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ORIGINAL ARTICLE

How Group Dynamics Research Can Inform the Theory and Practice of Postsecondary Small Group Learning

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Abstract After a brief review of integrative small group learning models that have appeared in the educational psychology literature, this article then looks into the group dynamics literature and describes one of that field's most well-documented findings: that interactions among group members change somewhat predictably over time. How theorists from various traditions within educational psychology might explain and explore the phenomenon of "group development" is proposed, followed by a description of the theoretical and practical features of an increasingly popular post-secondary instructional strategy designed to stimulate group development and leverage it to instructional ends. This strategy is a very specific form of collaborative learning called Team-Based Learning (TBL), and is considered as a promising context for future research into learning group development.

Keywords Team-Based Learning (TBL) · Group development · Postsecondary

In a series of publications, Slavin (1989, 1992, 1996) hypothesized a model of small group learning achievement that integrated six theoretical traditions. As a rationale for this integration and a challenge to future researchers he argued:

> Until recently, researchers have tended to work on parallel tracks, showing little recognition of work being done in other research traditions on issues related to the achievement effects of cooperative learning. It is now time to look beyond usual disciplinary boundaries to consider more broadly how cooperation among students can enhance their learning. (Slavin, 1992, p. 167)

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Here we continue this integrative effort, looking across disciplinary boundaries to enrich our understanding of learning in these settings,[1] especially as they occur at the post-secondary level. After a brief review of integrative small group learning models that have appeared recently in the educational psychology literature, we then look into the group dynamics literature and describe one of that field's most well-documented findings: that interactions among group members change somewhat predictably over time. We then propose how theorists from various traditions within educational psychology might explain and explore this phenomenon of "group development," followed by a description of the theoretical and practical features of an increasingly popular post-secondary instructional strategy designed to stimulate group development and leverage it to instructional ends. This strategy is a very specific form of collaborative learning called Team-Based Learning (TBL), and we conclude by considering it as a promising context for future research into how collaborative learning processes change as learning groups develop.

Integrative Models of Small Group Learning Processes

By definition, integrative theoretical frameworks represent the theorizing of many researchers within a field. Thus, comparing integrative models of small group learning can provide a sweeping view of the current disciplinary landscape. Three frameworks proposed in the last decade that may give us that bird's-eye view are the models of Slavin (1996), Topping and Ehly (2001), and Van Meter and Stevens (2000). A meticulous critique of each model is beyond the scope of this article. Rather, the goal of the following paragraphs is to help the reader develop a collective impression of the current thinking in the field. This will set the stage for a subsequent discussion of how the group dynamics literature can contribute to that thinking.

Slavin's model (1996, Fig. 1), integrates six theoretical traditions: motivational, social-cohesion, cognitive-developmental, cognitive-elaboration, practice, and classroom organization. In this model, Slavin emphasized the motivational dimension of learning in a small group setting and postulated that group goals increase three aspects of members' motivation: their individual desire to learn, the extent to which they encourage other members' learning and their willingness to support members' efforts to learn. Further, he maintained that these motivations increase learning because they result in member interaction that is characterized by elaborated explanation (peer tutoring), peer modeling, cognitive elaboration, peer practice peer assessment and correction.

Topping and Ehly's (2001, Fig. 2) integrative model of peer learning is more fine-grained than Slavin's, including many more sub-concepts and sub-processes. On the one hand, their model is more suggestive than Slavin's, because the larger number of constructs and processes placed in some kind of relation brings the reader closer to specific "how might *this* influence *that*?" kinds of question. On the other hand, this model is far less suggestive than Slavin's in terms of directionality: by only suggesting that certain constructs and processes are related, but making no clear claim as to how, this model ultimately does a better job of prompting interesting questions than suggesting possible answers.

Finally, to summarize and relate the findings presented in a special issue of *The Journal of Experimental Education* devoted to small group learning, Van Meter and

[1] We will sidestep the temptation to pit one form of nomenclature against another (e.g., "cooperative" vs. "collaborative" vs. "peer" learning) and simply refer to all of these models with the umbrella term of "small group learning."

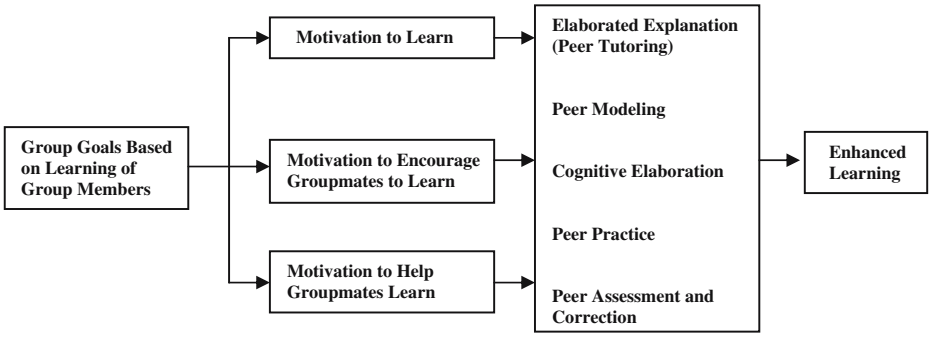

Fig. 1 Slavin's (1996) integrative model.

Stevens (2000, Fig. 3) suggested a "framework for integrating findings across theories" (p. 126). Like Slavin's model, this framework is intended to relate research driven by different theoretical traditions and show that these differences need not be considered contradictory, but instead complementary. Like Topping and Ehly's model, this framework is not directional, but it nonetheless usefully organizes the constructs and processes described in the special issue these authors were summarizing.

