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This chapter describes research on team member contributions to overall team effectiveness, and various applications of this research to developing and assessing teamwork by students on team and group projects and assignments.

Developing and Assessing College Student Teamwork Skills

Richard L. Hughes, Steven K. Jones

Astronaut Jim Lovell's words during the Apollo 13 lunar mission, "Houston, we have a problem," launched a remarkable tale of effective teamwork and creative problem solving by NASA engineers working to try to save the lives of the imperiled crew when two oxygen tanks exploded en route to the moon. Details of the dramatic and successful resolution to the problem became widely known in the motion picture *Apollo 13*, but it's not just during dramatic moments when the importance of good teamwork is needed or recognized. In fact, some form of team-oriented work is employed in most, if not all, organizations today (Hills, 2007; Kozlowski and Bell, 2003; Lawler, Mohrman, and Ledford, 1995; Morgeson, DeRue, and Karam, 2010). It would seem, then, that an important role for higher education should involve developing critical teamwork skills among students so as to prepare them for success in life.

This very point was highlighted in a 2009 poll conducted on behalf of the Association of American Colleges and Universities (AACU), in which 71 percent of employers said they wanted colleges to place greater emphasis on "teamwork skills and the ability to collaborate with others in diverse group settings" (Hart, 2010, p. 2). Many studies, in fact, have identified teamwork as one of the most valued and necessary skills among college graduates. For example, a report by the Conference Board (2008) indicated that for four-year college graduates, prospective employers rated the importance of effective teamwork and collaboration second only to oral communication in contributing to job success. This is consistent with findings from our own institutional surveys at the U.S. Air Force Academy,

in which graduates deem teamwork “very important” to one’s performance as an officer. Tellingly, the percentage of officers who endorse this view goes up as rank increases (O’Donnell, 2008). Thus, even though teamwork skills are viewed as important at all levels of employment, their importance may become increasingly evident and valued with ever-greater seniority in the organization.

It should be no surprise that teamwork was identified as one of eleven essential learning outcomes in the seminal AACU report *College Learning for the New Global Century* (National Leadership Council for Liberal Education and America’s Promise, 2007). Furthermore, teamwork also plays an important *instrumental* role in education. Kuh’s research (2008) shows that collaborative assignments and projects are especially potent in having a positive impact on student development. In other words, working and solving problems actively with others is not just a desirable *outcome* of student development; it is also an educational *practice* that has demonstrably high developmental impact.

The appeal of collaboration notwithstanding, the phrase *good teamwork* may seem so conceptually vague and subjective as to defy rigorous study and systematic practice. Quite a bit is known, however, about what constitutes effective teamwork, how to assess it, and how to develop it.

What Is Teamwork?

One way to answer the question “What is teamwork?” is to begin by clarifying the term *team*. Specifically, what makes a team something different from any other group of people? Teams are composed of individuals who share several defining characteristics: they (1) have a shared collective identity, (2) have common goals, (3) are interdependent in terms of their assigned tasks or outcomes, (4) have distinctive roles within the team, and (5) are part of a larger organizational context that influences their work and that they in turn can influence (Morgeson, Lindoerfer, and Loring, 2009; Kozlowski and Ilgen, 2006).

It is useful to think of these five characteristics as *dimensions* along which all groups naturally vary. Taken collectively, they are useful in distinguishing teams from certain other social collectives, such as a group of friends. On the other hand, there may not be much practical difference between a team as it is defined here and many other work groups more generally. All teams or groups vary to some extent along the five dimensions, and there is no specifiable point at which a “group” becomes a “team” (Morgeson, Lindoerfer, and Loring, 2010). Differences tend largely to be of degree rather than of nature (Guzzo and Dickson, 1996), and in many ways the terms can be used interchangeably. In academic settings, for example, it seems like splitting hairs to differentiate what may be called team projects in one course from what are called group projects in another course. What’s more important than the names per se are the

various structural, task, and contextual factors that influence the kinds of interactions taking place among members.

