

Chapter 58

Collaborative Teams as a Means of Constructing Knowledge in the Life Sciences: Theory and Practice

Grant E. Gardner

Middle Tennessee State University, USA

Kristi L. Walters

East Carolina University, USA

ABSTRACT

The use of small collaborative learning teams in STEM classrooms is not new to the field of education. At the undergraduate level, evidence continues to accumulate that organizing students into groups in which they engage in knowledge construction by completing active learning tasks is an effective means to achieve student-learning objectives. However, this teaching method is rarely used by postsecondary faculty, especially in large-enrollment classes. An argument for the efficacy of this method is presented in three parts. This chapter first outlines the theoretical basis for collaborative group learning. Grounded in the literature, this theory is then translated into practice by discussing evidence-based advantages and challenges to creating collaborative learning environments. The chapter concludes with a discussion of a case study examining how the first author has implemented this method of collaborative instruction with a unique means of structuring groups within a large-enrollment non-majors biology classroom.

ORGANIZATION BACKGROUND

Recent science education policy documents recommend that students learning science at all levels should be modeling the process of scientific discovery in their classrooms through inquiry-driven learning experiences (National Research

Council, 2000). In the context of undergraduate life sciences education the American Association for the Advancement of the Sciences' (2011) *Vision and Change in Undergraduate Biology Education* also highlights the benefits of modeling the process of science after and during formal instruction by adopting student-centered classrooms at all

DOI: 10.4018/978-1-4666-7363-2.ch058

levels from K-16. “In practice, student-centered classrooms tend to be interactive, inquiry-driven, cooperative, collaborative, and relevant. Classes authentically mirror the scientific process, convey the wonder of the natural world and the passion and curiosity of scientists, and encourage thinking” (AAAS, 2011, p. 7). This pedagogy, often called *scientific teaching*, is based on the idea that both the teaching and learning of science should model the methodologies of science and worldviews of scientists (Handelsman, *et al.*, 2004).

One of the most common means through which inquiry-based, student-centered instruction is implemented is by organizing students in larger classroom environments into small learning teams that promote cooperation, collaboration, and interaction in a more targeted manner than attempting to promote student-learning at the whole class level. These teams are typically groups of four to five students that work together to achieve classroom learning objectives in conjunction with, or independent of, the instructor (depending on the particular instructional methodology being implemented). At the postsecondary level, organizing students into collaborative groups in which they engage in knowledge construction by completing active learning tasks (within these groups) has been shown through Discipline-Based Education Research (DBER) to be an effective means to achieve critical learning objectives in Science, Technology, Engineering, and Mathematics (STEM) fields (Bowen, 2000; Springer, Stanne, & Donovan, 1999). More specifically, collaborative group work in STEM classrooms increases academic achievement, promotes positive attitudes, increases students’ reasoning ability and promotes student retention (Armstrong, Chang, & Brickman, 2007; Bowen, 2000; Jenson & Lawson, 2011; Johnson, Johnson, & Smith, 1998; McKinney & Graham-Buxton, 1993) as well as numerous other cognitive and affective advantages.

Despite the voluminous evidence base for team learning as a means for structuring effective

student learning environments, widespread implementation and sustainability of these types of classrooms models at the undergraduate levels remains a challenge. This is often due to STEM faculty being uncomfortable with, or outright resistant to these research-based methodologies. As Tanner (2009) states in her series on undergraduate biology teaching and learning, “(O)ften, we as instructors feel that we need to be an intimate part of each student’s learning, when in fact it is more important that we construct opportunities for them to do the learning themselves” (p. 94). The question becomes, in a historical paradigm of a lecturing “sage on the stage” that delivers content to students through the power of prose, why and how should postsecondary instructors be assisting students in constructing their own knowledge? More specific to this discussion, what advantages are there to utilizing small groups as a classroom tool for knowledge construction? The following chapter presents a case of one instructors’ implementation of a research-based instructional strategy in a large enrollment non-majors life sciences course.

Context of the Case

The lead author and instructor during this case reported here has worked at several large public universities in the southeastern United States including one with the third largest undergraduate population in North Carolina (East Carolina University) and currently at one with the largest undergraduate population in Tennessee (Middle Tennessee State University). Both of these institutions consist of populations of students that are largely rural, low-to-middle-class socio-economic status, and many who are first-generation college students. Like many state-funded institutions, the last few years have seen a decrease in funding from the state governing bodies with a subsequent increase in faculty classroom responsibilities, time commitments, and class sizes. In addition,

14 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/collaborative-teams-as-a-means-of-constructing-knowledge-in-the-life-sciences/121890

Related Content

The Power of Computational Modeling and Simulation for Learning STEM Content in Middle and High Schools

Mahnaz Moallem, Shelby P. Morge, Sridhar Narayanand Gene A. Tagliarini (2016). *Improving K-12 STEM Education Outcomes through Technological Integration* (pp. 135-171).

www.irma-international.org/chapter/the-power-of-computational-modeling-and-simulation-for-learning-stem-content-in-middle-and-high-schools/141185

Preparing Teachers to Implement Technology: The CCMS Experience

Stephen J. Pape, Sharilyn K. Owens, Douglas T. Owensand Karen E. Irving (2018). *K-12 STEM Education: Breakthroughs in Research and Practice* (pp. 189-215).

www.irma-international.org/chapter/preparing-teachers-to-implement-technology/190101

Semantics and Pragmatics in Mathematical Events: A Linguistics View

Vinod Kumar Kanvaria (2018). *K-12 STEM Education: Breakthroughs in Research and Practice* (pp. 134-148).

www.irma-international.org/chapter/semantics-and-pragmatics-in-mathematical-events/190098

Designing and Implementing Inclusive STEM Activities for Early Childhood

Mary M. Donegan-Ritterand Betty Zan (2018). *K-12 STEM Education: Breakthroughs in Research and Practice* (pp. 839-866).

www.irma-international.org/chapter/designing-and-implementing-inclusive-stem-activities-for-early-childhood/190133

Examining Young Children's Computational Artifacts

Apittha Unahalekhakaand Madhu Govind (2021). *Teaching Computational Thinking and Coding to Young Children* (pp. 265-294).

www.irma-international.org/chapter/examining-young-childrens-computational-artifacts/286056