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Boundary Crossings: Cooperative Learning, Collaborative Learning, and Problem-Based Learning

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Since the 1960s, there has been growing and sustained interest in small-group learning approaches at the school level and in higher education. A voluminous body of literature in this area addresses theory, research, classroom practice, and faculty development. The approaches most highly represented in the literature are cooperative learning, collaborative learning, and problem-based learning (PBL). In this article, the authors compare and contrast these approaches through answering questions such as the following: What are the unique features of each approach? What do the three approaches have in common? How are they similar, and how are they different?

Introduction

The development of learning in small groups in higher education has occurred, in part, because of strong evidence indicating that students working in small groups outperform their counterparts in a number of key areas. These include knowledge development, thinking skills, social skills, and course satisfaction. Much of this research has been reviewed and compiled by leaders in the field (see, for example, Barkley, Morgan, and Cross, 2014; Light, 1992; Johnson and Johnson, 1994; Johnson, John-

son, and Smith, 1991; McKeachie, Pintrich, Lin, and Smith, 1986; Springer, Stanne, and Donovan, 1999; Strobel and Van Barneveld, 2009). Numerous publications on small-group learning have emerged during the last four decades, in which myriad terms have been used to differentiate a number of different approaches to group learning, such as small-group learning, collaborative learning, cooperative learning, problem-based learning, team-based learning, peer instruction, peer tutoring, and team learning, to name but a few.

The benefit of the wide ranges of approaches is that teachers have multiple forms of group learning from which to choose. The challenge is that there are so many approaches that making a choice can be daunting, and, at times, it can be difficult to make distinctions between the myriad variations of specific group-learning approaches.

Some forms of group learning have become more mainstream than others, and these provide useful direction for faculty to consider as they weigh the options. The main areas of publication about group learning that have emerged in the past four decades appear under the terms collaborative learning, cooperative learning, and problem based learning (PBL). These three forms of group learning share important elements. All three movements, for example, stand against passive modalities and lengthy lectures. All three small-group approaches are forms of active learning (Bonwell & Eison, 1991). They all favor active engagement, small-group learning, development of thinking capabilities, and so on. They all have similar goals for teaching and learning, namely, to encourage development of content knowledge and related skills, even though there are differences in methodology. They have much more in common with each other than with the pure lecture method.

Unfortunately, the terminology associated with group-learning approaches has become so entangled that it is difficult to distinguish between them, and there are unclear and even muddled messages in the literature. Indeed, these approaches share so much that the terms often are conflated or used interchangeably, or alternately, they are considered related forms. As Weimer observes, group work, as it is currently used, is not always called *cooperative learning* or *collaborative learning* or *PBL*, or if it is, the name is often inappropriately applied. Most often, what students are doing in groups are blends of cooperative learning, collaborative learning, and PBL, or some form of group work that is unique and only peripherally illustrative of these major forms (M. E. Weimer, personal communication, March 22, 2014).

These three approaches—cooperative, collaborative, and problem-based learning—are also different from each other, however, and these differ-

ences are important. As Bruffee (1993) suggests, "Describing cooperative and collaborative learning as complementary understates some important differences between the two. Some of what collaborative learning pedagogy recommends that teachers do tends in fact to undercut some of what cooperative learning might hope to accomplish, and vice versa" (p. 16). We argue that the same idea applies to problem-based learning as well; to view it as a form of cooperative or collaborative learning understates important differences between it and the other approaches.

The underlying distinctions come from different origins and originators. Indeed, the three approaches have developed separately. There were different innovators, separate conferences, and separate publications. Initially, advocates of the three approaches were blissfully ignorant of the other camps, and they were often very cautious or even threatened upon hearing of the other two approaches. Each movement had its own turf or silo and seemed happy remaining there.

The emergence and development of each group work approach, with a few exceptions, has followed along disciplinary lines. Collaborative learning has been used mostly in the humanities, some in the social sciences, but rarely in other sciences or professional programs. Cooperative learning has been used mainly in the sciences, mathematics and engineering, the social sciences, and professional programs. PBL in various forms has been used across the board, but in its pure forms, it has been used most extensively in the health professions (M. E. Weimer, personal communication, March 22, 2014). There are reasons for the differences in adoption and use across the disciplines, which we believe are deeply rooted in the philosophies and purposes of the methods.

Many educators have asked intriguing questions about the similarities and the differences of these approaches. Is collaboration a special form of cooperation? Or is the reverse true? Is problem-based learning a form of one or the other, both, or neither? Such questions are not just about semantics; rather, they question the underlying philosophies, goals, and methods of the different approaches. Questions such as these are worthy of scholarly attention and lead to a larger question: "Does it matter what we call it?" (M. E. Weimer, personal communication, March 22, 2014).

By way of example, Mazur and colleagues have developed a method of small group learning in physics, which they call peer instruction (Crouch & Mazur, 2001). This approach is closely related to the cooperative learning method called think-pair-share (Lyman, 1992), but is enhanced by use of personal response systems (clickers) for immediate classroom assessment feedback. Here is an instance of leading innovators in different camps creating similar methods under different names, who might possibly learn from or with each other.

We argue that it is important for educators to understand the similarities and differences of these group approaches in order to make appropriate selections for their own classes, or, alternately, to blend the methods effectively. Finding a common language not only will benefit teaching practice, but also research on teaching, as scholars will be better able to name what they are studying and, therefore, be better able to articulate and understand the results. Thus, we believe it is critical to begin to clarify and untangle the definitions, finding commonalities as well as differences, in order to help the field of small-group learning advance.

While differences among the three major approaches are evident, given their common goals, there seems to be a unique opportunity for collaboration and learning from each other. So why not emerge from our silos, learn from one another, maintain an open mind about different approaches, and perhaps even consider opportunities for working together?

Objectives of This Article

This synthesis article will focus on the relationships among cooperative learning, collaborative learning, and problem-based learning (PBL). We selected these three approaches for examination because they have been intensively studied, they all incorporate small group work, and because of the ideological/philosophical similarities and differences among them. Moreover, many of our colleagues over time have asked us to differentiate among the three, indicating both a lack of and need for clarity in terminology (see the second synthesis article in this issue, by Michaelsen, Davidson, and Major, which focuses on the relationships among team-based learning [TBL], problem-based learning [PBL], and cooperative learning).

For each approach, we describe the following elements:

- origins of the approach
- definitions of the approach that appear in the literature
- essential features and elements of the approach
- goals of the approach
- specific strategies, techniques, and variations of the approach
- research that supports the efficacy of the approach

After the narrative synthesis, we present comparison tables illustrat-

ing common and varying characteristics across the approaches. We also present a concept map of how the main forms of problem solving learning done in groups may be categorized, and we show how the most closely comparable forms of each of these approaches are related. This article, then, serves as an initial effort at taking stock of what we know about these three approaches so that we can begin to expand knowledge about them.

Our aim is not to be prescriptive; rather, it is to be descriptive in ways that encourage conversation and collaboration or cooperation that can drive the field forward. What makes this article unique is its invitation to practitioners to cross traditional boundaries, to consider similarities and differences of these approaches, and to begin productive conversations that can advance the field of small-group learning.

Another boundary is the traditional distinction between higher education and school-level education. Much of the theory, research, and classroom procedures for cooperative and collaborative learning were first developed at the school level. That body of knowledge merits serious attention by higher education faculty. The procedures for cooperative learning are essentially the same in schools and in colleges and universities, even though the academic content is different. For example, a jigsaw at one age level is done in essentially the same way as a jigsaw at another age level. At the elementary, secondary, and higher education levels, a jigsaw is a jigsaw is a jigsaw (to paraphrase famous quotations involving roses by Shakespeare and, later, by Gertrude Stein).

