REFERENCES

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Evaluating Collaborative Learning and Community

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ABSTRACT. The goal of this study was to validate measures and assess the effects of collaborative group-learning methods in real classrooms on 3 specific dependent variables: feelings of campus connectedness, academic classroom community, and effective group processing (2 factors). Confirmatory factor analyses were conducted to evaluate a 4-factor model. Using hierarchical linear modeling techniques, results indicated that campus connectedness and collaborative learning (compared with no collaborative learning) predicted positive academic classroom community. For classes using more formal cooperative group work, campus connectedness and group processing–evaluation predicted positive academic classroom community. Suggestions for further applications of the measures are discussed.

Key words: campus connectedness, classroom community, collaborative learning, cooperative learning

RECENTLY, RESEARCHERS IN HIGHER EDUCATION have focused on creating community in increasingly diverse undergraduate classrooms (Boyer, 1990). Boyer stated that one priority for universities should be to establish a purposeful community, one in which "faculty and students share academic goals and

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work together to strengthen teaching and learning on the campus" (p. 7). Astin (1991, 1993a) suggested that the development of campus community should begin by adopting a philosophical and pedagogical framework that supports community at the classroom level by using instructional approaches that focus on collaborative learning. Using these methods, faculty can facilitate students' development of teamwork skills when they work together to obtain a common goal. Indeed, these competencies are essential to the development of an institutional learning community (Astin, 1991).

Although small-group learning methods are being promoted in college settings, currently there are few assessment tools to measure the effectiveness of collaborative learning on the development of community in the classroom. Thus, the foci of this study were twofold. The first was to develop and validate measures that assess students' perceptions of academic classroom community and of collaborative group processes. The second focus was to test the relationship between collaborative learning on students' perceptions of academic classroom community as an outcome variable in undergraduate classrooms.

Calls for Community Building

In 1990, Ernest Boyer wrote a report for the Carnegie Foundation entitled *Campus Life: In Search of Community*. In his report, Boyer catalogued a number of problems plaguing institutions of higher education, including students' incivility, lack of student motivation, and the dispersion of the student body into a transient-like population. Alarmed by these trends, he called on higher education personnel to put more emphasis on building campus community among faculty, students, and staff. Soon after Boyer's book was published, Pascarella and Terenzini (1991) wrote *How College Affects Students: Findings and Insights From Twenty Years of Research.* In their book, they cited the importance of student–faculty contacts and an institution's atmosphere as underlying mechanisms for the development of students as well-rounded individuals who could think critically. In addition, national surveys, such as the College Student Experiences Questionnaire (Kuh, Pace, & Vesper, 1997; Kuh & Vesper, 1997) and the National Survey of Student Engagement (Kuh, 2001), were developed to document activities and conditions of campus life that contribute to an enhanced undergraduate experience.

Most of these writings and instruments take a global view of educational institutional life (i.e., the institution as a whole). In a follow-up to Boyer's (1990) work, McDonald (2002) reported on a wide range of institutions that attempted to implement Boyer's principles. Two of the common concerns that McDonald reported were (a) the need to expand the institution's initial efforts to be inclusive of the entire campus and (b) the difficulty of assessing the impact of programs that address the needs of the institution as a whole. Thus, whereas Boyer's

work took a macro-approach to developing institutional campus communities, McDonald acknowledged that the source of community development might need to include more student-centered approaches that begin at the classroom level.

The Development of Learning Communities

The idea of developing learning communities on campus and in the classroom draws from the general ideas of community and constructivist theories of learning (Gabelnick, MacGregor, Matthews, & Smith, 1990), as well as from learning paradigms of student-centered education (Barr & Tagg, 1995). These studies indicated positive outcomes of developing campus learning communities, and the lack of community has intriguing negative outcomes on such variables as student retention. For example, Astin (1993b) reported that college student retention was positively related to student–student and student–faculty contact, both possible indicators for feelings of campus community. This finding is consistent with an earlier publication in which Astin (1984) described student–student and student–faculty contact as an indicator of student involvement or investment in their college education. For example, students who were more involved on campus (especially those who had copious amounts of faculty contact) were less likely to drop out of school than students who were not as involved. In the same study, campus size was negatively related to retention. Although some researchers have argued that large university campuses may make it difficult for students to feel part of a campus-level community (Pascarella, Edison, Nora, Hagedorn, & Terenzini, 1996), others have indicated that college size may not be as relevant to building campus community as originally thought (Summers, Svinicki, Gorin, & Sullivan, 2002).

Another noticeable omission from the learning communities literature is how student variables, such as gender, contribute to local (i.e., classroom-level) or global (i.e., school-level) feelings of community. In the "chilly climate" research originally reported by Hall and Sandler (1982), in which college classrooms were described as having an atmosphere rich with gender inequities, they observed that faculty behavior was generally preferential to male students over female students, and faculty directed many more disparaging remarks to female students than to male students. For women, collaborative learning is highly recommended as a method of inviting all students to actively participate in the learning process. For instance, in a follow-up to the original "chilly climate" study, Sandler, Silverberg, and Hall (1996) recommended strategies to increase participation of all students in class, including the use of group-learning techniques.

Also missing from the learning communities literature are quantitative investigations regarding success or failure outcomes of community-building methods. Most of the outcomes research of learning communities has been qualitative in nature, although Gabelnick et al. (1990) did report some initial quantitative re-

sults of community outcomes, such as student retention, achievement, and cognitive development. Most of the reported qualitative research that supports learning community outcomes has been based on participants' journals and interviews. Hence, one important aspect of our current research was to develop a survey that could capture outcomes of instructional methods targeted to develop learning communities.

