Using Psychotherapy Techniques to Reveal Misconceptions and Improve Learning

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The authors argue that the classroom setting instructors seek to establish for highly effective teaching closely parallels the environment established for group therapy sessions. The therapist must create a “safe” environment, help clients identify issues that may initially be hidden from them, address misunderstandings, and maintain open and honest communication. Likewise, the classroom environment must be safe for risk taking, be “owned” by the students, and be non-threatening. The authors’ study explores the application of therapy concepts in the classroom to identify and correct misconceptions that may hinder students’ higher level cognitive and analytical skills.

Introduction

The classroom setting instructors often seek to establish for highly effective teaching has some striking similarities to the environment established for family or group therapy sessions. In therapy groups, the therapist is a facilitator for discussion, and the participants are expected to interact to enhance their learning. In the ideal classroom setting, the instructor relies less on lecture and more on student discovery (National Research Council, 1997). In both group therapy and the ideal classroom, the participant is actively engaged in problem solving and learning new information. Both settings strive to create a safe environment in which participants feel free...
to ask questions, make errors, explore, and think aloud. In both settings, cooperative learning can be an advantage, as participants are interdependent, bring different perspectives and skills to the table, and learn from each other. Even the room layout may be similar: Therapy groups are typically arranged with individuals seated in a circle; likewise, instructors identify informal and intimate classes with circular seating.

Most importantly, group therapy settings and university classrooms both can be used to identify and correct "blind spots." In group therapy, blind spots are attitudes, perceptions, or behaviors that an individual does not recognize, admit to, take responsibility for, or accept as important. In the classroom, blind spots may range from students' missing of factual information to unrecognized or deeply rooted misunderstandings that limit their capacity for profound analytical thinking on a topic (National Research Council, 1997).

The objectives of this article are, first, to identify and describe therapy techniques that can help develop a classroom setting that is safe for students to express unrecognized misconceptions, and second, to explore therapy techniques that might be used to reveal and correct these misconceptions. It is intended primarily for instructors who might benefit from borrowing therapy techniques, rather than for therapists who are looking to improve their teaching. Consequently, instructors should use good judgment and discretion when applying these techniques, as therapy and teaching often have different goals. For example, instructors should be wary of labeling students too narrowly based on their perceived roles in the classroom, of involving themselves too deeply through active (intensely engaged) listening, or of overly intense probing of a student's level of understanding. Care also should be exercised to avoid mechanistic or disingenuous use of therapy techniques, or of over-reliance on stories, analogies, and hypothetical situations or questions.

Although the examples offered are from the authors' fields of geology, engineering, and general science, they can be adapted easily to other fields. Before describing how to establish the ideal classroom setting and offering useful therapy techniques, it is helpful to describe the "blind spots" or misconceptions we hope to correct.

**Reasons for Misunderstandings and Misconceptions**

Teaching involves both imparting new information and correcting misconceptions. The meaning of "misconception" is broad, but we define it as a fact, process, or model that is flawed or miscategorized and of which the holder is unaware. In the educational psychology literature, a mis-

conception is usually represented as being robust and resistant to change, often because it can still provide consistent and predictable explanations when tested (Chi & Roscoe, 2002; National Research Council, 1997). To understand better the nature and types of misconceptions, it is helpful first to explore the seven generally acknowledged reasons why students do not know or understand something.

**New Information**

College students invariably will relate a new concept to something from their own experience. For example, if I begin explaining why certain clay minerals expand when wetted, students may develop an image of a dry sponge expanding upon submersion. But when students have never heard about a concept, have no reference related to the concept, and have no preconceptions about it (see Figure 1), then the concept is difficult to convey.

**Hard-to-Understand Principles**

Hard-to-understand principles are ideas that are conceptually difficult, hard to visualize or grasp, and may require complex prerequisite knowledge (such as advanced mathematical training). For example, understanding analysis of variance or the response of soils to building loads require considerable a priori knowledge, examples, and practice with application.

**Missing Information**

Sometimes students recognize that they need more information to answer a question; that is, they are aware of what they do not know. For instance, if asked whether a water strider was an insect or a spider, a student immediately should ask how many legs it has as an aid to its classification.

**Fragmented Models**

Fragmented models are more comprehensive versions of the "missing information" problem. A fragmented model is a large collection of facts and observations, but the student recognizes that it is not complete enough to offer consistent and predictable explanations (Chi & Roscoe, 2002). For example, most college students have some basic understanding of weather, but they still may not be able to explain why El Niño cycles occur.
Preconceptions

Preconceptions are ideas or facts that have been misclassified and usually can be revised through instruction or conceptual reorganization (Chi, 2005; Chi & Roscoe, 2002; National Research Council, 1997). For example, students may initially believe that manta rays are a type of fish until shown that they are more closely related to sharks.