Amid this complexity, one thing seems clear: by whatever name groups or teams are known, appeals to the importance of good *teamwork* on them are common. Just what is meant by such appeals is less clear than one might think, because the term *teamwork* is inherently ambiguous and imprecise and is used in different contexts to refer to two rather distinct things. Sometimes teamwork is used to refer to *overall* team performance or effectiveness (see, for example, Goodwin and Bonadies, 2005). From this perspective, calling something “good teamwork” refers to the team’s performance as a whole and to its collective success. At other times, however, the focus is on the nature and quality of *individual* team members’ contributions to the team. This is clearly, for example, the aim of AACU’s adoption of teamwork as one of the essential learning outcomes in a college education; it underscores the importance of developing the attitudes and skills in *individual students* necessary for contributing productively to the myriad groups and teams they’ll serve on later in life. Arguably, the latter meaning of teamwork is a necessary condition for the former; you could not have effective collective teamwork without effective supporting behaviors on the part of individual team members. This does not, however, alter the fact that the level of analysis differs in the two cases.

Whereas the levels of analysis are different, the term teamwork refers in both cases to a *process* involving how team members interact more than to the team’s ultimate success or the quality of its end product. This distinction is particularly important when it comes to determining ways to assess effective teamwork. Quite simply, teamwork is *not* the same thing as team success. There are many reasons a team might be successful, and not necessarily because team members worked particularly well together. A team might be successful because one member made uniquely important contributions that ensured a quality product despite marginal efforts by most team members; or a team might be successful because it was operating in a particularly munificent environment virtually guaranteeing a successful outcome; or, as in an athletic context, it may be because the opposing team played atrociously. In academic contexts, it is important to distinguish between the overall quality (say, the grade) of a group project or assignment on the one hand and the quality of each individual member’s *teamwork* in contributing to that final product on the other. It may not be so uncommon, for example, that a bright and ambitious student does most of the work on a group report, earning high marks for the group while (truth be told) nonetheless exhibiting poor teamwork in producing it.

For all these reasons, as well as to avoid confusion, in this chapter we refer to teamwork primarily in its sense as a set of individual skills. Viewing teamwork as a set of skills, after all, is not the only way an individual team member’s contributions to overall teamwork might be viewed. For example, team member effectiveness has also been examined in terms of

personality traits such as initiative, openness, helpfulness, flexibility, and supportiveness (Kinlaw, 1991; Morgeson, Reider, and Campion, 2005; Stevens and Campion, 1994; Varney, 1989). However, because personality traits are considered to be rather enduring and resistant to change, they have been studied more for their applicability to team selection issues than as a target of developmental intervention. Our focus here on teamwork as a set of skills lays the foundation for exploring more specifically how students can acquire teamwork skills and improve their ability to use them through instruction, practice, and feedback.

This way of conceptualizing teamwork is consistent with contemporary approaches to team effectiveness, particularly those that take a functional approach. In the functional approach, team leadership is oriented around satisfaction of critical team needs and the various functions that need to be performed in order to satisfy those needs (Morgeson, DeRue, and Karam, 2010; Morgeson, Lindoerfer, and Loring, 2010; Burke and others, 2006). Illustrative team functions include defining the team mission, establishing expectations and goals, structuring and planning the team's work, sense making, monitoring work progress, and creating a supportive social climate. In this approach, all team members—not just formally appointed leaders—can play a vital role in satisfying team needs, and when they do we would say they are exhibiting good teamwork.

Therefore guidance for enhancing team effectiveness heretofore intended for formal team leaders now represents a legitimate area of contribution by other members too. Even when there are formal team leaders, multiple team members can perform many of the leaders' formal roles and functions with potentially even greater buy-in and impact. If no formal team leader is identified, knowledge of generic leadership functions can still serve as a useful template for guiding all team members' behavior in ways that enhance team effectiveness. For example, Stagl, Salas, and Burke (2007) identified a number of best practices intended to help team leaders facilitate team effectiveness. They included various practices, among them establishing a compelling direction, challenging the status quo, encouraging self-goal setting and self-observation among team members, determining team decision-making authority, establishing team norms, managing team boundaries and performance expectations, and reviewing and modifying strategies for maximizing team performance. These clearly represent functions that would enhance the effectiveness of leaderless teams, which necessarily implies that team members themselves must accept responsibility for performing them.

