

Optimizing Student Team Skill Development using Evidence-Based Strategies: Year 4 NSF Award 1431694

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Matthew W. Ohland is Professor of Engineering Education at Purdue University. He has degrees from Swarthmore College, Rensselaer Polytechnic Institute, and the University of Florida. His research on the longitudinal study of engineering students, team assignment, peer evaluation, and active and collaborative teaching methods has been supported by the National Science Foundation and the Sloan Foundation and his team received Best Paper awards from the Journal of Engineering Education in 2008 and 2011 and from the IEEE Transactions on Education in 2011 and 2015. Dr. Ohland is an ABET Program Evaluator for ASEE. He was the 2002–2006 President of Tau Beta Pi and is a Fellow of the ASEE, IEEE, and AAAS.

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David J. Woehr is currently Professor and Chair of the Department of Management at The University of North Carolina at Charlotte. He received his Ph.D. in Industrial/Organizational Psychology from the Georgia Institute of Technology in 1989. Dr. Woehr served on the faculty of the Psychology Department in the I/O Psychology program at Texas A&M University from 1988 to 1999 and as a Professor of Management at the University of Tennessee from 1999 to 2011. He has also served as a Visiting Scientist to the Air Force Human Resource Laboratory and as a consultant to private industry. Dr. Woehr is a fellow of the Society for Industrial and Organizational Psychology (SIOP), the American Psychological Association (APA), and the Association for Psychological Science (APS). His research on managerial assessment centers, job performance measurement, work related attitudes and behavior, training development, and quantitative methods has appeared in a variety of books, journals, as papers presented at professional meetings, and as technical reports. Dr. Woehr currently serves as editor for Human Performance as well as on the editorial boards for Organizational Research Methods, and the European Journal of Work and Organizational Psychology

Dr. Daniel M. Ferguson, Purdue University-Main Campus, West Lafayette (College of Engineering)

Daniel M. Ferguson is CATME Managing Director and the recipient of several NSF awards for research in engineering education and a research associate at Purdue University. Prior to coming to Purdue he was Assistant Professor of Entrepreneurship at Ohio Northern University. Before assuming that position he was Associate Director of the Inter-Professional Studies Program [IPRO] and Senior Lecturer at Illinois Institute of Technology and involved in research in service learning, assessment processes and interventions aimed at improving learning objective attainment. Prior to his University assignments he was the Founder and CEO of The EDI Group, Ltd. and The EDI Group Canada, Ltd, independent professional services companies specializing in B2B electronic commerce and electronic data interchange. The EDI Group companies conducted syndicated market research, offered educational seminars and conferences and published The Journal of Electronic Commerce. He was also a Vice President at the First National Bank of Chicago [now J.P. Morgan Chase], where he founded and managed the bank's market leading professional Cash Management Consulting Group, initiated the bank's non-credit service product management organization and profit center profitability programs and was instrumental in the breakthrough EDI/EFT payment system implemented by General Motors. Dr. Ferguson is a graduate of Notre Dame, Stanford and Purdue Universities, a special edition editor of the Journal of Engineering Entrepreneurship and a member of Tau Beta Pi.

Dr. Catherine E. Brawner, Research Triangle Educational Consultants

Catherine E. Brawner is President of Research Triangle Educational Consultants. She received her Ph.D. in Educational Research and Policy Analysis from NC State University in 1996. She also has an MBA from Indiana University (Bloomington) and a bachelor's degree from Duke University. She specializes in evaluation and research in engineering education, computer science education, and technology education. Dr. Brawner is a founding member and former treasurer of Research Triangle Park Evaluators, an American Evaluation Association affiliate organization and is a member of the American Educational Research Association and American Evaluation Association, in addition to ASEE. Dr. Brawner is also an Extension Services Consultant for the National Center for Women in Information Technology (NCWIT) and, in that role, advises computer science and engineering departments on diversifying their undergraduate student population. She remains an active researcher, including studying academic policies, gender and ethnicity issues, transfers, and matriculation models with MIDFIELD as well as student veterans in engineering. Her evaluation work includes evaluating teamwork models, broadening participation initiatives, and S-STEM and LSAMP programs.

