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On Teaching Adaptively

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New theory on adaptive teaching reflects the social dynamics of classrooms to explain what practicing teachers do to address student differences related to learning. In teaching adaptively, teachers respond to learners as they work. Teachers read student signals to diagnose needs on the fly and tap previous experience with similar learners to respond productively. Adaptive teachers use their experience to form flexible groups for learning. Teaching adaptively is intellectual as well as technical, requiring quick response to learner variation. Adaptive teachers create a symbolic area at the center of the teaching ground, a space for easiest teaching. Adaptive teachers aim to keep the most number of students within that center to capitalize on skills across the class, challenge students to share experiences, and develop aptitude. Future work should capture the adaptive strategies of practitioners that illustrate the general principles described to create constituent elements of microadaptive teaching practice.

A few years ago, I attended a lecture that Robert Sternberg gave to parents as the new Dean of Arts and Sciences at Tufts University; our son was an incoming freshman. One of his slides said something to the effect of “Every student can succeed when taught in a way that builds on strengths and compensates for weaknesses.” I thought to myself that Sternberg was telling a lay audience that good teachers capitalize on the capabilities and styles of their students, adjusting teaching for different conditions; he was talking about *adaptive teaching*.

Now, I have done some writing on the topic of adaptive teaching (e.g., Corno, 1995; Corno & Snow, 1986). This work has been little referenced by researchers and is even less likely to have crossed the desks of practicing teachers. But when I heard Sternberg’s talk, I thought maybe it is time to pull together modern ideas on adaptive teaching. There is new work on a number of topics, both directly and indirectly about adaptive teaching—ranging from Sternberg’s and Gardner’s instruction for different “forms of intelligence” (Gardner, 1983; Grigorenko, Jarvin, & Sternberg, 2002), to “responsive teaching” (Gay, 2000; Villegas & Lucas, 2002), to teaching for sociolinguistic diversity (Gonzalez, Moll, & Amanti, 2005; Williams, 1994), to the embedded assessments of computer-based, adaptive instructional systems (Bennett & Davis, 2001; Chang, Sung, & Chen, 2001).

It struck me that day that framing the concept of adaptive teaching in a manner that might appeal to practitioners was

not the only agenda item, though. If teachers need to know about theories of adaptive teaching, then researchers need to know more about the actual practice of adaptive teaching. Researchers need a better understanding of what practicing teachers *do* to address student individual differences successfully and less so when they teach. In this article, I discuss both of these topics, as well as offer some new direction for theory.

SOME ORIGINS AND GOALS

The idea that the success of education depends on adapting teaching to learner differences is an ancient one. Snow (1982) found references from Chinese, Hebrew, and Roman texts, written as far back as the 1st century BC. Snow liked to quote Quintilian, who wrote this passage in the 5th century BC:

Some students are slack and need to be encouraged; others work better when given a freer rein. Some respond best when there is some threat or fear; others are paralyzed by it. Some apply themselves to the task over time, and learn best; others learn best by concentration and focus in a single burst of energy. (Quintilian, trans. 1921)

Quintilian also commented on how teachers reach students at different levels of education and with different learning styles. Long before Bandura (1977) elaborated his theory of social learning, the Roman orator, Quintilian, recognized that being educated in a collective social environment like school enabled learning from the experiences of others as well as

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one's own. Quintilian's version of adaptive teaching is remarkably similar to Vygotsky's (1978) *zone of proximal development*; Quintilian describes the opportunity for guidance from a mentor as a climb—the student climbs one branch at a time (capitalizing on strengths), just a little farther than he or she could climb alone (compensating for weaknesses).

Unlike in ancient times, contemporary teachers rarely have the luxury of limiting class size and cannot realistically adopt Quintilian's methods in classrooms today. Yet our modern society expects instruction to reach all students across a broad range of special needs, talents, linguistic backgrounds, and sociocultural conditions. These include a daunting list of qualities such as developmental level, cognitive/intellectual ability, gender, race, cultural background, and more recently socioemotional aspects of personality. Despite the difficulty, however, some practicing teachers have found ways to address students as individuals, even though their work takes place in a social context. They have discovered efficient practices that successfully accommodate individuals within classrooms.

Extant theory defines *accommodation* as a twofold process of capitalizing on strengths while circumventing or compensating for weaknesses. To accommodate, for example, culturally and linguistically diverse students within the conventional classroom, the teacher has to provide for subgroups of students with academic talents while making plans for individuals with special language needs. The teacher supplements traditional whole-group instruction with so-called differentiation practices.

Differentiating, in this sense, is simply the idea of tailoring instruction (Clay, 1998; Tomlinson, 2003). By using various strategies for individualizing, for creative grouping, or for challenging students, teachers begin to accommodate the needs of a range of learners. Differentiating for today's broad range of student differences can be viewed a couple of ways.

On one hand, a goal of differentiation is to surmount obstacles to getting the most from classroom learning—trying to overcome or *circumvent weaknesses*. On the other hand, differentiation is an opportunity for enrichment, a chance for all students in a classroom to progress toward common curricular goals. This is the *capitalizing on strengths* side of accommodation.

