Sense of Community in the Mathematics Classroom:

Contributing Factors and Benefits

Hortensia Soto-Johnson, Nissa Yestness, and Casey Dalton

University of Northern Colorado

Abstract

In this qualitative study we explore how assessments contribute to building a sense of community (SOC) in the classroom of an undergraduate abstract algebra course. Strike (2004) describes community as a process rather than a feeling and outlines four characteristics of community: coherence, cohesion, care, and contact. Using a grounded theory approach we analyzed student interviews and report on the contributing factors to SOC as described by students as well as perceived benefits by these students. We found that contributing factors to SOC align with both Strike’s and McMillan and Chavis’ (1986) definitions of community as well as support social cognitive theory. These results fall into two large categories: teacher and environment. The contributing factors provide a model for a teacher that wishes to build a SOC in his classroom, and the benefits provide support for doing so.

Sense of Community in the Mathematics Classroom:

Contributing Factors and Benefits

In this qualitative study we explore how assessments contribute to building a sense of community (SOC) in the classroom of an undergraduate two-semester sequence abstract algebra course where a variety of six assessments are implemented. The purpose for simultaneously implementing the variety of assessments in the same course in the same term is to support every student's opportunity to learn important mathematics, a guideline put forth by Steen in *Assessment Practices in Undergraduate Mathematics* (1999). By having a variety of assessments, each student is hopefully more likely to associate with one of the assessments and demonstrate his or her knowledge.

Literature Review

Steen offers six guidelines to follow regarding undergraduate assessments in *Assessment Practices in Undergraduate Mathematics* (1999). He claims assessment should (1) be a continuous cycle, (2) be an open process, (3) promote valid inferences, (4) employ multiple measures of performance, (5) measure what is worth learning, and (6) support every student's opportunity to learn important mathematics. With this in mind, mathematicians and mathematics educators began implementing a diverse number of assessments into their undergraduate mathematics courses including: collaborative assessments, (Hagelgans, 1999; Roberts, 1999; Rouoviere, 1999) written projects, journals, (Blum, 1999; Crannell, 1999a; Emenaker, 1999; White, 1999) portfolios, (Knoerr & McDonald, 1999) e-mail, (Fried, 1999) and oral components through interviews or presentations (Crannell, 1999b; Heid, 1999). In order for every student to have an opportunity to learn, implementation of numerous and diverse assessments is required. Although the literature pertaining to implementation of diverse assessments in undergraduate mathematics is plentiful, there is little research on the impact of various assessments implemented simultaneously into the same undergraduate mathematics course.

McMillan and Chavis (1986) define SOC as a perception in which one (1) feels a sense of belonging, (2) feels influential, (3) feels nurtured, and (4) feels an emotional connection to the group. Hill (1996) suggests SOC goes beyond individual relationships and can differ from setting to setting, such as in a classroom. Strike (2004) further describes community as a process rather than a feeling and outlines four characteristics of community: coherence, cohesion, care, and contact. Coherence refers to a shared vision; cohesion is the SOC that results from the shared vision; care is a necessity to initiate one into the vision, and contact refers to structural features of the community.

Recent research on SOC primarily focuses on adolescents (Pretty, Andrewes, & Collett, 1994; Pretty, Conroy, Dugary, Fowler, & Williams, 1996; Sanchez, Colon, & Esparza, 2005; Strahan & Layell, 2006; Strike, 2004; Whiting, 2006). Pretty et al. argue that SOC is significantly related to adolescent's loneliness. Sanchez et al. discuss the role of sense of belonging and academic outcomes of urban, Latino adolescents. They attest that sense of school belonging is a good predictor for academic motivation, effort, and absenteeism. Strahan and Layell describe how struggling middle school students are able to progress in reading and mathematics under the tutelage of supportive teachers who provide a leaner-centered environment. Wighting's results indicate that the use of computers in teaching may contribute to SOC and suggests SOC can be related to academic success. In Pretty and McCarthy's (1991) study on SOC in the workplace they ascertain the length of time a person spends in a setting and SOC do not have a consistent relationship. We take from this that it is possible to develop a SOC within a short- or long-term frame.