Cooperative Learning

Origins of Cooperative Learning

Cooperative learning arguably is the oldest form of group learning in our comparison of approaches. For example, study partners were used by the Hebrews thousands of years ago, as boys studied the Talmud. In common parlance, the term "cooperate" has many synonyms: work together, act jointly, collaborate, join forces, share in, pitch in, work side by side, and stand shoulder to shoulder. According to the *Oxford English Dictionary*, the term "cooperate" comes from the late 16th century: from the Latin *cooperat* ("worked together"), from the verb *cooperari* (from *co* "together" + *operari* "to work")—in other words, to work together jointly to complete an educational operation, such as activity or project.

In their early work in the 1960s, the Johnsons were beginning to integrate social psychology and constructivism (D. Johnson, personal communication, July 7, 2014). Constructivist philosophy asserts that

students make their own meaning (in other words, meaning is not supplied by the teacher). Later, Johnson, Johnson, and Holubec (1998) make a direct connection between their approach and cognitive development theory, as seen in the work of Piaget (1951) and Vygotsky, putting their approach squarely in the constructivist camp. These theories suggest that when students work together, sociocognitive conflict stimulates reasoning. Vygotsky (1962, 1978) suggests that knowledge is a social product, that it arises at the social level before the individual level. He stresses that "Every function in the child's cultural development appears twice: first on the social level, and later, on the individual level" (1978, p. 57). Cooperative learning, then, involves a focus on students co-laboring to accomplish a learning task, a social product, together, just as the Latin root word suggests. A classic book by Miel (1952) describes cooperative procedures for learning. (For further discussion of the history of cooperative learning, see the article by Johnson, Johnson, and Smith in this issue.)

Definitions of Cooperative Learning

The many definitions of cooperative learning in the literature demonstrate the importance of construction of knowledge. The following are just a few examples:

> Cooperative learning will be defined as students working together in a group small enough that everyone can participate on a collective task that has been clearly assigned. Moreover, students are expected to carry out their task without direct and immediate supervision of the teacher. The study of cooperative learning should not be confused with small groups that teachers often compose for the purpose of intense, direct instruction—for example, reading groups. (Cohen, 1994, p. 3)

> Cooperative learning encompasses a wide range of strategies for promoting academic learning through peer cooperation and communication. As the term "cooperative learning" implies, students help each other learn, share ideas and resources, and plan cooperatively what and how to study. The teacher does not dictate specific instructions but rather allows students varying degrees of choice as to the substance and goals of their learning activities, thus making students active participants in the process of acquiring knowledge. . . . Cooperative learning encourages, and is in fact built upon, the contributions of group members (Sharan & Sharan, 1987, p. 21)

> Cooperative learning refers to a set of instructional methods in which students are encouraged or required to work together

> on academic tasks. Cooperative learning methods may be as simple as having students sit together to discuss or help one another with classroom assignments, or may be quite complex. Cooperative learning is distinguished from peer tutoring in that all students learn the same material, that there is no tutor or tutee, and that information usually comes initially from a teacher rather than a student. (Slavin, 1987, p. 1161)

> The structural approach to cooperative learning is based on the creation, analysis, and systematic application of structures, or content-free ways of organizing social interaction in the classroom. Structures usually involve a series of steps, with proscribed behavior at each step. An important cornerstone of the approach is the distinction between "structures" and "activities.'' A structure combined with academic content yields an activity. (Kagan, 1989, p. 12; also see Kagan's article in this issue.) [Examples of structures are the three step interview, think-pair-share, and jigsaw.]

Several other views of the nature of cooperative learning are given in the next section.

Essential Features and Elements of Cooperative Learning

Several scholars have attempted to define the critical features and elements of cooperative learning, with some agreement across the different versions. In the following paragraph, for example, Davidson and Worsham (1992) describe cooperative learning as follows:

> Cooperative learning procedures are designed to engage students actively in the learning process through inquiry and discussion with their peers in small groups. The group work is carefully organized and structured so as to promote the participation and learning of all group members in a cooperatively shared undertaking. Cooperative learning is more than just tossing students into a group and telling them to talk together. A class period might begin with a meeting of the entire class to provide an overall perspective. This may include a teacher presentation of new material, class discussion, posing problems or questions for group discussions, and clarifying directions for the group activities. The class is then divided into small groups, usually with four members apiece. . . . Students work together cooperatively in each group to discuss ideas, clarify their understanding, think and reason together, solve problems, make and test conjectures, and so forth. Students actively exchange ideas with one another, and help each other learn the materi-

> al. The teacher takes an active role, circulating from group to group, providing assistance and encouragement, and asking thought-provoking questions as needed. In each type of small group learning, there are a number of leadership and management functions that must be performed. . . . (pp. xi-xii)

Thus, the focus of the approach is upon ensuring that students are working *together*, not simply on the same project.

There is no single universal method of cooperative learning and no single guru who can speak for the entire field; definitions and methods vary to some extent. Davidson and Worsham (1992), for example, suggest that the following four critical attributes illustrate the importance of working together and are common to all methods of cooperative learning : (1) a task or learning activity suitable for group work, (2) student-to-student interaction in small groups, (3) interdependence structured to foster cooperation within groups, and (4) individual responsibility and accountability. In later work, Davidson (1994, 2002) added a fifth critical attribute: (5) cooperative, mutually helpful behavior among students. (This is needed to accomplish the task or learning activity.)

According to Johnson, Johnson, and Smith (1998), cooperative learning has five key elements: positive interdependence, face-to-face promotive interaction, individual and group accountability, development of teamwork skills, and group processing. (See their article in this issue.)

Kagan and Kagan (2009) identify four critical attributes of the structural approach to cooperative learning with the acronym *PIES*: Positive interdependence, Individual accountability, Equal participation, and Simultaneous interaction. (See Kagan's article in this issue.)

Millis and Cottell (1998) suggest that positive interdependence may be established as students achieve

> (1) mutual goals, such as solving specific problems or creating a team project; (2) mutual rewards, such as individually assigned cooperative-learning points that count toward a criterion-referenced final grade (points that only help, but never handicap); (3) structured tasks, such as a report or complex problem with sections contributed by each team member; and (4) interdependent roles, such as group members serving as discussion leaders, organizers, recorders, and spokespersons. (p. 11; see Millis's article in this issue)

The main idea in all the cooperative learning approaches is that students work and learn together actively in small groups to accomplish a common goal in a mutually helpful manner. Cooperative learning combines active learning and social learning via peer interaction in small groups on aca-

demic tasks. We argue that this also holds true for collaborative learning and problem based learning.

In a research review titled "When Does Cooperative Learning Improve Student Achievement?" Slavin (1983) identifies two conditions: group goals/rewards and individual accountability. This fits perfectly with his research on student team learning methods: student teams achievement divisions (STAD) and teams-games-tournaments (TGT). Different groups of researchers investigating effects of cooperative learning on achievement begin with different assumptions. Slavin (1995) identified *motivationalist, social cohesion, cognitive-developmental,* and *cognitive elaboration* as four major theoretical perspectives held by different researchers. He suggests that these perspectives be viewed as complementary rather than antithetical.

Cooperative learning has received considerable attention in scholarly literature over time. Works devoted to cooperative learning in higher education include those of Johnson et al. (1991, 2006), Millis and Cottell (1998), Millis (2010), and various works by Davidson and colleagues in teaching mathematics (see below). Kalman (2007) addresses successful teaching in science and engineering. Weimer (2002) describes learner-centered teaching methods including cooperative and collaborative learning. The work on small-group learning by Cooper and Robinson (2011) addresses the interface between cooperative and collaborative learning. (See their article in this issue.)

Schmuck and Schmuck (2000) address cooperative learning through the perspective of group processes in the classroom and organization development to create a cooperative culture. Brody and Davidson (1998) present a number of approaches for faculty development in cooperative learning**.** Cohen, Brody, and Sapon-Shevin (2004) describe various university programs in teacher education for cooperative learning. Baloche (1998), Gillies (2007), and Bennett, Rolheiser-Bennett, and Stevahn (1991) have contributed to teacher education related to cooperative learning.