Beyond what we have learned from research, the literature describing methods for accommodating learner differences has yet to contribute the sort of dynamic theory that appeals to educational psychologists today. Today, we look for nuanced explanatory theory—for example, of how the accommodation process takes place, how it changes over time, and how it can be used to help teachers meet their goals. I offer steps toward some more sophisticated theory of adaptation in teaching based on results from studies in which my colleague, Judi Randi, and I are taking a firsthand look at teaching in relation to student differences that influence classroom learning. Our intent is to identify techniques that

some practicing teachers use to reach and teach *all* students in their classrooms. We hope to better understand how these teachers teach “individuals *within* classrooms” (as opposed to “teaching classes”), so other teachers looking to be adaptive may use them as models. This new theory needs to be placed in context, however, with a recap of earlier theory on adaptive instruction.

Early Theory on Adaptive Teaching

In the late 1970s, two former presidents of American Psychological Association's (APA's) Division 15, Robert Glaser (1977) and Richard Snow (1980), each proposed systematic adaptive instruction as a solution to the dilemma of teaching individuals within groups. They defined adaptive instruction as a means for addressing the learning needs of individuals in pursuit of common as well as individual goals.

In this era, theorists called for experiments addressing combinations and sequences of instructional events that could be expected to mediate relationships between student aptitudes and outcomes. Their focus on instructional design skirted the issues faced by practicing classroom teachers, although Glaser and Snow recognized that student individual differences challenge classroom educators who must teach to students as a group. Their conceptions only hinted, however, at today's theory aimed at practitioners who value a diversity of talent in the collective, urging them to embrace and nurture student differences. Still, this earlier theory suggested that teachers should adapt instruction to individuals, while placing equal emphasis on guiding students to adapt *themselves* to whatever instruction they receive.

Adaptive theory describes a cycle connecting adaptive instruction and instruction designed to teach students strategies for independent or *self-regulated learning* (Corno, 2001). Initially, the teacher meets curricular goals by adapting instruction to students, but ultimately the teaching goal is for students to learn to adapt whatever instruction they are given for themselves. This cycle of adapting, teaching, and self-adapting over the course of ongoing activities is considered critical for the long-term development of academic aptitude. I use the term *aptitude* in Snow's (1992, 1997) sense, a readiness to perform in the various academic situations that students confront. Like contemporary theories of personality, modern aptitude theory recognizes that aptitude changes with circumstances and develops in the situation; it is not something innate to the person (Stanford Aptitude Seminar, 2002).

Education is fundamentally a program of academic aptitude development (Snow, 1996). Education provides more situations for learning than otherwise occur with unplanned experiences. So if teachers pay no attention to aptitude development in classrooms, then students remain dependent on teachers for knowledge building throughout schooling. Inattention to aptitude development does not help students learn how to learn from classroom teaching or how to fill

the gaps in incomplete instruction. It does not teach them how to negotiate the demands of schooling. Yet learning to learn and negotiate are life skills that students should acquire (Diamond, Barnett, Thomas, & Munro, 2007). When students can adapt to whatever instructional conditions they receive, ultimately they become skillful and productive learners capable of learning on their own.

Now, the reading audience for this journal is well acquainted with research that emphasizes strategies for successful classroom learning. Members of APA's division of Educational Psychology have built careers studying self-regulated learning (e.g., Pintrich, 2000; Zimmerman, 2000). Today educational psychologists are creating new ways to assess how students adapt their thoughts, feelings, and actions to support their learning and motivation. They are enhancing theoretical models of self-regulation; of course, educational psychologists know these models assume that differences in biological and developmental factors, as well as peer and instructional contexts, may interfere with as well as support efforts by students to self-regulate in classrooms. But do educational psychologists typically think of self-regulation as the natural outgrowth—the goal or endpoint—of successful adaptive teaching?

Extant adaptive theory makes a second distinction between adaptation at “macro” and “micro” levels. “Macro” adaptation refers to programs planned for groups of similar students based on formal assessments of qualities such as intellectual ability (as in “gifted” education) (e.g., Sapon-Shevin, 1994), or sociocultural background (e.g., Au & Blake, 2003)—another factor that influences response to instruction (as in teaching for cultural congruence; e.g., Ladson-Billings, 1995). Also known as homogeneous or “leveled” grouping, macroadaptations can be made district- or schoolwide and directed at target subject areas (such as math or foreign language; see Gamoran, 1993; Schoenfeld, 2002).

Educators recognize that planning instruction for similar students has practical advantages; it is an efficient way to match instruction to learner needs. However, the practice creates problems. Ability grouping or tracking has been discredited by research such as that of Oakes (1985), whose studies show that ability groups and tracking can promote social and economic inequities. This research also illustrates damage that can be done to motivation or self-confidence when students are placed into tracks they cannot later exit (Eder, 1981). Finally, there is evidence that some teachers treat higher skilled groups to more meaningful tasks (Filby, Barnett, & Bossert, 1982; Weinstein, 1996).

An alternative to tracking is “dynamic” or flexible homogeneous grouping, guided by ongoing assessment of student needs. Temporary within-class grouping is seen as a way to address individual needs without the harmful effects associated with tracking or leveling (Pettig, 2000). I have more to say about this later on; for now I note simply that frequent formal assessment is a mainstay of flexible grouping

as researchers promote it, and this intrudes on class time and teacher curriculum making. Moreover, the teacher who targets several groups of students within a classroom then has to manage them simultaneously, which makes teaching inherently more difficult.

