USING STUDENT SKILL SELF-ASSESSMENTS TO GET BALANCED GROUPS FOR GROUP PROJECTS

Paul Blowers

Abstract. Communication abilities, conflict management, and delegation are all important to students' success in the work force. Instructors often simulate situations that give students skills in these crucial areas by assigning group projects. It is often difficult for instructors to select individuals who will work successfully together. Common methods for selecting groups, many of which are ineffective, are discussed. A student self-assessment method used by the authors to group students according to their skills is described. The method, used for two years in both sophomore- and senior-level courses, has been proven to prevent intragroup skill imbalances.

The drive toward incorporating teamwork skills into educational programs at the undergraduate level (NACEAR 2000; ABET 2000) originated from, among other sources, employer surveys that reveal that teamwork skills are essential for student success in the workplace (Gardner and Korth 1998; Singh-Gupta and Troutt-Ervin 1996). To address new marketplace demands, national accrediting boards such as ABET in engineering have recently begun to require that teamwork skills be incorporated into undergraduate curricula (ABET 2000).

When one begins to consider how to include team-based projects into a course, it is often difficult to decide how to arrange students into groups. When groups are not formed well at the beginning, projects can be derailed before they even begin.

In this article we will discuss several strategies that have been used for selecting groups in educational projects, along with the limitations of those strategies. We will also review proposed grouping criteria and a new method of forming groups that has been implemented successfully in both introductory-level sophomore and senior-level engineering courses.

Paul Blowers is an assistant professor in the Department of Chemical and Environmental Engineering at the University of Arizona.

Random Group Selection Processes

Many professors use random methods to select groups, an approach that researchers advocate(Smith 1986, 1989; Stefani and Tariq 1996; Thomas, Hughes, and Hart 2001; Sharan and Sharan 1992). These methods include grouping students alphabetically, assigning random numbers to students, using student seating proximity, and other similar processes. Random methods are very attractive because they are easy to implement and do not require advance planning prior to selecting the groups. Although it may seem that a high level of randomness may be desirable, this may not be acceptable.

The major problem with grouping students using random criteria is that student differences are not accounted for. One could end up with imbalanced groups that lack the skills for success on a project. For instance, one group may consist entirely of members who have strong mathematical skills yet do not have the ability to write or communicate. It is for this reason that purely random methods are not suggested for group projects.

Non-random Group Selection Processes

Several grade-based criteria are routinely used by faculty to group students for projects in coursework settings (Johnson, Johnson, and Smith 1991). The two

most commonly used criteria—the "High with the Low" and the "High with the High" scenarios (Goldstein 1982; Slavin 1990; Kunkel and Shafer 1997)—are shown in figure 1. Faculty use aggregated lists of student grade point averages—either overall or discipline-specific—to select groups. In courses where teamwork is used before GPAs are available, faculty will often use the first midterm exam performance when selecting groups.

Using grade-based criteria to select student groups often fails because of student motivational effects. Figure 2 shows how pairing the high with the low GPA students can lead to student conflict. Often, the excelling student desires to get a high grade in the course, whereas the student that has not performed as well in other courses may be happy with a much lower grade. Here, the underperforming student may work until they feel that their group project has received the grade that they are comfortable with. Then the more motivated student must shoulder the rest of the academic burden to ensure that they receive an A, which is the lowest grade that they would want. Throughout the process, the motivated student may experience stress because they feel a sense of injustice as they do more work. The problems are compounded if there are no "independent effort" checks in place to apportion the credit according to the actual student effort on the final product.