Misconceptions

Like preconceptions, misconceptions are a type of prior conception. But misconceptions are more resistant to change, mainly because they seem to fit available concepts and facts (Chi & Roscoe, 2002; National Research Council, 1997). For example, college students intuitively sense that sand conveys water better than clay. Therefore, they have trouble understanding that when only partly saturated, clay, via capillarity, conveys water faster and at a higher rate of flux than sand.

Flawed Coherent Models

Unlike fragmented models, flawed coherent models can provide consistent explanations that are commensurate with new facts and concepts. They are a larger scale version of “misconception” models. For instance, Chi (1997, 2005) details how students’ misunderstanding of the diffusion process stems from their categorization of diffusion as a “causal” process, assuming distinct, sequential movement that will terminate in some equilibrium, rather than as an “emergent” process, which is uniform and continuous.

The authors’ typical teaching approaches address the first four reasons for misunderstanding: new information, hard-to-understand principles, missing information, and fragmented models (Santi & Santi, 2003). In all four of these cases, students are aware of a lack of understanding or a lack of correctness of their model (see Figure 1). Because of this awareness, we do not expect them to reorganize or recategorize information. We expect that their classification framework either does not yet exist or that it has gaps that we need to fill.

The last three reasons for misunderstanding—preconceptions, misconceptions, and flawed coherent models—all require students successfully to reorganize their classification system (Chi et al., 1994; Streveler & Miller, 2001). Yet because they have misclassified the concept, they are not aware of this need for reorganization. Students’ preconceptions can be addressed and refuted directly during instruction. Misconceptions and
flawed coherent models, because they are more robust, are more difficult to help students identify and recategorize (Reiner, Slotta, Chi, & Resnick, 2000). One of the reasons these types of misunderstanding are difficult to correct is that they may be miscategorized across ontological boundaries (believing, for instance, that electricity is a substance that can be stored or leaked out, rather than a process), or that appropriate new categories do not yet exist in students' minds (in the case of diffusion, students lack a mental "bin" for emergent processes) (Chi, 2005; Chi & Roscoe, 2002).

We will explore three groups of tools to address preconceptions, misconceptions, and flawed coherent models (all referred to from here on as "misconceptions"). (The other four types of misunderstandings described above also can benefit from these techniques and methods for improving the classroom atmosphere, but they will not be specifically addressed.)

The first group of tools helps instructors develop a classroom environment where students are comfortable exploring gaps in their knowledge. The second group consists of various classroom activities and teaching techniques that help students identify and address misconceptions. The third group includes suggestions for instructional mechanics and content delivery that the instructor may use to relate more effectively to students, thereby improving communication.

The teaching tools we describe are those used in individual and group psychotherapy. Non-therapeutic approaches to meet these objectives are also available. Some examples for teaching science and engineering include concept maps (National Research Council, 1997), conceptual tests (Evans et al., 2002; National Research Council, 1997; Olds, Streveler, Miller, & Nelson, 2004; Streveler, Olds, Miller, & Nelson, 2003), small-group discussions (National Research Council, 1997), collaborative learning (Felder & Brent, 2004a; Terenzini, Cabrera, Colbeck, Parente, & Bjorklund, 2001), and materialistic models of concepts/processes coupled with careful explanation of their limitations (Reiner, Slotta, & Chi, 2000). Detailed descriptions of these approaches are beyond the scope of this article.

Creating the Proper Classroom Environment

The first step toward addressing misconceptions is to develop a classroom setting that enhances learning. Like the therapist, the instructor must create an environment where students feel supported, where question asking is safe, and where students can identify and grapple with conceptual problems of which they may be initially unaware.

Ownership of the Classroom

A group setting that is safe for testing and revising ideas must be "owned" by the participants. Their sense of ownership comes from knowledge that the instructor cares for them as individuals and as students, that their classmates are taking the learning process seriously, and that everyone brings skills and experiences that can help all involved understand the material better. In establishing such classroom ownership, the instructor is shifting the responsibility of learning from himself or herself to students and is helping students become "mini-experts" in the subject.

Experts and Mini-Experts

The role of "expert" is an important one to students (Bransford, Brown, & Cocking, 2000). The instructor, whom they view as the expert, is presumed to have factual knowledge and an experience base in a subject that students do not necessarily have. An expert is also someone who uses judgment, decision-making skills, and resourcefulness to select the best answer when faced with difficult, open-ended problems. A mini-expert, on the other hand, is someone who is confident that he or she has the background and experience to learn and apply the course material properly. Rather than being based in content knowledge, then, mini-expertise is based on confidence.

Instructors must balance their expert role by giving students confidence that they have something valuable to teach them, yet without intimidating them or allowing them to continue in the mistaken assumption that we are right all of the time. Therefore, instructors can help students become "mini-experts" in the class material by allowing them to see how we, the "experts," arrive at answers. Several techniques from the counseling field can be used to build this confidence in students, including recognizing how students' own experiences and skills have prepared them for the class and recognizing the resources available to them in other students and in the instructor.