In general, field experiments with tailored or macroadaptive programs show particularly strong growth for targeted populations; for example, the work of Au (1980) on culturally based reading in Hawaii, and Lubinsky and Benbow's (2000, 2006) longitudinal studies of the effects of acceleration on students who excel mathematically. Whether the adaptation is culturally responsive teaching or teaching self-regulation strategies to highly motivated students with learning disabilities (Butler, 1995), teaching matched specifically to the strengths of students with common needs can produce strong and important improvements in educational outcomes. This was a major conclusion of Cronbach and Snow (1977) in their extensive review of aptitude-treatment interaction research, published now 30 years ago. The underlying explanation is that the teaching variations involved place demands on particular learning processes coordinated with measured outcomes. Effects such as these may explain some of the reasons why individual differences matter to teachers, as well as how they respond to them, especially in contemporary classrooms.

Apart from work by cognitive scientists in computer-mediated learning (e.g., Lajoie & Derry, 1993; Winne, 1992), there has been far less inquiry into the second avenue for adaptation described by extant theory—*microadaptation*. Practicing teachers, however, make microadaptations all the time—in the ongoing course of instruction and in response to particular students. They interpret the to and fro of classroom life, and intercede. In fact, with respect to classroom teaching, the term *microadaptation* might be defined as continually assessing and learning as one teaches—thought and action intertwined. Microadaptations are critically important for the nuanced line of theory we care about today. They represent a *direct response* by the teacher to individual learners and are deeply psychological because they play out in the provocative space between teaching and learning where anxieties, fears, and other concerns arise.

The conventional theory posits a continuum of microadaptation along two paths: *circumventing weaknesses* and *aptitude development*. Support moves back and forth from high to low, as learners change in capabilities (see Figure 1).

Figure 2 shows how the two paths converge to meet learners where they are, and move them toward independence. Along the first path, labeled *aptitude circumvention* or *circumventing weaknesses*, the teacher works by adjusting the level of support provided. A student's mistake stands apart from the teacher's normal feedback, requiring a corrective response. At the high end of the corrective support continuum are approaches such as so-called direct instruction. The

knowledge and skills but becomes lost in the morass of an authentic or “real” problem. To adapt a metaphor used in couple’s therapy, in true discovery environments, the teacher has to “titrate anxiety” (Abraham, 2007, p. 33).

Adaptive theory locates currently popular approaches to instruction at intermediate points on the support continuum. These include modeling and participant modeling or guided practice (Bandura’s, 1977, term is *enactive mastery*). Educators refer as well to “reform” activities that fit this category, such as metacognitive routines for independent reading and worked examples (Brown & Campione, 1996; Darling-Hammond, 1993). All of these approaches serve the function of demonstrating and engaging students in directed practice with new skills. They are often used with students whose achievement profiles suggest they will move along to higher levels—that they can climb with appropriate scaffolding. Here the teacher capitalizes on strengths.

In theory, the adaptive teacher traverses this support continuum on a regular basis in the classroom consistent with instructional goals. Teachers do this using more or less ongoing assessment of students’ repeated use of particular approaches to learning, pulling cues from all directions to make instructional decisions for individuals, as well as the class group. By accessing what can be known, the teacher can then apply knowledge to invent activities as needed that will temporarily overcome whatever impediments a particular class brings to the learning situation. Over time, weaker students become able to perform tasks previously beyond their reach. The more able students will experience challenges that they might not otherwise, and will come to understand the value of hard work. Now here is where we can update the older theory—and for that matter, Bob Sternberg.

New Directions for Theory on Adaptive Teaching

In new conceptions of adaptive teaching, education is a *situated* aptitude development program. In other words, the new theory takes as given that education occurs within a sociocultural context where even tasks targeting individuals have a wider influence. Both teachers and students need to engage in reflection and analysis in this problem-filled, dynamic classroom environment (e.g., Rogoff, 1990; Wells, 1999). Figure 3 represents the sociocultural context of a classroom as a cloud; the Ss depict students within the classroom. For discussion purposes, students are grouped into three “levels,” reflecting subgroups that might be formed on the basis of hypothetical factors related to learning.

Student heterogeneity is an increasingly common fact of classroom learning; however, adaptive teachers will value a diversity of talent in the collective. In fact, adaptive teachers will embrace and nurture some types of student differences. As a practical matter, teachers have to get the majority of their students to learn the content to be taught; curricular goals have to be met. Meeting expected goals will require adapting instruction to groups of individuals with like profiles

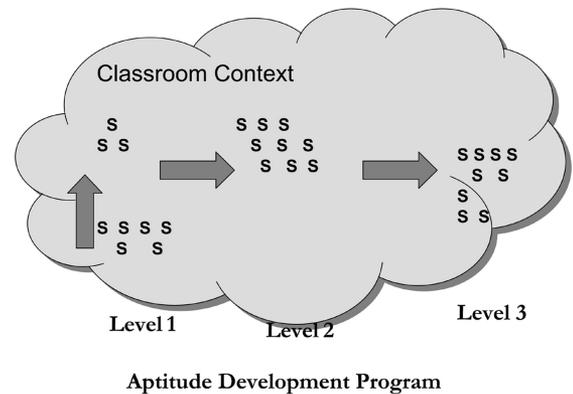


FIGURE 3 Microadaptive teaching as situated aptitude development (levels represent students grouped by a hypothetical quality related to learning).

(as in Level 1, 2, or 3), or adapting instruction to individual students *within the group context*. In addition, adapting (as opposed to teaching in the conventional sense) implies a hesitation to use one approach with all students, and a belief in the value of flexible rather than permanent grouping arrangements.