According to Van Meter and Stevens, the central tenet of their theoretical framework "holds that it is the structure of the collaborative discourse, not grouping per se, that has implications for the learning of individual members," and the authors go on to describe three theoretical areas that unfold around this central tenet: "the nature of effective discourse patterns, context factors that support that discourse, and the individual learning gains that can be expected to result" (p. 123). To illustrate the centrality of discourse in learning, Van Meter and Stevens describe Van Boxtel, van der Linden and Kanselaar's (2000) research as finding that "[i]mportantly, it was not elaboration itself that predicted learning outcomes, but collaborative elaboration, in which peers responded to groupmates' comments by adding or extending explanatory statements" (p. 123) represented in Van Meter and Stevens' model as Responsive Communication.

Clearly, there are more similarities and differences among these three models than can be explored here. However, two of the similarities bear directly on this article's integrative purpose. One is a consistent emphasis on discourses processes: all three models explicitly delineate specific forms and structures of interaction through which learning occurs. The other is a consistent omission, ignoring 50 years of evidence from the group dynamics literature showing that discourse structures in groups develop through clearly distinct and markedly different stages as groups mature over time. At the very least, group maturity merits mention among the most important "contextual factors" in models of small group learning. Further, rectifying this omission may very well require restructuring of our existing small group learning models. In our judgment, any model of small group learning will be incomplete unless it takes into account the fact that groups, like individuals, learn how to learn.

Group Dynamics: The Study of Group Behavior Among Adults

Most of the research on small group learning has been done in K-12 settings (D. W. Johnson & R. T. Johnson, 1993). By contrast, the field of group dynamics, which has focused almost exclusively on adults, has much to offer any exploration of small group

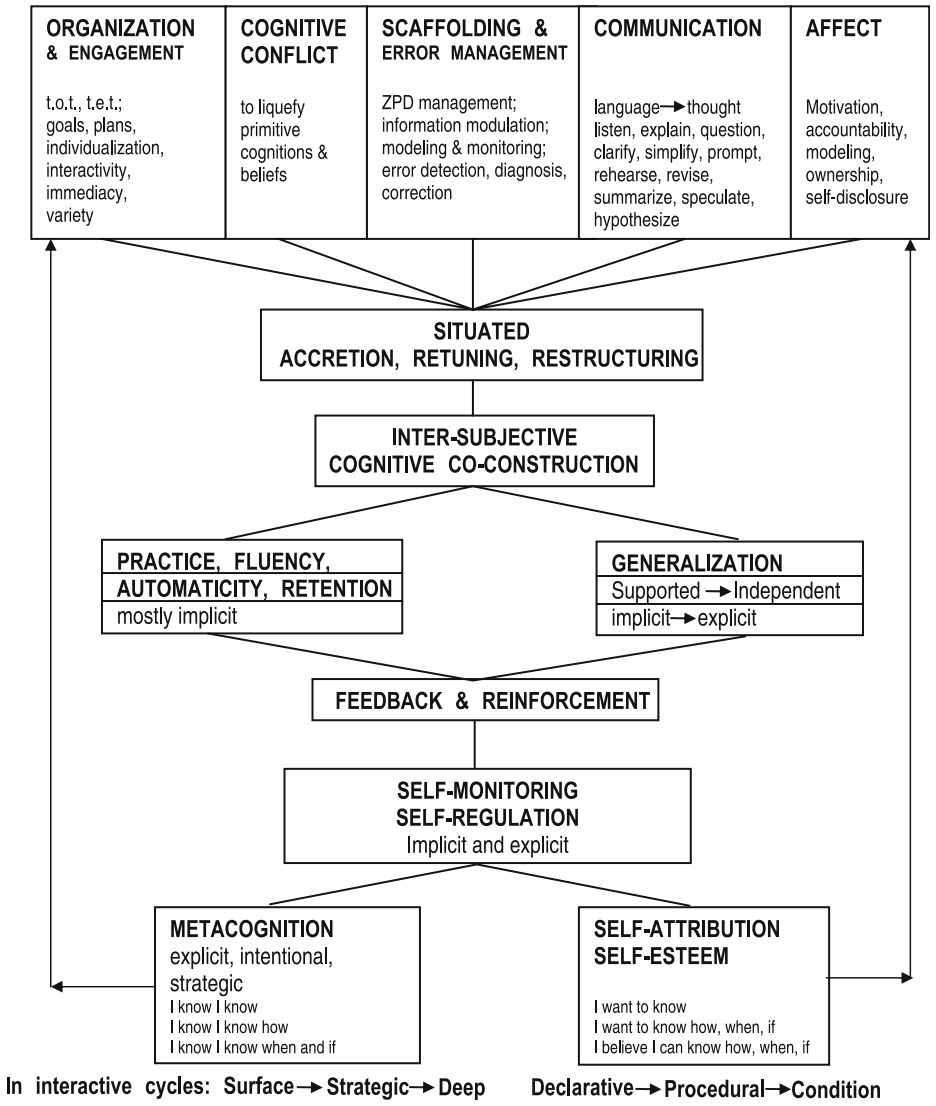

Fig. 2 Topping and Ehly's (2001) integrative model.

learning in post-secondary settings. Specifically, it describes the phenomenon of interaction among team members evolving through well-documented stages and resulting in members of mature groups interacting in very different ways from members of new groups.