More recently, researchers have begun investigating the impact of SOC with college students, albeit the research is minimal. Jacobs and Dodd (2003) establish how burnout among undergraduate students can be predicted by several factors including social support, especially from friends. Students who feel a sense of nurturing from friends are less likely to experience burnout. Lounsbury and Loveland's (2003) research infers a-psychological SOC is significantly related to extraversion, agreeableness, conscientiousness, and neuroticism in undergraduates enrolled in a lower-division psychology course. Thus, students who do not feel a SOC are less likely to interact with other students. These results are crucial given that collaborative work is quite standard in many classes, including mathematics courses.

Research at the graduate level (Austin, 2002; Ferrer de Valero, 2001; Nerad & Cerny, 1993) specifically in mathematics (Carlson, 1999; Grevholm, Persson & Wall, 2005; Herzig, 2002) and SOC is more abundant than at the undergraduate level, but certainly not overwhelming. Although the above-mentioned researchers do not use the term SOC, their results clearly indicate graduate students believe SOC is necessary for success in graduate programs. Austin describes the role of peer and faculty support in completing or continuing a graduate program. She also stresses the need for appropriate feedback and mentoring. Carlson characterizes good mentors as those who pose good questions, are non-intimidating, provide assistance in completing challenging problems, engage students in regular practice, and encourage students to discuss problems. Herzig stresses the importance of formal and informal interaction with faculty and the significance graduate students place on being viewed as junior colleagues in their graduate education. These are all behaviors exhibiting SOC characteristics described by McMillan and Chavis (1986).

Researchers are investigating graduate students' SOC and some even specifically in mathematics, yet there is little research on undergraduate students' SOC. In this report we discuss contributing factors to SOC as well as perceived benefits by these students through the voices of students enrolled in the course. The purpose of this study is to:

- identify how assessments contributed to SOC in the mathematics classroom
- provide benefits of creating SOC in the classroom.

Theoretical Perspective

In an effort to implement assessments relevant to the literature and in line with Steen's (1999) criteria, homework, exams, oral interviews, projects, worksheets, and presentations are used to evaluate students' understanding of the content. The use of the variety of multiple assessments attempts to promote valid inferences, allow for multiple measures of performance, measure what is worth learning, and support every student's opportunity to learn important mathematics (Steen, 1999). The homework, exams, and presentations are implemented on a continuous cycle, while the projects, worksheets, and presentations serve as an open process. The implementation process of the assessments is guided by social constructivism, which assumes that "the terms by which the world is understood are social artifacts, products of historically situated interchanges among people" (Gergen, 1985, p.267).

We believe social interaction influences students' understanding of abstract algebra and provides other benefits to the classroom. The researchers' belief in the necessity of social interaction influenced the choice of assessments and the social nature of these assignments. The teacher implemented the project through group work, and the presentations required interaction among the students in the classroom. The difficulty of the homework and specificity in which it was graded promoted collaborative work.

Method

The Course & Participants

The first-named author, who was the instructor of both courses, used the text *Abstract Algebra: A First Undergraduate Course*, by Hillman and Alexanderson (1994). The first semester centered on group theory and the second semester focused on rings and fields. Students successfully completed calculus I, II, and III, discrete mathematics, and linear algebra, before enrolling in the first semester course. Successful completion of the first course was a requirement for the second semester course. Eight male and twelve female students ($N = 20$) who completed the abstract algebra sequence participated in this study. The students were primarily preservice secondary teachers; three students intended to pursue graduate school.

Assessments Implemented

A rich description of the assessments can be found in Soto-Johnson, Dalton, and Yestness (2007) or by contacting the authors. For purposes of replicability, a description of the assessments is necessary, but for the purposes of discussion of contributors to SOC and benefits of SOC, this rich description is left as a reference.

The teacher graded all assessments for correctness and clarity. Homework was assigned daily, collected and graded on a weekly basis, and returned the class period after it was collected. The instructor encouraged students to work together on homework and provided solutions to the required exercises in the hope that students would assess their own work. Frequently, the solutions distributed came from students. This allowed students to examine proofs produced by other students.