At some point down the road, the adaptive teacher wants as many students as possible to benefit from instruction provided to the whole group. So one key hypothesis for new theory on adaptive teaching is that adaptive teaching is successful, ultimately, when students perform in ways that are more alike than different, as each student builds relative weaknesses into strengths. Notably, nowhere in this newer theory of adaptive teaching is the teacher adapting to *individual* students in a social vacuum. Compare this, for example, to classic theories of individualized instruction such as Klausmeier, Rossmiller, and Saily (1977), or even modern theories of adaptive tutoring, such as Winne’s (1992), where the individual student is the locus of instruction and adaptations are made relative to that student’s own performance over time.

To illustrate this principle, consider a teacher at a magnet school from one of Randi’s samples. The school drew students from urban and suburban homes, with a population that was quite diverse, culturally and economically. Struggling with how to differentiate in his school, the teacher explained that one way he dealt with diversity was by icing his curriculum with some content “just beyond the reach” of his most advanced students. He wanted to be sure that less advanced students were not the only ones who found assignments difficult—he said, “Everyone needs to stretch in my class.” In addition, the advanced students had to articulate strategies they used to access the difficult content, so his weaker students were exposed to some of the thinking of advanced students as they worked.

One way to interpret what this teacher did is to say that he thought about two extreme subgroups of students *in relation* to the balance in his class that year. Even though the two

groups were working at different levels—in terms of reaching and learning within this curriculum, what each subgroup did was actually more alike than different. Both advanced and weaker students had opportunities to be challenged and supported in the class. Now, this is not individualized or individually tailored instruction, but it is how successful practitioners teach on a microadaptive level. It is a way of *indirectly* developing aptitude.

This example leads to one of the main conclusions from the work that Randi and I have done: *As teachers gain experience with particular groups of students, as they get to know each individually in a way that is so familiar, they begin to see them as falling within a small number of subgroups they themselves generate as heuristic tools.* In this case, we saw a teacher speak of relatively more or less advanced learners, but teachers' penchants for organizing information about students lead them to define other subgroups as well—students who are “well behaved and quiet,” for example, or “apprehensive and insecure.” Forming just a few, manageable subgroups provides a kind of shortcut that leads the teacher to address who needs more or less immediate attention and support on different tasks (see Randi & Corno, 2005).

Assume again for the moment that a teacher creates three subgroups for a given learning activity. This is depicted in Figure 4. In teaching microadaptively, the teacher focuses on what we have come to call the *teaching ground*. Within the social context of the classroom, it is as if there is an area or space for easiest teaching and reaching that is symbolically *at the center*. Adaptive teachers aim to keep most of the students central within that teaching “middle ground,” by adjusting teaching to learners and learners to teaching. They do this by targeting ways to bring disparate groups of students in a class closer together so they can benefit from similar instruction. Again, in this case, the microadaptive teacher develops aptitude indirectly, not only by providing appropriate support and challenge but also by acting on the dual premises that students' own efforts enable learning, and that everyone can learn from one another. When teachers reach out to ensure that students come to more or less the same level, they are

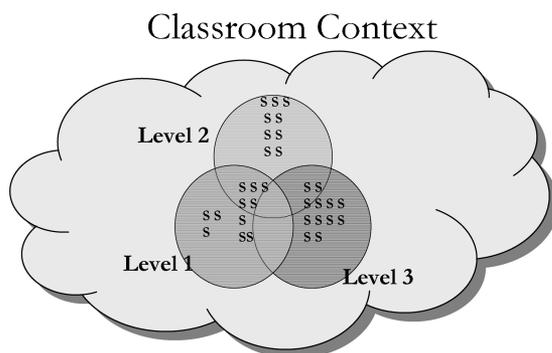


FIGURE 4 Creating the middle ground brings students at different levels closer together.

“widening the circle” of who can learn while not devaluing differences.

A good example of a procedure that increases the middle ground is reciprocal teaching, pioneered by Annmarie Palincsar and Mike Pressley (Palincsar & Brown, 1984; Pressley, Hogan, Wharton-McDonald, Mistretta, & Ettenberger, 1996), among others. The teacher models strategies that good readers use as a way to help weaker readers see what they are missing. In reciprocal teaching the idea is to harness and use those with expert reading skills to equip students who struggle with better ways to get the most from the material. We find that microadaptive teachers use approaches that capitalize on the strengths of other students in a class to bring more students into the teaching ground than were there at the start of an activity, project, or unit.

Some other examples of common techniques for increasing the middle ground include priming or preparing students for particular lessons and modeling or participant modeling. Teachers can cue students to pay attention to particular aspects of a lesson or of their own performance as a way of self-correcting. They can build scaffolding into activities and analyze errors and misconceptions. If they ask knowledgeable students to share their ideas with the larger group, there are fewer students left at the margins. Finally, if the curriculum brings in concepts that are new to all students (“novel” concepts), then for that activity as well the playing field is level (see Collins, Brown, & Holum, 1991; Pinnell & Fountas, 1996; Silver, Strong, & Perini, 2000).

Conventional adaptive theory does not get to the idea that microadaptive teaching results in *creating* this middle ground, in which most if not all students can participate in learning. But when a teacher develops academic and self-regulation skills in less successful students that are *the same* academic and self-regulation skills that mark the work of their more successful peers, then again, students become more alike than different as learners. They are more likely to be ready, ultimately, for similar (and, one hopes, equal) opportunities to learn. Note that, ironically, when teachers individualize instruction, the result is very different. Students become unique—*less*, rather than more like their peers (Randi & Corno, 2005).