Mr. Behzad Beigpourian, Purdue University

Behzad Beigpourian is a Ph.D. student and Research Assistant in Engineering Education at Purdue University. He earned his master's in Structural Engineering from Shahid Chamran University in Iran, and his bachelor's in Civil Technical Teacher from Shahid Rajaee Teacher Training University in Iran, Tehran. He has been official Technical Teacher at Ministry of Education in Iran from 2007 to 2018, and received many certificate in education such as Educational Planning, Developing Research Report, and Understanding School Culture. Mr. Beigpourian currently works in the CATME project, which is NSF funding project, on optimizing teamwork skills and assessing the quality of Peer Evaluations.

Mr. Frank Luchini,

Frank Luchini has five years experience in industry working as a Process/Design/Project Engineer. He recently returned to academia to earn a PhD in Engineering Education at Purdue University. He will be completing a Master in Engineering Education in May and starting as a Assistant Professor at Trine University in August 2019. He earned a BS in Mechanical Engineering and a BA in Arts and Humanities from Michigan State University.

Mr. siqing wei, Purdue University-Main Campus, West Lafayette (College of Engineering)

Siqing Wei received bachelor degree in Electrical and Computer Engineering at Purdue University. He is in the dual program to obtain master degree in Electrical and Computer Engineering and Ph.D degree in Engineering Education at Purdue University. After years of experience of serving a peer teacher and a graduate teaching assistant in first year engineering courses, he is now interested in study of the existence, cause and interventions on international engineers' teaming behaviors.

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As noted earlier, the broad goal of this work is to study the effectiveness of teamwork training methods, experience in teams, and receiving various forms of feedback on the development of team skills and the ability to evaluate teamwork. This is conducted through a series of studies including classroom experiments, lab studies, and analyses of historical data. The research leverages the National Science Foundation's (NSF's) prior investment in the Comprehensive Assessment of Team-Member Effectiveness (CATME) system to measure teamwork [1]. The CATME system automates some of the data collection and feedback, providing input to some of the seven empirical studies required to explore these research questions. The entire research protocol is shown in Figure 1. The two outcomes measured in this research are team-member effectiveness and the ability to evaluate the effectiveness of peers.

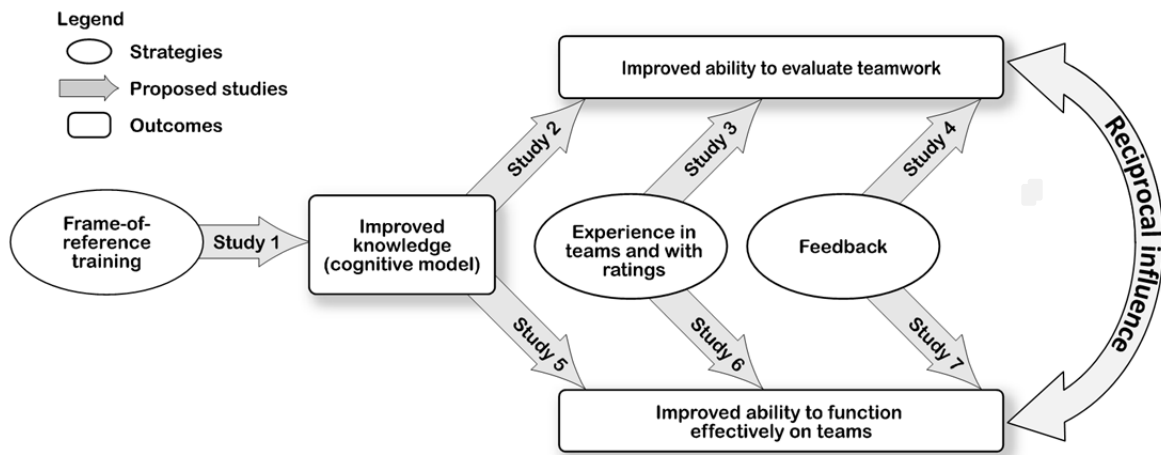


Figure 1. Model for improving self- and peer-evaluation skills and teaming skills.

