DEVELOPMENT AND ASSESSMENT OF COLLABORATION, TEAMWORK, AND COMMUNICATION

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Citizen Interaction Design is a novel approach to learning that partners the local government of Jackson, Michigan with University of Michigan student teams. The students found great value in the collaborative learning environment fostered by the interactions with the course professor and the community. Giving the opportunity for students to act as consultants allowed them to learn even more from the faculty, and enhanced their learning experience through interaction with their peers (project groups) and the community.[1]

The objective of the Medical Device Sandbox (MDS) is to promote engaged interdisciplinary learning between medical learners and students from a variety of other disciplines...It consists of a coordinated space and environment for engineering students and medical trainees to interact both with medical technology and with each other. These learners will perform team-based analysis and brainstorming on use of current [medical] equipment, with the goal of identifying design improvements.[2]

The purpose of Michigan Engaging Community Through the Classroom is to provide multi-disciplinary, experiential learning opportunities for undergraduate and graduate students pursuing professional careers that involve direct public service or that engage work on behalf of public clients and non-governmental organizations… Success in these professions increasingly requires that professionals have the ability to collaborate intelligently with professionals from other allied disciplines.[3]

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[2] John Gosbee, Rachael Schmedlen, & Jan Stegemann, "The Medical Device Sandbox: A Creative Learning Experience for Engineering Students and Medical Learners." TLTC grant, funded 2015.

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This Occasional Paper focuses on fostering and assessing collaboration, teamwork, and communication. This involves encouraging students to appreciate and leverage diverse contributions to a task, developing their ability to cooperate with others towards common purposes, and increasing their capacity to communicate effectively with teammates, clients, or stakeholders (Third Century Initiative Student Learning, http://thirdcentury.umich.edu/student-learning/). While equally important, this paper does not address students' general oral or written communication skills. Should that be of interest, available resources include the Sweetland Center for Writing (https://lsa.umich.edu/sweetland) and the Council of Writing Program Administrators (http://www.wpacouncil.org/whitepaper).

Aligned with previous TLTC Occasional Papers, we begin with a discussion of how the literature currently conceptualizes collaboration and teamwork, the role of communication skills during collaborative work, and a discussion of the importance of this goal for student development. A summary of different approaches to promoting this goal and a discussion of how to assess these skills follow.

Collaborative Learning & Teamwork

The need for collaborative work is widespread, and creating opportunities for students to practice collaboration and teamwork is imperative across disciplines (Fredrick, 2008; Hughes & Jones, 2011; McClellan, 2015). The key characteristics that define a team are that the individuals within the team "(1) have a shared collective identity, (2) have common goals, (3) are interdependent in terms of their assigned tasks

or outcomes, and (4) have distinctive roles within the team" (Hughes & Jones, 2011, p. 54; see also Guzzo & Dickson, 1996). While there seems to be agreement on a relatively concise definition of what constitutes a team, the same cannot be said of collaboration, with definitions dependent on the disciplinary field, organization, or culture (Katz & Martin, 1997; Ryser, Halseth, & Thien, 2009). Drawing primarily from the organizational studies literature, Kezar (2005) proposes the following definition: "In order to be considered collaboration, it is key that the process entail an interactive process (relationship over time) and that groups develop shared rules, norms and structures, which often become their first work together" (p. 833-834). Kezar then explains that collaboration can be internal, including interdisciplinary work or cross-functional teams, or external, including community, business, or industry partnerships.

For the purposes of this Occasional Paper, *collaboration* refers to learning or work that is accomplished through an interactive process leading towards a common goal, either internally or externally. Often used as an interchangeable term, *teamwork* is the collaboration of a group of individuals who have a shared identity and who are interdependent on each other to accomplish common goals (McClellan, 2015). In order for effective collaboration and teamwork to happen, the individuals that form these groups must *communicate* effectively with one another (Chan & Ching-Huei, 2010; Fredrick, 2008). Therefore, collaborative tasks essentially become exercises for developing communication skills (Bolton, 1999; Johnson, Veitch, & Dewiyanti, 2015; Walton & Baker, 2009).

Why Are Collaboration, Teamwork, and Communication Important?