Recognition of Experience

A therapy group might begin by having all participants introduce themselves and describe their backgrounds, family status, and experiences. This procedure begins to establish trust and will lend credibility to later interchanges (for instance, everyone will respect Jack's comments on issues with children because they know that he has four of his own). In a classroom setting, we can establish credibility in each other's back-
grounds and experiences during the first class meeting by asking, for instance, the following:

- How did you get interested in this field? (“I tinkered with every appliance my parents would let me touch”).

- Which previous classes best prepared you for this one? (“My high school chemistry class was entirely self-paced, so I learned how to teach myself”).

- What previous job or household responsibility has shaped the way you solve problems? (“I was a waiter/waitress and had to develop a good short-term memory for orders”).

Following this sort of interchange, the students can identify a particular expertise for each person, thereby recognizing the value each person brings to the “team.” In large classes, the same information can be obtained more quickly by suggesting possible answers to each question and inviting raised hands to indicate agreement. Many instructors do this sort of thing already when they ask for a show of hands to see who has already taken certain classes related to the current one. We may not recognize, however, that this information can be useful to students as well as us.

Recognition of Roles

In family therapy, it is beneficial for all family members to identify the role they typically play so that they can visualize the ideal changes they hope to achieve from therapy (Minuchin & Fishman, 1981). Who, for example, is the peacemaker? Who is the tragedy king or queen? Who is the silent dominator?

Student roles in the classroom clearly are different, but they can be established by asking a parallel set of questions. Who has work experience? Who has done research? Who is comfortable with math? Who is good at understanding new concepts? Who is organized? Who considers himself or herself people-oriented? Students may be reluctant to answer certain questions, which they may interpret as bragging, but instructors can rephrase each question in a neutral or humorous manner in order to identify some stereotypical roles:

- Who likes to play Trivial Pursuit or jeopardy (fact collector, detail-oriented, broad experience and interests)?
- Clue or Bridge (analyst)? Chess, Stratego, or Risk (organizer, strategist)?

- Who has their own toolbox or does they own car repair (mechanic, practical)?

- Who is comfortable doing fund-raising sales or debates (oral communicator)?

- Who writes poetry, short stories, or postal-delivered letters (written communicator)?

- Who doesn’t mind balancing their checkbook, doing their own taxes, or calculating their gas mileage in their head while driving (numbers person)?

- Who has taught themselves a hobby that required reading a book to do so (understands new concepts)?

- Who has taught swim lessons, merit badges, or day camp (teacher, simplifier, and repackager of concepts)?

- Who lines up their socks in the drawer or has finished a term paper a day early (organizer)?

- Who considers himself or herself an excellent shopper (including food, so that no one will feel stereotyped) (attention to detail, patience, judgment)?

Several of these questions can be posed to students within a few minutes and the potential roles of the responders discussed. The goal of these questions is not so much to show students whom to turn to when they have a specific type of problem, but to help them recognize that, as the co-owners of the class, they have substantial expertise and experience among themselves. Furthermore, each of them has something of importance to bring to the table.

Recognition of the Instructor as a Resource

The instructor’s expertise is a resource for learning that students usually recognize. They may not, however, initially recognize the instructor as an advocate for their learning. In the counseling setting, this is referred to as the “therapeutic bond,” or the trust that the client has for the therapist as his or her advocate and champion. The therapeutic bond has been identified by some as the most important component for successful work in therapy (Beutler, Bongar, & Shurkin, 1998; Yalom, 1985). In the classroom,
this bond takes the form of the rapport an instructor has with the students. Felder and Brent (2004b) include “a sense of caring about students” (p. 287) as one of the critical instructional conditions that promote intellectual growth. How students view instructors in terms of our rapport and caring can be conveyed through some diagnostic questions we may ask ourselves as instructors: Do students feel that I value their learning more than adhering to the lecture schedule? Am I willing to change an exam date or assignment due date if several students have a significant conflict? Do I request and implement students’ feedback on the effectiveness of assignments, labs, readings, lectures and lecture style, and in-class exercises? Am I accessible outside of class and approachable at all times? The goal of striving toward positive answers to these questions is not to allow students to manipulate the class for their own benefit. Rather, if students sense that their learning is important to the instructor, they will assume ownership of the class, setting the stage for a more profound learning experience.

**Safety for Risk-Taking**

Integral to students’ ownership of the classroom environment is cultivating a feeling that it is a safe place to confront feelings of ignorance, inadequacy, and fear of a subject. Instructors play a powerful role in establishing the “safety” of the classroom, a role requiring many of the same behaviors that a therapist needs in order to create a safe group therapy setting. First, we must demonstrate respect by showing a sincere interest in group members’ development (Benjamin, 1987). We must be willing to exclude outside interferences from our classes: We should show up for class early, linger afterwards, and shut the door during class time to protect the learning space.