A final consequence of this deliberately inclusive view of team leadership is that social skills become more important in determining team members' ability to fulfill their shared responsibilities for team leadership and meeting team needs (Morgeson, DeRue, and Karam, 2010; Morgeson, Reider, and Campion, 2005; Mohrman and Cohen, 1995). Social skills reflect "interpersonal perceptiveness and the capacity to adjust one's

behavior to different situational demands and to effectively influence and control the responses of others” (Ferris, Witt, and Hochwarter, 2001, p. 1076), and this kind of flexible interpersonal repertoire becomes vital in team settings, which increase interdependence among people and typically produce more work sharing, need for coordination, and greater conflict than work performed independently (Campion, Medsker, and Higgs, 1993).

In sum, we are describing teamwork as a set of skills that individuals use to foster the success of groups or teams. Some of these skills (for example, setting team goals) may be primarily cognitive in nature, while others (effectively navigating team dynamics) may be much more social. Regardless, the importance of these skills is not limited to the assigned leader of a group or team; indeed, it is important for all students to acquire teamwork skills. Consequently, we are assuming that teamwork skills can indeed be acquired as part of students’ educational experiences. This seems reasonable from the fact that the AACU identified teamwork as one of the important skills to be developed during college, as well as from the record of substantial financial investments in both the government and the corporate sectors to develop teamwork skills in employees.

Assessing Teamwork

Now that we have defined *teamwork*, it is possible to identify ways to assess it in our students. Fortunately, the literature already features several attempts to assess teamwork, which we review in this section. We conclude by discussing a particularly promising practice: scoring students’ teamwork skills demonstrated as they perform real work in groups or teams.

Written Teamwork Tests. One possible approach to assessing teamwork is through a written test. For example, Stevens and Campion (1994, 1999) developed a paper-and-pencil selection test for staffing work teams. Their test was designed to assess individuals’ knowledge, skills, and abilities in five major areas: (1) conflict resolution, (2) collaborative problem solving, (3) communication, (4) goal setting and performance management, and (5) planning and task coordination. This was done with a thirty-five-item test in which students read brief scenarios and then chose a response from four multiple-choice alternatives. Here is a sample item from that test:

Suppose that you find yourself in an argument with several co-workers about who should do a very disagreeable, but routine task. Which of the following would likely be the most effective way to resolve this situation? [Stevens and Campion’s best answer is in italics]

A. Have your supervisor decide, because this would avoid any personal bias.

- B. *Arrange for a rotating schedule so everyone shares the chore.*
- C. Let the workers who show up earliest choose on a first-come, first-served basis.
- D. Randomly assign a person to do the task and don't change it.

A similar effort is illustrated in the work of Mumford, Van Iddekinge, Morgeson, and Campion (2008), whose Team Role Test is designed to measure respondents' knowledge of relevant team roles (see also Mumford, Campion, and Morgeson, 2006). Akin to the work described earlier, this test consists of a series of brief scenarios, followed by multiple possible responses. Test takers are asked to rate the effectiveness of each response, ranging from "very ineffective" to "very effective." A sample item from this test is shown below. This item calls for the "calibrator" role, which involves managing disputes between members of the team. An example scenario from that test is given here as well:

You are a member of a sales team at a local bookstore, where recent sales have been decreasing substantially due to a shrinking number of customers. You are in a team meeting discussing solutions to the declining sales problem. The discussion becomes a bit heated when the oldest team member suggests that the sales numbers for the new sales reps are quite low. One of the younger reps quickly counters that every time he asks for help with a customer, the older rep takes credit for the sale. The other new sales rep simply looks at the floor and says nothing.