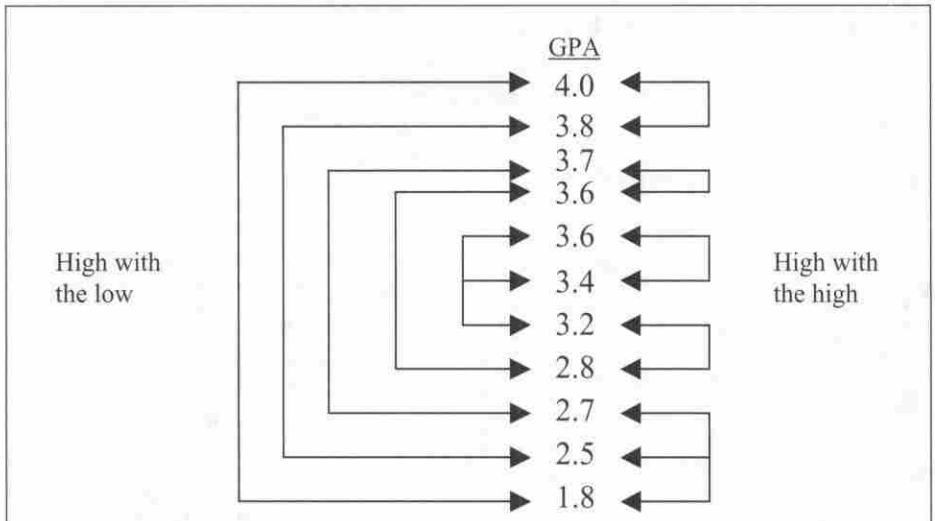

FIGURE 1. Grade based criteria for grouping students.

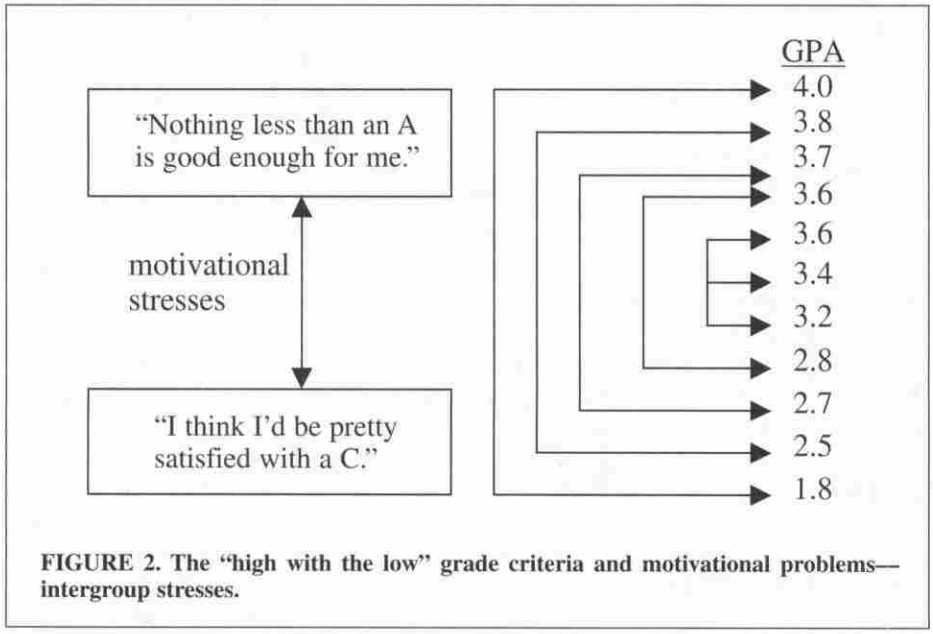

FIGURE 2. The "high with the low" grade criteria and motivational problems—intergroup stresses.

Figure 3 shows why pairing the "highest with the highest" can also lead to student motivational problems. Students that are near the lower end of the pairings may feel that the deck has been stacked against them and that they should not bother making a serious attempt at producing a successful project. The students near the top of the pairings may similarly believe that they do not need to put much effort into the project because they will probably get a high grade anyway. These motivational problems are exacerbated when the class is graded on a curve because students then are competing against their peers (Roth 2000). Some groups will appear to have an inherent advantage over other groups because they have higher grades, leading to conflicts among groups.

Faculty may also use student surveys to pair students for group projects according to some predetermined philosophy. These surveys often cover information such as student performance in specific prerequisite courses, past work history, current time conflicts, and other personal characteristics such as race and gender. Some professors use compatible schedules as the most important pairing criteria, whereas others use gender or race. Others may use student performance in a specific prerequisite course as a substitute for the grade-based criteria, which we discussed earlier.

There are two major facets of the survey method that make it unattractive for use in selecting student groups. First, sorting through and ranking all the students on the appropriate criteria is very time consuming for the professor. The size of the class dictates the amount of effort required of faculty because all of the students must be evaluated individually before they can be paired.