Group development processes

Literally dozens of theoretical models describing the evolution of group behavior have been proposed since Bennis and Shepard's original (1956) pioneering work in the area. Wheelan's recent (2004) integrative model draws upon four traditions in the group development literature: sequential/life-cycle models (e.g., Tuckman, 1965, Tuckman &

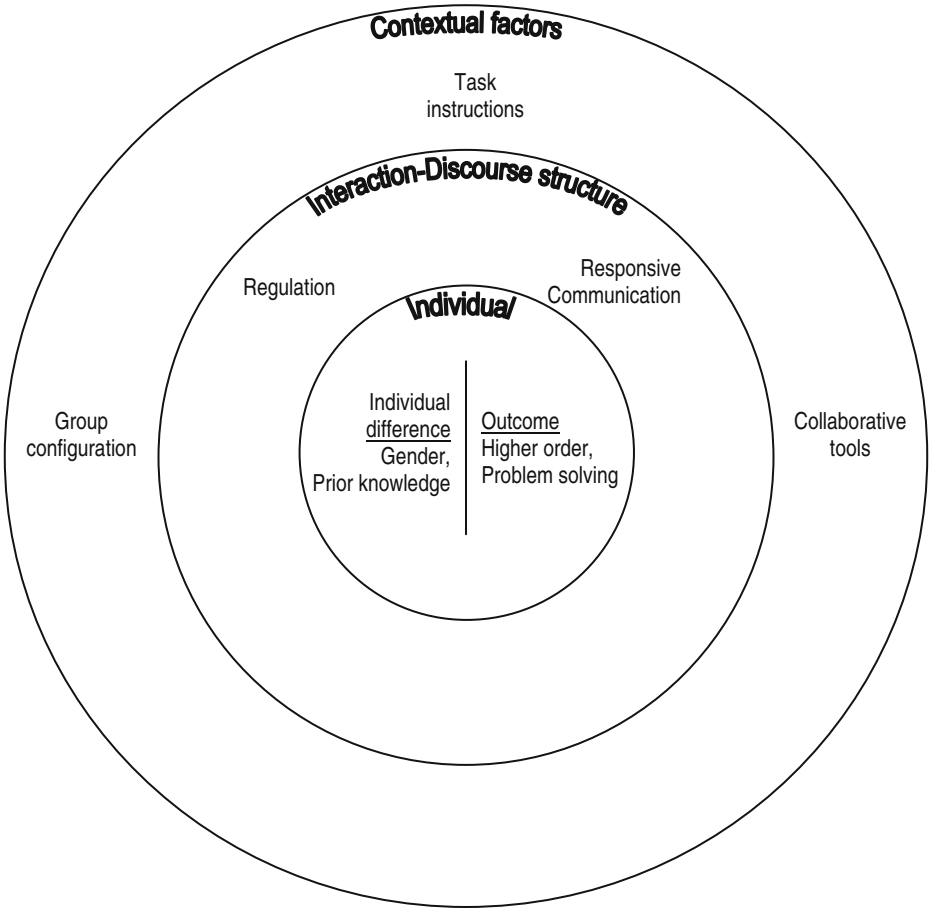

Fig. 3 Van Meter and Stevens' (2000) integrative model.

Jensen, 1977), cyclic models (e.g., Worchel, 1994), equilibrium models (e.g., Gersick & Hackman, 1990), and adaptive/non-sequential models (e.g., McGrath, 1991). Wheelan's model has been validated in a number of empirical studies and "is, essentially, a life cycle model" (p. 13) describing how groups mature in a generally linear—but not always perfectly predictable—fashion. Like individuals, groups may get stuck in a stage of development for some time, may regress when under stress, and not all groups develop to full maturity.

In the first stage of Wheelan's (2004) model, brand new groups begin relationships in a state of *Dependency and Inclusion*, marked by high anxiety, uncertainty, and politeness. Group members at this stage are mostly concerned with psychological safety, uncertainty-reduction and boundaries, and will therefore tend to defer to a "leader," and be tentative—even defensive—with task-related work occurring only minimally. The second stage is *Counterdependancy and Fight*. In this stage, conflicts arise among group members as each member seeks to identify and define individual roles more clearly. Individuals and coalitions may have different ideas about how the group should operate procedurally, as social structure within the group is still forming. Clear power struggles can sometimes ensue at this stage, and the full resources of the group are not available for application to the group task. As suggested

by Do and Schallert's (2004) findings of the extent to which adult students "tune out" to manage experiences of extreme affect in the classroom, the heavy socio-emotional burden of these first two phases of group development have clear implications for the quality of learning that may (not) be likely to occur while a group is growing through them.

At stage three, *Trust and Structure*, the group has navigated through the majority of its growing pains and begins "a more mature negotiation process about group goals, organizational structure, procedures, roles, and division of labor" (Wheelan, 2004, p. 18). Communication becomes more task-oriented, and feedback becomes safe to give and receive. Information is shared more freely as the group becomes an increasingly safe place where members know (more or less) what to expect from each other. Stage four is simply called *Work* and is the stage in which group members comfortably and habitually share information with each other and have a relatively good sense of where different kinds of knowledge and expertise lie within the group. *Termination*, the fifth stage, is marked by a general awareness of an impending loss of group stability, which can create anxiety and even conflict. Consciously recognizing and managing these effects can set members up for successful experiences in subsequent groups, but Wheelan noted that this kind of conscious processing does not happen as often as it should.