Collaborative Learning as a Way to Develop Community

Although the collaborative learning movement was originally derived from literature and practice at the elementary and secondary level (Slavin, 1991), the application of these strategies has become a widely practiced instructional method in higher education. Indeed, Chickering and Gamson (1987) included the use of collaboration among college students in their influential work "The Seven Principles for Good Practice in Undergraduate Education." Subsequent applications of the suggestions found in Chickering and Gamson's article, as well as other publications that incorporate some or all of these principles, have demonstrated that collaboration among college students relates to positive student outcomes. For example, Kuh et al. (1997) found that collaboration among students was one variable that had a positive effect on educational gains. Furthermore, Astin (1993b) stated that college students' retention is positively correlated with most measures of students' school-related involvement, such as student–student contact and student–faculty contact. On the other hand, he also reported that faculties' use of teaching strategies that promoted students' active learning, possibly in the form of group projects, had a negative effect on college students' retention. Astin cited Johnson, Johnson, and Smith's (1991) review of the literature as offering a possible explanation for this finding, suggesting that poorly designed group learning can produce worse results than competitive approaches. Based on their findings, Johnson et al. suggested that further refinement of collaborative group procedures was necessary. The current literature on collaborative learning methods is, therefore, very specific about the techniques and procedures necessary for teachers to follow to have positive learning outcomes in their classes.

Collaborative Group Work and Learning

In the best collaborative learning situations, the members of a group should benefit in several ways. For example, according to Slavin (1995a, 1995b), in the process of working together, students should acquire new strategies and knowledge, both about the subject and about thinking in general. When a class is divided into groups, a new social context is created in which students have the opportunity to share individual cognitions with their peers and come to a conclusion based on the sum of those cognitions. One can think of the benefits of collabo-

rative group learning arising in several ways. Among these are benefits derived from the method itself and benefits derived from the social context of learning that is part of group learning.

Benefits from characteristics of the method itself. The collaborative learning process requires that all members of the group agree on the team goals and each member must attribute his or her own successes to the success of the group to maximize the learning potential of the whole group (J. Cooper, Robinson, & McKinney, 1994). This is where individual accountability becomes key: When students themselves are motivated and are invested in the success of the group, they will be more likely to encourage success and motivation among other members of the group. Colbeck, Campbell, and Bjorklund (2000) reported extensively on the processes that need to occur in groups for students to deem the group successful. Their study included focus group responses to questions about elements that were most helpful in making group learning beneficial. Their study sample, consisting mostly of engineering students working in project teams, reported that prior experience in group work had been most beneficial in helping them collaborate effectively on a current project.

Benefits derived from learning in a social context. According to Ickes, Bissonnette, Garcia, and Stinson (1990), coordinated cognitive activity depends on *intersubjectivity*, that is, a shared understanding among group members of the work to be accomplished. In the case of collaborative learning, the instructor is responsible for setting up a problem so that intersubjectivity can be reached even before the process of problem solving begins. Once initial understanding of the problem has been reached, one outcome that can come out of the problem-solving process is socially shared cognitions (Levine, Resnick, & Higgins, 1993).

Traditionally, individual cognitions have been the subject of educational and psychological research. Some progress has been made in the recent development of social perspective theorists, who have accepted the role of social and cultural contexts on individual cognition (Reynolds, Sinatra, & Jetton, 1996). These theories can be traced back to Vygotsky (1978), who was the first to postulate that social experience can shape the cognitive processes of individuals in a learning situation. However, even social perspective theories are focused on cognitive processes of individuals within a context and not necessarily on the cognitive process of group interaction. Levine et al. (1993) challenged the idea that cognition is exclusively an individual act, as psychologists have assumed, and proposed that cognitive and social aspects of working in a group are fused together.

Because peer-learning techniques provide opportunities that are both social and academic in nature, students may be influenced via peer interactions in a classroom that uses peer-learning groups. *Collaborative* activities in the classroom are some of the most effective means for increased conceptual gains and enjoyment of the learning task (M. Cooper, 1999). In a traditional collaborative

group activity, the instructor assigns a task with an outcome goal to each small group, gives the groups a set amount of time to complete the task, and then asks the group to share its results with other groups, the whole class, and the instructor. In contrast to collaborative learning techniques, *cooperative* learning techniques typically are seen as more structured learning tasks that are monitored much more closely by the instructor; cooperative learning is also known as a specific type of the more general collaborative learning activities. For example, Johnson and Johnson (1998) have been very specific about the instructor's role in the implementation and monitoring of cooperative learning in the following ways: The instructor introduces the lesson, assigns students to groups of two to five members, gives students the materials they need to complete the assignment, and assigns students roles; explains the task, teaches any concepts or procedures the students need, and structures the cooperation among students; intervenes when students do not understand the academic task or when there are problems in working together; and evaluates the academic success of each student. Thus, we interpreted cooperative learning as a process-oriented, methodical, and more formal form of collaborative learning. Student outcomes of cooperative learning include but are not limited to characteristics such as positive interdependence, accountability, cognitive development, and social development (Slavin, 1991).

Building on the Current Literature

Although progress is being made in extending collaborative and cooperative learning research to postsecondary settings (Johnson et al., 1991), often what is found is based on nonstandard instruments and measures that cannot or have not been used elsewhere. This makes cross-institutional comparison difficult in the absence of a sufficient body of work to conduct meta-analyses on all but the most general variables. In an early compendium of measures that were appropriate for problem-based learning, a version of a collaborative learning scale was found in Woods's (1997) compilation of instructor activities to improve student learning. Woods listed several assessment tools designed to measure outcome variables of student learning. Unfortunately, some of these instruments lacked validity and reliability information.