Contemporary issues and unanswered questions in most disciplines are increasingly complex, often requiring the diversity of perspectives inherent in collaborative approaches. As students engage with these knotty issues both at U-M and beyond, it is imperative that they have opportunities to practice collaborative work, exercising teamwork and communication skills (Fredrick, 2008; Hughes & Jones, 2011; McClellan, 2015). For example, a study commissioned by the Association of American Colleges and Universities (AAC&U) revealed that most employers (67%) believed that colleges should place more emphasis on "teamwork skills and the ability to collaborate with others in diverse group settings" (Hart Research Associates, 2013, p. 8).

Moreover, practice working in teams carries advantages for workforce preparation and academic performance at the university. For example, an extensive literature review found that there is substantial evidence indicating that students on teams outperform the highest achieving individual students working alone (Finelli, Bergom, & Mesa, 2011; Page, 2007). Additionally, higher-order thinking skills (e.g., analysis, synthesis, evaluation, and problem solving) are more likely to be attained by students who collaborate on teams (Finelli et al., 2011; see also Hsiung, 2010; Johnson & Johnson, 1999; Johnson, Johnson, & Smith, 1998; Springer, Stanne, & Donovan, 1999; Wankat & Oreovicz, 2015). This is especially true of cognitively diverse teams (i.e., teams made of individuals with diverse perspectives, interpretations, heuristics, and predictive models), because these teams offer differing perspectives and approaches to solutions, leading all team members to think more critically through their problem solving process (see Page). In addition, there is evidence that collaborative learning has a positive effect on student development in terms of intellectual and practical competencies (Kuh, 2001, 2003, 2008). Collaboration and teamwork experiences are "not just a desirable *outcome* of student development," but are also educational practices with "demonstrably high developmental impact" on student learning (Hughes & Jones, 2011, p. 54).

Fostering Collaboration, Teamwork, and Communication Skill Development

To help students develop effective collaboration, teamwork, and communication skills, instructors must go beyond simply creating assignments that require students to work in teams. Hughes & Jones (2011) explain, "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" (p. 61). There are a variety of research-based practices that support the effective implementation of teams in university classrooms, including:

- Having teams develop contracts defining team roles and expectations (Finelli et al., 2011; Johnson et al., 1999)
- Using videoconferencing or other computer-mediated communication to accomplish project tasks or conduct team meetings (Ertl, Kopp, & Mandl, 2006; Wang, 2009)
- Using course wikis or course forums to encourage collaborative group discussion (De Wever, Schellens, Valcke, & Van Keer, 2006; Judd, Kennedy, Cropper, 2010; Trentin, 2009)
- Using co-teaching as a method for modeling and teaching teamwork (Kliegl & Weaver, 2013)
- Asking students to engage in peer assessment of collaborative work (Finelli et al., 2011; Fredrick, 2008)

The educational context, including students' academic level, desired learning outcomes, and complexity of the project, will determine which of these practices is most appropriate.

Team-based learning, problem-based learning, group discussion, and peer instruction are other examples of educational practices that have been shown to foster collaboration and teamwork skills (Hmelo-Silver, 2004; Michaelson & Sweet, 2011), as well as outcomes such as creativity (Huggins & Stamatel, 2015), critical thinking (Garside, 1996), and student engagement and retention (Dym, Agogino, Eris, Frey, & Leifer, 2005). U-M examples of how these pedagogies are being effectively implemented include *Cleveland Design Lab*

courses in Taubman College (http://thirdcentury.umich.edu/cleveland-design-lab/). These problem- and team-based courses ask students to study complex urban phenomena in the Great Lakes Region, challenges too complex to be tackled individually. Students are placed on multidisciplinary teams to study the interconnected relationships between urban systems, environmental issues, construction techniques, and cultural identity. In the process, they have the opportunity to practice and hone teamwork and collaborative communication skills and self-directed learning (Wright, Bernstein, & Williams, 2013). Similarly, the *Citizen Interaction Design* project pairs student teams with local government partners to tackle community challenges with information-based solutions, such as creating an anonymous texting service for police tips (https://myumi.ch/pZQjZ). This project-based educational experience provides an avenue for students to practice collaboration skills not just with fellow university students, but also with community partners and stakeholders.