Goals of Cooperative Learning

Cooperative learning activities can be designed at all levels of the taxonomy by Bloom and associates (1956): knowledge, comprehension, application, analysis, synthesis, and evaluation. In particular, there is a strong connection between cooperative learning and the development of higher-order thinking skills (HOTS). Publications in this area include those of Bellanca and Fogarty (1991), Davidson and Worsham (1992), and Solomon and Davidson (2009). Meta-analyses have shown profound effects of cooperative learning in developing thinking skills and processes. (See the article by Johnson et al. in this issue.)

One major goal of cooperative learning is to help students learn academic content. One of the earliest systematic examples of this occurred in the late 1960s in mathematics, before the term "cooperative learning" was invented. Davidson (1970, 1971) developed and applied a "small group discovery method" in teaching an entire first-year calculus course. Students working together cooperatively in small groups discussed mathematical ideas, developed techniques for solving problems, made conjectures for investigation, proved theorems, and discovered many ideas and techniques which were new to them. The method was based on the educational philosophy of John Dewey (1916, 1938), whose many ideas included this profound statement: "The primary source of social control resides in the very nature of the work done as a social enterprise in which all individuals have an opportunity to contribute and to which all feel a responsibility" (1938, p. 56). The means to implement Dewey's philosophy were based upon research in social psychology and group dynamics: cooperation versus competition (Deutsch, 1960), leadership styles (White & Lippitt, 1960), group size (Bales & Borgatta, 1961), avoiding conformity pressure (Asch, 1960), and the effects of anxiety upon learning (McKeachie, 1951; McKeachie et al., 1986).

Certain major professional associations have published works on cooperative learning in their academic field. For example, the Mathematical Association of America has published not only a number of journal articles (for instance, Davidson, 1971; Weissglass, 1976) but also several major books related to cooperative learning in mathematics. These include volumes by Hagelgans, Reynolds, Schwingendorf, Vidakovic, and Dubinsky (1995); Dubinsky, Reynolds, and Mathews (1997); and Rogers, Reynolds, Davidson, and Thomas (2002). An MAA publication on learning to teach in mathematics (DeLong & Winter, 2001) places major emphasis on cooperative learning.

Strategies and Techniques for Cooperative Learning

Because of the intense focus on having students work together, cooperative learning advocates have developed a range of strategies for ensuring that it does happen. The task, as suggested above, is structured, requiring students to work together in order to be able to complete the assignment. Table 1 provides some examples of cooperative learning strategies.

Research on Cooperative Learning

Cooperative learning has shown up well in education research studies designed to test its effectiveness. Research conducted in many different

Table 1
Sample Cooperative Learning Strategies

Sample Cooperative Learning Strategies	*Description*
Think-Pair-Share (Lyman, 1992)	(1) The instructor poses a discussion question and gives students time to think through a response individually. This "think-time" may be spent writing (called Write-Pair-Share). (2) Students then turn to a peer and discuss their responses. (3) Students respond within a larger group or with an entire class during a follow-up discussion. Think-Pair-Share is very rich, with many variations on how to think, how to pair, and how to share.
Timed Pair Share (Kagan & Kagan, 2009)	(1) The teacher announces a topic, states how long each student will share, and provides think time. (2) In pairs, Partner A shares; Partner B listens. (3) Partner B responds with a positive remark. (4) Partners switch roles.
Three-Step Interview (Kagan & Kagan, 2009)	(1) Students form pairs, and one student interviews the other for a fixed period of time. (2) Students switch roles; the interviewer becomes the interviewee, and vice versa, for the same time. (3) The pair links with a second pair, and the four-member team then shares and discusses the information or insights gleaned from the initial paired interviews.

Table 1 (*continued*)
Sample Cooperative Learning Strategies

Sample Cooperative Learning Strategies	*Description*
Jigsaw (Aronson, 2000; Aronson et al., 1978)	Students are seated in home groups with four members. The instructor divides an assignment or topic into four parts, and each group member is responsible for one part. The instructor forms four expert teams, with each team becoming expert on the same part of the assignment. Expert teams work together to master their fourth of the material and also to develop a plan to help others learn it. All experts then reassemble into their home groups with four experts leading in turn, one expert on each part, in each learning group.

subject areas and various age groups of students has shown positive effects favoring cooperative learning in academic achievement; development of higher-order thinking skills (both critical and creative); self-esteem and self-confidence as learners; intergroup relations, including friendship across racial and ethical boundaries; social acceptance of mainstreamed students labeled as handicapped or disabled; development of interpersonal skills; and the ability to take the perspective of another person.

Much of this research has taken place at the school level, and some at the college or university level. For major syntheses of cooperative learning research, see the extensive reviews by Johnson and Johnson (1989), Slavin (1990), Sharan (1980, 1990), and Newmann and Thompson (1987) at the high school level.

In a meta-analysis by Springer et al. (1999), the authors found that postsecondary students participating in cooperative learning in science, technology, engineering, and math, STEM courses, *demonstrate greater achievement* than non-CL students, *express more favorable attitudes* than their non-CL counterparts, and *persisted through STEM courses or programs to a greater extent* than non-CL students.

Additional reviews have focused on conditions for productive group work such as challenging and demanding tasks, delegating authority to the groups, and teacher behavior to foster effective interaction in groups (Cohen, 1994). In studies of task-related group interaction in mathematics

groups (Webb, 1991). Farivar and Webb (1991) and others (for example, Peterson, Janicki, and Swing, 1981) found that giving and receiving elaborated help through explanations are more strongly related to achievement than are giving and receiving non-elaborated help, for example, just the answers. Simply receiving answers without explanations can be detrimental to learning.

Research on processes of implementing and sustaining change is important for cooperative learning and other approaches to small group learning. Learning new approaches requires change, and supporting people in the change process is critical for learning to "take hold." Schmuck and Runkel (1994) have studied the effects of organization development in change processes in schools and colleges. Fullan (1991, 1993) and colleagues have examined the change process in relation to the culture of the school or college. Sahlberg (2011) has presented lessons learned from Finnish educational reform. Hall and Hord (1987) created a Concerns-Based Adoption Model (CBAM) for looking at changes processes for individuals. Schniedewind and Sapon-Shevin (1998) have studied professional development for socially-conscious cooperative learning, which fosters teachers' reflection on democratic and cooperative values and on issues of equity and social justice involving race, gender, learning styles, and so on.

The International Association for the Study of Cooperation in Education (IASCE), established in 1979, is an international, non-profit organization for educators who research and practice cooperative learning in order to promote student academic improvement and democratic social processes. Its conferences deal with cooperative learning, occasionally with collaborative learning, and rarely with problem-based learning (See www.IASCE.net).

The *Newsletter of the International Association for the Study of Cooperation in Education* (IASCE.com) helps educators keep abreast of current conferences and publications on cooperation and collaboration in education around the globe. Each issue includes reviews of major books and brief summaries of current publications. A few varied examples, some at the higher education (tertiary) level internationally, are cooperative learning in a research methodology course (Agashe, 2012), a special issue of a journal on cooperation in education (Breeze, 2011), cooperative learning in music (Cangro, 2004), cooperative learning in multicultural groups in New Zealand (Clark & Baker, 2009), group work in foreign language education (Fushino, 2010), cooperative learning in the thinking classroom (Lee, Ng, & Jacobs, 1998), celebratory learning (Flood, Liebling, Gilmer, Kinzie, & Markovchick (2007), structures for success in chemistry (Plumb, 2005), and assessment and evaluation in social studies (Myers, 2004).

Collaborative Learning

Origins of Collaborative Learning

According to the *Oxford English Dictionary*, the term "collaborate" comes from the late 19th century: from the Latin *collaborat* ("worked *with*"), from the verb *collaborare* (from *col* "together" + *laborare* "to work"); thus, it means to labor with each other towards the same end, but not necessarily cooperatively on the same tasks.

At the school level, collaborative learning approaches were employed in the 1970s by Britton (1973) and colleagues in the field of language and learning such as Barnes (1976) and Barnes and Todd 1977).

Theorists including Vygotsky (1962, 1978), Dewey (1938), and Piaget (1951) have influenced both collaborative and cooperative learning. Kelly (1955) and Polanyi (1958) have had more influence in collaborative learning circles. Other authors contributing to social constructivism in education include Palincsar (1998) and Flynn, Mesibov, Vermette, and Smith (2013).