To further our understanding of what happens in collaborative and cooperative learning at the college level, we need to encourage researchers and faculty alike to consider a more consistent approach to studying the phenomena. If we look at the kinds of claims being made about the effects of group work, we see some fairly standard outcomes that are believed to result from using group work. Student attitudes about the effectiveness of group work can be seen as either specific to the situation and, therefore, a mediator of change in the other variables or as a pre-existing condition that influences how well group work is able to change the other variables. Whichever perspective is taken, these student perspectives

are independent of course content and, therefore, are amenable to study across disciplines. The investigation of group work at the college level would benefit from valid and reliable measures that could examine these variables.

In the research that we present here, we investigated two primary hypotheses. We anticipated that (a) students enrolled in courses that used either collaborative or cooperative group learning techniques would experience significantly higher feelings of classroom community than students enrolled in courses that did not use any form of group work, and (b) for students enrolled in courses that consistently used cooperative learning techniques throughout the semester (also known as *formal group learning* and *long-term projects with group goals* [Johnson & Johnson, 1998]), positive evaluations of group processes (i.e., the effectiveness of group work) would significantly predict feelings of classroom community. We included gender and feelings of overall campus connectedness as predictors in our study for the following reasons: (a) The role of gender currently is absent in the learning community literature, but it is prevalent in research on the "chilly climate" and group learning; and (b) we wanted to establish an empirical relationship between the feelings of campus connectedness and the effects of group learning as suggested by Astin (1993a).

Method

Measuring the Impact of Group Work

Extant research has led us to believe that students' experience of positive group processes in higher education settings may relate to their feelings of community in the class itself. Therefore, our study included classrooms that practiced either more formal cooperative learning methods, informal collaborative learning methods, or no group work in a pre-posttest design with the intention of testing any significant differences in students' perceptions of classroom community as a function of group work (formal and informal) or no group work over time. *Formal cooperative group work* was characterized by students participating in the same group over the entire semester, using strategies associated with cooperative learning (e.g., enhanced role of the instructor), with a large project as the outcome of group efforts. *Informal collaborative group work* was characterized by students participating in group discussions, collaborative tasks, and having inconsistent or unassigned groups, with small short-term projects as the outcome of group efforts. *No group work* was associated with classrooms that used a traditional lecture style with no opportunity for student interaction.

During the fall and spring semesters of the 1999–2000 academic year, 30 faculty members at a large southwestern university allowed the research team to gather data from their undergraduate classes at the beginning and end of the semester. Six of these faculty members were accepted on a university grant initiative supporting the incorporation of formal cooperative learning methods in their

classes and the assessment of consequent outcomes in their classrooms. Faculty accepted on the grant received a small honorarium that could apply to instructional development, including teaching assistant support. These faculty, most of whom had never used group work in their classes previously, were required to attend a training seminar so that they could learn and apply the techniques associated with formal cooperative group learning techniques in their courses. The training seminar consisted of a 2-hr mini-lecture designed to introduce the principles of cooperative learning, a binder that included relevant articles and book chapters on implementing cooperative learning in college classrooms (see the Appendix for binder section guide), and a videotape that the participants could view for an example of instruction using formal cooperative learning techniques. Within the lecture and the binder, content focused on the following topics in implementing cooperative learning techniques: philosophy of cooperative learning; diversity in the classroom; research on cooperative learning; how to use, design, and assess cooperative learning; and tools for using cooperative learning. Faculty that participated in the seminar taught in a variety of course domains, including social sciences (introductory psychology and child psychology), liberal arts (classics, introductory French, and American government), and engineering (engineering statistics). Observations of these classes confirmed that the instructors were following the tenets of cooperative learning (i.e., similar to expectations of training; Appendix). Within each class, a group of students volunteered to be observed at least 2 times during the semester and were audiotaped by a research assistant. The tapes were analyzed for quality of interaction among students, using benchmarks such as group characteristics (i.e., ethnic and gender diversity), participation, task interpretation, and group process.

An additional 24 faculty members who did not submit grant proposals agreed to participate as volunteers (faculty were selected from a range of disciplines and instructional levels that were representative of undergraduate student interest and enrollment, i.e., with more liberal arts than natural science instructors being asked to participate; Table 1). Some of the volunteer faculty members already used group learning strategies; others did not use any form of group work in their classes. We learned who was using formal, informal, and no group work by simply asking the instructor what type of instructional techniques they used in their classes. For those that claimed to use cooperative or collaborative group work, a similar observation technique like the one described in the grant-recipient classes was used to verify student interaction, except that there was only one observation and no use of audiotapes. Using this technique, we estimated that seven of the courses used formal cooperative group work, five used informal, collaborative group work, and the remainder used no group work. The classes ranged in size from 10 students enrolled in a biology seminar to 248 students enrolled in an American history class. It should be noted that because our data for verifying cooperative learning were solely observational, we chose not to offer feedback to

TABLE 1. Demographic Characteristics of Participants in Classes With Group Work (n = 652)[a] and Participants in Classes Without Group Work (n = 1,487)[b] Compared With University Statistics[c]

