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The Use of Collaborative Learning as a Tool for Skill Integration: The Problem of Group Self-Selection

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ABSTRACT

This study examines whether instructor intervention in group formation is necessary to achieve diversity. Consistent with prior studies, diverse groups are found to outperform groups without diversity. Yet, without instructor intervention, groups are unlikely to achieve diversity in terms of ability and ethnic composition.

I. INTRODUCTION

Technology is changing the way that business is conducted. As the pace of technological change increases, specialization becomes more important since it is difficult for one person to master several diverse skills simultaneously. Specialization increases the need for interpersonal skills since the accomplishment of an objective may require several persons each possessing diverse skills to work together to achieve the right combination of skills (Rogers, 1996). Recognizing the importance of interpersonal skills to facilitate the transfer of knowledge to accomplish objectives, business and accounting classes have introduced pedagogical techniques in which interpersonal skills can be developed and improved (Seufert & Seufert, 1998). For example, the Accounting Education Change Commission in Position Statement Number One states "to become successful professionals, accounting graduates must possess communication skills, intellectual skills and interpersonal skills" (Accounting Education Change Commission, 1990: 307). It further states that "working in groups should be encouraged" (Accounting Education Change Commission, 1990: 309).

A key component of the popular collaborative learning techniques is the use of small groups (Bruffee, 1993). In a small group setting, students are confronted with the importance of interdependence where an individual's success depends on the success of others (Johnson and Johnson, 1990). By fostering an environment where interdependence is necessary for success, these pedagogical techniques are useful in training students to work cooperatively. This interdependence of group members simulates real-world scenarios where individuals bring unique and necessary skills (often-specialized technology skills) to a business problem and success requires these individuals to mesh these skills to achieve objectives. As a pedagogical tool,

collaborative learning emphasizes exactly the skills predicted to be important in the future business environment. For example, besides acquiring the knowledge necessary for entry into the accounting profession, the Bedford Committee (American Accounting Association, 1986) noted that an essential component of an accounting education is "communication including application of organizational concepts and interpersonal relationships in both formal and informal settings" (page 182).

To achieve the objectives of collaborative learning, its proponents suggest that the small groups should be composed of a diverse set of students each of whom bring different abilities and perceptions to a problem (Johnson *et al.,* 1984; Putnam, 1997). This raises two issues which are examined in this paper. First, does diversity in the groups influence performance? Second, to achieve diversity within the groups, is the active involvement of the instructor required?

The results of this study show that if group formation is left to self-selection, diversity in the resulting groups is usually lacking. Further, the results show that groups lacking diversity perform at a lower level than the groups with diversity. The lack of diversity appears to limit student learning in these situations and could leave them unprepared for work environments where a diverse set of skills must combine to achieve a business objective.

The rest of this paper is organized as follows. The next section describes the hypothesis development. The data are described in section three. Section four contains the discussion of the study's methodology and its results. The paper concludes with a section that discusses the results including the effects of diversity on performance and whether diverse groups form without instructor intervention. This section also identifies the study's limitations and makes suggestions for future research.

II. HYPOTHESIS DEVELOPMENT

In developing the following hypotheses, I assume, consistent with earlier studies (Slavin, 1991; Webb, 1992), that diversity within groups increases the performance of these groups. This assumption is tested later since the earlier studies did not use business or accounting students and other studies have shown that these students differ systematically from other students on many dimensions. For example, Scott, Tassin, and Posey (1998) find that accounting students have different math capabilities, parental influence, interests, communication skills, grades, and technical computer skills than nonaccounting students. They find that accounting students are not different than other business students although Persons (1998) finds accounting students score higher peer evaluations in group work than other business majors. Giacomino and Akers (1998) find that accounting majors have a different values structure than nonaccounting majors.

Ideally the small groups should be diverse so that students with different skills can assist the others (Putnam, 1997). The composition of the small groups is so critical that their formation is often supervised by the instructor to assure the appropriate levels of diversity. This supervision may assure the formation of groups with the proper diversity but it imposes costs on the instructor. First, the supervision requires the instructor's effort that might be better employed elsewhere. Second, the supervised formation of groups may force the creation of groups that would not normally form and might not work well together at least initially. This initial difficulty may require instructor attention or intervention to correct.

In an effort to create diverse groups, the instructor is limited to using observable characteristics and is usually done early in the class when the instructor has had little opportunity to obtain additional information. Observable characteristics that may be used by the instructor include sex, ethnicity, and ability (often measured by cumulative GPA or performance on some exercise)(Slavin, 1994). By taking these characteristics into account, the instructor can construct diverse groups but allowing the students to self-select into groups may result in groups without diversity. Baloche (1998) observes "when students are permitted to choose whom they will work with in the classroom, existing social identities and boundaries tend to be maintained" (page 49). In other words, if students are allowed to self-select into groups, there is a propensity to associate with persons with whom one feels comfortable and this usually means persons with similar interests, values, and personality traits (Byrne & Griffit, 1973). Generally, this would mean that the groups self-selected would be homogeneous. Yet, research has found that the greatest learning takes place in heterogeneous groups as the groups incorporate the diverse skills and forge consensus among the members who have different perceptions and opinions (Bruffee, 1993). In this study, I examine situations where groups form by self-selection to see if groups form where the members closely resemble one another consistent with Baloche's prediction.