Studies that have investigated group development among post-secondary learning groups have found that these groups do indeed develop. The findings of Watson, Michaelsen, and Sharp (1991), and Watson, Kumar, and Michaelsen (1993), detailed in the "Research on Team-Based Learning" section below, clearly show a developmental progression within learning groups, though not measured in terms of a stage model. Studies that do map group development onto a stage model unfortunately show that fewer groups achieve the optimum condition of Work than one would like. In a quantitative study using repeated questionnaires, Wheelan and Lisk (2000) investigated college student cohorts in an accelerated degree completion program and found that higher GPAs correlated positively with increased group development (as measured by a Group Development Questionnaire, or GDQ). A year after pre-test, 10 of the 19 original groups had achieved Trust and Structure, and six had achieved a stable condition of Work. In a follow-up study also using the GDQ, Lisk (2003) found that learning groups in a college level business course also progressed through these phases over the course of a semester. Again, group development positively correlated to individual performance, but in this study only 19 of the 37 groups reached the Work stage of development. Because these studies show that group members' achievement is positively correlated to group development, they make clear the importance of a small group learning strategy that facilitates group development as effectively and efficiently as possible. It is, after all, safe to assume that any teacher would want considerably more than half of their groups to achieve a Working stage of group development.

Change in groups over time: A more detailed view

Beyond the general phase model of development, many group dynamics scholars have looked at more specific ways in which members of mature groups interact differently from newly-formed groups. In their review of the group dynamics literature, Birmingham and McCord (2004) saw several dimensions along which new groups differ from long-term, developed groups. Rather than re-cite all of the works these authors reviewed, we direct the interested reader to Birmingham and McCord's chapter for the dozens of references that led to these specific conclusions. Here we review the seven main distinctions between new and long-term groups that these authors identified.

Birmingham and McCord reported that the first dimensions along which new groups differ from long-term groups is that members of new groups tend to have a lower sense of *trust in and attraction to the group*.

Second, members of new groups tend to exhibit little *identification with the group or its goals* and are *motivated primarily by self-interest* whereas members of long-term groups exhibit high levels of identification with the group and its goals, and are mutually supportive.

Third, members of new groups tend to base their *perceptions of the abilities and skills of others* on stereotypes, whereas members of long-term groups have a higher level of awareness of the actual skills and abilities of their team-mates.

Fourth, communication in new groups tends to be *more socially-focused*, with decision-behavior depending heavily on the group's "best" member, whereas *communication in long-term groups tends to be task-focused*, with input from all members.

Fifth, members in new groups tend to focus on areas of agreement, whereas members of long-term groups exhibit a higher *willingness to disagree* and make attempts to resolve differences.

Sixth, members of new groups tend to *resolve conflict via strategies that save face* (such as voting or compromise), whereas long-term groups tend to have more open discussions in pursuit of consensus.

Finally, new groups tend to be inherently less able to *complete difficult intellectual tasks* whereas developed groups are better able to put their combined resources to use, giving them a greater ability to complete difficult tasks.

Group Development and Prominent Educational Theories

The discourse patterns reported by Birmingham and McCord (2004) can inform, and be informed by, prominent educational theories employed in the research of small group learning. Three of these theories are Piaget's theory of equilibration, Vygotsky's zone of proximal development, and Bandura's social-cognitive theory. Here we use Ochs' (1990) definition of "discourse" to consider the group dynamics findings reviewed by Birmingham and McCord appropriate for several kinds of analysis, some that focus more upon spoken language than others. Ochs defined discourse as a:

> Set of norms, preferences, and expectations relating language to context, which speaker-hearers draw on and modify in producing and making sense out of language in context... Discourse relates language to both social and psychological contexts, including affect, knowledge, beliefs, social acts, activities and identities (p. 289).

Piaget's equilibration

De Lisi and Golbeck's (1999) summary of Piaget's theories as they apply to small group learning concisely describes the theoretical components of what Piaget called the process of "equilibration." Four components of equilibration relevant here are *subject-object relations, assimilation, accommodation*, and *perturbation*. In contrast to views on cognition that focus mostly on passive reinforcement (Object→Subject) and also in contrast to views that present learners as "beneficiaries of evolutionary struggles worked out centuries before" (Subject → Object, p.7), Piaget's research investigated cognitive functioning as a more active, relational experience: (Subject⇆Object). This relational model of cognitive functioning

leads to two complementary cognitive processes, which Piaget called assimilation and accommodation. In short, assimilation is the process of incorporating new sensory experience into an existing cognitive framework, and accommodation is the process of modifying one's cognitive frameworks in order to account for experience that one cannot simply assimilate. Learners are motivated to maintain a balance between these two processes: making sense of the world in their own terms but continually developing those terms in order to make better sense of the world. A perturbation occurs when the balance between assimilation and accommodation is lost, and equilibration, finally, is the self-regulatory mechanism that motivates the learner to maintain (or, if perturbed, re-acquire) that equilibrium. Clear parallels exist between Piaget's "perturbation" and what Festinger (1957) called "cognitive dissonance," both terms describe a cognitive imbalance that motivates action in pursuit of balance.