Please rate the effectiveness of each of the following responses:

1. Get the quiet new sales rep involved by asking if she has noticed the older sales rep has taken some of her sales as well.
2. Remind the two sales reps that personal attacks are not appropriate and that the team should focus on the future solutions.
3. Support the new team members by taking their side to make sure they are not used as "scapegoats" for the team's problems.
4. Remind the team that making critical remarks about specific people makes people defensive and will prevent the members from accomplishing anything as a team.

The idea of a teamwork test is appealing on a number of levels. For one, paper-and-pencil tests of this sort are easy to administer and score. Furthermore, they are relatively easy to validate; respondents' scores can be correlated with other measures of team performance. Indeed, the results of both the Teamwork Test (Stevens and Campion, 1999) and the Team Role Test (Mumford, Van Iddekinge, Morgeson, and Campion, 2008) have been shown to correlate significantly with peer ratings of team performance. As such, it is possible that performance on these sorts of tests could be used as a surrogate (albeit an imperfect one) for these other ratings, which tend to be more difficult to obtain.

Despite the positive features of these paper-and-pencil tests, they may not be an ideal solution for assessing teamwork skills in our students. The principal reason is that both the Teamwork Test and the Team Role Test were designed to be selection tests for staffing work teams. As a result, each was meant to provide a snapshot of an individual's knowledge about teamwork at the time of selection. Researchers did not design these tests to be given to the same person more than once, and they did not intend the tests to be used as tools for helping students improve their teamwork skills by providing feedback about changes in those skills.

This argument is similar to one made by Wiggins (1998), who distinguished between an "audit" and what he refers to as "educative assessment." Wiggins describes an audit as something designed to check up on someone after the person's activity is over. The most obvious example would be a tax audit, which may check up on an individual's financial records after having filed the tax return. In our context, the paper-and-pencil teamwork tests described above can be considered an audit. They would presumably be administered at a single time, as a way to check up on students' knowledge and choose the highest scorers for particular tasks.

This is in contrast to educative assessment, which Wiggins (1998) describes as being in the service of educating students and improving their performance in the future. This type of assessment tends to rely on more authentic tasks where students actually demonstrate their teamwork performing real tasks. Students then receive feedback about their performance, and they can use this feedback to improve their performance the next time they try a similar task. Similarly, faculty members also use student performance as feedback about areas of strength and areas that need improvement, to guide the faculty member as she prepares students for future challenges. It is in this way that assessment can be used not just to audit student performance but also to actually enhance their learning.

Comprehensive Assessment of Team Member Effectiveness (CATME). One significant step toward Wiggins's vision of educative assessment (1998) is the Comprehensive Assessment of Team Member Effectiveness, or CATME, developed by Loughry, Ohland, and Moore (2007). The CATME consists of eighty-seven items (thirty-three on a shorter version) that load onto five factors: (1) contributing to the team's work (for example, "Did a fair share of the team's work"), (2) interacting with teammates ("Communicated effectively"), (3) keeping the team on track ("Stayed aware of fellow team members' progress"), (4) expecting quality ("Expected the team to succeed"), and (5) having relevant knowledge, skills, and abilities ("Had the skills and expertise to do excellent work"). To respond to the CATME, college students are asked to "think of a student project team that you worked on last semester. Select one member of the project team (not yourself) and evaluate that one person on all

of the items in this survey.” The result is a detailed set of feedback from the rater about the quality of the students’ teamwork skills.

In initial testing, the CATME has been used only to measure the students’ past performance. However, use of this method could potentially be expanded in a number of ways. For instance, students could be introduced to the items on the CATME at the beginning of a team project, as a way to teach them how to effectively contribute to teams. As the project went along, team members could then rate each other on their respective contributions. Conceivably, faculty members could also make observations of student teams, making independent ratings of each person’s work. Those scores could then be fed back to individual students to help them improve their teamwork skills as the project continues.