Putnam (1997) states that one of the disadvantages of self-selection for group formation is "the high achievers and the low achievers will end up in the same groups" (page 59). Such a grouping is possible in this study since the subjects are students in a senior-level class and, for the most part, the students have been together in other classes and have general perceptions of the other student's abilities. Students of high ability may wish to form a group with students of similar ability in order to maintain high performance in this class while possibly minimizing their efforts (Gallagher & Coleman, 1994). Students of low ability may wish to form a group with students of high ability in order to improve their performance in the class but this group formation may be resisted by students of high ability that may see this arrangement as diluting their ability. Thus, students of low ability may only have the

option of forming a group with other low-ability students. This suggests this hypothesis (null form):

$H1_0$: In the absence of supervision in the formation of groups, the resulting small groups will be composed of students of diverse abilities.

Another threat to the diversity of groups is the propensity of students to form groups comprised of members primarily of the same sex. A key contributor to this tendency is the fraternity/sorority system that allows members of only one sex. Since persons sharing living situations tend to associate with one another in other situations as well, the fraternity/sorority system may increase any existing tendency to cluster in same-sex groups (Bruffee, 1993). In addition, if groups are expected to work together outside of class, like in the classes in this study, a group formed primarily with members from the same living group makes the logistics of outside-of-class work much easier. This suggests this hypothesis (null form):

$H2_0$: In the absence of supervision in the formation of groups, the resulting small groups will be comprised of an equal number of members of each sex.

The final threat to the diversity of groups is the propensity of ethnic students to form in groups with other ethnic students (or alternatively, for non-ethnic students to form groups with other non-ethnic students). Because of similar cultural experiences, students may feel more comfortable with other students of the same ethnic group (Bruffee, 1993). Additionally, ethnic students may feel uncomfortable speaking English (particularly if English is not the student's primary language) and as a result may feel more comfortable speaking in groups with other students also not comfortable with English (Bruffee, 1993). This suggests this hypothesis (null form):

$H3_0$: In the absence of supervision in the formation of groups, the resulting small groups will be ethnically balanced.

III. DATA COLLECTION

Data for this study were collected in a senior-level auditing class from a medium-sized research institution over a 2-year period (seven sections). The data were initially collected to study whether bias exists in self-evaluations (Linville, 2000) but allow exploration of this topic as well.

The one hundred and thirty (n = 130) students form thirty-three (n = 33) groups. Three groups are comprised of three members, one of five members, and the rest (n = 29) of four members. All groups are allowed to form without input from the instructor with the only constraint being that groups of four should be maintained whenever possible.

Of the 130 students, 72 are females and 58 are males. Twenty-six (26) of the students are ethnic with 14 being Oriental, 6 Hispanic, and the rest of various ethnic groups.

IV. METHODOLOGY AND RESULTS

1. THE EFFECTS OF GROUP DIVERSITY ON THE PERFORMANCE OF STUDENTS

Prior research (e. g. Bruffee, 1993; Slavin, 1991) shows that student performance is improved when learning takes place in diverse groups. Based on the results below, the finding of an association between group diversity and performance is extended to accounting students.

To measure the improvement in scores attributable to diversity, individual ability must be controlled. Group performance is scaled by individual exam scores to create a measure called relative performance. When relative performances are compared, a higher (lower) relative performance indicates a group score higher (lower) than would be expected given individual exam scores. Consistent with the predictions of the advocates of collaborative learning, relative performance in diverse groups is significantly higher than in non-diverse groups. When groups are diverse on one of the observable dimensions of diversity (ability, sex, or ethnicity), the diverse groups have a relative measure significantly greater than the non-diverse groups (0.29843 vs. 0.27625, one-tailed p-value of 0.0051). When diversity is achieved on two dimensions, diverse groups again have a significantly greater relative performance (0.30574 vs. 0.28248, one-tailed p-value of 0.0046).

These results suggest that proper group formation is important to classroom performance and enhances a student's ability to succeed. Given the improved student performance in diverse groups, an instructor should have an interest in forming diverse groups, particularly if inattention to group formation will result in non-diverse groups.

2. GROUP FORMATION WITH STUDENTS OF SIMILAR ABILITY

Hypothesis one (null form) predicts that if group formation is unsupervised by the instructor the resulting groups will be comprised of students of diverse abilities. The actual composition of groups is compared to the theoretical composition of groups to determine if students of differing abilities are distributed throughout the groups as expected.