	Fall 1999					Spring 2000			
	Group work		No group work		University	Group work		No group work	
Characteristic	*n*	%	*n*	%	%	*n*	%	*n*	%
Gender									
Male	123	37.7	391	45.9	50.4	99	30.4	221	34.8
Female	203	62.3	461	54.1	49.6	227	69.6	414	65.2
Ethnicity									
White	219	67.2	566	66.4	64.6	216	66.3	405	63.8
Hispanic	45	13.8	123	14.4	13.7	44	13.5	87	13.7
African American	14	4.3	32	3.8	3.4	18	5.5	3	0.5
Asian American	45	13.8	131	15.4	14.5	39	12.0	102	16.1
Native American	2	0.6	4	0.0	0.4	0	0.0	6	0.9
Other	0	0.0	30	3.5	3.3	9	2.8	3	0.5
Course domain									
Liberal arts	214	65.6	770	90.4	41.2	170	52.1	148	23.9
Engineering	59	18.1			11.6	69	21.2		
Natural sciences			82	9.6	31.8			314	50.8
Fine arts					6.9			22	3.6
Education	53	16.3			8.5	87	26.7	165	26.7

Note. Classes that incorporated cooperative learning participants included either formal or informal group work strategies.
[a]Fall 1999: n = 326; Spring 2000: n = 326. [b]Fall 1999: n = 852; Spring 2000: n = 635. [c]Based on university enrollment statistics collected for the 1999–2000 academic year; course domain statistics are proportional to the total for those domains only.

instructors regarding effectiveness or change until the study was complete, at which time we provided a brief report of student survey data to each instructor.

Participants

We asked students enrolled in these classrooms to complete pretest and posttest surveys, approximately 2 weeks into and 2 weeks from the end of the semester (approximately 3 months passed between the pretest and posttest surveys). The return rate between the pretest and posttest surveys was approximately 50% of students enrolled in these classes: We retained data only for students with complete datasets. On completion of the posttest survey, students were referred to a Web site containing debriefing information. Although we were concerned about the student response rate, it was understood that there would be some attrition due to student dropout, lower levels of attendance at the end of the semester, and instructors who did not monitor student attendance. Although some might view this as a limitation for pre-post research, we believed that the importance of the study superceded the possible issues related to student attrition, thus we were satisfied with the approximately 1,500 complete data cases for purposes of analysis.

Because the posttest surveys contained all scales used in this study, responses of students on the posttest surveys who participated in courses that used group learning activities in the fall 1999 and spring 2000 semesters were used for psychometric analyses (only students enrolled in classes that used group work responded to the group-processing scales, giving us reason to use only this population for our confirmatory factor analysis). A total of 533 students in group work classes (326 in the fall 1999 semester and 207 in the spring 2000 semester) completed the pretest and posttest surveys, and a total of 961 students in non-group work classes (326 in the fall semester and 635 in the spring semester) completed the pretest and posttest surveys. The demographic characteristics of students included in the confirmatory factor analysis were representative of the university population available for 1999, although we did survey more women than men in our sample. Most of the students surveyed were between the ages of 18 and 22 years. Table 1 contains the demographic characteristics of our total student sample.

Instruments

We administered the adapted Social Connectedness Scale (Lee & Robbins, 1995) in both the pretest and posttest. The Group Processing Scale and the Academic Classroom Community Scale were administered only as part of the posttest survey. In addition, the Group Processing Scale was administered only to students in courses that implemented group work.

Social connectedness. Lee and Robbins (1995) originally developed the Social Connectedness Scale to measure general feelings of connectedness to peers in college, defining *connectedness* as "a student's psychological sense of belonging" (Lee & Davis, 2000, p. 110). We modified this scale specifically to measure connectedness to the campus and included such statements as "I know a lot of people *on this campus*" or "I have a lot of friends *on this campus* that I feel I can tell anything." Students indicated on a 6-point Likert-type scale the degree to which they agreed or disagreed with each statement (1 = *strongly disagree*; 6 = *strongly agree*). Lee and Robbins reported a Cronbach's alpha of .92 for their data, suggesting strong support for the internal consistency of their Social Connectedness Scale.

Academic classroom community. As a corollary to the Social Connectedness Scale, we designed our own Academic Classroom Community Scale to measure students' feelings of community in the classroom. To develop these items, we identified constructs in the literature that were relevant to feelings of community (e.g., classroom climate) and transformed these constructs into self-report items. This scale included such items as "I feel connected to people in this class" and "I feel I fit into this class."

Group processing. Finally, we developed our own Group Processing Scale based on elements of successful group work (Walker & Angelo, 1998). Our final measure contained items designed to assess students' perception of the effectiveness of group work on completion of a course that used group work. This scale included such items as "Overall, each of the group members contributed his or her fair share" and "As a result of group work, I improved my problem-solving skills."

Analysis

To ensure that there was no variation in perceived instructor effectiveness, we collected student-evaluation data for a sample of instructors from each domain (engineering, liberal arts, education, natural sciences, and fine arts) during the target semester. The faculty evaluation data showed that the average of overall instructor ratings ranged from 3.3 to 4.9 on a 5-point scale (3 = *satisfactory*; 5 = *excellent*). Using the Kruskal–Wallis test, a nonparametric version of the one-way analysis of variance (ANOVA) for independent samples, we found no significant difference in instructor effectiveness between domains.

We anticipated that a complete battery of the established and new scales would yield a fairly predicable factor structure with a minimum of four factors (one for each scale) emerging. We conducted an initial confirmatory factor analysis using complete datasets with Bentler's (1993) structural equation modeling program to explore the factor structure underlying the fall 1999 sample's responses to the set of surveys. The final structure was then cross-validated through a multiple-group

confirmatory factor analysis constraining factor loadings and intercorrelations between the factors to be equal across the fall 1999 and spring 2000 samples' responses.

After conducting a confirmatory factor analysis and cross-validating the fall and spring semesters for students who participated in cooperative learning classrooms, we conducted hierarchical linear modeling (HLM) using software developed by Raudenbush, Bryk, and Congdon (2001) to test the effects of individual-level predictors (Level 1) and classroom-level predictors (Level 2) with academic classroom community (ACC) as the dependent variable.