At the school level in Great Britain, Australia, Canada, and the United States, collaborative learning has often developed in conjunction with areas such as Language Across the Curriculum, Whole Language Learning, Oracy, Psycholinguistics, Learning through Talking, Negotiating the Curriculum, etc. These perspectives tend to focus on creating an environment that best helps an individual to develop mentally, emotionally, and socially through being an active participant, personally committed to learning within the context of a supportive learning community.

Brubacher, Payne, and Rickett (1990) identify the individuals who have taken significant leadership in collaborative learning at the conceptual and research level, and in the practical classroom implementation level, with some contributing to both. At the conceptual and research leadership level, they cite James N. Britton, Douglas Barnes, Jerome S. Bruner, Gordon Wells, Ian Pringle, Aviva Freedman, Nancy Martin, Patrick Dias, Louise Rosenblatt, Michael Marland, Michael Fullan, Michael Halliday, Harold Rosen, Donald Graves, and James Moffat. At the classroom implementation level, they cite Bill Green, Jo-Anne Reid, Peter Forrestal, Garth Boomer, Peter Chilver, Diane Patterson, Tony Martin, Ernie Tucker, and Peta Heywood. Some experts on collaborative learning (for example, Hill & Hill, 1990) focus on younger learners.

In higher education, collaborative learning is arguably the most recent of the three approaches to group learning, being recognized as a unique approach to group learning in higher education in part through the efforts of Bruffee (1973, 1984, 1993). Bruffee often identifies collaborative learning

as interpretivist in nature, meaning that individuals strive to understand and act in the world around them. His definitions share much with social constructivism, but with a critical stance, as he recommends that professors should see themselves as change agents who help students better themselves by developing independence through interdependence.

Collaborative learning has helped to spur interest in learning communities. That banner was carried forward by the Washington Center at Evergreen State College and at other colleges (see Gabelnick, MacGregor, Matthews, and Smith, 1990). The Washington Center's National Learning Communities Directory has over 250 learning community initiatives in colleges and universities throughout the nation. And with learning communities came a wave of curricular innovations that involved linked and cluster courses, freshman interest groups, and the first-year experience. All of these efforts have advocated group work and collaborative discussions.

Definitions of Collaborative Learning

The definitions of collaborative learning in the literature most often describe the importance not only of students working together in groups, but also of the group working together with the teacher in an effort to develop knowledge, thus shifting the nature of authority in the classroom. Bruffee (1993), an advocate of collaborative learning, describes knowledge as "something people construct by talking together and reaching agreement" (p. 3). Consider the following definitions from leading proponents of collaborative learning, in which the critical/emancipatory stance is evident:

> Collaborative learning occurs when students and faculty work together to create knowledge. . . . It is a pedagogy that has at its center the assumption that people make meaning together and that the process enriches and enlarges them. (Matthews, 1996, p. 101)

> Collaborative learning provides a social context in which students can experience and practice the kinds of conversation valued by college teachers. (Bruffee, 1984, p. 642)

Thus, unlike in cooperative learning, where the focus is on working together, or interdependence, in collaborative learning, the focus is on working with each other (but not necessarily interdependently) toward the same goal, as the root word suggests—in this case toward the discovering, understanding, or production of knowledge. For example, in a collaborative project, in contrast to a collaborative group discussion, students could divide up the task and assemble the individual parts in

order to accomplish the common goal. In contrast, cooperative learning would require some cooperation in which all members would be held accountable to increase their knowledge of the individual parts. For example, in the jigsaw method of cooperative learning, with material divided into component parts, all team members are expected to learn all parts of the material, not just the piece that they present in their role as experts. (Incidentally, the jigsaw is one of the methods employed at times by collaborative instructors.)

A classic example of a complex, real-world collaborative project would be creating an original production of a musical theater drama. Major tasks would involve creating the stage play, the instrumental music, vocal music, choreography, costume design, sets, lighting, and so on. One person is primarily responsible for each major aspect of the design. Yet all of the major components must be fitted together interdependently to create the whole drama under the leadership of the stage director. While this example conveys the idea of a collaborative project, it is much more complex and ambitious than a typical classroom discussion in collaborative learning groups.

Critical Features and Elements of Collaborative Learning

The critical elements of collaborative learning are less precise than those of the other two group learning approaches we describe in this article. Smith and MacGregor (1992), however, provide some insight into the essential features:

> In most collaborative learning situations, students are working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product. There is wide variability in collaborative learning activities, but most center on the students' exploration or application of the course material, not simply the teacher's presentation or explication of it. Everyone in the class is participating, working as partners or in small groups. Questions, problems, or the challenge to create something drive the group activity. Learning unfolds in the most public of ways. (p. 11)

Goals of Collaborative Learning

One goal of collaborative learning is getting students to take substantive responsibility for working together. Because of this, collaborative learning requires a shift of the responsibility for learning away from the teacher

and to the students. Another goal of collaborative learning is to enable students to build knowledge together. By working together to achieve a common goal, they construct knowledge through their interactions with each other.

Strategies and Techniques for Collaborative Learning

In collaborative learning, the role of student talk in small groups is central. According to Barnes (2008), "exploratory talk provides an important means of working on understanding. . . . Presentational talk, on the other hand, offers a 'final draft' for display and evaluation" (p. 6). Barnes goes on to say that

> Students can be encouraged to contribute examples, make connections with their own experience, and discuss areas where the new material seems to clash with what they thought to be the case. Discussion and explanation *by the pupils* should be a central part of lessons, and this should also include the producing and evaluating of supporting evidence. Pupils should be expected to ask questions as well as to answer them; their questions not only engage them in productive thinking but can provide valuable information to the teacher about their level of comprehension. (p. 12)

Pierce and Gilles (2008) elaborate on the use of talk through the following categories: social talk, exploratory talk, presentational talk, meta-talk (making their talk visible), and critical talk. According to them, "These forms of talk work interdependently and concurrently in a classroom focused on making and sharing meaning. Each is important for creating meaning, as well as for creating the action to bring about change" (pp. 51-52).

Forrestal (in Brubacher et al., 1990) describes five stages of the collaborative learning process, typically employing open-ended rather than closed questions:

- *Engagement (or Input):* In this stage of the learning process, students meet and engage with information. Input may be provided in a wide range of ways: lecture, reading, media, and the like.
- *Exploration:* Students have the opportunity to make an initial exploration of the information. Students can make tentative judgments as they bring their past experience and understandings to bear in coming to terms with

new information. Students are free to think aloud, to make mistakes, or not to fully understand.

- *Transformation:* Students are asked to work with the information to better understand it. The teachers´ role during this stage is to monitor their students´ learning, to address misconceptions or to provide additional information.
- *Presentation:* Students are asked to present their findings to an interested and critical audience. Group presentations can occur with varied audiences, such as the whole class or in a combination of two groups of four into a group of eight.
- *Reflection:* By looking back at what they have learned and the process they have gone through, students can gain a deeper understanding of both the content and the learning process itself.

Just as there are no fixed criteria and methods for all cooperative learning approaches, there are very few specific strategies or techniques that are expressly collaborative.

Research on Collaborative Learning

The research on collaborative learning is not as robust as that of cooperative learning. This shortcoming may be due to differences in disciplinary orientation of their leading contributors—mainly psychology in cooperative learning, and language and literature in collaborative learning. Professors in language and literature are not typically inclined to do experimental research with statistical analysis. Yet there are some notable research exceptions. Cabrera et al. (2002), for example, found positive effects of collaborative learning on learner preference, student outcomes, and openness to diversity. Tinto, Goodsell, and Russo (1993) found positive effects of collaborative learning on student engagement.