The primary purpose of the exams was to assess students' mastery of the content in a timed setting. The exams throughout the year included in-class, take-home, and oral interview components. The teacher instructed the students not to work together on take-home components, one of the few assessments where collaboration was not allowed. The oral interviews were also individual assessments, which served as an opportunity for students to express their knowledge orally. Two to three weeks after the midterm oral, the instructor gave students a list of potential questions for the final oral. The students pooled resources to help one another prepare potential solutions to the questions.

The intention of the discovery-based projects was to assist students with discovering abstract algebra ideas, connecting abstract algebra and the high school mathematics they will teach in the future, and studying abstract algebra applications. The students investigated the topic with little assistance from the instructor. The groups turned in one written copy of their project, and toward the end of the semester presented their project. The final assessment implemented was worksheets designed to connect several complex abstract algebra concepts through in-class group work. In the second semester, presentations served as a channel for students to communicate mathematics orally and to learn presentation and proof techniques from one another.

Research Instruments

The data for analysis came from semi-structured interviews (Patton, 2002) with the 20 students enrolled in the second semester of the undergraduate abstract algebra sequence (see Appendix I). The researchers audio-taped and transcribed the interviews. Using a grounded theory approach (Strauss & Corbin, 1998) we analyzed the interviews allowing themes to emerge. Two researchers performed the coding and theme searching to provide validity to the research and improve the quality of research by providing a setting to openly discuss ideas and confirm findings. The last two questions (numbers 15 and 16 on Appendix) specifically about SOC yielded the most data; however, students' discussions of particular assessments also provided some insight to the contributors to SOC. It is important to note that the SOC questions came at the end of the interview, and a few of the students volunteered the idea of a community in the classroom earlier in their interviews. Two such questions where students volunteered the idea of community even though the questions do not specifically solicit information about SOC are questions one and nine, which can be found in the Appendix.

Results

During open coding, we found that students mentioned teacher and environment as the primary contributors to the SOC. Figure 1 displays these categories and their subcategories. The first category of teacher includes the subcategories of teacher characteristics and teacher imposed structure of the classroom including assessments. The environment category includes the subcategories of the classroom setting and the students enrolled in the course. These contributors to SOC align with the definitions of SOC given by both Strike (2004) and McMillan and Chavis (1984).

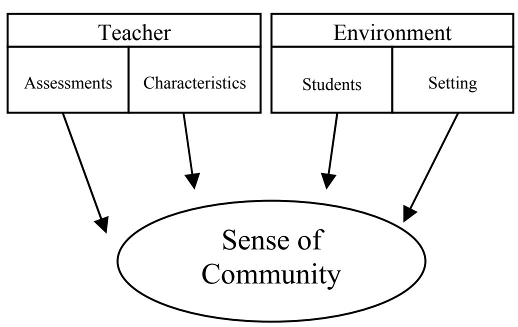

Figure 1

Contributors to SOC: Teacher

Fifteen of the twenty students mentioned the teacher being a contributor to the building of a SOC. The two main teacher characteristics reported by students are social and receptive aspects mentioned by 9 and 7 of the 20 students respectively. Sarah and Melissa share how the example set by the teacher, the teacher's caring personality, and her flexibility contributed to SOC.

> I think it's not only the people that we have in there but the attitude that you set for us. Like you set the example and everybody follows, and then everybody becomes comfortable with the example you set. – Sarah

> I think we communicate well with you. I think that's a huge part, that it's not like we're scarred to come see you. Whereas other classes you rarely go in to see the professor. – Melissa

The teacher-imposed structure of the classroom includes the way the teacher set up the class through group assignments and requiring students to work with a variety of classmates. Assessments contribute to the building of SOC mainly through group work as acknowledged by 17 of the 20 students. The assessments and the number of students who referenced the assessment as a contributor to SOC as shown in parenthesis include tests (1), homework (2), worksheets (3), mini-presentations (6), and projects (12). One student mentioned that the difficulty of tests pushed him and other students to work together to study for the tests and provided an opportunity for student interaction. The difficulty of homework also provided for an opportunity for both peer interaction and student interaction with the teacher. The worksheets and the project were assigned as group assessments thus requiring more student interaction. Students specifically noted that the difficulty of the project required collaboration. The mini-presentations, while not considered group work by the traditional definition, did require student interaction in the classroom. Students reported feeling supported by one another and a sense of respect from peers during their presentations. Caroline and Agustin describe their feelings about the presentations.