It follows, then, that a Piagetan explanation of Birmingham and McCord's (2004) findings would begin with the extent to which a group member has been able to make the group and its other members Objects of learning. When a group is new, members have no prior knowledge of each other and can only base their expectations for the upcoming group experience upon vague assumptions about group goals, stereotypical assumptions about other members, and guesses about how others will react to disagreement. As the group matures, stereotypical expectations that are not met cause socio-emotional perturbations, and the relational Subject⇄Object learning process helps develop each member's cognitive frameworks about what belonging to *this* group means. Over time, social boundaries are determined, relational perturbations occur less frequently, and some level of equilibration about the group is reached in some or most of the members. As this occurs, the group can increasingly then get down to the business of task-focused communication in which cognitive conflict generated by disagreement among members leads to greater learning.

Vygotsky's zone of proximal development

Unlike Western psychologists who distinguish between social and cognitive processes, Vygotsky argued that the mind is inherently social and that high-level cognitive processes begin as social events that individuals then internalize to differing degrees (Forman, 1992). The difference between the learning theories of Piaget and Vygotsky can be described as the difference between learning that occurs in the mind of an individual vs. learning that occurs as a social event in the "inter-subjective" space between people as they negotiate a common understanding of the world. Wertsch (1985) described *inter-subjectivity* as follows:

> When interlocutors enter into a communicative context, they may have different perspectives or only a vague interpretation of what is taken for granted and what the utterances are intended to convey. Through semiotically mediated "negotiation," however, they create a temporarily shared social world, a state of inter-subjectivity (p. 161).

Forman (1992) described an example of such negotiation occurring when children are first placed in a teacher-organized group learning situation. The discourse rules that children normally use with each other are very different than the discourse rules they associate with formal classroom situations. Therefore, a structured small group learning situation demands that they interact in a whole new way, integrating the discourse rules of classroom and playground. Forman noted that developing an inter-subjective state "depends upon one's interpersonal needs to please or dominate others with a common need to work together" (p. 155) and finds children of different ages having different kinds of difficulties with this process.

In their review of Vygotskian theory as it relates to small group learning, Hogan and Tudge (1999) observed that the zone of proximal development (ZPD) is the Vygotskian construct most frequently cited in discussions of small group learning. The ZPD describes the instructional effects of inter-subjectivity, when one member of the intersubjective state is more knowledgeable than another and can lead the less-knowledgeable partner into greater understanding. As Hogan and Tudge took pains to emphasize, however, the ZPD is neither automatic nor one-dimensional: simply putting two people together, one of whom knows more than another, in no way guarantees a positive instructional outcome, and can in fact be instructionally worse than students working alone. This risk of "the blind leading the blind" is what many college teachers fear from small group learning, and makes a strong argument for caution when organizing small group learning activities and forming learning groups.

Hogan and Tudge (1999) described cultural-historical, individual, and interpersonal factors affecting the development and quality of a ZPD between people. For our purposes, some of the interpersonal factors they mentioned are the most relevant: competency levels among peers, interpersonal socioemotional factors, joint understanding, interaction style, and feedback. A detailed discussion of each of these factors is beyond the scope of this article, but their enumeration makes the point that there are many sources of difference and uncertainty that a learning group must negotiate in pursuit of a functional inter-subjective discourse.

A Vygotskian explanation of group development would, then, focus on the efforts necessary by members of a new group to determine collectively how they will co-construct an intersubjective discourse capable of supporting the ZPDs necessary among members. Based on the research reviewed by Hogan and Tudge (1999), this co-construction would involve the group determining how they are to go about answering questions that include (but are not limited to) the following: For any given topic, in any given moment, how will we determine and communicate who is the "more knowledgeable other?" In the pursuit of the ZPD, how will we leverage potentially positive affective influences like confidence and credibility, while managing potentially negative affective influences like anxiety and distrust? How can a less knowledgeable member describe the gaps in his or her own understanding and ask for help in filling them? How will we manage the demands of the task, the feedback it gives us (if any), and feedback amongst ourselves? How can I say what I know without being perceived as arrogant or pushy? How can I disagree without being seen as "disagreeable?" A Vygotskian theorist would say that as these questions get answered, and these discourse dimensions stabilize, the group will become an increasingly fertile ground for the development of "inter-psychological," higher-order cognitive functioning. As group members become increasingly trusting and willing to disagree, ZPDs will come into being with increasing frequency between members, creating opportunities for inter-psychological, higher-order functioning to become "intra-psychologically" internalized by individuals. In other words, the group and its members can increasingly get down to the business of learning.

Bandura's social cognitive theory

Bandura's social-cognitive theory is based upon a model of human agency taking place within a system of "triadic reciprocal causation" (Bandura, 1997). In his view, our choices are governed by the mutual influence of behavioral, psychological, and environmental factors present in any given situation. In other words, we are simultaneously the creators and products of our environments. Within this framework three constructs are particularly relevant to small group learning: *perceived self-efficacy, modeling*, and *perceived collective-efficacy.*

Bandura (1997) defined perceived self-efficacy as "the beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). Because the construct is perceptual, it makes no claim about objective ability, and because it revolves around "attainments" (goals), it includes motivational elements that the preceding theories do not: "unless people believe they can produce desired effects by their actions, they have little incentive to act" (pp. 2–3). Slavin's (1996) emphasis on the primacy of motivational factors in small group learning certainly argues for the merit of perceived self-efficacy as a construct of interest to small group learning researchers. In the classroom, perceived self-efficacy has been shown to be among the strongest contributors to academic success (Zimmerman, 2000).