The idea of sincerity and genuineness also extends to how we represent ourselves to students. Benjamin (1987) urges that revealing our humanness is critical. We should be willing to cast aside any “professional equipment that creates barriers between our [students] and ourselves” (p. 100), such as over-reliance on our expertise, our power as grade-givers, and our desire to provide answers to every question students ask. We must not attempt to be model teachers, but instead be open and spontaneous. The way we dress may be part of this image: A certain level of informality can balance both respect and warmth. Benjamin (1987) suggests that we should not be afraid to reveal ourselves, because that is what we expect our students to do.

One way to create a barrier between instructors and students is the use of our authority as a defense. We consciously or unconsciously maintain the role of instructor-as-expert and student-as-novice by leaning on the authority imparted by our age, knowledge, and role as grade-givers. Students may hold the opinion that “teachers are never wrong” or that “adults have more experience” (Benjamin, 1987, p. 168). To counter these notions, we should establish an atmosphere “in which a sense of equality prevails—not in knowledge, experience, or professional skill, but in worth and dignity” (Benjamin, 1987, p. 169). This atmosphere is created when we offer examples from our experience of times we were wrong. Such examples show students that learning and development of mature judgment are continuing processes requiring repeated analysis. This approach is supported by early research in intellectual development (Perry, 1970), and confirmed and expanded by more recent work (Felder & Brent, 2004a) that describes intellectual development as a progression from blind acceptance of “absolute truth” to an understanding that all truth is contingent and contextual.

Instructors’ manner of asking questions is key to creating a safe environment. One technique is to make ourselves the vulnerable party in the question by playing the novice: “Let’s say I don’t understand this . . . someone explain it to me.” Having the students answer questions in groups of three or four (“Turn to two people around you and answer this question in the next 60 seconds”) gives students a protective level of anonymity and shared responsibility when they volunteer an answer, with the added benefit that they get to interact with their peers as mini-experts. Finally, if we value participation as more important than correctness, we can respond to incorrect answers in a way that does not embarrass students. One of the best talents instructors can develop, from the standpoint of encouraging thinking and active participation in class, is the ability to validate students by drawing something positive out of an incorrect answer while engaging them to work toward a correct answer. For instance, we might respond, “You have recognized that equilibrium is the final goal; now, what is another way to get there?” “Your approach is valid for steady-state conditions; how would you solve this for unsteady-state?” or “OK, that is part of the answer; now I want you to think bigger.” This is easier to do if we ask open-ended questions rather than yes-no or multiple-choice questions, and if we ask questions that require “it depends” as part of the answer. These types of questions also lead to the important learning question: “Why?” (Hyman, 1979).

The way we listen to students can be just as important as the way we talk to them. Active listening on the part of the instructor demonstrates sincere concern for students and reinforces the positive environment of
the classroom. Active listening is conveyed when the instructor makes eye contact, leans forward, and uses tracking words like “yes,” “uh-huh,” or “go on.” The instructor as active listener frequently reflects or reframes the question asked (reflection and reframing are described in more detail later). Finally, the active listener validates the speaker by allowing him or her to finish and by responding to the question asked rather than posing or answering a different one (Benjamin, 1987). In more extended interactions outside the classroom, active listening provides the instructor with cues to help him or her better teach that student. These cues do not come from the content of students’ questions, but from our impressions of the types of questions and the types of information they seek. Cues that we might look for include the following (modified from Benjamin, 1987):

- how students perceive themselves and their peers,
- how students think their peers perceive them,
- how students perceive the course materials, and
- what defense and coping mechanisms students employ.

Part of creating a safe environment in therapy is instilling hope in the therapy process. An analogy from medicine is the documented efficacy of placebo treatment, which is based entirely on hope and conviction (Yalom, 1985). Patients who have undergone therapy remark that it was important to observe the improvement of other patients. Research on therapy substantiates that it is vital that therapists also believe in their abilities and in the effectiveness of the group therapy process (Yalom, 1985). In a classroom, students also need to observe success: They should be aware that students are achieving good test grades, that the instructor recognizes their progress with the material, and that they can make informed analysis and decisions. Hope is also instilled when students see others who reveal and take risks by asking questions, confronting an error in the instructor’s lecture, and so forth being treated with respect and dignity.

Similar to instilling hope is the concept of “universalism” or “normalizing the problem”: helping individual students see that they are not the only ones who feel inadequate or incapable. Common sayings illustrating universality abound: “Misery loves company,” “We’re all in the same boat,” “Welcome to the human race” (Yalom, 1985, p. 8). Establishing universality between students reduces social isolation and improves the ability of a group to move forward. This can be done with non-threatening comments, such as, “Who remembers all their calculus?” or “Well, nobody got homework problem 7 completely right, so I have thought of another way to teach you the concept.” When a student asks a question, the instructor can immediately establish universality by commenting, “I know that you are not the only one with a question. Thanks for asking.” The instructor can also become part of the universality: “I remember having a terrible time with this concept” or “I thought I understood this until I got to the test.”