Progress on research protocol

The project team has published three peer-reviewed journal articles, including one about the learning impact of frame-of-reference training, one that analyzes patterns of disagreement in peer ratings, and one that evaluates methods of justifying aggregation of ratings of team-level variables. A fourth paper is currently under review that looks at the impact of perceptions of team members' warmth and competence on team members' willingness to work together. A fifth paper is currently in progress that analyzes the approaches used by team members to exert peer control over one another.

Figure 2 illustrates progress toward the research plan shown in Figure 1. Study 1 and Study 2 were combined in a single serial intervention leading to a publication that documented the impact of Frame-of-Reference Training (FORT) on peer evaluation quality [2]. This same publication included the first findings for Study 5; further evidence is being developed for publication.

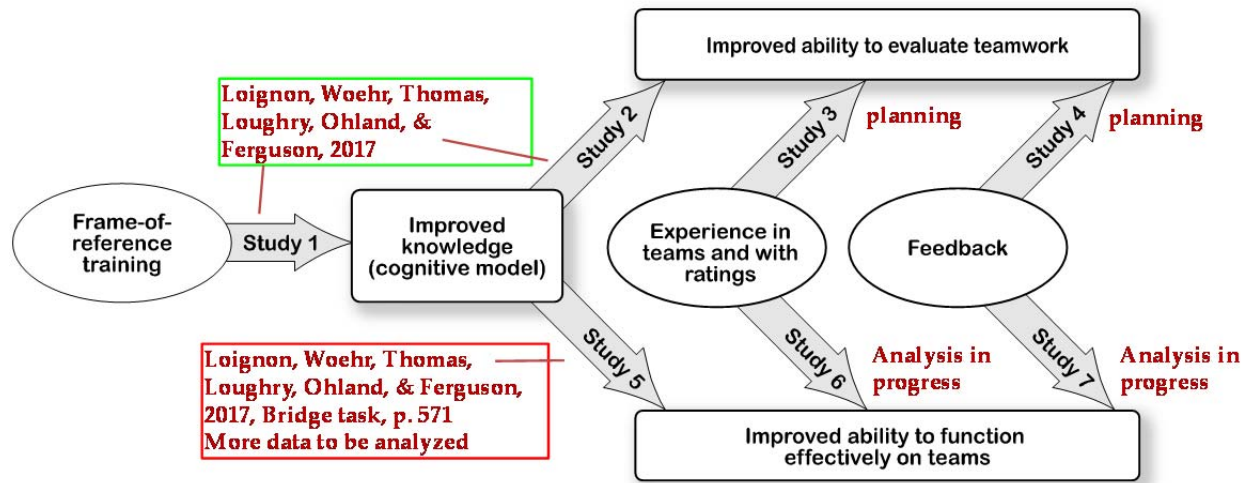


Figure 2. Model for improving self- and peer-evaluation skills and teaming skills showing research progress.

Data supporting Study 6 and Study 7 have been collected and are being analyzed. While we have preliminary data related to Study 3 and Study 4, a more significant plan is being developed to address those objectives in the coming year. In our early progress on Study 4, we have evidence of how peers influence each other to improve their behavior in teams. This work is being developed for publication [3].

Advances in the science of teamwork

In developing and conducting our planned studies, it became clear that our plans required advances in the study of consensus-based team outcomes and in the study of round-robin peer evaluation data. Many team outcomes are measured as consensus constructs; they are studied in the aggregate. Nevertheless, it is clear from inspection that it is possible for teammates to disagree on those outcomes. It is possible for one team member to report a high level of conflict in the team even though the average level of conflict is reported as low. We provided a revised set of guidelines for researchers to justify the decision to aggregate consensus-based constructs [4]. The rate of citation has increased rapidly since publication; the paper has already been cited 55 times, including 25 citations in 2018. The volume of round-robin data in CATME made it possible to test a published theory predicting the possible dispersion patterns in such

datasets. We were able to confirm many of the hypothesized patterns empirically as well as identify additional patterns to refine the published theory [5].