To measure a student's ability, the scores for all class work except group projects are totaled. This work represents the work of the individual and should provide the best

measure of an individual student's ability. A median score is calculated for each section to divide the class into two equal groups of students. Those students with scores exceeding the median are considered to be of high ability and those with scores below the median are considered to be of low ability.

Expectations about the distribution of students of different abilities throughout the groups are calculated in the following manner. Since ability is determined by whether a student is above or below the median, a random draw of a student would have a 50% probability of the student being of high ability (H) and a 50% probability of the student being of low ability (L). With groups of four, sixteen combinations of student abilities are possible representing all combinations of independent draws of four students. Since the hypothesis is concerned with group formation of students with different abilities, these sixteen combinations can be expressed by the number of students of different abilities. Two of the sixteen combinations would have all four students of the same ability (HHHH and LLLL). Eight of the sixteen combinations would have one student with abilities differing from the rest of the group (any combination of three Hs and one L or of three Ls and one H regardless of the order of the Hs and Ls). Six of the sixteen combinations would have two students of different ability (two Hs and two Ls regardless of the order of the Hs and Ls). Assuming a random process, on average, 12.5% of the groups should have members of the same ability, 50% of the groups should have one member of different ability, and 37.5% of the groups should have two members of different ability. The calculations for groups of three and five are done in the same fashion resulting in expectations for groups of these sizes. A weighted average is taken of the expectations to arrive at the final expectations for a sample consisting of 3 groups of 3 members, 29 groups of 4 members, and 1 group of five members. For this portion of the study, if group formation is random, 4.4375 groups of members all with the same abilities would form, 17.0635 groups with one member of different ability would form, and 11.50 groups with two members of different ability would form. Since groups cannot form with partial members, these results are rounded to the nearest integer (4, 17, and 12 respectively).

The results of the analysis of whether or not groups of diverse abilities form are shown in Panel A of Table 1. Where it was expected that 4 groups of members with similar ability would form, 10 actually did. The actual number of groups forming with one person of different ability was about as expected (15 versus 17 respectively) while the actual number of groups with two persons of different ability (8) is less than the predicted number of 12. Using a Chi-square test, the probability of this formation of groups occurring by chance alone is 0.0051 ($\tilde{a}2$ = 10.5686 with 2 degrees of freedom). If the expectations are expressed as a continuous variable rather than rounding to the nearest integer, the null hypothesis is still rejected at the 0.0159 level ($\tilde{a}2$ = 8.2875

with 2 degrees of freedom). These results suggest that students left to form group without instructor supervision are likely to form groups with students of similar ability. Based on these results the null form of Hypothesis 1 is rejected.

TABLE 1
Actual And Predicted Characteristics Of Groups

Panel A: Formation by Ability.

	Actual	Predicted
All persons of same ability.	10	4
One person of different ability.	15	17
Two persons of different ability.	8	12
Total number of groups	33	33

ã2 = 10.5686 with 2 degrees of freedom, p-value = 0.0051.

Panel B: Formation by Sex.

	Actual	Predicted
All persons of same sex.	9	5
One person of different sex.	16	17
Two persons of different sex.	8	11
Total number of groups	33	33

ã2 = 4.0770 with 2 degrees of freedom, p-value = 0.1302.

Panel C: Formation by Ethnicity.

	Actual	Predicted
All persons of a minority group.	1	0
Three or four persons of a minority group.	2	1
Two persons of a minority group.	4	6
One person of a minority group.	7	13
No persons of a minority group.	19	13
Total number of groups.	33	33

ã2 = 15.3051 with 4 degrees of freedom, p-value = 0.0041.

3. GROUPS FORMATION WITH STUDENTS OF THE SAME SEX

Hypothesis two (null form) predicts that in the absence of instructor supervision groups will form that is balanced in terms of sex. This hypothesis is tested by comparing the actual group composition by sex with the theoretical group composition by sex.

Expectations of group formation by sex are calculated in a manner similar to the expectations of group formation by ability. Unlike the prior calculations, the probability of a selected subject being either a male or a female is not necessarily 50% since the class composition may have more of one sex than another. To account for this, the percentage of females and the percentage of males in each class section are calculated and these calculations are used to determine the likelihood of each of the possible combinations of students. These calculations result in an expectation of 5.2933 groups with all members of the same sex, 16.8978 groups with only one member of a different sex, and 10.8089 groups with two members of a different sex. Again, since groups cannot form with partial members, these expectations are rounded to the nearest integer (5, 17, and 11 respectively).