Let me say loudly that *the path of indirect aptitude development continues to be underexplored by contemporary research on teaching, despite its potential for successfully addressing the dilemma of teaching individuals within heterogeneous classrooms.* There are important issues here still to be addressed. For example, as Brophy and Good (1986) have shown, some teachers form subgroups for differential treatment but instead of capitalizing on student strengths to develop weaknesses, they inadvertently lower standards and reduce opportunities for students whom they believe cannot do the work.

A second approach to microadaptation I referenced when I touched on self-regulated learning. In this approach, called

direct aptitude development, teachers target particular student skills and abilities. They teach students how to self-motivate, for example, or how to manage their homework. But recall that the ultimate goal for adaptive teaching is to increase the number of learners who are capable of working independently within the class group. So teachers who wish to develop aptitude directly cannot be overly short-circuiting. If they are targeting motivation, they have to show some students how to create their own embellishments and how to streamline tasks to add interest. They have to help students set their own contingencies for engagement and to seek out resources for additional guidance; then they have to make opportunities for these new motivation control strategies to be fine-tuned.

It is, I should add, nontrivial that the aptitudes that teachers develop in students to help them succeed in school extend beyond cognitive skills and strategies. Sternberg (2001) wants teachers to develop wisdom in students, and characterizations of wisdom have an affective component (wisdom = “heart” + “mind”). Teachers have loads of noncognitive goals. Elsewhere we (Stanford Aptitude Seminar, 2002) called these *affcon* goals, to capture both affect and conation (motivation and volition) in a way that reflects the empirical interrelations of these noncognitive functions.

Just as researchers have difficulty separating affective and conative processes, Randi and I (2005) find that practicing teachers tend to think about affect and conation simultaneously. We have records in which teachers speak of “how much it takes out of students to work hard” or “not giving up when frustrated.” They describe active engagement with statements like “She was just ‘on’ today,” “He’s a self-starter,” and “That group will work when they are interested.” It does not really matter, I suppose, if a teacher learns (from us researchers?) that the processes underlying effort and engagement are deeply motivational and volitional and that there is a long illustrious history of theory and research on these constructs (Corno & Mandinach, 2004). Microadaptive teachers constantly devise ways to plan for, establish, and get students to persist toward goals. Direct aptitude development attends to both cognitive and *affcon* qualities.

THE FORWARD RESEARCH AGENDA

According to contemporary social cognitive theory, what individuals know comes about through common interaction and experience with shared resources in the learning environment (Greeno, Collins, & Resnick, 1996; Lave & Wenger, 1991). The jargon that mentors acculturate apprentices into communities of practice (Brown & Campione, 1996) means that beginning students learn to participate in a classroom community with peers as mentors as well as their teachers. As well, these learner and mentor roles are fluid, and individual differences are valued as opportunities for learning. The theory of “distributed cognition” (e.g., Salomon,

1993), expanded to include “distributed *affcon*” holds that because expertise cuts across individuals in a community, then an individual’s cognition, motivation, affect, and so on, plays a role in changing the system. The nature of a classroom community and the variations in its knowledge base are dynamic reflections of the collective knowledge of the individuals that comprise it. “As one becomes better, everyone becomes better.” Or, put differently, *When teaching and learners adapt with reciprocity, learning-related differences become less visible, so all students can participate in the learning experience.*

There are several key hypotheses that derive from the work that Randi and I have been doing. These are, that adaptation will be successful if

- those differences *affecting learning* become less visible or evident
- all students participate in learning
- students move from the periphery to the center of the teaching ground
- strengths appear challenged while weak areas are supported
- aptitude develops

No wonder few teachers manage to teach microadaptively. To seriously address this enterprise going forward seems enormously complex.

It follows from the line of theory we are developing that teaching adaptively depends on being able to do a pretty good job of assessing student strengths and weaknesses in areas that affect learning. You have to have a sense of how your students differ in response to classroom tasks order to adjust features of the learning environment. And here is another major issue that remains to be explored.

Assessment in an Adaptive Classroom

There is considerable controversy over how to assess student learning differences during teaching. At issue, as this audience is well aware, is how to determine a method–student match that is valid and reliable for the purpose. Even the most promising, empirically validated instruments have to be interpreted carefully to avoid sending incorrect messages—that a child lacks “musical” intelligence, for example. So one of the things Randi and I did was try to look at how adaptive teachers approach assessment of student differences.

One finding is that these teachers were not as inclined as we researchers might like to pull assessments off the shelf. Even when using instruments that accompany instructional programs, teachers tended to remake tasks or items to fit what they were doing. Many testlike events were developed on the fly—informal, ongoing experiences with students, sometimes planned and sometimes not. Our teachers told us that formal assessments take time away from the

TABLE 1
How Researchers and Teachers View Assessment of
Student Qualities That Affect Classroom Learning

<i>Researchers</i>	<i>Teachers</i>
Formal instruments (tests)	Informal assessments (testlike events)
Measuring characteristics/qualities/processes in students	Responding to student needs within context; enacting a curriculum
Empirically valid and reliable	Response-sensitive but psychometric properties not known
Scheduled, take time from curriculum	Continuous, curriculum embedded

curriculum they cannot afford to lose, so they prefer to assess student differences less formally within the learning experiences they plan. Some scholars today call this a kind of data-driven assessment (Sharp, 2004; Shepard, 2000); in this case the “data” are disruptions in the field, sometimes only faintly sensed, that require an adjustment to the flow of instruction.