In order to improve the learning environment, students need to be given better tools to learn. The concept of “imparting information” in therapy is that in addition to the implicit education clients take away from the therapy process, they may need didactic information on specific topics (Yalom, 1985). In the classroom, this may include teaching students study habits, note-taking skills, and deductive and reasoning skills. It may require the instructor to predict and deal with students’ anxieties and fears by providing example tests or holding review sessions.

Identifying and Addressing Misconceptions Through In-Class Learning Activities

Once instructors have established the proper environment for deep, vulnerable exploration of students’ understanding of the course material, they are prepared to identify and rectify their misunderstandings. While certainly not comprehensive, the psychotherapy techniques outlined below can help instructors understand students’ thinking processes and, thereby, better understand how they develop misunderstandings.

Storytelling

In the therapy setting, stories, metaphors, and analogies can be used to help clients see an issue clearly. For example, if a client lacks confidence in his or her ability to overcome obstacles, the therapist could recommend watching a movie demonstrating a triumph of the human spirit. The storytelling technique is familiar to most people, and indeed is even used with great effect in classic literature. Two examples include the book of II Samuel in the Bible, in which the prophet Samuel tells a story to reveal to King David his own sin in killing Uriah and taking Bathsheba as his own wife; and in Shakespeare’s Hamlet, in which the prince stages a play reenacting Claudius’s murder of the King in an effort to get Claudius to confess.

In the classroom, stories and analogies can be used to give students a fresh viewpoint on a concept or process as well as provide them with
practice using new models of understanding. A story or analogy can help students process the missing information necessary to recategorize their misconceptions (Chi & Roscoe, 2002), and it can help them identify how their current model is flawed. For example, an effective analogy for teaching ground-water flow, diffusion, and retardation is the classic chocolate factory episode from the I Love Lucy show. Showing the clip of the scene in which Lucy is frantically removing, eating, and passing back chocolates on the conveyor belt leads students through the tricky concept that the velocity of contaminant flow (the chocolates) is the same as the velocity of ground water (the belt), even though it takes longer for any of the chocolates to reach the end of the line (because Lucy is causing retardation and diffusion). Likewise, stories from the instructor’s industry experience, or case histories illustrating certain points, allow students to visualize themselves as professionals unraveling a problem—reinforcing their role as mini-experts—and to step outside their flawed models to identify areas in need of correction.

The Empty Chair

A strong tool for breakthroughs in counseling is the use of an empty chair to represent someone in the client’s life who is not physically present. On occasion, the therapist may suggest that the client “tell grandma (pointing to the chair) what you would say to her about ignoring grandpa’s drinking.” In teaching, instructors can use the empty chair concept to bring an expert, a pessimist, or a client into the room: “How might Thomas Edison (or MacGyver) approach this problem?” or “What would the opposing lawyer have to say about this theory?” or “Would Microsoft incorporate such a feature?”

Circular Questioning

Circular questioning is a technique used to shift the emphasis away from the need to be correct and to help a client view a problem from another angle. In a family group, for example, the therapist might ask each member, “Where do you see Bob’s problem with anger coming from?” and then ask Bob what he thinks of the family’s answers. In the classroom, the instructor should play the foil by describing the misconceived model as if it were his or her own and asking students or groups to suggest, “Where do you see the weakness in my model?” or “Think of an exception to my theory.”

Role Playing/Enactment

This technique is used in family therapy so that the therapist can see the family “dance.” The therapist constructs an interpersonal scenario in which dysfunctional transactions among family members are played out. The therapist can intervene to make necessary changes during the enactment (Minuchin & Fishman, 1981). A variation of this technique is “sculpting,” where the therapist positions each person in a manner reflecting his or her relationship to the others (crouching with face hidden, towering, in a fighting stance, turned away) (Sattir & Baldwin, 1983).

Role playing is a powerful classroom tool for students to experience the balance between advocacy of a view and professional judgment, to improve their ability to communicate, and to probe the subtleties of a model or theory. Examples of this application include the following:

- Santi (2000) gives detailed examples of role playing for a class project evaluating ground-water contamination at a site. The roles enacted included engineering consultant, nearby resident, and oversight agencies. Each group was given a list of theories to advocate for their roles during a “public meeting.” Afterwards, students dropped their advocacy roles and discussed their perceptions of the outcome of the meeting.

- As a short in-class exercise, students can be split into groups and asked to defend one of several theories describing a situation or observation. After a few minutes of instructor-facilitated debate, groups should be directed to switch their advocacy to another of the theories.

- The technique of sculpting may be used to address the diffusion misconception identified in Chi and Roscoe (2002): Men and women are placed on opposite sides of the room (one group represents coffee and the other cream). Upon direction, both groups move toward the center of the room and continue moving randomly. Students will develop an indelible image of diffusion as a continuous process rather than one that terminates upon mixing (a common misconception) and that both elements experience, instead of only the cream (another misconception).
Role playing or enactment allows the instructor to see how students identify a problem and think through a solution. Some spontaneous transactions give insight into how students function together and how their group work can be improved.