The results of the tests of whether or not groups will form with diverse sex composition in the absence of instructor supervision are presented in Panel B of Table 1. Although the actual number of groups of each composition differ from the expected number, the results do not achieve normal levels of statistical significance ($\tilde{a}^2 = 4.0770$ with two degrees of freedom, p = 0.1302). Thus, chance cannot be reasonably eliminated as a cause of the reported results and therefore the null form of hypothesis two cannot be rejected.

4. GROUP FORMATION WITH ETHNIC STUDENTS

Hypothesis three predicts that student groups will have ethnic diversity in the absence of instructor supervision of the group formation. To test the hypothesis, a comparison of the actual group formation is made to the theoretical group formation as was done in the tests of the prior two hypotheses.

Expectations are calculated as before. The probability of any student being an ethnic student is calculated by each class section. This probability is used to determine the probability of a particular group composition occurring. These calculations result in the expectation that 0.15 groups will form with all ethnic members, 1.33 groups with 3 ethnic members (3 or 4 ethnic members if a 5-member group), 5.63 groups with 2 ethnic members, 13.00 groups with 1 ethnic member, and 12.89 groups with no ethnic members. For the reason discussed above, these expectations are rounded to an integer value (0, 1, 6, 13, 13 respectively).

The results of the test for ethnic diversity are presented in Panel C of Table 1. As can be seen in the table, more groups with no ethnic members formed than was predicted. The most striking result is that groups with no ethnic members were expected to number 13 whereas the actual count was 19. In addition, the groups with one ethnic member (n = 7) are fewer than predicted (n =13). Using a Chi-square test, the probability of this formation of groups forming by chance is 0.0041 ($\tilde{a}2$ = 15.3051 with 4 degrees of freedom). If the expectations are expressed as a continuous variable rather than rounding to the nearest integer, the null hypothesis is still rejected at the 0.0231 level ($\tilde{a}2$ = 11.3261 with 4 degrees of freedom). These results suggest that if students are left to self-select their groups, they are unlikely to achieve ethnic diversity in the groups that are formed. Based on these results, the null form of hypothesis three is rejected.

V. DISCUSSION, LIMITATIONS, AND SUGGESTIONS FOR FUTURE RESEARCH

Overall, the results of this study suggest that absent instructor involvement in the formation of groups the resulting groups do not exhibit appropriate diversity. If diversity is necessary to achieve the objectives of collaborative learning (and the results of this study and previous research find that diversity does lead to higher performance), this result is troubling as a pedagogical issue.

If the instructor must be involved in the group formation, this is another responsibility that the instructor must meet and might influence the instructor's decision about adopting collaborative learning techniques. If instructors are not adopting collaborative learning techniques despite the reported successes of the methods, it would be interesting to learn if such additional responsibilities are at least partially to blame for this.

The overall results are subject to limitations. Although the actual self-selected groups did not achieve diversity on two of the observable dimensions studied, the groups may have achieved diversity on other less obvious dimensions. To the extent that diversity and performance are linked, the results linking diversity and group performance indicate that the observable diversity traits are probably capturing diversity but it is still possible that a correlated unobservable trait is driving the results on performance.

The result showing groups tend to form with students of similar ability is driven by the overrepresentation of groups composed of students of the same abilities and the under-representation of diverse groups with two students of different abilities. This result is subject to limitation. It is assumed that students are aware of the abilities of the other students. If this assumption is not true, then some other factor must be driving the unusual group formation.

It is not possible to conclude that the self-selected groups lack diversity in terms of the sex of the group members since the overall results failed to achieve statistical significance at traditional levels. Although chance cannot be ruled out as an explanation for this reported result, the relative significance of the p-value ($p = 0.1302$) suggests that chance is not a good explanation. By eliminating the groups with only one member of a different sex (actual = 16, predicted = 17), a Chi-square test of the differences between the actual count and predicted count of the remaining two groups show significant results ($p = 0.0450$, $\tilde{a}2 = 4.0182$ with 1 degree of freedom). The ambiguity of these results suggests that future research into this issue might be fruitful.

The results suggest that self-selected groups will not exhibit ethnic diversity. With the data collected, it is not possible to determine if this formation is due to the reluctance of the non-ethnic students to include ethnic students or if ethnic students prefer a group comprised primarily of ethnic students or a combination of both. Although the results suggest that ethnic diversity is not obtained when self-selection of groups is used, it would interesting to determine why this result is being obtained.

If self-selected groups fail to achieve diversity, students are interacting with students more likely to have homogeneous abilities, perceptions, and opinions. In such an environment, much of the advantage of collaborative learning may be lost since students are less likely to have to incorporate diverse skills (with the associated opportunities to teach and learn new skills) and to deal with controversy before forming consensus. Thus, students may be unprepared to deal with such issues in a real-world situation. As the technology leads to more specialization in the work place, this need for interpersonal skills will become more pronounced. By sending out graduates without these necessary skills, universities are failing two important constituents: students and the employers of these students.

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