> The people were asking questions like it was just more out of genuine curiosity, not like how many points am I going to get for asking this question. – Caroline

> I definitely liked it as a presenter because I felt like I had to write something good because it was going to be in front of my class. …They were always really supportive. … They provided helpful comments. – Agustin

Agustin's quote is an example of an answer to a question not specifically related to SOC:

> Did you learn from the presentations? Why or why not? Discuss from the standpoint of a presenter and evaluator.

Contributor to SOC: Environment

The description of the classroom setting that contributed to SOC included tables (instead of desks) in the first semester and a smaller class size as well as smaller classroom in the second semester. Students mentioned these comments two, six, and three times respectively. These observations were commonly situated in a comment about growth of SOC from first to second semester, which eight students brought up during the interview. The following statement by Caroline refers to the shared vision described by McMillan and Chavis (1986).

> The class is smaller, the room was conducive, the people who couldn't pass it or not interested are no longer there. – Caroline

Anjelina describes an existing feeling of cohesion resulting from the SOC created in the first semester. It appears coherence and a sense of belonging to this classroom and this community began in the first semester course (Strike, 2004; McMillian & Chavis, 1986).

> I think we just had time to bond last semester, and then it just kept going this semester. – Anjelina

Half the students mentioned the two-semester sequence and having a common major as contributors. This is an example of coherence as described by Strike (2004); the students' common major translates, at least in this classroom, to a shared vision.

> Our class, I feel like we always run into each other. We're also all math majors, so most likely we've had other classes with each other. So with that, we can use each other as resources. I think that that's a huge part of our community, because we all have something in common. – Melissa

> For a lot of people it is the first time that they are struggling in math and so other people that are also struggling in math it just automatically builds camaraderie. – Bruno

Bruno's comment also ties into the literature about SOC in graduate school that a challenging assignment brings students together to collaborate on the assignment.

Benefits of SOC

Our initial SOC model can be expanded to include benefits of SOC as shown in Figure 2. Through the coding process, we unveiled two important benefits of SOC as perceived by the students. The students described how SOC improved collaboration and promoted asking more questions. These benefits stem from an environment that endorses learning through increased comfort level among the students and between the students and the professor as illustrated by George and Lauren.

> We are totally different people and never would have become friends or associate if it wasn't for classes… The whole class, we can all discuss and ask each other questions. It's a comfortable atmosphere. – George

> Its nice to have that class that you can kind of, it's almost like a safety net. … It's nice to have all those friends in class. – Lauren

Students reported they were more prone to ask questions in class and work-with other students both in and out of class compared to other math classes. Many instructors tell students there are no stupid questions, but finally Victoria believes her instructor.

> I always felt comfortable asking people questions and not thinking I was dumb or something like that. – Victoria

> I think there was a group dynamic. I got to the point where I could even ask people that I wouldn't have talked to before how to solve a problem or work through things. – Jayden

More importantly, the students describe how SOC helped their learning. Students felt their grades reflected their involvement in the classroom community. Melissa specifically comments on how her involvement in the community impacted her grade.

> When we work outside of your office, I don't have time to do that anymore. People I used to converse with, I don't really talk to as much anymore. So it's a little different this semester. I think it has impacted my learning. Feeling not necessarily as big a part of the community as I was. I think it's made me less confident in the class, and with that obviously my grades are not nearly as good as they were last semester. – Melissa