**Miracle Questions**

Under the solution-focused therapy style, clients develop a concrete vision of what they expect to accomplish through therapy (Green, Lee, Mentzer, Pinnell, & Niles, 1998). One way the therapist helps clients accomplish this is to have them picture the answer to a question, such as, “Suppose one night, while you were asleep, there was a miracle and this problem was solved. How would you know? What would be different?”

Instructors can use this same technique to check students’ understanding of processes and models, through questions such as, “If you had to create a machine to imitate this process, what would it have to do?” or “Describe the characteristics (gravity, atmosphere, temperature, etc.) of a mythical planet where this process would be optimized,” or “If you could suspend the law of [gravity, surface tension, friction, thermodynamics], what effect would it have on your model?” As part of a quiz, the instructor might have students write the answer to the question, “If I left the room and you could ask each other any question, what would it be?” Likewise, misconceptions can be identified and addressed during a quiz by letting students compare answers after a few minutes of work (they should not know ahead of time that this will be an option).

**Paradox**

This broad category comprises a group of techniques that includes what is casually referred to as “reverse psychology.” Three common aspects of paradox include

- **redefining** the problem in order to change the family’s perception of it (anger is redefined as caring, suffering is redefined as self-sacrifice, and so on);

- **prescribing** the cycle of interactions as an inevitable conclusion of the family’s own logic. When the cycle is consciously enacted, it loses its power to produce the symptom; and

- **restraining** the family from changing from this position (which will cause members to press for change).

These techniques help the therapist to regulate the pace of change, predict the consequences of change, and anticipate new difficulties (Minuchin & Fishman, 1981). In the classroom, they must be used carefully and respectfully to avoid offending students. In general, paradox involves the use of hyperbole or absurdity, such as extreme changes in scale or intensity. For instance, suppose the instructor suspects that several students are stuck in the misconception that electricity has properties of a substance and can be stored or leaked (Chi & Roscoe, 2002). He or she can help students recognize the flaws in this model by “prescribing” the problem: For example, “If a battery does not work as well in the cold, why does supercooling improve current flow and minimize resistance?” or “If you had the perfect battery housing, would the battery still work in 50 years?” The “restraining” technique will look a little different. In this case, the instructor might give students a model and tell them that they can use that model only to explain specific aspects of the system. Restraining might include requiring students to solve derivatives using long methods before demonstrating the shortcuts.

**Reflecting and Reframing**

Reflecting is repeating what someone has said to verify that the listener heard correctly. Reframing is more involved, consisting of restating what you heard using different words and stating the hidden emotions. Reflecting verifies facts, whereas reframing verifies understanding. In therapy, reflective comments might be, “You had an argument” or “He made you late for the dinner.” Reframing comments might be, “The argument upset you, so you felt you needed to leave” or “He treated you like your schedule was not important.”

Instructors can ask for reflecting and reframing from their students. Reflective questions or exercises might include writing a one-minute paper extracting the most important concept of the lecture (Felder, 1992) or creating a study sheet for an exam. Reframing exercises might include asking students to reframe a concept verbally or in writing, to draw a flowchart to portray a topic visually, to work in pairs to explain a concept to each other (Lochhead & Whimbey, 1987), or to write a multiple-choice question in which they include a potential misunderstanding in each of the incorrect answers.
The surprise technique is not intended to unnerve clients, but to create a radically different point of view that may help them see what they cannot see currently. Likewise, surprise can be used to move students out of complacency, to give them the motivation to look for flaws in their models, and to help them recognize the importance and potential applications of what they are learning. The pop quiz is an excellent example of use of the surprise technique. Other strategies include asking students questions that require on-the-spot thinking. For example:

- “If I were giving a test in five minutes, what questions would you ask me now to prepare for it?”
- “If I dropped you in the Middle Ages without your textbook, what, of importance, could you teach the people?” or
- “In five minutes, the department head is coming in to fire me unless you can explain this theory to his or her satisfaction. Where is your understanding weak?”

Developing Effective Instructional Mechanics

The instructor’s attitude and the mechanics of his or her content delivery also affect students’ willingness to explore the soundness of their conceptual models. These factors include the way the instructor asks questions, waits for answers, and reveals his or her thought process when working toward an answer.

Using Imitative Behaviors

Imitative behavior is not so much a technique as a realization that clients (or students) exhibit such a behavior and that it can be used to teach. As noted by Yalom (1985), “[P]ipe-smoking therapists often beget pipe-smoking patients. Patients . . . may talk, and even think like therapists . . . or . . . other group members” (p. 17). It has been experimentally demonstrated that imitation is an effective therapeutic force (Yalom, 1985).

In the classroom, we want students to imitate the problem-solving approaches modeled by us and by their high-achieving peers, as this is an important part of their intellectual development (Felder & Brent, 2004a). They need to see the correct approach modeled and have confirmed for them that it is indeed correct. A simple example is to lead students through solving a problem in small pieces, calling on more advanced students to explain how they would set up each piece to be solved. Instructors need to recognize that this is the goal of working example problems: that students see our thought process as we work toward a solution, not just the sequence of steps. Such an approach stimulates and improves students’ intellectual development (Felder & Brent, 2004b).