Regardless of the chosen approach to creating collaborative assignments and spaces for students, they most effectively succeed in collaborative and team experiences when instructors carefully design and guide the process (Bolton, 1999; Knowles, 1975; Kolb, 1984; McClellan, 2015; Schroeder, 1993). This

is particularly important for the communication aspect of collaborative work. Some approaches faculty can use to guide a student team might be to ask students to explicitly define team roles early in the project by identifying students' strengths, or to allow a few minutes of class time for teams to do a quick "check-in" meeting with the instructor. An available resource to help prime students for effective communication between team members is a "Group Work Plan," from the Sweetland Center for Writing, which can be used to guide students' early team communication (https://myumi.ch/M9R5p).

Finelli, et al. summarize the general consensus in the literature for how to best design collaborative team assignments (2011, p. 2-4):

- Begin with simple, well-defined tasks, then increase their difficulty.
- Define individual versus team accountability.
- Develop assignments that require interdependence.

CRLT Occasional Paper No. 29 by Finelli, Bergom, and Mesa (2011) is an excellent resource regarding how to effectively use team-based learning in the classroom (http://www.crlt.umich.edu/resources/occasional), (see Finelli et al., p. 2). Additional published examples of University of Michigan faculty's research on groups and team-based learning are shown in Table 1.

Table 1. Examples of U-M Faculty Implementing Team-based Learning

Cited Publications	Summary of Work
Fowler (2014)	This paper investigates differences between collaborative work done face-to-face versus computer-supported collaborative learning via Google Drawing with synchronous chat. The result of this study was that students were much more likely to equally participate when collaborating via chat than when meeting in person.
Remington, Hershock, Klein, Niemer, & Bleske (2015)	This paper discusses the experiences, challenges, and lessons learned from the College of Pharmacy's implementation of team-based learning pedagogy in the curriculum. The paper closes with 9 key recommendations for faculty interested in adopting team-based learning.
Bleske et al. (2014)	This paper investigates the effectiveness of team-based learning as compared to traditional lectures in a therapeutics course sequence, using multiple choice and essay questions to score students. The authors found that moving to a team-based learning pedagogy allowed students to perform at a similar level as students with an additional year of education on application-of-knowledge type questions, but not on recall-type questions.
Wright, Bernstein, & Williams (2013)	The researchers describe how "hevruta"—a pedagogy involving sustained, pair-based learning—in a large U-M English classroom fostered students' reflective capacities.

Additionally, common goals, strategies, and challenges to fostering collaborative learning experiences were discussed by a group of multidisciplinary U-M faculty and scholars during a 2016 CRLT-Vice Provost's Office event on fostering and assessing collaboration and teamwork. Additionally, a small panel of students from diverse academic backgrounds shared their perspectives on collaborative experiences in their engaged learning courses and programs. A summary of that discussion, which identifies strategies for mitigating common challenges, can be found at this link: https://myumi.ch/n8b9r.

Assessing Collaboration and Teamwork

When assessing collaborative or team-based work, it is best to distinguish between teamwork, i.e., overall team performance, and individual work, i.e., personal performance (Hughes & Jones, 2011). It is important to be transparent early and often about when and which work will be assessed as a team and which work will be assessed individually. Equally, it is important to distinguish how peer assessment will be factored into grades. One popular approach to peer assessment is the Fink Method, which asks students to distribute a set of points among their teammates based on each team member's level of contribution (Table 2). Two similar approaches (the Michaelson Method and the Koles Method) are described at https://myumi.ch/3k2pn.

For situations that do not involve assigning grades (e.g., co-curricular programs), it may still be helpful to assess collaboration and teamwork skill development, for example, to serve as part of a program evaluation.

Regardless, meaningful assessment of students' teamwork skills should focus on teamwork *process* and on the end *product* (Hughes & Jones, 2011, p. 61). Assessment of the end product is also valuable for evaluating other outcomes, such as creativity (Hallman, Wright, & Conger, 2016), innovation (Kusano, Conger, & Wright, 2016), and content knowledge. However, while a poor end product might be an indicator of poor teamwork, it does not offer complete evidence of the quality of the communicative and collaborative process.

Assessment Strategies

Peer assessment is one of the most commonly discussed approaches to assessment of collaboration and teamwork. First, peer judgment has been shown to be a significant motivator for students as compared to a single instructor-led assessment (Searby & Ewers, 1997). Second, in order for students to adequately assess their peers, they are required to be more thoughtful and to have a more comprehensive understanding of the relevant process or activity (Cestone, Levine, & Lane, 2008).