The best way to investigate the impact of classroom effects and individual effects is to use different levels of analysis, or HLM, so that one level is represented as group effects and one level is represented as individual effects. This method also prevents a violation of the assumption of independence, given that students in the same class are not really independent of classroom effects, which would otherwise deflate standard errors and Type I errors.

The models in this study have a two-level hierarchical structure, with students nested in classes. The multilevel analyses proceeded in two steps: (a) to investigate the unconditional model and (b) to analyze the effects of individual- and class-level variables on achievement goals. Unconditional models, which include no explanatory variables entered at Level 1 or Level 2, allow one to assess the proportion of variance in the dependent variable that can be explained at the individual level (σ^2) and at the class level (τ_0^2). From these estimates, the intraclass correlation coefficient can be calculated as follows:

$$\rho(Y) = \frac{\tau_0^2 \text{ (between-group variance)}}{\tau_0^2 + \sigma^2 \text{ (total variance)}}.$$

This parameter allows one to assess the proportion of total variability that is associated with classroom differences (Snijders & Bosker, 1999). If the intraclass correlation is relatively large, then it is important to include Level 2 in the model because there is variance to be explained at this level. Once relevant predictors are included in the model, the proportion of variance explained by the predictors can then be assessed. For example, the unconditional model equation for ACC was specified as follows:

$$\text{ACC} = \beta_{0j} + e_{ij},$$

where ACC represents the academic classroom community for individuals at Time 2, β_{0j} represents the mean for students' academic classroom community scores, and e_{ij} represents any remaining unexplained variance or error variance.

Once Level 1 predictors were added, all slopes (up to three; β_{1ij}, β_{2ij}, and β_{3ij}) were modeled as fixed and grand-mean centered, meaning that each individual's score was adjusted by subtracting it from the grand mean ($\bar{X}.. - X_{ij}$). Grand-mean

centering yields an intercept that can be interpreted as an adjusted mean for class *j*, so that a score of zero can be interpreted as a score that falls on the grand mean (Bryk & Raudenbush, 1992). For example, a Level 1 equation with three parameters that are grand-mean centered is expressed in the following equation:

$$Y_i = \beta_{0j} + \beta_{1ij}(\bar{X}_{1..} - X_{1ij}) + \beta_{2ij}(\bar{X}_{2..} - X_{2ij}) + \beta_{3ij}(\bar{X}_{3..} - X_{3ij}) + e_{ij}.$$

β_{0j} is still the mean or average level of motivation at Time 2 for students belonging to class *j*, now taking into account the means of the other predictors in the equation (X_1, X_2, and X_3). In the Level 2 model, the intercept in the Level 1 model becomes an outcome variable that is modeled as a function of Level 2 characteristics. In this case, these were classroom characteristics. In addition, all the predictors in the Level 1 equations are modeled as fixed, that is, the effects of these variables are fixed across classrooms and are, therefore, not allowed to vary. This is modeled by setting the predictor intercepts as having no error variance, as follows:

$$\beta_{1ij} = \gamma_{10},$$
$$\beta_{2ij} = \gamma_{20},$$
$$\beta_{3ij} = \gamma_{30}.$$

Level 2 predictors were also grand-mean centered and fixed. The first step of these HLM analyses involved running an unconditional model to evaluate the proportion of unexplained variance in the pertinent dependent variable at Level 1 (the student level) and Level 2 (the classroom level). The second step involved adding Level 1 and Level 2 predictors to investigate the relationship between the dependent variable and specific student and classroom variables (i.e., group work, no group work).

Scale Development and Validation

The factor structure best explaining responses to items on each of the scales was established individually before the final investigation of the model incorporating each scale's factor structure and the correlations between those factors. We anticipated that two correlated factors, one underlying responses to the Adapted Social Connectedness Scale and one underlying the Classroom Community Scale, would best explain the pattern of responses to these scales. This hypothesis was supported empirically. Adapted Social Connectedness Scale items loaded strongly on a social connectedness factor; the Academic Classroom Community Scale items loaded on a separate but correlated classroom community factor. The loadings ranged from .57 to .82 for the two factors (Table 2).

Group processing. For the group processing items, fit indices indicated the data did not fit a one-factor model. After a content analysis of the items, it appeared

that each of the 10 items fell into one of two categories. The items seemed to evaluate a group's effectiveness at working together (Group Processing—Evaluation) or to measure the effect on the individual of working in a group (Group Processing—Effect on the Individual). A statistical comparison of the one- and two-factor models supported the selection of the two-factor model. The loadings ranged from .59 to .83 (Table 3).

Four-Factor Model

Once the factor structure underlying responses to the scales had been established, we tested the resulting four-factor model concurrently using the fall 1999 sample's data. The comparative fit index (CFI) and the non-normed fit index (NNFI) resulting from the maximum likelihood confirmatory factor analysis were both greater than .90 (CFI = .92, NNFI = .91), indicating that the data fit

TABLE 2. Factor Loadings for Social Connectedness and Classroom Community From a Confirmatory Four-Factor Solution

Item	Factor loading
Factor 1: Social Connectedness (adapted)	
1. I feel disconnected from campus life.[a]	.69
2. There are people on campus with whom I feel a close bond.	.58
3. I don't feel that I really belong around the people that I know.[a]	.65
5. I feel that I can share personal concerns with other students.	.57
7. I feel so distant from the other students.[a]	.80
8. I have no sense of togetherness with my peers.[a]	.82
9. I catch myself losing all sense of connectedness with college life.[a]	.71
10. I feel that I fit right in on campus.	.77
11. There is no sense of brotherhood/sisterhood with my college friends.[a]	.70
13. I don't feel related to anyone on campus.[a]	.74
14. Other students make me feel at home on campus.	.70
15. I don't feel I participate with anyone or any group.[a]	.71
Factor 2: Classroom Community	
4. I feel connected to people in this class,	.76
6. I've made friends in this class.	.77
12. I feel I fit into this class.	.52
16. I know other people well in this class.	.78

Note. Students were asked to respond to each item choosing from 6-point Likert scale with the following response choices: 1 = *strongly disagree*, 2 = *moderately disagree*, 3 = *slightly disagree*, 4 = *slightly agree*, 5 = *moderately agree*, and 6 = *strongly agree.*
[a]Items are reverse coded.