One powerful source of perceived self-efficacy is *modeling*, or "observational learning." Observing how others do in a given situation can help a person estimate how he or she would do in the same situation. Bandura (1997) described at length the contours of the modeling process and its effects upon attention, retention, production, and motivation, citing Vasta's (1976) findings of corrective modeling as the most informative form of feedback, leading to the greatest subsequent achievements. Webb (1992) theorized about the learning processes of children who do and do not seek help, and included observational learning as a critical element of learning in the small group setting.

As the group-level counterpart to perceived self-efficacy, the construct of *perceived collective-efficacy* describes a group's perception of its capacity to accomplish some collective goal. Bandura (1997) took care to emphasize that perceived collective-efficacy, however, is "not a disembodied group mind... that operates independently of the beliefs and actions of the individuals who make up the social system" (p. 76) but is instead a belief, held by individual group members, in the group's ability to achieve a collective goal. In the same volume, Bandura (1997) noted the mutual influence between perceived *self*-efficacy and perceived *collective*-efficacy: "high perceived efficacy is vital for successful functioning regardless of whether it is achieved individually or by group members working together. A collective system with members plagued by self-doubts about their ability to perform their roles will achieve little" (p. 77). The emergent nature of perceived collective-efficacy can make it tricky to measure, but empirical studies have tackled this challenge and shown perceived collective-efficacy as a critical factor in group effectiveness (e.g., Prussia & Kinicki, 1996; Baker & Campbell, 2005; Hodges & Carron, 1992).

A social cognitive explanation of group development would begin by arguing that the findings reviewed by Birmingham and McCord (2004) support the claim that perceived collective-efficacy is both real and emergent. As group members accumulate experience with each other and feedback from the environment, they become better able to estimate their own capacity to perform necessary tasks and fill certain roles within the group. Roles then stabilize and perceived collective-efficacy emerges, leading to a greater motivation to achieve group goals. As it becomes evident where resources in the group reside, group members learn how to determine who among them is most likely to provide accurate corrective modeling on any given topic, leading to a more effective sharing of task-related information and, ultimately, a greater ability to complete difficult intellectual tasks as a group.

Implications for Instructional Practice

Regardless of one's theoretical orientation, the findings that groups develop over time as described by Wheelan's (2004) integrative model, and the specific lines along which they

develop as described by Birmingham and McCord's (2004) review, have clear implications for instructional practice. Both of these sources are based on decades of research, so in combination they argue powerfully in favor of instructional practice that (1) keeps groups together long enough for them to develop into effectiveness, and (2) promotes both cognitive efforts and effective group interaction.

Prescriptions for the promotion of effective group interaction vary widely among practitioners of small group learning. Some argue that class time must be set aside before group work for "team-building" activities like "appreciation" and "visioning" as described by Abrami *et al.* (1993). Some advocate assigning members to rotate specific roles like facilitator, recorder and timekeeper (Millis & Cottell, 1998). Others advocate setting time aside after group activities to discuss what a team is doing well and how it could improve (e.g., D. W. Johnson, R. T. Johnson, & Smith, 1991).

There is, however, one post-secondary small group learning strategy that is specifically designed to facilitate student groups toward effective group interaction without explicit team-building activities or imposed role structures. Instead of formally "telling" students how to develop into effective teams, the sequence and structure of the method motivates and enables students to learn this quickly on their own. As a result, many educators are finding they can cover more content with this strategy than they could even with traditional methods (Michaelsen & Richards, 2005). Based on the notion that, to become most effective, "groups" must develop into "teams," this strategy is called Team-Based Learning (TBL).

Team-based learning: promoting group development without explicit "team-building" activities

Proponents of TBL claim that two features enable it to capitalize on the increased effectiveness of more highly-developed teams without elaborate team-building exercises for which most post-secondary teachers simply have no time. First, most of the learning in a TBL classroom is done in permanent, strategically-chosen student groups. Second, TBL employs a "Readiness Assurance" process, a specific sequence of individual work, group work, immediate feedback, and clarification that motivates and enables students to develop as a group. This section first describes the features of TBL in practical terms, and then proposes theoretical explanations for those features, drawing upon all three theoretical traditions described above.

Contrary to most small group learning classrooms where group sizes of four are recommended (Millis & Cottell, 1998), TBL students are organized into teams of five to seven, using stratified systematic sampling with the goal of distributing course-relevant student characteristics (e.g., prior coursework in the field) as equitably as possible across teams. This strategic selection is designed to ensure heterogeneity within teams and homogeneity across teams, and the larger size ensures that all teams have a high probability of containing necessary intellectual resources, even if one or more team members are absent. Also, unlike some "ad hoc" uses of learning groups, teams are permanent for the entire course, so that they have a chance to develop past the socio-emotionally burdened early stages of group life on their way to a stable Work condition.

A TBL course is typically segmented into five to seven instructional units, determined by the specific ways the instructor wants students to be able to use course material in the "real world" once they have completed the course. For each instructional unit, students are assigned relevant readings to be completed before the first day of the unit, and each unit

begins with a Readiness Assurance Process (RAP). Here, the term readiness refers the how well-prepared students are actually to put course concepts to use.

A RAP involves students first taking a short, multiple-choice test over the assigned readings, frequently called an *individual Readiness Assurance Test* (iRAT). After students turn in the completed iRATs, they then take the exact same test as a team (frequently called a *group Readiness Assurance Test*, or gRAT), engaging in whatever discussion is necessary to reach consensus on answers for each question. For this process, Michaelsen, Knight, and Fink (2004) strongly recommend using self-scoring answer sheets such as the Immediate Feedback-Answer Technique (IF-AT, Fig. 4) form.