Problem-Based Learning

Origins of Problem-Based Learning

Problem-based learning (PBL) developed as a curricular approach in the 1960s with the faculty led by Howard Barrows at McMaster Univer-

sity medical school, and was soon after adopted by The University of Limburg at Maastricht in the Netherlands, the University of Newcastle in Australia, and the University of New Mexico in the United States. The method was soon adopted by other health professions, such as dentistry, nursing, and occupational and physical therapy; professional schools, such as engineering and architecture; and, eventually, undergraduate education (Savin-Baden & Major, 2004). The idea behind the development of the approach was that with the information explosion, physicians could no longer rely upon rote memorization of information; they simply could not retain that much content. Rather, these physicians needed to develop the critical thinking and problem solving-skills necessary to analyze the essence of a problem and then the research skills necessary to gather information required to solve the problem. As with collaborative learning, PBL is based upon constructivist ideas, but moves more toward constructionism, as suggested by Papert (1991) and others, in that there is always a tangible expression of the knowledge that is shared with others, most often as an original oral or written solution to the problem posed. Others have adapted this curricular model to the course level (see Savin-Baden and Major, 2004 for additional information).

Definitions of Problem-Based Learning

In problem-based learning, it is the *problem* that drives the learning. The constructionist nature of the approach may be seen in the following definitions in the literature:

> PBL is an approach to learning in which problems serve as the context and the stimulus for students to learn course concepts and metacognitive skills. PBL problems are compelling theoretical or practical problems, are based on real situations, and often have more than one right answer or more than one right way to get to an answer. In a PBL classroom, students confront a problem before they receive all of the relevant information necessary to solve it. Students work in teams to define the nature of the problem, to identify what additional resources they need, and to find viable solutions to the problem at hand. Students must generally apply the knowledge they have gained through their research, not only to solve the problem, but also to communicate the results of their findings. Faculty members act as facilitators who guide students by asking probing questions and monitoring group processes. (Major & Eck, 2000, pp. 1-2)

> In the problem-based approach, complex, real-world problems are used to motivate students to identify and research the con-

> cepts and principles they need to know to work through the problems presented for students to solve. Students work in small learning teams, bringing together collective skill at acquiring, communicating, and integrating information. Problem-based instruction addresses directly many of the recommended and desirable outcomes of an undergraduate education, specifically, the ability to do the following:
>
> - Think critically and be able to analyze and solve complex, real-world problems
> - Find, evaluate, and use appropriate learning resources
> - Work cooperatively in teams and small groups
> - Demonstrate versatile and effective communication skills, both verbal and written
> - Use content knowledge and intellectual skills acquired at the university to become continual learners. (Boud & Feletti, 1997, p. 2)
>
> PBL fosters the ability to identify the information needed for a particular application, where and how to seek that information, how to organize that information in a meaningful conceptual framework, and how to communicate that information to others. (Duch, Groh, & Allen, 2001, pp. 6-7)

Essential Features and Elements of Problem-Based Learning

Barrows (1986) identifies the essential characteristics of problem-based learning; PBL is

- *Problem-based*. A real-world problem is the learning catalyst.
- *Interdisciplinary*. Because the problem is real-world, it necessarily spans disciplines.
- *Authentic*. The problem presents a situation that mimics what students would find in the real world, often in the workplace. Learning then is authentic, and students may directly see its relevance and value.
- *Motivating*. One goal of problem-based learning is to create a situation in which students are motivated to

learn. If they need information for the express purpose of solving a problem, then they are, it is assumed, motivated to find it and learn it.

- *Student centered*. Students are responsible for their own learning and for the learning of their peers.
- *Self-directed*. Students determine the direction of their problem-solving process, rather than having the instructor determine it for them.
- *Skill directed*. In addition to developing knowledge, the approach is specifically geared toward helping students to develop problem-solving, critical-thinking, and team skills.
- *Collaborative*. Teams work toward solving the problem.
- *Reflective*. Student teams typically reflect upon the learning that took place, helping to solidify it.

Goals of Problem-Based Learning

There are myriad goals for PBL. Among them are the development and long-term retention of content knowledge. Other goals include problem-solving; collaborative skills; self-direction and self-regulation; and, at times, clinical skills (see Savin-Baden and Major, 2004; Strobel and Van Barneveld, 2009). Thus, PBL is associated with the development of knowledge as well as higher-order thinking skills.

Strategies and Techniques for Problem-Based Learning

Barrows (1986) proposed a taxonomy of problem-solving methods (all of which he identified as problem-based learning). The taxonomy has highlighted the educational objectives that it is possible to address through problem-based learning and has included the following varieties:

- *Lecture-based cases.* Students receive information through lectures, and case material is used to demonstrate that information.
- *Case-based lectures.* Students read case histories or vignettes before a lecture that then covers relevant material.

- *Case method.* Students receive a complete case study that they must research and prepare for discussion in the next class.
- *Modified case-based.* Students receive information and must decide upon the action they may take. Following their conclusions, they receive more information about the case.
- *Problem-based.* Students meet with a client in some form of simulated format that allows for free inquiry to take place.
- *Closed-loop problem-based.* This is an extension of the problem-based method, in which students consider the resources they used in the process of problem-solving in order to evaluate how they may have reasoned through the problem more effectively.

Research on Problem-Based Learning

Hundreds of studies have compared PBL to traditional instruction (see, for example, Kendler and Grove, 2004; Parker, 1995; Pennell and Miles, 2009). Several meta-analyses/systematic reviews have been conducted of these individuals' studies (see, for example, Albanese and Mitchell, 1993; Colliver, 2000; Dochy, Segers, Van den Bossche, and Gijbels, 2003; Gijbels, Dochy, Van den Bossche, and Segers, 2005; Kalian, Mullan, and Kasim, 1999; Newman, 2003; Savin-Baden and Major, 2004; Strobel and Van Barneveld, 2009; Vernon and Blake, 1993). The meta-analyses and individual studies also show positive results for cognitive, developmental, and affective outcomes. The studies show mixed results with regard to short term knowledge retention: Some show slightly higher knowledge on the part of PBL students, some show no differences, and some show slightly less knowledge. Measures that focused on recall over recognition (for example, free recall and short answers) favored PBL. Measures that focused on long-term knowledge retention favored PBL. Strobel and van Barneveld (2009) found, overall, that PBL students outperformed their counterparts on professional skills and elaborated assessments (essay questions and case studies). Severiens and Schmidt (2009) found that exposure to PBL improved student study pace and progress as well as social and academic integration for undergraduate students. In addition, students in PBL courses and curricula cited improved satisfaction with

their learning compared to students receiving traditional instruction (Sobral, 1995). PBL students have reported that their studies were more engaging, difficult, and useful than have non-PBL students (Albanese & Mitchell, 1993). PBL students also give higher ratings for their instruction than students in traditional programs, who are more likely to describe instruction as boring and irrelevant (de Vries, Schmidt, & de Graff, 1989; Schmidt, Dauphinee, & Patel, 1987). (See the Albanese and Dast article in this issue for further information about findings from PBL studies).

Common Features of Cooperative, Collaborative, and Problem-Based Learning

While we have acknowledged differences in origins, philosophies, and elements of these three group work approaches, there also are some commonalities across them. In a theoretical synthesis of varied cooperative and collaborative learning approaches, Davidson (1994, 2002) has identified five attributes that are common to both. We will show that these attributes apply to PBL as well. We expand on these attributes as follows, bearing in mind that they refer to group discussions in class and not necessarily to group projects done outside of class. Here is the list of five attributes common to the three small-group approaches:

- *A common task or learning activity suitable for group work.* With the CLs, the task may or may not be a problem. In PBL, it must be a problem.
- *Small-group interaction focused on the learning activity.* In each of the approaches, there must be small group interaction for the purposes of completing the assignment.
- *Cooperative, mutually helpful behavior among students as they strive together to accomplish the learning task.*
- *Individual accountability and responsibility.* In all of the approaches, students must have individual accountability for what they learned and/or contributed toward the learning goal.
- *Interdependence in working together*.