The second major reason this method is unattractive is because it is a "black box" phenomena for students. The students complete their surveys and then send them off to be evaluated. Some indeterminate time later, they find themselves in groups without knowing how they

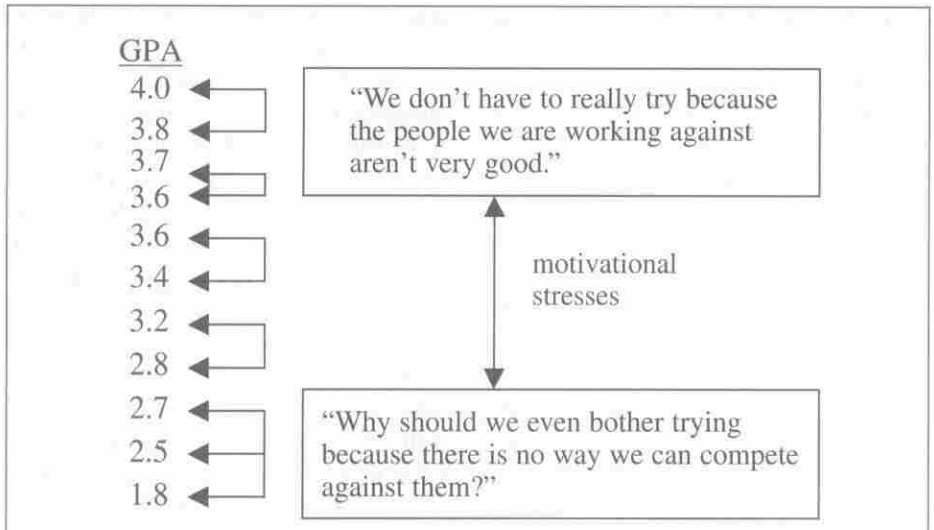

FIGURE 3. The "high with the highest" grade criteria and motivational problems—intragroup stresses.

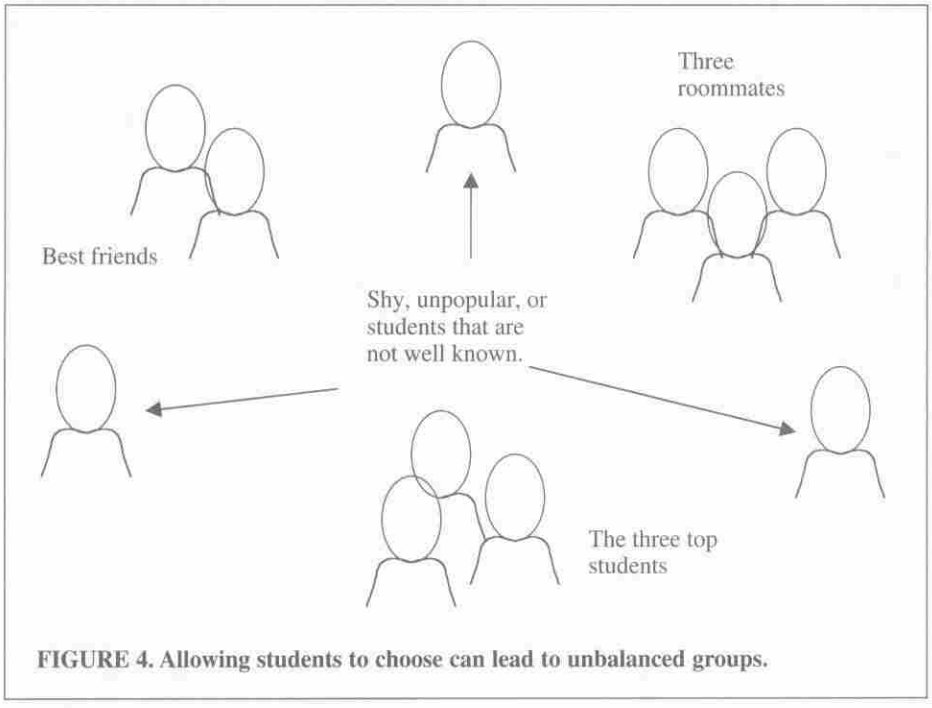

FIGURE 4. Allowing students to choose can lead to unbalanced groups.

were placed into them. In some cases, students will be suspicious of the selection criteria and may believe that some form of favoritism led to the formation of the groups. This can lead to student distrust of the faculty member.

Some educational experts suggest that professors pair student groups using nonskill-based criteria (Tannen 1991) that may appear on student surveys or in student files. This is suggested especially when minority or women students are participating in the group projects. Two underrepresented students will be able to support each other throughout the project and to withstand any discrimination that occurs during the project. Selecting groups using nonskill-based characteristics, though, is not suggested as a primary method because it is random and pairs students only on superficial criteria instead of considering their abilities.