Continuing our work to explore the use of consensus-based measures, we have shown that there is value in studying both aggregate outcomes and the variation of student perspectives about those outcomes – particularly where a dyadic perspective is available [6].

The continued growth of the CATME user base

The growth of the CATME user base continues to be strong. From October 1, 2017, to September 30, 2018, another 203,043 unique students have used the CATME system for the first time. In the same year, we reached faculty at 202 new institutions, adding 2,433 new faculty accounts. Since its release in 2005, CATME had served over 1,240,000 unique students, primarily in the United States. Figure 3 shows the trajectory of the growth of CATME’s user base in terms of students, institutions, instructors, and countries. This figure is updated monthly on our website [7].

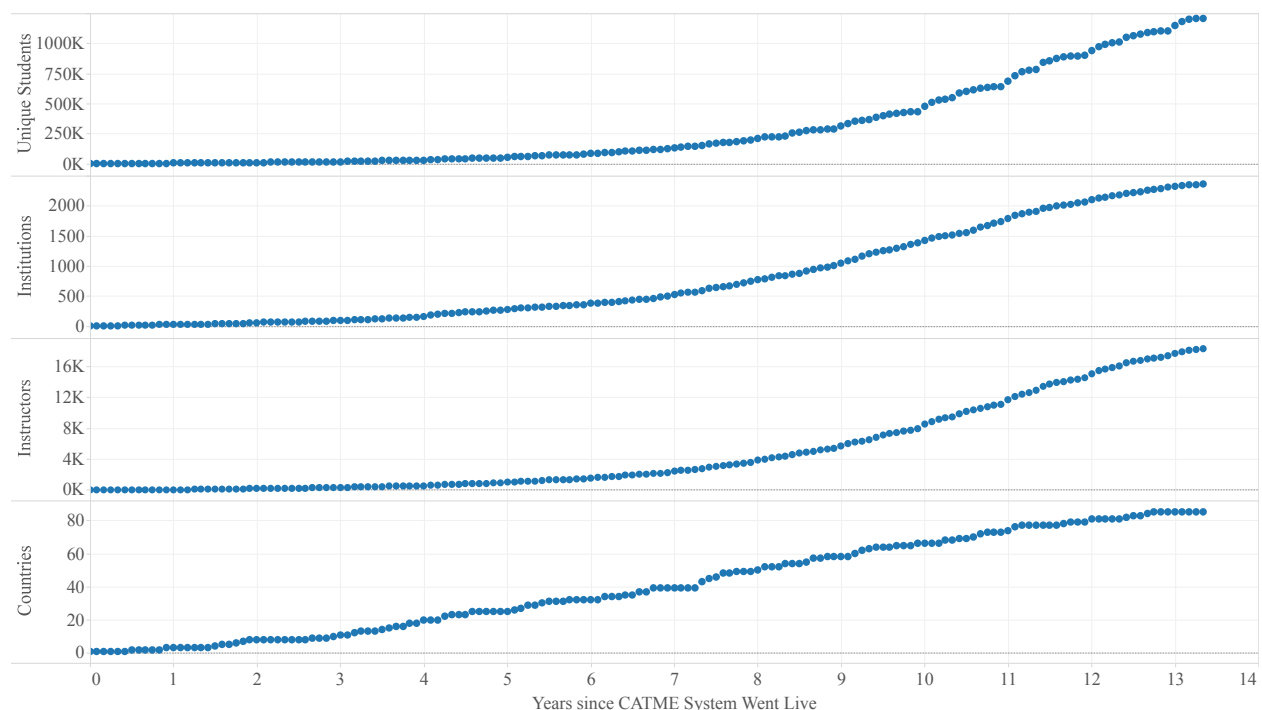


Figure 3. Growth of the CATME user community in students, institutions, instructors, and countries

Such a large data resource allows us to restrict our studies to include high-quality data that controls certain confounding issues. We can constrain our study to include only teams of four students at U.S. institutions with complete data. Further, those results can be compared to teams of other sizes to explore how team size affects team dynamics. CATME’s user base is also geographically distributed, which helps to ensure that our results are generalizable. Figure 4 shows the institutions in the continental United States where CATME has been used.