Valid Assessment of Learning in Undergraduate Education (VALUE). The Association of American Colleges and Universities (Rhodes, 2010) has published rubrics for fifteen of their essential learning outcomes as part of their program Valid Assessment of Learning in Undergraduate Education (VALUE). Broadly speaking, a rubric is a scoring tool that reveals the standards by which a particular piece of work will be judged (Huba and Freed, 2000; Stevens and Levi, 2005). In the case of the AACU’s teamwork rubric (available electronically at <http://www.aacu.org/value/rubrics/index.cfm>), the standards of performance are (1) contributes to team meetings, (2) facilitates the contributions of team members, (3) individual contributions outside of team meetings, (4) fosters constructive team climate, and (5) responds to conflict. For each of these standards, descriptions of relevant behavior are provided for four levels of performance, allowing a student’s teamwork skills to be rated relatively low on one dimension but markedly higher on another.

AACU has stated that their VALUE rubrics are intended for institutional-level use, rather than for grading individual students. However, the teamwork rubric could be easily adapted to serve as a guide for students enrolled in a specific course. Then the rubric could be used in many of the same ways in which the CATME could be used: students could rate teammates on their performance, and faculty members could also rate individual students on the basis of their observations of team functioning.

Implications for Educators

The CATME and the AACU’s VALUE rubric are potentially valuable tools for assessing teamwork among our students. However, implementing them successfully requires intentional effort on the part of college faculty and staff and, in many cases, requires a change to how we typically do business. In this final section, we outline what are likely to be the most significant changes.

Committing to the Development of Teamwork. Like anything else, teamwork skills are not likely to emerge spontaneously; they must be

intentionally developed. Therefore, faculty members need to commit to the development of teamwork skills by going out of their way to teach students what it means to be an effective teammate, asking students to practice working in teams, and offering feedback about the development of students' teamwork skills (Bain, 2004; Fink, 2003). These may seem like obvious steps, but they are ones that may not always be taken by faculty members otherwise focused on the content of their discipline.

Making Assignments That Elicit Teamwork. To assess students' teamwork, assignments that elicit teamwork behaviors must be created (Walvoord and Anderson, 1998). This may be a change for faculty members who are accustomed to giving tests and assignments that must be completed individually. For example, an introductory engineering class at our institution asks cadets to work in teams to build a rocket—a task much different from taking an individual test or writing an individual paper. It is also possible to find teamwork opportunities outside the typical classroom setting. For instance, at our institution all of our students work in teams in field training during the summer months and, during the academic year, participate in some form of competitive athletics (intercollegiate or intramural), another venue where teamwork is regularly displayed.

Focusing on the Process. As noted earlier, a team's success or failure can occur independently of the teamwork skill of its members. This suggests that a meaningful assessment of students' teamwork skills needs to focus on the teamwork *process*, rather than on the end *product*. It is not sufficient to give students a team assignment and then score their final project (or paper, or lab report, or whatever) for its accuracy. The quality of the team process, using something like the CATME or the VALUE rubric, must also be assessed.

Providing Meaningful Feedback. Effective learning takes place when students have an opportunity to practice, receive feedback, and then try again (Bain, 2004; Fink, 2003; Wiggins, 1998). Therefore, students developing their teamwork skills must receive feedback about the quality of those skills. This feedback can reasonably come from their peers, who are most likely to see their teamwork skills in action, or from faculty members, coaches, or others who may see their teamwork in a more limited setting. Regardless of the source, feedback about student performance is necessary, meaning that faculty and staff members need to build in opportunities for it to take place. It may also be necessary to train raters on using the assessment tool. Otherwise, raters may use differing implicit definitions of effective teamwork. For example, Sexton, Thomas, and Helmreich (2000) found ratings of teamwork between nurses and physicians to be highly dependent on one's role. Seventy-seven percent of intensive care doctors reported a high level of teamwork with IC nurses, but only 40 percent of IC nurses reported high teamwork with the IC doctors.

Conclusion

In this paper, we have described teamwork as a set of important skills that can be developed in individual students. To develop those skills, we must be very clear about how teamwork is defined and how we can promote it in our students. Perhaps even more so than other outcomes described in this volume, the development of teamwork may require willingness to redesign our courses, programs, and existing assessment methodologies.

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