With the self-scoring answer sheets, students scratch off film covering an answer box in search of the mark indicating a correct answer (a star). As a result, teams receive truly immediate feedback with every choice they make. If the team finds a star on the first try, they receive full credit. If not, they continue scratching until they do find the star, but their score is reduced with each successive scratch, with partial credit motivating continued discussion and learning. When teams complete their gRAT, they can appeal any questions that they got wrong but for which they feel they can make a convincing case that: (a) the answer they chose can be considered correct, (b) the question needs to be revised, or (c) the reading material was inadequate. Only teams, not individuals, can write appeals, and appeals must be supported by evidence from the course materials (readings, previous lectures, etc.). This appeal process is designed to drive the students immediately back into the areas of the content they did not understand in pursuit of either clarification or support for their appeal.

Instructors can either review and address team appeals immediately, or review them after class and report later which appeals they have decided to grant. The latter is recommended, based upon the emotional energy generated by the RAP. In either case, it is important for instructors to explain their rationale for appeal decisions, as this keeps the discussion instructional and content-oriented. If an appeal is granted, only those teams that successfully appealed the item receive points—teams cannot "piggyback" on appeals written by other teams.

Once the appeal process is over, the RAP is complete. The instructor can now review for the class those questions that most teams missed on their gRATs and briefly clarify the concepts related to these questions. Questions which all groups answered correctly can be considered as representing material already mastered by the process of individual preparation and group discussion. This relieves the instructor of the burden of lecturing over content that students are able to understand on their own, thus freeing up a great deal of class time in which students can learn to put course material to use in application-oriented activities.

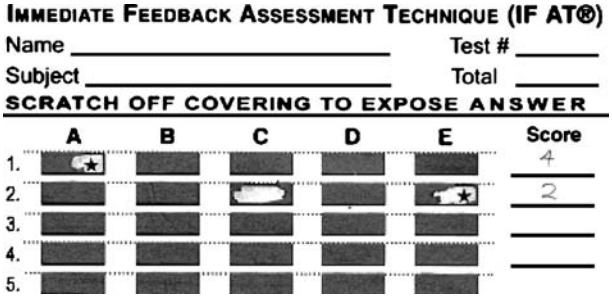

Fig. 4 Self-scoring answer sheet.

The RAP, then, serves three purposes. First, it motivates students to read and study the required readings before discussing them in class. Second, it allows student misconceptions and misunderstandings to be clarified by either team members through discussion during the gRAT or by the instructor using the gRAT diagnostically to identify areas of misunderstanding. Finally, the immediate feedback after gRAT discussions tends to develop groups into increasingly cohesive and effective learning teams. Michaelsen *et al.* (2004) maintained that,

> With no input whatsoever from the instructor, teams quickly learn how to work together effectively. In fact, IF-ATs ["scratch-offs"] virtually iliminate any possibility that one or two members might dominate team discussions. 'Pushy' members are only one scratch away from having to 'eat crow' and quiet members are one scratch away from being validated as a valuable source of information and two scratches away from being told that they need to speak up." (p. 269)

The discussion above offers a common-sense explanation of how the RAP enables groups to develop, but theoretical explanations based upon our previous discussion of Piaget, Vygotsky and Bandura can also be considered (Table I).

Research on team-based learning

Postsecondary implementations of TBL in disciplines as diverse as computer science (Trytten, 1999), economics (Aarestad & Moewes, 2004), electrical engineering (Weeks, 2003), sports psychology (Meeuwsen, 2002), and microbiology (McInerney, 2003) attest to the transferability of TBL across disciplinary borders. Particularly noteworthy in the field of medical education is the TBL dissemination effort coordinated by the Baylor College of Medicine.[2] The project now involves over 60 medical and allied health schools (Schneider, 2006) and, in addition to an annual conference and many research publications, has produced instruments used to measure student engagement and classroom dynamics (O'Malley, Moran, & Haidet, 2003).

Given its origins in a business management classroom, it is not surprising that most early TBL articles appeared in management education journals and interest there continues today. Michaelsen and his colleagues laid the groundwork in the 1980s (e.g., Michaelsen, Watson, Cragin, & Fink, 1982; Michaelsen, Watson, & Schraeder, 1985) and today the literature on TBL in management ranges from reflective pieces (Fairfield & London, 2003) and notes from the field (Herring & Higgins, 2004), to correlational and quasi-experimental research. Because the latter forms of research provide more convincing evidence of TBL as an instructional/motivational system, three such studies merit brief descriptions here.

First, Watson *et al.* (1993) investigated how varying levels of cultural diversity among team members affected group performance over time in a course on the principles of management. They found that culturally diverse groups generated more perspectives on a problem and more alternative solutions than culturally homogenous groups but took longer to achieve equal levels of group process effectiveness, accurate problem identification, and solution quality than less diverse groups. These authors argued that their findings justify further longitudinal research into group dynamics in real problem-solving contexts.

[2] Baylor's TBL dissemination project was funded by a FIPSE grant (http://www.bcm.edu/fac-ed/team_learning/index.html) and has spawned the "Team-Based Learning Collaborative" a group of over 300 TBL practitioners in the medical field alone. The Collaborative has recently achieved status as a non-profit organization (http://www.tlcollaborative.org).