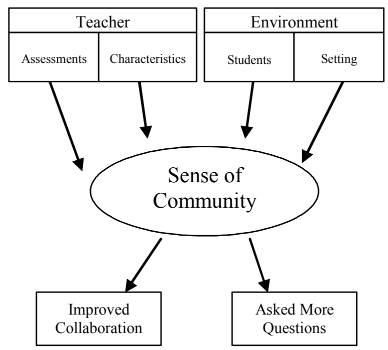

Figure 2

Discussion

The model's two main categories emerged from the original research question regarding how assessment contributed to the SOC in the classroom. We broadened the assessments category to include teacher characteristics and named it Teacher since the teacher is also responsible for the assessments. We also found that students mentioned their physical setting as well as each other as contributors to the SOC. However, by studying the model it is evident that both the teacher and environment categories have a human aspect, the teacher and the students. Looking at the model in this way helps us situate our results within the literature, see Table 1 below. These two subcategories of teacher characteristics (from teacher) and students (from environment) align with care and coherence from Strike (2004) as well as feeling a sense of belonging, nurturing and influential from McMillan and Chavis (1986). The assessments subcategory of teacher aligns more closely with contact from Strike, as does the environment subcategory of setting.

Table 1. **Results Related to Literature**

Research Results	Category: Teacher Subcategory: Characteristics	Category: Environment Subcategory: Students	Category: Teacher Subcategory: Assessments	Category: Environment Subcategory: Setting
Literature	• Coherence – shared vision (Strike) • Care – necessity to initiate once into the shared vision (Strike) • Feels a sense of belonging (McMillan & Chavis) • Feels influential (McMillan & Chavis) • Feels nurtured (McMillan & Chavis)		• Contact – structural features of community (Strike)	

By looking at our model situated in the literature, we can extend the human and environment aspects to Bandura's model of social cognitive theory. Bandura describes his model as "Human functioning is explained in terms of a model of triadic reciprocity in which behavior, cognitive and other personal factors and environmental events all operate as interacting determinants of each other" (as cited in Schunk, 2004, p.84). The environment node includes the classroom setting (e.g. the physical aspects) as well as the student characteristics (e.g. they are all math majors). Further, the teacher can be a part of the environment because of the feedback provided to the students and the manner in which it is done. Thus, the environment is composed of students, teachers and physical attributes of the classroom. The behavior and the personal components of Bandura's model can be represented through both the teacher and students.

The teacher's behavior or the example that she sets impacts how the students interact with one another and creates an environment conducive for questions to the teacher and to other students. Thus, her behavior motivates the personal category. The teacher's personal components (or characteristics) influence the behavior in the classroom as described by students. Similarly, the students' behavior can sway the teacher's behavior. When the students are asking questions and engaged, the teacher may reflect this and stimulate more positive energy in the classroom. The students' personal interactions influence the behavior of the teacher and that of the entire classroom.

The results suggest that creating a SOC in the classroom and the factors contributing to the SOC have some classroom implications. Our model and student comments illustrate transferable components as well as other components that a teacher wishing to build a SOC in the classroom can replicate. Some of the contributors such as teacher and student characteristics are not transferable. On the other hand, contributors such as teacher-imposed structure of the classroom and classroom setting are easily transferable into the classroom. The variety of assessments and their challenging nature provide a setting in which a class can build a SOC.

Some students commented that the difficulty of some assignments influenced them to work with other people when in previous classes they had worked by themselves because they did not feel the need to collaborate with other students. Multiple group assignments again provided the opportunity for students to work with one another. Students mentioned the emphasis on group work in the classroom and group assignments as a major contributor to the building of SOC. Other transferable contributors include environmental factors such as tables (instead of desks), small class size, small classroom, and a yearlong two-semester sequence.

We found one way to build a SOC in a mathematics classroom is by starting with a theoretical perspective of social constructivism. We did this by engaging students inside and outside the classroom through challenging assignments. It is logistically easier to facilitate students working together in the classroom. We encouraged this collaboration outside the classroom with challenging assignments so that students would seek the support of their classmates and collaborate outside the classroom. Miguel describes this for us from the perspective of a student.

> Especially because it's gone on all year. We've all taken this really, really hard class, or at least everyone says it's really hard, but maybe it's not that bad. We all had a chance to work with each other on at least something. I've worked with nearly everybody. It's a good community. – Miguel

Limitations and Future Research

One limitation of this investigation is that the instructor was the primary researcher and interviewer, thus the research lacked anonymity. Although this can influence students to say what they believe the instructor wants to hear, the students did not hesitate to state pros and cons of the assessments.

