Optimizing Student Team Skill Development using Evidence-Based Strategies: Year 5

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Matthew W. Ohland is Associate Head and 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 for the best paper published in the Journal of Engineering Education in 2008, 2011, and 2019 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.

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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.

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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 at West Lafayette

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. Siqing Wei, Purdue University-Main Campus, West Lafayette (College of Engineering)

Siqing Wei received both bachelor’s and master’s degrees in electrical and Computer Engineering from Purdue University. He is currently pursuing a 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 a research assistant at CATME research group studying the existence, causes and interventions on international engineering teamwork behaviors, the integration and implementation of team-based assignments and projects into STEM course designs and using mixed-method, especially natural language processing to student written research data, such as peer-to-peer comments. Siqing also works as the technical support manager at CATME research group.
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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.](image)

**Progress on research protocol**

The project team published its fourth peer-reviewed journal article related to this work, examining the impact of perceptions of team members’ warmth and competence on team members’ willingness to work together [2]. A fifth paper is currently in progress that analyzes the approaches used by team members to exert peer control over one another [3].

New data related to Study 3 and Study 4 were collected in partnership with Pennsylvania State University in Fall 2019, and analysis of the data collected is in progress. 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.
Advances in the science of teamwork

Our revised set of guidelines for researchers to justify the decision to aggregate consensus-based constructs [4] continues to gain an increasing number of citations each year. The rate of citation has increased rapidly since publication; the paper has already been cited 87 times, including 31 citations in 2019. Our evaluation of the theory regarding possible dispersion patterns in such datasets addresses a much more obscure corner of this type of research, so it has hardly been cited. The study of patterned dispersion was more of a “basic science” piece of research—the kind that sometimes turns out to much more helpful later—particularly in the automated processing of large volumes of peer evaluation data [5].

By demonstrating the value of studying data from both a consensus approach and a dyadic perspective [2], we have raised a question that can fuel a substantial amount of research—much of which can be conducted using CATME historical data.

The continued growth of the CATME user base

Since its release in 2005, CATME has served over 1,430,000 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 [2].

![Figure 3. Growth of the CATME user community in students, institutions, instructors, and countries](image)
Such a large data resource allows us to restrict our studies to include high-quality data that controls certain confounding issues. For example, 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.](image)

**New features are rapidly adopted**

The peer-to-peer feedback introduced last year has now been used by instructors as a part of their peer evaluations in more than 10,000 course sections. 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.

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 568,000 times.
References