Table 1 characterizes some of the ways that teachers and researchers differ in their views of assessment. Although we have found that teachers’ decisions about instruction are often based on sophisticated and subtle assessments of student qualities that influence learning, their assessments are not of the same kind that we researchers develop when we conduct field experiments or study student aptitude and its correlates. Teachers also use informal assessments because they trust their judgment about what best guides instruction and helps to move an individual *and* a class through the curriculum. Researchers use formal measures to reduce the possibility of errors in judgment, providing a more reliable basis for predicting outcomes. This means that, when it comes to understanding student individual differences, teachers and researchers often work toward different ends.

We have found that teachers assess and revise their instruction in a continual evaluation process that includes direct observation of students’ responses in the moment. Teachers tend to *respond directly* to variations in individual student response that reflect patterns observed over time (they are using pattern recognition). That is, they decompose student responses rather quickly and informally from the first days of class, but they do so in a number of sensitive ways that they can repeat easily—open-ended questions that elicit thinking and allow for targeted feedback; mini-in-class assignments that quickly reveal fundamental skills, common problems, and quirky mistakes; intellectual games and puzzles that allow teachers to linger on responses from students. With this sort of evidence they can then analyze errors as windows into thinking (e.g., see Shaughnessy, 1977). As noted previously, we find that teachers mine these data for patterns that they

highlight and begin to group students heuristically as a means to streamline (or make for more efficient) teaching. Our evidence for this comes from observations and interviews with teachers coded for examples across teaching contexts and grade levels, although we still have small samples (Randi, 1996).

Another finding is that the teachers in our samples were especially inclined to look out for student characteristics that might *impede* instruction (including qualities such as inattentiveness and unwillingness to participate)—things that could be noticed easily. They had mentally documented a repertoire of academic problems, presented by (often) hundreds of previous students that had now become telltale signs for adjustment. For example, one elementary teacher was a stickler for organization. She described a male student in her class as “so disorganized that his lack of attention to details actually interfered with my attempts to teach the whole class.” The teacher said she had to stop teaching to help this student organize his notes. She also said that this student failed to benefit from homework reviews because he rarely completed his homework.

The strategy in this case was to provide the student with an assignment checklist. The teacher required an adult at home to sign and return the checklist daily. She also customized instruction for this student’s organizational problems by showing him how other students in the class took notes, and used other students’ ideas as support. In one sense, this teacher differentiated instruction; in another, however, she increased her middle ground by developing the student’s aptitude to participate more fully in the classroom, which meant being ready to take notes during lessons and to come to class with completed homework. Notably, she never really “individualized” instruction—she worked with this student *within* the group context, keeping in mind the need to better the student *in order to better the group*.

When asked to describe some relatively more formal systems that assisted them to document information on students’ academic work habits, our teachers said they kept notes on index cards (how many times a student participated, which students read aloud, and remarks or questions on things like oral reading or problem solving). They made checklists for certain (good and bad) behavior patterns that they could modify with contingent rewards. One teacher said she saved and discussed “questionable” work with students, focusing limited time and attention where it was needed most.

Teachers also based microadaptations on more subtle assessments that were less apparent, even, it seemed, to students. We called these informal, response-sensitive assessments. A biology teacher asked students to resolve a conflict between writing about what they knew and a “brainstorming” activity assigned to encourage creative thinking. She said she “eavesdropped” on her students as they worked in small groups to do the lab, debating, discussing, and then making decisions. Through classroom discourse, the teacher could see that students themselves resolved the dilemma of

writing about something “unusual” concurrent with something they “knew well.” By informally observing as students worked, this teacher gained insight into how her students learned to write, which she then used in future instruction. Teachers learn from their students, just as students learn from them.

To summarize our preliminary findings on microadaptive assessment, microadaptive assessment includes informal, response-sensitive assessment wrapped into microadaptive teaching. The teacher looks for variations in student response that influence their learning in the classroom setting. These are traceable in the stream of interactive events, which can be used immediately to inform teaching. Teachers also use their prior teaching experience to create instructionally meaningful but flexible subgroups of students who can be addressed in similar ways. This allows the teacher to capitalize on assessment opportunities for individuals and subgroups in the class at hand (see also Randi & Corno, 2005, Table 2).

Overlapping Areas of Adaptation

In a different aspect of our work, we tried to identify the key learning-related areas in which teachers made microadaptations. We found that they adapted content, they adapted to subgroups of students, and they adapted to individual students. But it was hard to separate out examples of each area in which they made adaptations, because we saw all three areas intertwined. And of course, some teachers adapted more than others.

Implementation research describes teachers as reluctant to change their teaching practices (Randi & Corno, 1997). However, we worked as collaborators with practitioners rather than as researchers asking them to “install” a new program or “follow a script.” This approach resulted in a very different experience. The teachers we observed continually and deliberately adjusted their practice—from lesson to lesson, class group to class group, and moment to moment—within various segments of their curriculum. Curriculum theorists call such continuous adaptation “curriculum enactment” (Snyder, Bolin, & Zumwalt, 1992). Let me share some examples of how this perspective was evident in the practice of our most adaptive teachers.

One high school social studies teacher observed her students generate drawings as part of a textbook assignment. Thinking these drawings might replace the lecture she planned for her next class, the teacher collected the drawings from the first class and took them into the second, to improvise an activity where students used the drawings as text. She explained that this activity provided “an alternative way into the content” for students who had difficulty reading, or for whom she considered less likely to benefit from listening to her lecture. “If you can’t get ’em one way, get ’em another.”