TABLE 3. Factor Loadings for Group Processing From a Confirmatory Four-Factor Solution

Item	Factor loading
Factor 3: Group Processing—Evaluation	
1. Overall, each of the group members contributed his or her fair share.	.59
4. Overall, my group was effective working together.	.81
5. Typically, my group had a clear understanding of the expectations for the group tasks.	.83
7. Overall, my group members responded positively to peer questions.	.75
8. Typically, most group members shared their own ideas during group work.	.66
9. My group was successful in completing the requirements of most tasks.	.74
Factor 4: Group Processing—Effect on Individual	
2. At this point in the semester, I have a positive attitude about group work.	.78
3. I value my group as a resource for learning.	.83
6. As a result of group work I improved my group-building skills.	.77
10. As a result of group work I improved my problem-solving skills.	.83

Note. Students were asked to respond to each item choosing from a 7-point Likert scale with the following response choices: 1 = *strongly disagree*, 2 = *moderately disagree*, 3 = *mildly disagree*, 4 = *neutral*, 5 = *mildly agree*, 6 = *moderately agree*, and 7 = *strongly agree*.

the model well (Tanaka, 1993). The loadings were each significant ($p < .05$). The estimated correlations between each pair of the four factors are listed in Table 4. Support for the convergent validity was provided by the strength of the correlations between the pairs of factors underlying each scale. The connectedness that a student felt to campus life was significantly related ($r = .55$, $p < .05$) to his or her connectedness to fellow classmates. In addition, there was a significant correlation ($r = .67$, $p < .05$) between how a group member evaluated his or her group's processing and the effect that the group had on the individual.

Cross-Validation

Once the factor structure of the scales was confirmed, we conducted multiple-group confirmatory factor analyses to cross-validate the results from the 1999 sample with those of the 2000 sample. Table 4 contains the means and standard deviations for each scale for the 1999 and 2000 samples. To simplify the analyses, we ran two models, one for each of the two-factor scales (the two factors of the Social Connectedness Scale and the two factors of the Group Processing

TABLE 4. Intercorrelations, Means, Standard Deviations, and Cronbach's Alphas for a Confirmatory Four-Factor Model

	Factor				Fall 1999			Spring 2000		
Factor	1	2	3	4	*M*	*SD*	α	*M*	*SD*	α
1 Social Connectedness	—				4.61	0.94	.92	4.63	0.89	.90
2 Classroom Community	.55*	—			4.20	1.07	.80	4.03	1.15	.82
3 Group Processing—Evaluation	.16*	.21*	—		5.61	1.02	.86	5.28	1.36	.90
4 Group Processing—Effect	.17*	.41*	.67*	—	5.28	1.29	.88	4.57	1.53	.91

*$p < .01$.

Scale). The factor loadings and interfactor correlations were constrained to be equal across both samples for each of the two models.

The CFI and NNFI for each of the three pairs of related scales indicated that the data fit the model well (the CFI and NNFI were 0.92 and 0.91, respectively, for the two-factor Social Connectedness Scale; and .93 and .92, respectively, for the two-factor Group Processing Scale). This provided evidence supporting the measurement invariance of the four scales across the two samples.

Reliability Analyses

We estimated internal consistency for each of the six scales for the 1999 and the 2000 samples using Cronbach's alpha (Table 5). Despite the shortness of the scales, they demonstrated very good item-test reliability, ranging from .80 to .92 for the 1999 data and from .82 to .91 for the 2000 data.

The stability of the pretest and posttest data provided further support for the reliability of the instruments. There was a moderate degree of test–retest reliability, with a value of .73 for the 1999 sample for the Adapted Social Connectedness Scale. The corresponding reliability estimate for the 2000 sample was slightly higher (.76), supporting moderate test–retest reliability.

Results

We conducted a preliminary investigation to determine the relationship between student and classroom-level characteristics and various dependent vari-

TABLE 5. Results for Hierarchical Linear Modeling With Academic Classroom Community as Dependent Variable, by All Classrooms

Fixed effect	Coefficient	*SD*	*df*	*t*	*p*
Intercept, γ_{00}	3.65	.12	24	29.91	.001
Gender, γ_{10}	.33	.08	1,170	4.21	.001
ACS_Pre, γ_{20}	.50	.03	1,170	16.49	.001
Group, γ_{01}	.39	.16	24	2.45	.020

Random effect	Variance component	*SD*	*df*	χ^2	*p*
Between classrooms	.139	.373	24	186.76	.001
Within classrooms	1.000	1.000			

ables (including academic classroom community). Because we hypothesized that there might be some potential dependency between scores of students within the same classroom, we used HLM to partition score variance between and within classrooms.