Interdependence is a fundamental construct in all three approaches. This concept warrants additional attention, however, as advocates of the various methods approach this notion in very different ways. It is variously called interdependence, positive interdependence, or mutual

interdependence. A fourth term to describe interdependence, explored by Pradle (1982), is *mature dependency*. This concept, then, is at the heart of the differences among the approaches, and it includes the following alternative techniques to foster positive interdependence:

- *Goals.* These include both social and academic goals.
- *Tasks.* These include structured learning tasks or assignments, which can be designed at varying levels of intellectual challenge.
- *Resources.* Materials may be limited, for example, two information sheets in a group of four, or divided into parts as in jigsaw, where each group member has different information to share.
- *Roles.* These include students assuming assigned, pre-set roles, either task roles or group maintenance roles.
- *Extrinsic rewards.* These include bonus points for improved performance, or public recognition for groups that meet criteria.

In fostering positive interdependence, *cooperative learning* teachers consider using all of the techniques named above: goals, tasks, resources, roles, and rewards. *Collaborative learning* teachers mainly use goal and task interdependence and occasionally resources, say with a jigsaw. They almost never use assigned roles and rewards. *Problem-based learning* teachers almost always use goals, tasks, and resources. They use roles at times; rarely do they use rewards.

Additional Attributes That Vary Among the Three Group Learning Methods

In addition to the five attributes common to the group learning approaches, there are others that vary among the approaches to cooperative, collaborative, and problem-based learning. Examples of these are as follows: how groups are formed, how or whether to teach interpersonal skills, the structure of the group, and the role of the teacher:

- *Grouping.* Instructors decide whether to do intentional grouping (typically heterogeneous) or random assignment or to allow students to choose their groups. Cooperative learning groups typically have 2-4

members, occasionally 5 if required by the class size. Collaborative learning groups sometimes have 2 members but typically have 4-5 members. PBL groups range in size, with approximately 5 members, on average.

- *Teaching and processing social skills (for example, listening without interrupting, paraphrasing, summarizing, disagreeing agreeably, and so on).* Processing refers to reflection on group process, as described next.
- *Reflecting on group process after an activity.* Students reflect on how well their group worked together and employed social skills effectively, and what needs to be improved.
- *Community building activities (AKA class building or trust building).* Whole class activities get everyone acquainted by interacting in a positive manner.
- *Team building activities.* Students participate in activities to become better acquainted and to build group cohesiveness.
- *Use of structures.* There are prescribed ways of organizing the communication pattern in the group. Examples include three-step interview, think–pair–share, round robin, and pairs check (Kagan & Kagan, 2009).
- *Simultaneous interaction.* In pairs, 50% of the class members are speaking simultaneously; in quads, 25% are speaking simultaneously.
- *Role of the instructor.* The role of the cooperative teacher in some models is activist—akin to McWilliam's (2009) "meddler in the middle," in contrast to the "sage on the stage" or "guide on the side."
- *Classroom management.* Strategies include the quiet signal, timed activities, making sure that everyone has a partner or group.
- *Status treatments.* The instructor, for example, notices a commendable performance by a student of low status and calls this to the attention of the entire class (Cohen, 1994).

- *Perspective-taking activities.* These are designed to help students understand the perspective (or viewpoint) of another person, whether or not one agrees with it. This is related to empathy.

  (These attributes are refined slightly from the ones given by Davidson, 1994, 2002.)

Table 2 provides a comparison of the essential elements of the most commonly used forms of collaborative, cooperative, and problem-based learning.

In sum, all three of these approaches share some common features. Each has characteristics that it may share with one or both of the other approaches. They all have differences as well. The analysis in Table 2 leads to the following conclusion: The cooperative learning approaches all employ certain elements which are not used by the collaborative teachers and which are not accepted by them. Hence, cooperative learning is not a form of collaborative learning (and vice versa). Likewise, PBL is not a form of either. Cooperative learning, collaborative learning, and PBL are all forms of small-group learning and have some major points in common. However, none of the approaches is a special case of any of the others. In the following sections, we lay out in detail the similarities and differences among these approaches.

Comparisons and Contrasts Between the Three Approaches

Several authors have discussed the relationship between cooperative and collaborative learning. We first consider the relationship between cooperative and collaborative learning, and subsequently move on to consider their relationships with PBL. The volume by Brubacher et al. (1990), for example, includes chapters on both cooperative and collaborative learning. An international handbook by Hmelo-Silver, Chinn, Chan, and O'Donnell (2013) includes both approaches. An article by Matthews, Cooper, Davidson, and Hawkes (1995) also examines the relationship between these two approaches to small-group learning, concluding that cooperative learning is more structured and employs more active teacher facilitation than collaborative learning.

Brody (1995, 2009), in contrast to Bruffee (1993), makes the case that collaborative and cooperative learning are complementary educational practices. Jacobs (n.d.) asserts that the two terms should be treated as synonymous, as both represent a flexible, student-centered approach

Table 2
Overview of Three Approaches

	Collaborative	*Cooperative*	*PBL*
Value on academic learning	All	All	All
Value on social learning	All	All	All
A common task or learning activity suitable for group work	All	All	All
Required task that is a "real world" problem			All
Small-group interaction focused on the learning activity	All	All	All
Individual accountability and responsibility	All	All	All
Interdependence in working together, through:	All	All	All
• Goals	All	All	All
• Tasks	All	All	All
• Resources	Some	Some	Some
• Roles		Some	Some
• Extrinsic rewards		Some	Some
Intentional grouping	Some	Some	Some
Teaching and processing social skills		Some	Some
Reflection on group process	Some	Some	Some
Community-building activities		Some	
Team-building activities		All	Some
Use of structures	Some	Some	Some
Simultaneous interaction		Some	Some
Instructor as activist	Some	Some	Some
Classroom management: quiet signal, timed activities		All	Some
Status treatments		Some	

Table 2 (*continued*)
Overview of Three Approaches

	Collaborative	*Cooperative*	*PBL*
Perspective-taking activities		Some	

Note. "All" means present in all models/varieties of a given approach. "Some" means present in some models/varieties of an approach. No notation means that the characteristic is not typically present in the models/varieties of an approach.

to learning, and that educators should be flexible in how they facilitate peer learning. Panitz (1997) examines several definition of collaborative and cooperative learning to compare the two approaches. Cuseo (1992) proposes a taxonomy of cooperative and collaborative approaches in higher education.

Table 3 provides three sets of illustrative questions from these different perspectives. The first two are adapted from Brubacher (1991); the third is our own construction.

Summary of Contrasts Between the Approaches

Cooperative and Collaborative Learning

Some of the main contrasts between cooperative and collaborative learning, as drawn from Table 2 and elaborated upon via the key questions in Table 3, are as follows:

- Cooperative learning fosters interdependence through a combination of goals, tasks, resources, roles, and rewards, while collaborative learning employs only goals, tasks, and, occasionally, limited resources to foster interdependence.
- Collaborative learning never uses assigned group roles, but some cooperative learning approaches do this.
- Similarly, collaborative learning does not teach group interaction skills or group reflection/processing of those skills, while some cooperative approaches do so.
- Most models of cooperative learning employ intentional grouping stipulated by the instructor, or random assignment, while collaborative learning more often employs student choice of group members.

Table 3
Question Sets

Collaborative/Whole Language Learning Perspective	*Cooperative Learning Perspective*	*Problem-Based Learning Perspective*
1. What is the purpose of this activity?	1. How do we teach social skills?	1. How do we help students deal with the information explosion?
2. How do children/adults learn?	2. How can we develop self-esteem, responsibility, and respect for others?	2. How do we teach students to think?
3. What is the importance of talk in learning?	3. How does social status affect learning in small groups?	3. How can we promote problem-solving skills?
4. How much do we see with our eye and how much with our expectations?	4. How do we promote problem solving and manage conflict?	4. How do we help students use information and resources?
5. To what extent is getting off topic a valuable learning experience?	5. Is extrinsic or intrinsic reward more effective?	5. How do we help students determine when they are working with irrelevant information?