One more common, nonrandom method is allowing students to choose their own groups. However, there are several reasons to avoid this method. First, some students are unfairly penalized, as we show in figure 4. For instance, the top students will often just pair themselves based on grade-based criteria, which will lead to the same problems as the "High with the High" scenario described earlier. In other cases the shy students or students that communicate poorly will all be left out of the other groups and will form their own group. This may fate that group to failure because they may not be able to communicate adequately their results to the class or professor.

Transfer students, nontraditional students, or unpopular students are also all penalized in the self-selection scenario because students tend to prefer to work with people that they already know. Most likely, students will benefit most by working with someone that they have had little interaction with rather than with their closest friend or their roommates. Encouraging students to work with new people allows them to become more comfortable at communication and in conflict resolution.

In the working world, employees rarely get to choose their collegues on team-based projects. A supervisor will generally ask for some input before selecting the groups that must work together to complete the project, but employees rarely have control over which groups they are part of and which ones they are not.

An Industry Model for Selecting Groups

We briefly discussed how employers build groups to tackle problems in the workforce. Can you imagine a company pairing employees on a project using an alphabetical list of employees? Can you imagine a company using corporate performance evaluations to pair the best employees with the worst employees? Can you imagine a company pairing employees based only on external criteria such as race or gender?

The answer to all of these questions is no. The only group selection method discussed so far that companies routinely use for projects is to put the best employees together to solve their problems. However, employers also take into con-

sideration the skills that each employee offers before finalizing the makeup of a group. The group is composed of those individuals who will ensure the best chances of the project's success.

Now that we have identified a successful industry model for selecting groups, we will discuss how this model was used in undergraduate chemical engineering courses. To our knowledge, grouping students by their skills has only been used explicity in one other academic setting (Metheny and Metheny 1997). In this work, students were paired into groups of three or four students to present problem solutions to their peers during a discussion section. Each group would do two group presentations during the semester, and each presentation would last approximately twenty minutes. After each presentation, the groups were evaluated by their peers in a variety of categories including oral delivery, use of appropriate media, and use of time. After each presentation, each group completed a self-assessment that addressed equal group participation and distribution of effort on the presentation. More details about this project are available elsewhere (Blowers and Wilcox 2001).

Student Self-Assessment to Achieve Balanced Groups

The three skills listed in figure 5 were deemed most important in a presentation-oriented project such as the one just described. First, the group must have a member that is willing to present in front of the class. Second, the group must have a student that is able to use computer media competently to generate class handouts, PowerPoint presentations, or spreadsheet solutions. Last, the group must have a student who has strong math skills so that they can verify that their solution is correct and complete.

We asked students to rank their strengths in these categories from highest skill level to lowest skill level. Because some students were unable or unwilling to rank these skill sets, they were told to add a fourth category called "Jack of All Trades". Once all students had performed this internal self-assessment, an open group selection process began. Again, we chose an open process so that the "black box" phenomena could be avoided.

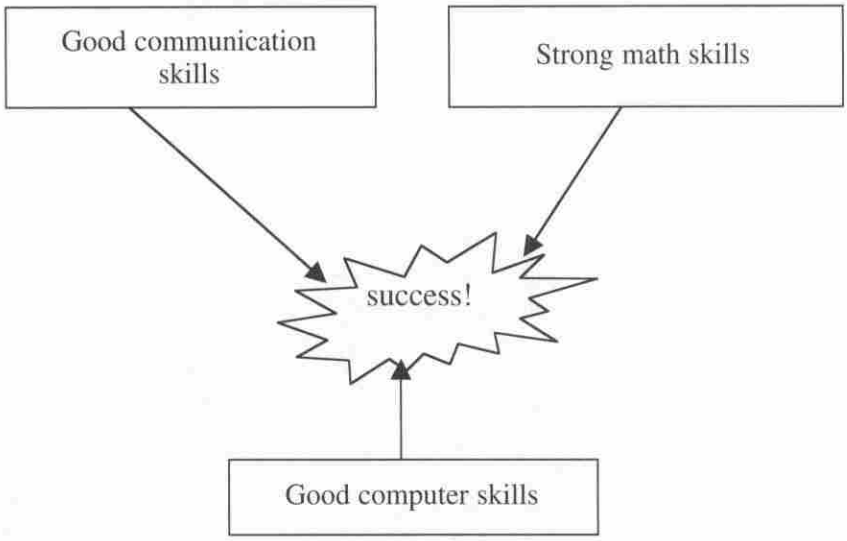

FIGURE 5. Skills important for the success of a group presentation.