For the past 15 years we have seen an increased amount of classroom collaboration in mathematics classrooms (Vidakovic, 1992). However, we are not aware of the full impact of this collabation. More research is needed to validate the findings of this study as well as to continue to discover and document benefits of collaborative work and alternative assessments. It is clear that in this course, the collaboration was effective and students learned not only from the teacher but also from one another. Future research on facilitating effective collaborative work will also help to expand the research base on collaborative work.

Another possibility for future research includes investigating the influence that courses with multiple assessments have on pre-service teachers. Specifically, how do these courses impact their teaching and assessment styles? In answer to the question "What assessments did you enjoy most?" Sarah relates this course to her future career as a teacher

The presentations. Because it's like teaching and that is what I want to do. I felt like it was, I think in the atmosphere we have in this class, it's so easy to get up there and do it. Like I'm in this English class right now, and there's no atmosphere in there that's inviting, so it's not fun to get up there. – Sarah

References

Austin, A. E. (2002). Preparing the next generation of faculty: Graduate school as socialization to the academic career. *The Journal of Higher Education, 73*, 94-122.

Blum, D. J. (1999). Using writing to assess understanding of calculus concepts. In B. Gold et al. (Eds.), *Assessment in Undergraduate Mathematics: MAA Notes # 49* (pp.126-128). Washington, DC: MAA.

Carlson, M. P. (1999). The mathematical behavior of six successful mathematics graduate students: Influences leading to mathematical success. *Educational Studies in Mathematics, 40*(*3*), 237-258.

Crannell, A. (1999a). Assessing expository mathematics: grading journals, essays, and other vagaries. In B. Gold et al. (Eds.), *Assessment in Undergraduate Mathematics: MAA Notes # 49* (pp.113-115). Washington, DC: MAA.

Crannell, A. (1999b) Collaborative oral take-home exams. In B. Gold et al. (Eds.), *Assessment in Undergraduate Mathematics: MAA Notes # 49* (pp. 143-145). Washington, DC: MAA.

Emenaker, C. E. (1999). Assessing modeling projects in calculus and precalculus: Two Approaches. In B. Gold et al. (Eds.), *Assessment in Undergraduate Mathematics: MAA Notes # 49* (pp. 116-119). Washington, DC: MAA.

Fried, M. D. (1999). Interactive e-mail assessment. In B. Gold et al. (Eds.), *Assessment in Undergraduate Mathematics: MAA Notes # 49* (pp. 80-83). Washington, DC: MAA.

Gergen, K. J. (1985). The social constructionist movement in modern psychology. *American Psychologist, 40*, 266-275.

Hagalgans, N. L. (1999). Combining individual and group assessment. In B. Gold et al.

(Eds.), *Assessment in Undergraduate Mathematics: MAA Notes # 49*, (pp.134-136). Washington, DC: MAA.

Heid, M. K. (1999). In-depth interviews to understand student understanding. In B. Gold et al. (Eds.), *Assessment in Undergraduate Mathematics: MAA Notes # 49*, (pp. 109-112). Washington, DC: MAA.

Herzig, A. H. (2002). Where have all the students gone? Participation of doctoral students in authentic mathematical activity as a necessary condition for persistence toward the Ph.D. *Educational Studies in Mathematics, 50*, 177-212.

Hill, J. L. (1996). Psychological sense of community: Suggestions for future research. *Journal of Community Psychology, 24*, 431-438.

Hillman, A. P., & Alexanderson, G. L. (1994). *Abstract algebra a first undergraduate course*, (5th ed.). Prospect Heights, IL: Waveland Press.

Knoerr, A. P., & McDonald, M. A. (1999). Student assessment through portfolios. In B. Gold et al. (Eds.), A*ssessment in Undergraduate Mathematics: MAA Notes # 49*, (pp. 123-125). Washington, DC: MAA.