Table 3 (*continued*)
Question Sets

Collaborative/Whole Language Learning Perspective	*Cooperative Learning Perspective*	*Problem-Based Learning Perspective*
6. How can we empower students to become autonomous learners?	6. Should competition be an element in the learning experience?	6. How do we help students learn to learn?
7. How are ideas born?	7. How do we teach thinking skills?	7. How can we help students develop as independent learners?
8. What is the difference between using language to learn and learning to use language?	8. How do you ensure positive interdependence?	8. How can we interact with students in a real way by asking only real questions rather than those we already know the answer to?
9. How can we model our own learning on that of our students?	9. How do we achieve individual and group accountability?	9. How can we use our awareness of the social nature of learning to create effective small-group learning environments?

10. How can we negotiate relevant learning experiences with our students?	10. How can we prove that cooperative learning increases academic achievement?	10. How might we teach students to work together?
11. How can we ensure that we interact with our students in a real way by asking only real questions rather than those we already know the answer to?	11. How do we teach students to take on various roles?	11. How can we help students build knowledge together?
12. How can we use our awareness of the social nature of learning to create effective small group learning environments?	12. How do we structure cooperative activities?	12. How do we best help students function in their future occupations?

- Collaborative learning groups are mostly self-managed, while cooperative groups sometimes need help from the instructor, and often use group methods or structured procedures stipulated by the instructor.
- In designing instructional activities, cooperative learning instructors tend to plan for and employ specific group processes and methods in order to arrive at a learning outcome, with individual accountability in a given time frame. Collaborative learning instructors tend to be less deliberate about these design conditions.

Cooperative learning instructors generally are more activist in interacting with the groups than are collaborative learning instructors, some of whom keep their "hands off" of the groups. Some university-level collaborative learning instructors utilize a *laissez-faire* leadership style, while others typically act as a constant silent observer ready to offer support when needed—being careful not to take away the ownership of learning from the students. Cooperative learning instructors are usually inclined to use a democratic style ("guide on the side") or benevolent directive style ("meddler in the middle"). Neither approach employs a "sage on the stage" style, but the degree of instructor guidance is higher in cooperative than in collaborative learning.

In summary, collaborative learning tends not to employ explicitly the following practices, which occur in some of the cooperative learning approaches: team-building or class-building activities, role assignments, teaching social skills, reflection/processing questions on the use of social skills, group structures (except for jigsaw and perhaps group investigation), classroom management techniques, status treatments, and perspective taking. However, this story is not so simple and clear-cut as it appears on the surface.

According to Brubacher (personal communication April 3, 2014), "the instructional practices are engaged in a more organic or natural manner in collaborative learning than in the more direct and explicit methods of cooperative learning. For example, collaborative learning uses a variety of ways to form groups beyond student choice. Those involved in collaborative learning tend to ask students to work at first with friends and then with others with common interests, and gradually have a goal of working with many others. Collaborative teachers may also encourage a time for reflection on how the group functions, but not based on explicit social skills."

Collaborative learning employs several attributes indirectly, informally,

and implicitly, in contrast to the conscious use of techniques in cooperative learning. According to Brubacher et al. (1990), five examples in collaborative learning are as follows:

- Collaborative learning uses only intrinsic rewards that arise naturally out of an activity, such as the satisfaction of learning a new concept, the joy of making a discovery, the enthusiasm of a lively discussion, or getting to know a classmate better. (This point and the others below can also occur naturally in cooperative learning, building on the structured activities.)
- Collaborative learning engages in non-explicit community building, which can occur when groups successfully resolve a highly challenging task or experience interesting and varied group presentations, leading to a grand feeling of mutual accomplishment.
- Collaborative learning encourages organic team building through working together: developing group spirit by encouraging lively and creative thinking, by appreciating the contributions of others, and by the rest of the group giving moral and informational support when an individual presents to the class.
- Collaborative learning works toward improving the status of those in need, subtly and not as a deliberate technique.
- Collaborative learning enhances respect for different perspectives through open exploratory discussion.

To what extent will these desired outcomes actually occur in collaborative learning? That depends on the students and on the level of awareness and skill of the teacher. In contrast, cooperative learning designs for these outcomes. In general, collaborative learning practitioners tend to view classroom activities through the lens of psycholinguistics, negotiated learning, and holistic experience, while cooperative learning practitioners tend to view classroom activities through the lens of developing cooperative group interaction via explicit techniques and strategies. Both approaches emphasize the importance of students making knowledge their own through interaction with others in small groups.

Problem-Based Learning

Problem-based learning instructors tend to be more like instructors using collaborative learning in some instances and more like instructors using cooperative learning in others, depending on the needs of the students. Building upon the detailed comparison and contrast between cooperative and collaborative learning, we can readily state contrasts between these two approaches and PBL. In the two CLs, the task might be a problem but might be otherwise. In PBL, the task must be a problem. PBL groups are typically larger than groups in cooperative and collaborative learning. Some PBL models are similar to several cooperative learning models, but unlike certain collaborative models, by employing intentional grouping, teaching and processing social skills, reflection on group process and social skills, use of structures, instructor as activist, and classroom management techniques. PBL often does not employ whole class community building, status treatments, and perspective taking.

The Most-Related Subtypes of Cooperative Learning, Collaborative Learning, and Problem-Based Learning

Thus far in this article, we have compared and contrasted three different approaches to group learning. What complicates the issue further is that there are different varieties within these overarching instructional approaches that appear to be even more closely related than their parent forms. Particularly, when collaborative and cooperative learning take on a task or activity that focuses on a problem, the three approaches share even more than otherwise; however, we argue that they are still different forms philosophically. We have identified versions of each of the three general approaches that we believe to be closely related to each other.

Cooperative Learning: Group Investigation (Sharan & Sharan, 1992)

One form of cooperative learning specifically is focused on problem solving: group investigations, as developed by Sharan and Sharan (1992). The philosophical perspective, again, is on the social construction of knowledge, as is evident in the phases of the approach:

1. The class determines subtopics of a multi-faceted problem and organizes into research groups.
2. Each group plans what it will investigate and how it will go about it.

3. All groups carry out their plans.
4. Groups plan their presentations.
5. Groups make their presentations.
6. The whole class evaluates the group investigations and presentations.

Collaborative Learning: Open-Ended Problem Solving

In describing the use of collaborative learning in science classes, Bruffee (1993) argues that it is still a fundamentally different instructional approach from any other small-group approach. Bruffee's view is that the difference between collaborative and other small group approaches is philosophical and related to the nature of authority in the classroom:

> . . . simply adding "small groups" to science classes, without integrating collaboration systematically into the course by changing the nature of the tasks that students undertake together, will not achieve the fluency in the language of the relevant scientific community that an interpretive approach to science can achieve. The problems that this chemistry student and her fellow students were solving together were closed-ended, result-focused jigsaw-puzzle tasks . . . the kind of tasks usually found in problem sets. In the context of an interpretive course, in which the goal is to confront the uncertainties of science as well as its certainties, problems of an open-ended, interpretive, tool-making kind . . . would make peer-group work more rewarding still. Under these conditions, that is, collaborative learning, student conversation would go beyond helpful cooperation and teamwork to active construction of knowledge, although, of course, of limited scale and authority. (Bruffee, 1993, p. 153)

Thus, open-ended collaborative problem solving provides small groups of students with problems that might be approached in several different ways and that do not necessarily have a single correct response. (This is also true of several of the cooperative problem solving models, for instance, small-group discovery in mathematics. Collaborative and cooperative learning might employ exactly the same open-ended problems, but with more social structure in the cooperative groups.)

Problem-Based Learning: Open-Ended PBL and Seven-Step PBL

Problem-based learning has many forms, which vary with the degree of structure. Two versions that are at the extreme ends of the PBL spectrum

are open-ended PBL and seven-step PBL. We highlight the differences in Table 4.