We informed students that they would be asked to raise their hand once during the group selection process and that we would proceed through the categories until everyone was in a group. Students would raise their hands for the first category if they ranked it highest then would not raise their hand again for other categories unless we had more than twelve students in the first category. Students who raised their hand for a skill would receive a random number between one and twelve, as there were to be twelve groups for the projects to accommodate the class size. Students who raised their hand for the first skill but were not needed for that skill were asked to raise their hand for their next highest skill. And so we moved through the list of skills until all the "Jack of All Trades" students were apportioned among the groups. At this point, all the students of like number were formed into groups so that there were twelve groups with three to four students in each group.

There is still some degree of randomness in the process because of the use of random numbers as the students are counted into their groups. We did this purposely to make sure that students were not necessarily paired with a specific group by manipulating their skill choice. Also, it was obvious that there was no favoritism during the selection process, not only because it was random but also because it was done in the open. Students also clearly saw that all of the groups had the same characteristics for success.

Another benefit of using this method to choose student groups is that it is very efficient. The total time for choosing groups in our class of approximately fifty students was under ten minutes. This includes a brief introduction to how the process will work and an exchange of contact information among students and the instructor.

Student Response to the Selection Process

We used group assessment surveys to query students about their team-based experience during the semester and again at the end of the semester. Not one student from three semesters of application (approximately 130 students) made any negative comments about the selection process or the groups that resulted. In addition, there were no negative comments on any of the course evaluation forms that the university required. However, students did make many positive comments, including:

- "Good group selection!"
- "All groups were cohesive."
- "Don't change the group projects because the group members were picked so that each person brought a different strong trait to the group."

• "I like having different skills in the group to work with."

Comments from students after group projects are normally not this positive, but rather focus on how poorly the groups functioned.

Students also made several other comments about the group projects and the selection method, including some that revealed unexpected benefits. One would have anticipated students saying that they felt that had learned how to work on a diverse team to accomplish a task, or that they had learned to communicate more effectively, or that they had become more comfortable giving presentations. However, students also commented that they "had found several people they could work with in their other classes, and among them they always got the best understanding." Others thought that "more people would make it through to graduation because of the way they worked together during the semester." Many others paraphrased these comments and suggested that the team-based projects in the introductory course really helped them integrate material as they became aware of how to learn in cooperative groups.

Applications to Other Courses

In this article, we have explained how to use a student self-assessment process to form groups for an educational project involving student presentations. However, there are many other projects where inherent skill set needs can be used to form such groups. In figure 6 we show several other possible projects and their important skill sets. With lab projects, one student should be good with his or her hands or have used the experimental equipment before. Another student should be good with language to ensure that the group's reports and presentations are strong. Finally, another student should be skilled at using computers so that the report and supporting documentation are professionally done. With this skill set, all groups should be able to complete a complicated experiment and submit a solid technical report on their results. One can envision many other projects and skill sets for application of the student self-assessment in group selection processes.

Conclusions

The student self-assessment method using an open process and some degree of randomness that we have described has been used successfully twice in an introductory chemical engineering course and once at the senior level. No students have complained about how groups were selected from any of the courses. Students made comments instead that showed that they liked the randomness because they got to meet other students outside their normal clique and they got to meet students that were very diverse. Students also stated that they felt all of the groups had an equal chance to succeed on the project because they all had the necessary skills. Based on the success of implementation of this group selection process, we will continue to use it in the introductory sophomore course and will expand it to other courses as well.

Key words: self-assessment, group selection process, teamwork, skill sets, surveys

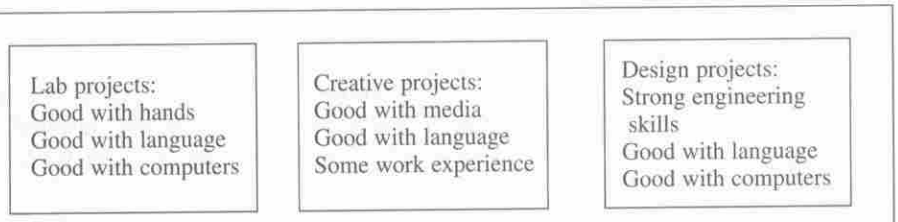

FIGURE 6. Other skill sets that could be used in group projects.

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