussions.

Discussion and Educational Implications

At the start of theory building there are often many unanswered questions. With a SPARC prototype developed, there is now opportunity to engage in some empirical research, both qualitative and quantitative in nature, to explore questions about the efficacy of SPARC for increased interactions, to study the character of these interactions, and also to engage participants in quasi-experimental studies to test the potential effects of SPARC on participants' learning outcomes.

There is also a need to look at SPARC components and consider the necessity of various parts within the whole, in order to arrive at the most parsimonious theory of SPARC participation. Currently, we cannot point to any part of the SPARC experience and consider it in isolation. For example, what if reflection journals were not required, or peer feedback was not encouraged, or goal setting was not consistent? Or, what if goal setting was at a classroom rather than an individual level?

Classroom use of SPARC may have pragmatic implications as well. Class size is often perceived as detrimental to learning. At the very least, teacher time is divided further with the addition of each new student. Yet, the reality of classrooms today is movement

towards larger, rather than smaller, class sizes. SPARC holds potential to transform class size from a constraint on the problem space to an affordance, through optimizing participant interactions within group discussion.

The results of this inquiry into the emergence of SPARC are exciting, in that both the qualitative and quantitative data tell similar stories, and therefore act as triangulation of the data to increase trustworthiness of the study (Patton, 2002). Much more inquiry into the efficacy of SPARC is needed, but these preliminary findings are promising for the future of SPARC as an effective group discussion approach. By nesting small group discussions within a larger whole group discussion, the discussion environment suddenly affords *both* opportunity for dialogic interaction that is found most often in small group discussions, *and* a collective reflection-in-action (Schön, 1991), afforded by the perceptions and actions of a greater number of participants than is afforded by a small group.

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