Commonalities in Problem-Solving Learning and Small-Group Learning

At the intersection of problem-solving learning and group learning, there are four approaches that appear in the literature: (1) collaborative learning's open-ended problem-solving model (and other cooperative problem solving approaches such as small-group discovery), (2) problem-based learning's open-ended model, (3) PBL's 7-step model, and (4) cooperative learning's group investigation (see Figure 1 for a conceptual model of the relationship of these approaches). Learning in groups is not specifically restricted to problem solving, yet when cooperative and collaborative learning employ problem solving for their learning activities or tasks, they take on characteristics of inquiry learning compatible with problem-based learning. Specifically, open-ended collaborative learning is similar to open-ended PBL, and group investigation is similar to 7-step PBL. Alternately, problem-based learning, a form of inquiry learning itself, can be less structured (meaning less interdependence), aligning more closely with collaborative learning, or more structured (like 7-step PBL), aligning more closely with cooperative learning.

What Advocates for One of These Approaches Can Learn From the Others

Earlier in this article we suggested that those who use any given approach might learn from those who use the other approaches. In the spirit of learning together, we offer the following suggestions:

- *What cooperative learning might learn from collaborative learning:* You don't always have to structure everything, especially after students develop some skill in group work.
- *What collaborative learning might learn from cooperative learning:* You can't assume that students have skills in working together; some of them don't. Be prepared to teach some social skills as needed.
- *What PBL might learn from cooperative and collaborative learning:* There are many interesting and productive as-

Table 4
Comparison of 7-Step and Open-Ended PBL

7-Step PBL	*Open-Ended PBL* Boud (1985) outlined eight characteristics of more open-ended problem-based learning courses:
1. *Examination of the case*. The group studies the case material.	1. An acknowledgement of the base of experience of learners.
2. *Identification of the problem*. The group discusses the overarching problem.	2. An emphasis on students taking responsibility for their own learning.
3. *Brainstorming*. Individual students in a group discuss their ideas about the problem. They try to identify what they collectively already know and discuss how the case relates to their previous knowledge. The ideas are said aloud or written on self-stick notes, which may be organized on a white board.	3. A crossing of boundaries between disciplines.
4. *Sketching of an explanatory model*. The group constructs an initial version of the explanation for the problem, and the most important concepts and their relations are identified.	4. An intertwining of theory and practice.
5. *Establishing the learning goals*. The parts of an explanatory model that seem mysterious, unclear, or unknown are identified, and the central ones are chosen as learning goals for the group.	5. A focus on the processes rather than the products of knowledge acquisition.
6. *Independent studying*. Each student studies independently to accomplish all learning goals. This phase includes information gathering, including significant reading.	6. A change in the tutor's role from that of instructor to that of facilitator.

Table 4 (*continued*)
Comparison of 7-Step and Open-Ended PBL

7-Step PBL	*Open-Ended PBL* Boud (1985) outlined eight characteristics of more open-ended problem-based learning courses:
7. *Discussion about learned materials.* The group reconvenes to discuss the case. The discussion focuses on explanation of central concepts and mechanisms and analysis of the material as well as evaluation of its validity and importance. It is the individual construction of knowledge then, aided by group discussion, that is the focus of this approach.	7. A change in focus from tutors' assessment of outcomes of learning to student self-assessment and peer assessment.
	8. A focus on communication and interpersonal skills so that students understand that in order to relate their knowledge, they require skills to communicate with others, skills which go beyond their area of technical expertise.

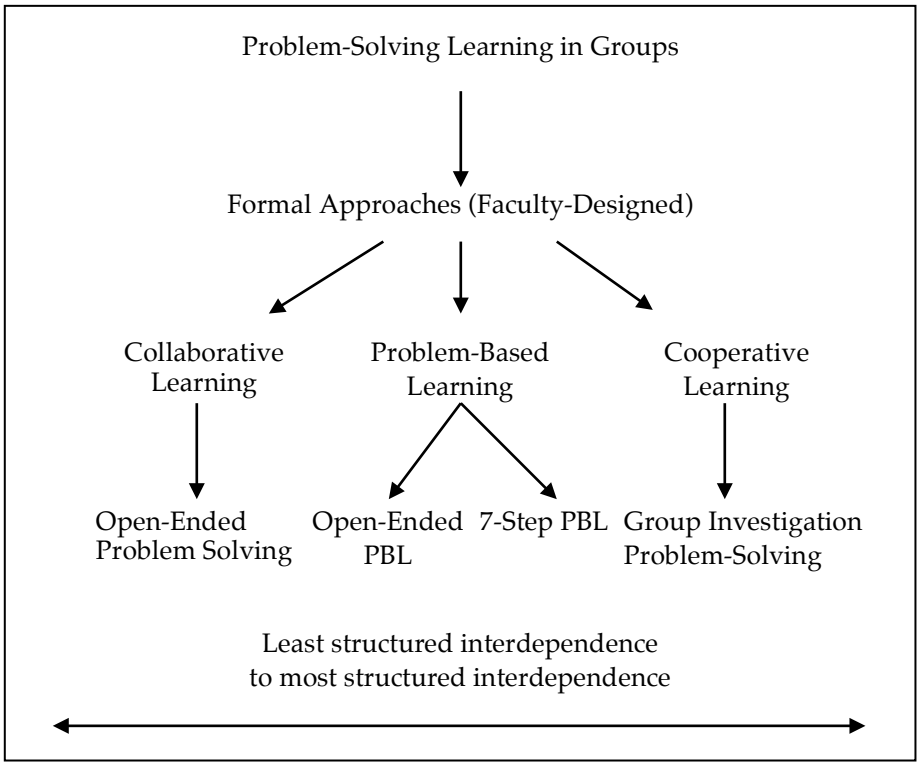
signments other than real-world problems that students can work on together to develop meaningful learning; variety in tasks is the spice of life in groups.

- *What cooperative and collaborative learning might learn from PBL:* Real-world problems can form the foundation of meaningful and productive group work.

Conclusions

In this article, we have compared and contrasted cooperative learning, collaborative learning, and problem-based learning, arguing that while they share many elements, they are unique from a philosophical perspec-

Figure 1
Concept Map of Approaches to Group Learning



tive and that their underlying philosophies drive the learning. All three are forms of small-group learning, related but different, and none is a special case of another. Yet all of these forms of small-group learning promote active engagement in learning and student-to-student interaction in small groups, resulting in enhanced student motivation and achievement and the development of critical- and creative-thinking capabilities. Proponents of any small-group learning approach have much more in common with one another than with proponents of passive learning modalities such as the lecture.

We end this article by providing a series of conjectures about how students with experience in one small-group method might fare in another. We argue that exposing students to problem-solving learning in sequence from more structured to less structured will provide scaffolding to prepare them to succeed.

No research exists to show any optimal sequence in which students need to experience these three approaches. In fact, very few teachers have experience in using more than one of them. The following statements or questions are all conjectures for investigation.

- Students with experience in structured cooperative learning will be enabled to participate in problem-based learning and collaborative learning. We believe that participation in cooperative learning provides students with models, scaffolding, and social skills developed through social negotiation of meaning that enables them to perform problem-solving learning in other group settings.
- Students with well-developed social skills and teamwork skills developed through structured cooperative learning eventually need less structure and are able to participate in any form of group work.
- Students with experience in more structured problem-based learning will be enabled to participate in both cooperative learning and less structured collaborative learning, as PBL will provide them with mental models necessary to understand and engage in problem solving.
- Students with preparation in cooperative and problem-based learning will perform well in the open-ended collaborative problem-solving model, as they will be ready to make meaning with each other and to solve real-world problems.
- Students with experience in structured cooperative learning in a particular academic discipline will be enabled to participate in problem-based learning and collaborative learning in that discipline. For example, students with experience in the cooperative small-group discovery method in mathematics will be enabled to participate in collaborative problem solving and in problem-based learning in mathematics.
- Skills in cooperation and teamwork developed in any academic discipline will transfer to small-group learning in any other academic discipline.

- Proponents of collaborative learning might argue as follows: Students in collaborative learning will be better prepared to participate in problem-based learning as well as in the more structured and socially conscious methods employed in cooperative learning.
- Is there an optimal sequence for using cooperative, collaborative, and problem-based learning?

Thus, while unique, these three approaches, when used singly or together in sequence, can offer a powerful approach to helping students develop knowledge and skills, both intellectual and social.

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