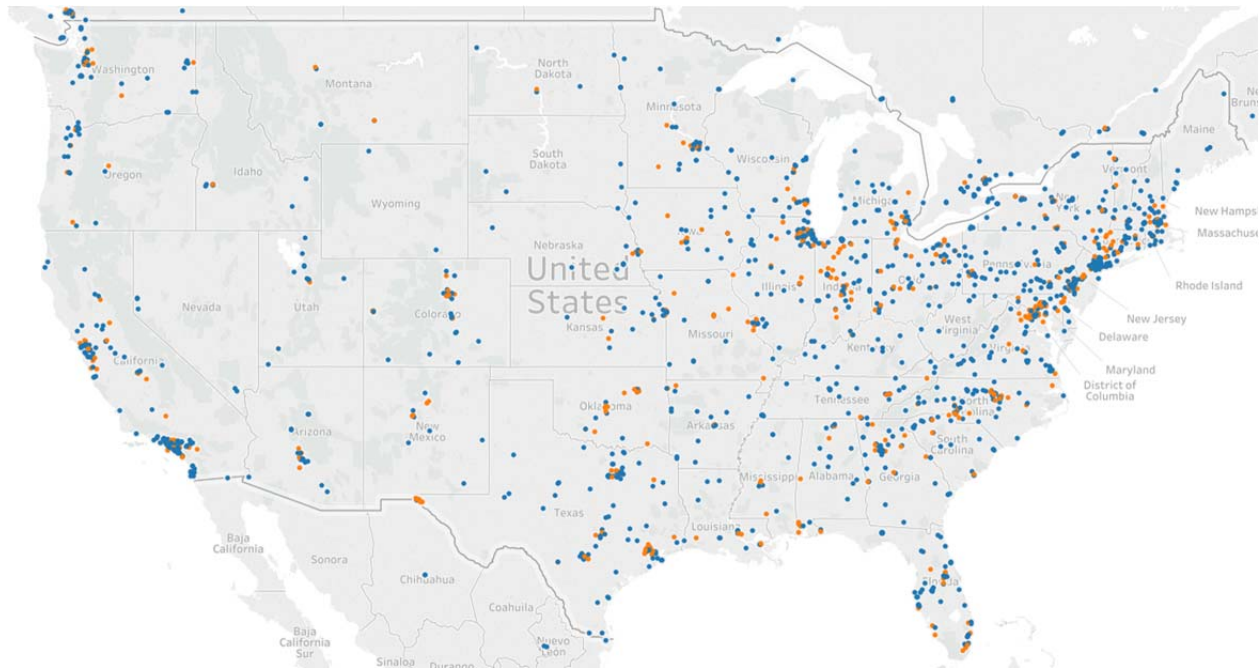


Figure 4. Distribution of institutions in the continental U.S. where instructors have had CATME accounts. Pre-college institutions are represented by orange dots.

New features are rapidly adopted

Peer-to-peer feedback boxes for students provide comments about each team member were released as a new, optional feature to the peer evaluation system in August 2017, along with links to instructor and student 'how to' videos describing the new feature. In the past year, instructors have chosen to assign peer-to-peer comments as a part of their peer evaluations more than 4,000 times with over 200,000 students. The addition of this feature has the potential to substantially improve both the quality and quantity of feedback that students share with their teammates and the instructor, which should enhance their development of team skills. This affects engineering above other disciplines because engineering still comprises the largest share of the CATME user base.

CATME's Rater Practice activity, designed to improve student rating accuracy, was updated August 2017 to be a game-like simulation that instructors can assign as homework. Since that change, students have completed Rater Practice over 350,000 times.

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