When using peer assessment, it can be helpful to involve students early in the process of negotiating the criteria that will be used. This will enhance the assessment validity, as well as offer students familiarity and ownership (i.e., student buy-in) over the criteria by which they will be assessed (Falchikov & Goldfinch, 2000; Finelli et al., 2011). Different peer assessment methods to consider are listed in Table 2. One of the most commonly used instruments is the Comprehensive Assessment of Team Member Effectiveness (CATME),

Direct measures are associated with student output and represent actual student learning such as performance and behavior on a team. In addition, measures within the scope of direct assessment can be further categorized into authentic or other direct measures. Authentic measures demonstrate classroom learning via performance on real-world tasks involving representative challenges in a field (Wiggins, 1990), such as the projects completed by students in "Cleveland Design Lab" (see p. 4). Other types of direct measures demonstrate learning via performance on closed-ended and possibly standardized tasks, such as taking a quiz testing content knowledge. While authentic measures provide a richer understanding of student learning and its applicability to the real world, they can be more time intensive and costly to quantify for purposes of student comparisons. Conversely, other direct measures are usually standardized and can be quantifiable, but may fail to tap into the extent to which students are able to apply what they have learned, especially for the unscripted nature of engaged learning. Indirect measures are associated with students' attitudes, opinions, or reported learning, such as responding to a survey asking whether they agree with statements thought to tap into their perceived collaboration and communication skills. The use of both direct and indirect measures is recommended for the best understanding of student learning and experiences.

Table 2. Peer Assessment Instruments for Teamwork and Collaboration

Measure	Assessment Method	Reference(s)	Notes
Teamwork skill performance	Comprehensive Assessment of Team Member Effectiveness (CATME)	Loughry, Ohland, & Moore (2007)	Full version: 87 items Short version: 33 items Items load onto five factors: 1. Contributing to team's work 2. Interacting with teammates 3. Keeping the team on track 4. Expecting quality 5. Having relevant knowledge, skills, and abilities *Cost: Free; must request account* *Access: info.catme.org*
Perception of teamwork skills	Teamwork Survey	Based on Tuckman (1965)	Using a 32-item questionnaire, students rate their team as a whole for how frequently members display certain behaviors. Score system ranges from 1 (almost never) to 5 (almost always). Sample items include: • Our team feels that we are all in it together and share responsibilities for the team's success or failure. • The team leader is democratic and collaborative. • We argue a lot even though we agree on the real issues. *Cost: Free* *Access: https://myumi.ch/e689j*
Team contributions	Fink Method	Michaelsen, Knight, & Fink (2002)	Given 100 points to divide among team members, students assign each team member a score based on the extent to which they believe their teammates contributed to overall team performance. An individual student's grade is then based on their average peer ratings, multiplied by the group score. *Access: https://myumi.ch/J825x*

which is an online system of tools for facilitating making teams, teamwork training, team communication support, and peer evaluations. Cestone et al. (2008) offer some key insights to keep in mind when considering peer assessment:

1. *The skill of performing evaluation is not intuitive*—Students will likely need guidance or training for how to constructively evaluate their peers' work.
2. *Practice is essential in order to become comfortable with the process*—Students will benefit from having multiple opportunities to go through the process of peer assessment and become more comfortable evaluating their peers' work.

3. *Peer review is best received in an environment in which there is a culture of professionalism and a minimal amount of competition and mistrust*—Feedback from peers should be constructive and received positively. The process should be seen as a collaborative exercise that helps everyone learn and improve, rather than as a competitive exercise aimed at ranking everyone's work.

