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P O

The Process

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Process skills are really important, and facilitating them or choosing activities which elicit them is vital to success and to making this more than group problem-solving.

—*A POGIL practitioner*

POGIL is unique when compared to other cooperative learning strategies in that process skills are specifically identified. Guidelines are provided for learning team roles and interactions, as well as other classroom facilitation strategies that support the development of process skills. This chapter will describe process skills and their importance in a POGIL classroom. Definitions and a literature review of process skills are provided, along with a description of how activities and classroom facilitation help develop process skills. The assessment of process skill development to date is summarized, and future assessment strategies are outlined.

What Are Process Skills? Why Are They Important?

Students need to become proficient in skills that will help them optimize their education in active learning environments and prepare them to be successful in the modern workplace. Over 25 years ago, a joint research project between the American Society for Training and Development and the U.S. Department of Labor culminated in a publication titled "Workplace Basics: The Skills Employers Want" (Carnevale, Gainer, & Meltzer, 1988). They found that in addition to basic reading, writing, and math skills, employers placed increasing importance on skills such as problem-solving, management, creative thinking, leadership, communication, teamwork, and learning how to learn. This article and the subsequent book (Carnevale, Gainer, & Meltzer, 1990) outline how *employers* can train workers in these critical skills that are often lacking. These

documents, aimed at employers, seem to indicate that employees enter the workforce without acquiring these key skills from the educational system from which they emerge. With the expanding use of technology and global interaction, these skills (subsequently referred to as process skills) have continued to gain importance for workplace success. Recent national reports (American Association for the Advancement of Science, 2009; National Research Council, 2012, 2013; Singer, Nielsen, & Schweingruber, 2012) note that current global challenges will require people working in science (and other) fields to be skilled in solving problems, reasoning, communication, and collaboration with people in other disciplines. For example, the engineering community lists teamwork, communication, and ethics/professionalism as being critical to the modern workplace (ABET Engineering Accreditation Commission, 2016).

The use of active learning strategies has seen substantial growth at all educational levels in response to increasing evidence of the impact of these pedagogies in supporting the development of meaningful learning and preparation for the workforce. Students need to develop fundamental process skills to optimize their educational experience in active learning classrooms; ideally, instructors provide explicit opportunities for this process skills growth, feedback on this growth, and the continual monitoring of development over time. Thus, as curricula shift from the delivery of content to the development of concepts and analysis of real-world problems, teaching must move from providing practice opportunities to developing key process skills in the classroom. The POGIL pedagogy is one such active learning strategy that marries conceptual learning and the development of process skills.

Historical View of Process Skills for The POGIL Project

The explicit development of process skills has been important for The POGIL Project from its inception (Hanson, 2006; Hanson & Wolfskill, 2000; Moog, Creegan, Hanson, Spencer, & Straumanis, 2006; Moog & Spencer, 2008). One of the key characteristics of POGIL activities is to "use discipline content to facilitate the development of important process skills including higher-level thinking and the ability to learn and to apply knowledge in new contexts" (Moog & Spencer, 2008, p. 3). While other skills may be developed, the process skills explicitly called out within The POGIL Project are assessment, communication (oral and written), critical thinking, information processing, management, problem-solving, and teamwork.

Operationalized Definitions

A goal of The POGIL Project was to develop resources to support instructors adopting the POGIL pedagogy. One necessary resource was a set of