Another teacher told us, “The real test of any teaching is face-to-face with those kids.” As this observation implies, teachers judge the effectiveness of their work by how it plays

back in their students’ immediate and spontaneous reactions. The criteria our teachers took into account ranged from looking at “what students feel is fair” to what seemed a source of “inspiration.”

Again, although these teachers’ judgments reflected what they noticed about individual students, the teachers also thought about how subgroups of students or whole classes responded. For example, one teacher explained, “Every class makeup is different. You know what works in one group; and yet, somehow you sense that would not work in another.” So teachers considered how different classes of students would respond to particular tasks. One middle school language teacher explained, “If I’d had a slower class that year, I don’t think they’d have gotten quite as much out of it. . . . When you’re trying something, you’ll say, last year this worked beautifully, but then you have to think about, will it work as well with these students?” This illustration brings us to the hypothesis I expressed previously: that teachers tend to characterize students collectively once they are familiar. Teachers said that no two class groups are alike, even when the groups are composed of students with similar academic skills studying the same curriculum.

When beginning a new topic, our teachers described a need to get the group “up to speed” so instruction could proceed according to topics on the curriculum menu. Although teachers were establishing benchmark goals for the whole class, they also saw a need to work to the same goals for individuals within the group, often through subgroups, as a way to make the whole group more homogeneous. We called this *benchmarking* in the sense of adapting tasks and content to support students as they process information. One high school English teacher explained how she got started when she had to teach new material:

If I have a new book to teach, I think, “what should I do with this?” I can’t just read the book, or say that I’ll have the kids do such and such. . . . I might get an idea, but realize these kids cannot do that; they might need study questions first to get them thinking about key themes. Or they might need to be told to look for particular things, and then we’ll pull it together afterwards. It’s really only the top-notch kids who . . . can do something on their own right off the bat.

With this start, the teacher then created a common foundation for all students. The foundation included, as she said, “a lot of prep, because some kids might . . . struggle. So I’ll give them examples.”

As a general rule, we saw teachers do “a lot of prep” to get weaker students up to tasks. Another teacher explained, she could “do cooperative learning” with this group because her students were accustomed to small groups and sharing. On the other hand, the teacher claimed that another class “would have a difficult time with something like that.” She said, “You can tell, based on the kids, which group needs a hands-on activity. Some groups have to have the pieces of

the puzzle that they can put together; whereas, another group can find the pieces of the puzzle themselves.”

Not only did this teacher change her instruction from class group to class group, she also set a goal to develop aptitude for accomplishing the task at hand in the subgroup that needed “prep.” In short, microadaptive teachers seemed to bring subgroups of students along—and, ultimately, together—working with each group at the edge of its competence, and then providing strategic coaching to scaffold individual learning. The teachers gave even students at the extremes enough common experiences to prepare them for further instruction. When students do not bring like experiences with academic work into the classroom, and teachers can provide them, then instruction serves the function of aptitude development (Randi & Corno, 2005).

Researchers cringe when teachers say they “teach to the middle” of a class. Teaching to the middle means targeting instruction to a single readiness level. The teachers we worked with did not do this. Again, they did something markedly different—they created a middle ground—a common and dynamic center for their teaching that expanded to include more learners over time.

Another thing Randi and I did was try to ferret out the key student differences teachers found salient. In planning for instruction, teachers often referred to differences in students’ cognitive skills and abilities, as well as their mistakes in understanding or misuse of concepts. Well, of course, academic work requires cognitive/intellectual skills and understandings, and based on other research this was no surprise. However, as I have already said, our teachers routinely directed instruction to students’ affect responses and qualities as well (Stanford Aptitude Seminar, 2002). For example, one middle school math teacher expressed an awareness of how student motivation influenced her instruction in large groups. She noted that grades seemed to be primary motivators for her more successful students, who sought to compete for bonus points. However, this teacher felt that grades undermined the efforts of her less successful students. She said these students “were uncomfortable having their grade depend on something they had to do on their own.” She said, “I think, my ‘level ones’ [what she called her high achievers] were confident about working on their own, and much more excited about quick-point quizzes. . . . The level two students were a little hesitant.”

Another teacher who taught a lesson on Web design described a motivational strategy she used with her “creative” students. This teacher judged the impact of her instruction based on her students’ motivational states.

I’m looking at . . . if they’re involved, if they’re enjoying it, if they do wonderful things without realizing the work they’re doing. And if the work they produce is superior to their previous work, then I know what I did was effective, and I will use that assignment again.

Aspects of emotion are important considerations for teachers—again, we see that they compile experiences with many students into a repertoire of psychologically complex factors that influence classroom learning, and these become salient in their thinking: reticence, gregariousness, distracting demands, or jittery anxiousness, all of which can cause missteps and errors in learning. One middle school English teacher said she tried to anticipate how her students would react emotionally to lessons as she planned: “So I think about how themes of family would be good to emphasize—family’s big to these kids—I guess that’s just where they are in life.”

We had an interesting experience with some high school teachers who had to “implement” a new instructional program they had been trained with during a recent professional development day. One teacher said his students were “giving me the ‘face’—especially the brighter ones—rolling their eyes as soon as I began using the new program’s jargon phrases.” “Oh my God,” he said, “the seniors were almost insulted.” Without some microadaptation, there would be a real problem in this classroom with “fit.” Assessing student affect allowed the teacher to evaluate and change instructional practices at the same time (see also Perry & Winne, 2001).