McMillan, D. W., & Chavis, D. M. (1986). Sense of community: A definition and theory. *Journal of Community Psychology*, *24*, 381-394.

Patton, M. Q. (2002). *Qualitative Research and Evaluation Methods* (3rd ed.). Thousand Oaks, CA: SAGE.

Pretty, G. H., Andrews, L., & Collett, C. (1994). Exploring adolescents' sense of community and its relationship to loneliness. *Journal of Community Psychology*, *22*, 346-358.

Pretty, G. M. H., Conroy, C., Dugay, J., Fowler, K., & Williams, D. (1996). Sense of community and its relevance to adolescents of all ages. *Journal of Community Psychology, 24*(4), 365-379.

Roberts, C. A. (1999). Group activities to evaluate students in mathematics. In B. Gold et al. (Eds.), *Assessment in Undergraduate Mathematics: MAA Notes # 49*, (pp. 137-139). Washington, DC: MAA.

Rouviere, C. W. (1999) Continuous evaluation using cooperative learning. In B. Gold et al. (Eds.), *Assessment inUndergraduate Mathematics: MAA Notes # 49*, (pp. 140-142). Washington, DC: MAA.

Sánchez, B., Colón, Y., & Esparza, P. (2005). The role of sense of school belonging and gender in academic adjustment of Latino adolescents. *Journal of Youth and Adolescence, 34*(6), 619-628.

Schunk, D. H. (2004). *Learning Theories: An Educational Perspective* (4th ed.). Upper Saddle River, NJ: Pearson.

Soto-Johnson, H., Yestness, N., & Dalton, C. (2007). *Assessments of Alternative Mathematics Assessments*. Manuscript submitted for publication.

Steen, L. A. (1999). Assessing assessment. In B. Gold et al. Eds.), *Assessment in Undergraduate Mathematics: MAA Notes # 49*, (pp. 1-6). Washington, DC: MAA.

Strahan, D. B., & Layell, K. (2006). Connecting caring and action through responsive teaching: How one team accomplished success in a struggling middle school. *The Clearing House, 79*(3), 147-153.

Strike, K. A. (2004). Community, the missing element of school reform: Why schools should be more like congregations than banks'. *American Journal of Education, 110*, 215-232.

Strauss, A., & Corbin, J. (1998). *Basics of qualitative research: Techniques and* *procedures for developing grounded theory.* Thousand Oaks, CA: SAGE.

Vidakovic, D. (1992). Collaborative Work – opportunities for learning through social Interaction. *Paper presented at The Fifth Annual International Conference of Technology in Collegiate Mathematics*. Rosemont, IL.

White, A. (1999). Journals: Assessment without anxiety. In B. Gold et al. (Eds.), A*ssessment in Undergraduate Mathematics: MAA Notes # 49*, (pp. 129-130). Washington, DC: MAA.

Wighting, M. J. (2006). Effects of computer use on high school students' sense of Community. *Journal of Educational Research, 99*(6), 371-379.

Appendix

Interview Questions

1. Did you learn from the presentations? Why or why not? Discuss from the standpoint of a presenter and evaluator.
2. Did you learn from the projects? Discuss in terms of the presentations and presenting?
3. What were the advantages of working on a project as a exam?
4. What were the disadvantages of working on a project as a exam?
5. Do you feel that it was valuable to try to read mathematics on your own as part of the exam #3 project? Why or why not?
6. What assessments do you feel reflected your knowledge of the material best? Why?
7. What assessments do you feel do not reflect your knowledge of abstract algebra? Why do you feel this way?
8. What assessments did you feel were the most challenging? Why?
9. What assessments did you enjoy the most? Why?
10. Did you enjoy having a practice midterm oral? Why or why not?
11. How do you feel about having an oral component to the final? Explain.
12. Have your feeling towards the oral component changed from last semester? If so, how? If not, why not?
13. Do you feel that your proof –writing skills have improved over the last two semesters? What do you attribute this too?
14. Is there any thing that you would like to share with me about the assessments that have been used in the abstract algebra class?
15. Did you feel that there was a sense of community during this and last semester? Why or why not?
16. What do you feel contributed to this?