Academic Classroom Community

The intraclass correlation estimated with Academic Classroom Community Scale as the dependent variable indicated that 13.5% of the variability occurred between classrooms, with the majority (86.5%) of the variability in Academic Classroom Community Scale scores occurring within classrooms. The Level 2 variance was significant, $\chi^2(25, N = 1{,}494) = 211.64$, $p < .001$, indicating a substantial amount of variability between classrooms. We added two covariates (gender and scores on the initial Adapted Social Connectedness [ASCS] scores) as Level 1 fixed covariates. In addition, we added a classroom-level predictor variable indicating whether or not group work was used in a classroom, resulting in the following Level 1 model being evaluated:

$$Y = \beta_0 + \beta_1 \text{Gender} + \beta_2 \text{ASCS\_Pre} + e_{ij}, \quad (1)$$

and the following Level 2 system of equations:

$$\begin{cases} \beta_0 = \gamma_{00} + \gamma_{01}\text{Group} + U0 \\ \beta_1 = \gamma_{10} \\ \beta_2 = \gamma_{20} \end{cases} \quad (2)$$

where Y represented a student's score on the Academic Classroom Community

Scale, *U*0 represented error variance for the main intercept, the gender variable was coded 1 for females and 0 for males, and group was coded 1 for group work and 0 for no group work being used in a classroom.

As can be seen in Table 5, the coefficients for each of the three predictors were significant. The values for the coefficients indicated that women tended to report higher feelings of classroom community than men and that the average classroom community score for classes employing group work was higher than for classrooms without group work. However, only 14.37% of the variability between classrooms was explained by the addition of the group variable, and only 9% of the variability in average classroom community within classrooms was explained.

Formal cooperative groups. We hypothesized that, for the subset of classrooms in the study that used group work that most closely matched formal cooperative learning, the sense of classroom community might be related to how the students evaluated the usefulness of group work. We found a significant amount of variability between classrooms, although the majority (88.62%) of the variability in Academic Classroom Community Scale scores occurred within classrooms. The same Level 1 model was evaluated, including gender and pretest scores on the Adapted Social Connectedness Scale, with the addition of students' scores on the Group Processing—Evaluation scale:

$$Y = \beta_0 + \beta_1 \text{Gender} + \beta_2 \text{ASCS\_Pre} + \beta_3 \text{GP\_Eval} + e_{ij}.$$

At Level 2, we hypothesized that class size might explain some of the variability in the intercept term, β_0, as well as interacting with the relationship between the Group Processing—Evaluation (GP_Eval) and the Academic Classroom Community Scale scores:

$$\begin{cases} \beta_0 = \gamma_{00} + \gamma_{01} Class\_Size + U0 \\ \beta_1 = \gamma_{10} \\ \beta_2 = \gamma_{20} \\ \beta_3 = \gamma_{30} + \gamma_{31} Class\_Size + U3 \end{cases}$$

Table 6 contains the results for evaluating this model. We found that students' evaluation of group processing was significantly ($p = .040$) related to classroom community (after controlling for gender and Adapted Social Connectedness Scale pretest scores). The direction of the effect was as expected in that the higher a student rated his or her group's processing, the higher the student rated his or her classroom community. Class size (a continuous variable that ranged from 10 students enrolled in the smallest class to 248 students enrolled in the largest class) was not a significant predictor.

TABLE 6. Results for Hierarchical Linear Modeling With Academic Classroom Community as Dependent Variable, by Formal Cooperative Classrooms Only

Fixed effect	Coefficient	*SD*	*df*	*t*	*p*
Intercept, γ_{00}	3.74	.096	5	39.10	< .001
Gender, γ_{10}	.46	.081	285	5.71	< .001
ASC_Pre, γ_{20}	.44	.02	285	23.14	< .001
Group_Eval, γ_{30}	.27	.10	5	2.77	.040
Class size, γ_{01}	–.002	.0008	5	–2.41	.059
Class size, γ_{31}	–.002	.001	5	–2.41	.059
Random effect	Variance component	*SD*	*df*	χ^2	*p*
Between classrooms	.0427	.207	5	10.98	.051
Within classrooms	.832	.912			

Discussion

One of the weaknesses of research that investigates cooperative learning in higher education is the paucity of validated, reliable instruments for many important constructs. In a great deal of this research, the variables are measured using nonestablished measures developed specifically for that study without even determining the psychometric properties of the scale. We believe that an important step forward in gaining acceptance of the research would be the use of well-designed and empirically supported instruments with reliability and validity data available for reference to future users. In this article, we have made a first step toward providing such a set of scales for investigating variables of classroom community and quality of group processes, instruments that were developed and validated in this study, and social connectedness, an instrument that was derived from pre-existing scales and further validated by this study.

Factor Analysis

In the first set of factors identified (Social Connectedness and Classroom Community), we can see from the correlation ($r = .55, p < .01$) that these two factors are correlated but not synonymous. In other words, we detected a difference between a student's perceptions of social connectedness on the campus and social connectedness within a given class; although they are highly related, as indicated by a strong correlation coefficient, they deserve to be considered as sep-

arate factors. Furthermore, we would like to speculate that these two factors are functionally related such that feelings of classroom community may influence feelings of campus connectedness, a causal path that calls for further study.

A similar distinction appears to be acting within the second instrument on group processes. Here, the two factors of evaluation of group effectiveness and effect on the individual are highly correlated with one another, but they are different enough to make some distinctions between them. An important observation is that both of these factors have some degree of correlation with the Classroom Community factor, indicating a possible connection between them. This would be consistent with our belief that what happens in the classroom (e.g., effective group work) influences the student's perceptions of the class as a community.