When students worked together to accomplish assigned tasks, teachers seemed to have more opportunities to observe and learn about students’ thinking and understanding. Group activities not only make student work products visible but also reveal something of their thinking processes and work styles—what Messick (1984) called their “information processing regularities” (p. 4). The teachers we observed used small group or pair activities with great frequency, across all grades. They explained that group activities not only afford good opportunities to evaluate students’ work, they also lead to guidance for students as they work.

The lesson here is that differentiation in these classrooms was not something teachers did routinely, or even an experience they could plan ahead for. These teachers did not “implement” particular “models of differentiation” as if blindly following a mantra from staff development (e.g., Heacox, 2001). Rather, their adaptations were spontaneously responsive to the individuals in their particular classrooms at the particular moments of instruction that occurred. These adaptations were informed by their own prior teaching history and experience with their curriculum—the heuristic tools they stored as shortcuts.

Features of Microadaptive Teaching and Assessment

The features of microadaptive teaching that our research identified include adaptation of instruction *and* adaptation of students on a number of levels, and for a number of strengths and weaknesses. Microadaptation means continual monitoring to determine necessary and helpful levels of support in classroom learning tasks, some of which is assessment of

work products and some of which is assessment of thinking, affect, and behavior. Microadaptive teaching involves responsiveness to students during the course of instruction, traversing the support continuum, providing support when needed and withdrawing support as students demonstrate more capabilities. The microadaptive teacher tries to create that symbolic area at the center of the teaching ground that provides space for easiest teaching. The aim is to keep the most number of students within that middle ground, where students share experiences, develop aptitude, and the teacher can capitalize on skills available across the class to challenge and support all students.

Adaptive teachers provide appropriate support when they think it is needed, and withdraw support when they see students as capable of working alone. Adaptive teachers seek to provide all students with opportunities for their weak areas to be supported and their strengths to be challenged, though not always at the same time. Without formal knowledge of aptitude theory and research, and without objectively assessing student individual differences, some teachers we observed managed to teach in ways that were optimally adaptive, in the sense that they were (a) efficient for group instruction and (b) respectful of the individual learning profiles and patterns their students brought to the class. This *responsiveness* is a pattern of teaching behavior, which in turn directs teaching practices (Randi & Corno, 1997).

The teachers we observed had a range of 5 to 33 years teaching experience, yet even the less experienced seemed comfortable with the unpredictable and dynamic nature of their practice. One hypothesis based on these data is that teachers' ongoing experience in classrooms develops an aptitude for adaptation and responsiveness to the demands of the teaching; having to provide instruction that moves all students through a curriculum develops the capacity to adapt (Randi & Corno, 2007) (see Figure 5). Adaptive teachers tend to view learner variation as an *opportunity for learning from teaching* rather than as *obstacles to be overcome* (Figure 5).

Individual Differences as *Obstacles* to be Overcome

- Individualize instruction
- Use adaptive computer-based instruction
- Use homogeneous grouping
- Change grouping arrangements flexibly

Individual Differences as *Opportunities* for Learning

- Provide challenging and supportive learning environments
- Capitalize on strengths of students
- Compensate for weak areas
- Enables adaptive teaching and learning
- Develops teacher's aptitude for adaptive teaching

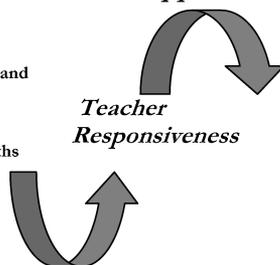


FIGURE 5. Two views of differentiation.

CONCLUSION AND FUTURE EFFORTS

This article opened by tracing adaptive teaching back to its roots. I close with where I think the study of adaptive teaching needs to go now. Earlier I said that researchers need to come closer to the ways that practicing teachers address student differences when they teach—to their microadaptive teaching—and teachers need to be encouraged to evaluate the utility of this knowledge base for their own purposes. This point is echoed by another educational psychologist, the late Graham Nuthall (2004), who wrote that teachers would benefit from understanding how particular kinds of educational experiences affect learning for different students in different situations. In Nuthall's view, such knowledge would give teachers the ability to actually predict student learning and design activities accordingly. In setting an agenda for future research relating classroom teaching to student learning, Nuthall challenged researchers to collect, "in-depth and continuous data on classroom activities, student experiences, and learning processes" (p. 296). The goal, as he described it, would be to produce explanatory theory that allows teachers to distinguish principles generalizable across contexts from those that are unique to specific classrooms or teaching situations.

From the work with Randi I also see a "mindset" for microadaptive teaching that similarly needs to be better understood. An adaptive teacher views student differences as assistive, affording, and enabling for teaching as well as student learning; has a propensity to check students' thinking and understanding on a continuous basis in a variety of ways; shows respect for students' varied talents and perspectives; and has a hesitant attitude about using any one approach with every student (see Table 2 in Randi & Corno, 2005). This is an *inquiring* mindset, consistent with a view of teachers who are themselves self-regulated learners, doing their best to make sense of the complex social environment in which they have to be productive (Randi, 2004).

Finally, new theory that explains how practicing teachers address student differences within classrooms can lead to promising approaches to teacher development for adaptive teaching. These new approaches would view adaptive teaching as intellectual as well as technical, and seek to capture the dynamic teaching strategies of practitioners that illustrate the general principles I have described. The goal is to create systems of the constituent elements of effective microadaptive practice. Ultimately, then, more teachers might realize that when they take different routes to meet learners where they are, they can help set a course toward independence.

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