There are a variety of assessment instruments available to guide direct assessment of teamwork behavior, interprofessional collaboration, and teamwork knowledge and skills, via observations on process and evaluations of work products. Examples of these assessment instruments are described in Table 3, with AAC&U's VALUE rubric on teamwork being one of

Table 3. Examples of Assessment Instruments Related to Collaboration, Teamwork and Communication

Instrument	Measure	Notes	Measure Type
AAC&U VALUE Rubric – Teamwork	Teamwork behavior	Performance descriptors include: • Contributes to team meetings • Facilitates the contributions of team members • Individual contributions outside of team meetings • Fosters constructive team climate • Responds to conflict Cost: Free *Access: https://www.aacu.org/value/rubrics/teamwork*	Direct
Inter-professional Collaborator Assessment Rubrics (Curran, et al., 2011)	Inter-professional collaboration	Made up of 6 distinct rubrics measuring: • Communication • Collaboration • Roles and responsibilities • Collaborative patient/client-family centered Approach • Team functioning • Conflict management/resolution Cost: Free *Access: https://myumi.ch/y9GjJ* Note: developed for health care fields, but adaptable to other disciplines	Direct
Teamwork Knowledge, Skills, and Abilities Test (KSA) (Stevens & Campion, 1994; 1999)	Teamwork knowledge & skills	Assesses: 1. Conflict resolution 2. Collaborative problem solving 3. Communication 4. Goal setting/management 5. Planning and task coordination *Cost: $312.80 for 10 tests/1 manual + fees* *Access: https://myumi.ch/29Pqk*	Direct
Pre-Post Survey Inter-professional Socialization and Valuing Scale (ISVS) (King, Shaw, Orchard, & Miller, 2010)	Beliefs, behaviors, and attitudes toward inter-professional collaboration and socialization	24 items loaded onto 3 factors: 1. Self-perceived ability to work with others 2. Value in working with others 3. Comfort in working with others *Survey items have been validated* Cost: Free Note: developed for health care fields, but adaptable to other disciplines	Indirect
Student Attitude Survey (Ku, Tseng, & Akarasriworn, 2013)	Attitudes toward online collaborative work for problem solving	19 items measuring 3 factors: 1. Team dynamics 2. Team acquaintance 3. Instructor support *Cost: Free*	Indirect

the most widely used. As with other VALUE rubrics, this is a widely accepted and very adaptable tool used to measure student development in terms of their teamwork skills and behaviors. The Interprofessional Collaborator Assessment Rubrics include 6 measures aimed at assessing interprofessional collaboration competencies of health workers from different professional backgrounds. The Teamwork – KSA Test is a validated instrument that measures how likely an individual is to succeed in a team setting, measured along the five dimensions.

For assessing students' perceptions or attitudes toward team or collaborative work, there are a number of existing instruments available, such as the Inter-professional Socialization and Valuing Scale (ISVS) and the Student Attitude Survey listed in Table 3. These instruments are relatively short surveys that can be quickly implemented in most classes or educational programs. Particularly useful for assessing changes in perception or attitudes, these instruments can be used as pre-/post-surveys. In addition to the tools listed here, the Curtis Center has also collected information on assessment instruments and measurement tools for interprofessional education efforts (https://umichipemeasures.wordpress.com).

Some of the instruments in Table 2 and Table 3 also incorporate communication measures. These include CATME (Table 2), Interprofessional Collaborator Assessment Rubric, Teamwork KSA Test, and ISVS (Table 3). The Interprofessional Collaborator Assessment Rubric on Communication measures if an individual "consistently uses communication strategies (verbal & non-verbal) appropriately in a variety of situations." Another example is the AAC&U VALUE teamwork rubric, which measures the extent to which students "help the team move forward by articulating the merits of alternative ideas or proposals." The takeaway is that there are assessment instruments that can be used or adapted to measure both collaboration and communication skills, thereby helping to minimize over-assessment of students.

Conclusion

Just as with the other TLTC engaged learning goals, collaboration, teamwork, and communication skills are competencies that must be practiced to truly develop. Therefore, it is valuable for U-M to offer a variety of opportunities, both curricular and co-curricular, for students to practice these skills. According to a 2015 university-wide survey (University of Michigan Asks You, or UMAY), about a third of U-M students (34%) stated that they never, rarely, or only occasionally worked on group projects with classmates outside of class. This indicates that there are either not enough opportunities for all students to practice collaboration and teamwork during their U-M careers, or that students are not making the connections of how their experiences are equipping them with collaborative skills. Of course, this learning goal should not be thought of as a simple competency that can be fully mastered within the boundaries of the university, but rather as a learning process to promote and develop. Ideally, assessment of communication, collaboration and teamwork should then reflect this process, by using both direct and indirect assessment measures throughout time, rather than a single assessment method to a capture a single point in time.

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