In the first author’s discipline of geology, field interpretation and mapping of rock units relies heavily on developing multiple hypotheses to explain the occurrence of various rock types at a location, then eliminating invalid hypotheses through field observations. Students develop this difficult skill during a summer field session by working closely with a professor in the field, observing and then imitating his or her methods. Instructors for field sessions learn that they must “think out loud” from the beginning of the course, verbalizing possibilities they know will later turn out to be dead ends, so that students can then imitate the same mental processes.

Asking Questions

Instructors are accustomed to asking questions of students. We are also used to answering our own questions. Both are used for questioning our own questions. Both presuppose that the instructor is the expert, has all the answers, and “owns” the classroom. One effective way to challenge this paradigm is to turn questions back to students. If one student asks, “How do you know to apply theory A or B?” the instructor can simply turn to the class and say, “Can someone answer this?” This technique confirms that students are capable of independent thought and can be taken seriously, it gives them ownership of the classroom ideas, and their answers to other model the thinking process for imitation. Turning a question back to the class also can engage other students in participation when one student seems to ask all of the questions.

When dealing with students’ questions, one of the most important answers instructors can give is “I don’t know.” This shows that we are human and limited to the same resources and analytical tools for arriving at an answer as students. An important advance in students’ intellectual development is when they recognize that they can develop similar judgment tools as their instructors (Felder & Brent, 2004a). And although it should be done in a manner that does not suggest disapproval, one of the most important questions we can ask is “Why?” For example, we can ask, “Why does this happen?” rather than “Why did you use that answer?”
Productive Use of Silence

Students' silence following questions can be uncomfortable, and instructors usually respond by answering their own questions. Sometimes, however, it can be productive to let the silence linger a bit longer in order to try and discover the meaning behind it. In therapy, Benjamin (1987) identifies six possible reasons for silence from clients (which can also apply to students) and suggests using one's intuition to identify the particular reason and then respond appropriately:

1. the desire to listen rather than to speak;
2. evasion and escape;
3. resistance, hostility, aggression (to probing);
4. a lack of interest or boredom;
5. confusion, lack of direction, or lost bearings; and
6. deep concentration.

In the classroom setting, reason 1 is the mode students usually are in when they have been listening to the instructor and are suddenly asked a question. They need time to move voluntarily to another mode. Reasons 2 and 3 may be defense or coping mechanisms and should be treated cautiously, in order to maintain students' dignity. Reason 4 is problematic and can be addressed in terms of what the instructor perceives students to need: providing mental breaks in a long lecture, demonstrating application and importance of course material, and using techniques like storytelling to vary the delivery of information. Reason 5 can be tackled by reverting to more basic questions or asking leading questions that provide direction. Reason 6, like reason 1, means that students need more time to process information before they are ready to answer.

Removing Obstacles to Communication

Open, clear communication is an obvious requirement for being able to interact with students at a level where misconceptions can be identified. Benjamin (1987) notes that obstacles to communication in therapy take common forms: talking too much or too little (the therapist monopolizes the conversation or does not provide enough feedback), cutting off (not enough time is provided to fully expand a thought), and improper responses (the therapist answers a different question from the one asked or does not give a clear response). These same obstacles are present in the classroom. Instructors must be willing to let students hold the floor, and we should respond to the questions asked, recognizing that the ensuing discussions may lead to deeper understanding than would using those minutes to cover more material.

Removing Instructor Resistance

Instructors themselves may resist some of the very elements of student interaction that students need most. Once again, parallels can be drawn to the role of the therapist (the following examples are from Benjamin, 1987). For instance, the therapist might too easily accept family resistances to change or give up too soon. Likewise, an instructor might answer a question too soon, give too few opportunities for students to develop understanding on their own, or be too quick to show students how to do something rather than letting them learn how to teach themselves.

A therapist or instructor may resist revealing his or her lack of experience or fear of ignorance. As noted previously, there are numerous benefits to being vulnerable: Students recognize our humanness and believe that it is possible for them to achieve the same abilities that we display, they can observe and imitate our decision-making process, and they become honest and vulnerable with us, so that we might better identify and work them through their misconceptions.

Instructors can be resistant in their attitudes as well. Benjamin (1987) describes the "true believer" approach towards one concept: "Finite element modeling is the only way to really understand what is going on," or "You must use the outline I give you to prepare a successful report," or "Even though they do not recognize it in industry, the modified Bishop method is the best slope stability calculation and the only one we will use." While we should certainly use our best judgment and experiences to help students sort through their options, we need to convey to them that this is still our professional opinion. Likewise, we must make room for a variety of learning styles in the classroom, some of which may not fit into the path to classroom success that we envision.