Table I Theoretical Explanations for Each Element of the RAP

	Piaget	Vygotsky	Bandura
iRAT	Focuses attention and clarifies the student's current understanding of the concept underlying each question.	Clarifies how the student has intra-psychologically internalized the concept underlying each question.	Enables the student to develop and refine self-appraisals regarding their capacity to use course concepts to answer questions.
gRAT	Forces cognitive conflict among members in pursuit of consensus. Knowledge-building discussion ensues.	Illuminates where potential ZPDs may exist among members. Discourse-building interaction ensues.	Enables social comparison and illuminates where potential for corrective modeling may exist among members.
Immediate gRAT feedback	Makes the group itself an Object of learning in relation to which each Subject (student) can consider how they want to re-align themselves when discussing the next question.	Helps the group gauge the effectiveness of their intersubjective discourse, enabling individuals to refine their sense of when and how they want participate in future ZPDs. Feedback reveals who should and who should not be actually considered a "more knowledgeable other."	Enables individuals to refine their levels of perceived self- and collective-efficacy, as well as judge who should and should not be accepted as a provider of corrective modeling for the next question.
Team appeals	Tests the group's conviction that they can assimilate the answer to this particular question instead of having to modify their cognitive frameworks to accommodate it. Possibly generates high-level cognitive conflict based on the instructor's response.	Tests the quality of the group's intersubjective discourse against the discourse of the field (as understood and represented by the instructor.)	Tests the group's argument that their own assessment of their ability to use course concepts correctly (their perceived collective-efficacy) is more accurate than the assessment of their ability as made by a given test item.
Teacher clarification	Helps resolve cognitive perturbations and return assimilation and accommodation to balance.	Continues negotiation to bring group discourse in harmony with the discourse of the field as understood by the teacher.	Provides feedback and corrective modeling at the group and class level, ideally increasing both actual ability and perceived self- and collective-efficacy.

In another correlational study, Watson *et al.* (1991) examined how individual scores and team scores developed over the course of a semester in an organizational behavior course. They found that within teams, the highest individual score became less predictive of the team score over time, even as team scores improved. A "synergy ratio" for each team was also calculated across three time points. *Synergy* was calculated by dividing the amount by which the team outscored its best member (team score—best member score) by the amount by which it was *possible* for the team to outscore its best member (total possible points—best member score). Because individual scores all increased over time, it became more difficult for a team to outscore its best member, yet team synergy ratios increased at every

measure. The authors concluded that these patterns reflect the team members' increasing willingness and ability to discuss test questions longer and more deeply (and therefore make better decisions) as opposed to relying on the opinion of socially dominant members as they do early in the term.

A later study by Birmingham and Michaelsen (1999) examined the extent to which groups resolved conflicts that arose as members came to agreement on answers to a series of group tests by using a compromise as opposed to problem solving. They found that, over time, groups steadily and dramatically shifted from compromise to problem solving. On the first test, two thirds of the 192 groups in the study used the compromise strategy. However, on the fifth test, which occurred after the groups had worked together for approximately 25 h, the number of groups who used a compromise strategy had dropped to zero. Based on student narratives collected as part of the study, members consciously and conscientiously moved from focusing on people (i.e., trying to figure out "who was right") to focusing on the issues related to the correct answer (i.e., "what was right").

Future Research

It is one thing to cite decades of group dynamics research and related educational theories as a rationale for why a certain small group learning strategy may be of specific theoretical interest to educational psychologists. It is another thing entirely to say with any certainty that those dynamics are actually in play in classrooms using that strategy, and that they are promoting learning more effectively than other methods might. For this reason, three directions for future research suggest themselves. First, does TBL promote group development as its proponents suggest? Second, does that development matter to the learning process or outcomes? And third, if so, how might those findings rearrange our integrative models of small group learning?

Although the indirect data seem to suggest it, and Michaelsen *et al.* (2004) offer an intuitively attractive mechanism to explain it (the cumulative effects of immediate feedback after every group decision) we still have no direct evidence that groups develop faster and/or further in TBL classrooms than in classrooms using other kinds of small group learning. At the very least, a simple comparison using Wheelan and Lisk's (2000) Group Development Questionnaire seems like a clear place to start. As a follow-up, analyses of discourse within learning groups across TBL and non-TBL classrooms could substantiate, refute, or clarify any initial findings made with the GDQ.

If it is determined that learning groups in TBL classrooms clearly do develop faster or further than groups in other small group learning situations, then whether and how that development influences individual learning within the groups becomes salient. This question could be approached in many ways, but changes in patterns of discourse, satisfaction, and performance, and perhaps even differential performance across different kinds of task, depending upon how developed a group has become, would seem to be fruitful methods to begin answering questions about differences in learning process. Either the "revised" Bloom's taxonomy (Krathwohl, 2002) or Fink's (2003) taxonomy of significant learning objectives offer ready frameworks for exploration of how the unique features of TBL may in fact produce significantly different learning outcomes than other forms of instruction.

Finally, this article is based upon the premise that discourse structures matter to learning. As we have seen, group discourse structures change over time, and if these changes can be shown to occur in ways that are compatible with existing educational psychology constructs,

then the question arises of how those findings would affect our models of small group learning. Perhaps these findings would not structurally alter these models at all: they may just inform our understanding of which "contextual aspects" of a learning situation are most pressing to the learner at a certain stage of group development. Perhaps, however, research into how learning changes as groups mature could reformulate our models of small group learning in more structural, unforeseen ways.

Simply put: how groups talk matters to learning, and how groups talk changes, but does that change matter to learning? Only future research can tell us.

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