HLM—Student Perceptions of Classroom Community

We conducted an additional analysis to explore the interrelationships among these measures. Our first set of analyses investigated student perceptions of academic classroom community as a dependent variable using HLM to account for the clustering of students within classrooms. Results indicated that the use of group work (both formal and informal) methods in undergraduate classrooms was positively related to students' feelings of classroom community, significantly more than for classrooms that did not use group work techniques. This was especially true for women, who perceived significantly more classroom community than men within the same classes. In addition, within classrooms that formally included cooperative learning, the evaluation of group processing was related to students' feelings of classroom community, although course size was not a significant predictor of either classroom community or group processing. Again, women were significantly higher than men in their perceptions of classroom community. These findings confirm positive outcomes of collaborative learning in higher education, namely academic classroom community. Moreover, these findings provide information about who benefits the most (i.e., women more than men) and the relationship between classroom characteristics and perceived classroom community (i.e., large compared with small classrooms). The results concerning gender should not be surprising when we consider that, in the literature, females are believed to be more concerned with making connections with others than are males in our culture (Belenky, Clinchy, Goldberger, & Taroule, 1986; Gilligan, 1979; Tannen, 1990) and that collaborative learning techniques come highly recommended as a way to help women make those connections (McGlynn, 1996). Thus women's tendency to feel more connected in courses using collaborative learning might be a natural reflection of their social connectedness development in general. Although one might assume that smaller classrooms tend to feel more personal to students, our results indicated that students felt community in courses that used formal group work, regardless of class size. Per-

haps the opportunity to meet in small groups over time in the context of a large class allowed students to express themselves and form connections with others just as easily as in smaller classes.

In conclusion, this study provides a validation of several scales that can be used to measure the perceptions of classroom community, social connectedness, and group processing of students in higher education. These tools can evaluate programs used to enhance classroom instruction through the inclusion of group work. The findings from this study encourage further validation and generalization using populations of students from additional institutions of higher education. We hope that other researchers will be intrigued by the possible combinations and relationships among these factors and will join us in investigating in more detail the relationship of group work to a variety of academic variables. We also encourage other researchers to develop and validate other instruments that can be used to study this important and rich instructional method more thoroughly.

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APPENDIX
Binder Section Guide for Training Purposes

Philosophy of Cooperative Learning

This section includes general readings about cooperative learning that answer questions such as "What is cooperative learning?" "What are its benefits?" and "How can cooperative learning be used in college classrooms?" Cooperative learning is an alternative method of instruction founded on some general principles of learning. These articles are intended to familiarize you with some of the theory behind cooperative learning. We hope that they will serve both as an initial source of information to begin the development of your course redesign, as well as a reference tool throughout the semester.

Cooper, J. L., Robinson, P., & McKinney, M. (1994). Cooperative learning in the classroom. In D. F. Halpern & Assoc. (Eds.), *Changing college classrooms* (pp. 74–92). San Francisco: Jossey-Bass.

Nelson, C. (1994). Critical thinking and collaborative learning. In K. Bosworth & S. J. Hamilton (Eds.), *Collaborative learning: Underlying processes and effective techniques* (pp. 45–58). San Francisco: Jossey-Bass.

Diversity in the Classroom

One of the primary objectives of this initiative is to positively affect students' openness to diversity through the use of cooperative instructional methods. The cultural diversity of the classrooms at The University of Texas is one of its greatest resources, but if students are not open to this resource, then it is wasted. At times, diversity can also be a challenge for instructors and students alike in reaching a common goal. These articles discuss strategies for teaching and working with students by implementing cooperative learning methods to meet the needs of a diverse students population.

Obler, S., Arnold, V., Sigala, C., & Umbdenstock, L. (1991). Using cooperative learning and classroom research with culturally diverse students. *New Directiond for Teaching and Learning, 52,* 9–19.

Slavin, R. E. (1995). Enhancing intergroup relations in schools: Cooperative learning and other

strategies. In W. D. Hawley & A. W. Wells (Eds.), *Toward a common destiny: Improving race and ethnic relations in America* (pp. 291–314). San Francisco: Jossey-Bass.

Research on Cooperative Learning

As the implementation of cooperative learning techniques becomes more common, educators have begun to evaluate the success of the innovative teaching method. This section of readings includes empirical studies of the effects of collaborative learning on college students in the classroom. Although some of the research is based on measures constructed by the researchers, classroom research can be simplified to observations of naturally occurring data. We hope that these articles will give you a sample of the types of variables that are related to cooperative learning, and some ideas of outcomes you might look for in your own classes.

Cooper, J. (1995). Cooperative learning and critical thinking. *Teaching of Psychology, 22,* 7–9.

Courtney, D. P., Courtney, M., & Nicholson, C. (1994). The effect of cooperative learning as an instructional practice at the college level. *College Student Journal, 28,* 471–477.

Lindauer, P., & Petrie, G. (1997). A review of cooperative learning: An alternative to everyday instructional strategies. *Journal of Instructional Psychology, 24,* 183–187.

How to Use/Design/Assess Cooperative Learning

In thinking about your cooperative course design, it is important to consider "What do I want my students to get from this, and how can I tell if it worked?" The focus of this section is on how to develop different types of cooperative activities that are more effective in achieving their goal. Design and use readings will detail several different specific cooperative methods (e.g., jigsaw, co-op). The assessment portions of the articles will help you find ways of grading group and individual performance as well as determining the success of each activity.

Bosworth, K. (1994). Developing collaborative skills in college students. In K. Bosworth & S. J. Hamilton (Eds.), *Collaborative learning: Underlying processes and effective techniques* (pp. 25–31). San Francisco: Jossey-Bass.

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Wallace, J. (1995). Cooperative learning in college classrooms: Getting started. *College Student Journal, 29,* 458–459.

Tools for Using Cooperative Learning

Because each course has different cognitive and behavioral objectives, we have included a variety of suggestions, sample forms, assessment criteria, and checklists such that some might match your course.