Feedback From Students

The authors have used these techniques in numerous therapy groups and classes over several years. Verbal feedback from two recent classes
in which these techniques were implemented (with 13 students in 2004 and eight students in 2005) provides helpful input for their effective execution.

Creating the Proper Classroom Environment

Students suggested that when recognizing their experience and roles to help establish classroom ownership, the instructor's list of questions should be broad enough that all students can respond affirmatively to at least one of them. Otherwise, students feel inadequate—which is the exact opposite of the feeling we are attempting to develop. Other aspects of creating the proper classroom environment and developing effective instructional mechanics (see Table 1) were seen as being far enough in the background of the class operation that students could not specifically identify their effects.

Identifying and Addressing Misconceptions Through In-Class Learning Activities

Regarding the use of storytelling, students noted that they listened to stories very intently because the stories brought what they were learning into the real world. But they added that the stories must be carefully chosen to be effective and that repetition or the use of too many stories was tedious. Perhaps not surprisingly, students found failure stories more difficult to listen to and less effective than success stories.

Students found the empty chair technique most effective when the instructor actually sat in the chair to play the role. They saw value in being forced to justify their answers and explanations when this technique was employed.

The value of the circular questions, in students' eyes, was that they provided a memorable experience to guide future thinking on a concept. One student suggested, and others agreed, that understanding is greatly deepened when the professor insinuates that a student's answer may be wrong (even though it is actually right), thereby requiring the student to justify the response. Such a technique should be done with care, however, to avoid isolating the student or creating a hostile or adversarial environment.

Role playing was one of the most-favored techniques. Students admitted that it changed their mindset and that it helped to hear the justifications of other students' points of view. They particularly liked exercises that involved solving a problem in a single class period, because this "hyper-
focus” intensified their concentration and the resulting learning. Students noted that receiving feedback at the end of a role-playing exercise was important. Especially helpful was when the instructor walked through what he or she would do in the situation (or what was actually done, if the case was taken from industry).

Students felt that miracle questions could be confusing or obscure if not plausible or realistic. Yet they agreed that this technique provided a deeper understanding of the basic elements of a topic.

Reflecting and reframing, in the students’ opinion, were valuable assignments. Students thought that constructing a decision tree for a complex set of concepts was an effective way to clarify their thinking. They suggested that one-minute papers be assigned every two weeks, and reviewed regularly.

The paradox and surprise techniques were received favorably but did not elicit any notable feedback.

**Summary**

The goals of family or group therapy sessions are strikingly similar to the goals of the classroom, especially when highly effective teaching methods are designed to identify and root out misconceptions in understanding. In both cases, blind spots, or misconceived views or misunderstandings, must be recognized and corrected. Because of these similarities, techniques developed for group therapy may be applied in the classroom to create an environment that is safe for risk taking and exposure of misconceptions, and that adequately addresses misguided models (see Table 1 for a summary of potential applications). Some of these techniques, such as circular questioning, reflecting, and storytelling, are commonly used by many instructors already. Others, such as recognition of experience and roles, reframing, surprise, imitative behaviors, asking questions, and productive use of silence may be used, but perhaps without recognition of the degree of impact they can have. Still others, such as miracle questions, role playing, the empty chair, and paradox, may be entirely new to many instructions. Furthermore, these techniques easily can be incorporated into classes in a manner that breaks up a lecture into smaller segments, addresses a variety of learning styles, and provides for a deeper and more memorable learning experience for students.

The authors plan future work to validate and identify the ideal situations for the application of each of these techniques.

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**Table 1: Potential Applications of Therapy Techniques in the Classroom Setting**

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<th>Technique</th>
<th>Developing Effective Instructional Mechanics</th>
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<td>Asking Questions</td>
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<td>Productive Use of Silence</td>
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<td>Removing Obstacles to Communication</td>
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<td>Removing Resistance</td>
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References


What a Difference a Day Makes: The First Day of Class

Colleen S. Kennedy
Joel D. Schwartz
R. Heather Macdonald
The College of William and Mary

The authors suggest that instructors devote the first day of class to teaching course content in a manner that models how they want students to engage that content. A survey of 86 faculty teaching content-based first-year seminars indicates that faculty who involve the students in some activity—discussion, writing, presentations—on the first day are more likely to use that activity frequently throughout the term and to be better satisfied with the quality of that activity at the end of the term. Examples given by faculty in the survey illustrate the variety of ways that instructors can use the first day of class effectively.

Introduction

It’s the first day of the fall semester, and on college campuses across the country, instructors are earnestly explaining course requirements to their new students—students who are at once curious about the course and sleep-deprived, who nervously eye the syllabus and furtively check the time, hoping for an early end to the session. The instructors, in their turn, wonder how much they will have to repeat to students who will add late or who simply slept late. They wonder, in short, how soon the course will actually get started. This scenario is common enough. Many students and instructors expect that the real coursework won’t start before the second class. It’s no surprise, then, that some students don’t attend class the first day—and that some faculty send teaching assistants or department secretaries to hand out course materials.