TEN ESSENTIAL IDEAS FOR BETTER TEACHING

Marilyn N. Suydam
The Ohio State University
Columbus, Ohio

In most surveys of what teachers want from meetings and in-service workshops or courses, activities that can be used in the classroom rank high. We feel very good about getting something tangible that we can use. However, there are some intangibles that are also important in promoting better teaching -- and better achievement from students. These, too, are ideas that you can use in your classroom. They have a strong base in research on mathematics instruction; however, they are also ideas that have a "common sense" appeal, backed by the experiences of many teachers in many classrooms. So, let's look at ten essential ideas -- some very briefly.

1. Time

You are probably familiar with findings about time-on-task -- in particular, the idea that:

- The more time a student spends actively engaged in tasks related to a topic, the more he or she will probably achieve on a test of that content.

We also know that:

- A large proportion of the time available for teaching mathematics (and other subjects as well) is consumed by non-instructional activities.

Some studies have placed this amount of time as high as 40%. It is small wonder, then, that we feel we have too little time to teach!

How is the instructional time used? When numbers of teachers were observed, it was found that:

- Teachers talk about three times as much as students do in mathematics classes. (Stilwell, 1968)
- Teachers talk for almost two-thirds of the instructional time. (Meckes, 1972)

Some have argued that this large amount of teacher-talk is appropriate for mathematics instruction, where students "must be told what to do." Others, however, have countered that mathematics should be more oriented toward student participation and discovery if mathematics is to be meaningful.

Perhaps of even more importance are these ideas:

- Better teachers devote about half of the instructional time to lecture, demonstration, and discussion, and somewhat less than half the time to individual seatwork for practice.
- Less effective teachers devote about one-fourth of the instructional time to lectures, etc., and over half the time to seatwork. (Evertson et al., 1980b)

This recent research evidence supports findings by Shipp and Deer and others in the 1960's. There appears to be a connection between the amount of time devoted to developing mathematical ideas, and student achievement.

What is the typical pattern of mathematics classes? Several recent studies have indicated that the following is the most usual plan:

Opening activities - 5 minutes
Checking/grading homework - 10 minutes
Lecture/discussion - 10 minutes
Seatwork - 20-30 minutes
Closing activity - 5 minutes

Good and Grouws (1979) have proposed an alternative model that has been demonstrated to promote achievement:

Daily review - 8 minutes
Development - 20 minutes
Seatwork - 15 minutes
Homework - daily
Special reviews (of all content) - once a week

With this model, a greater amount of time is spent on developing mathematical content. Moreover, it incorporates systematic review, an ingredient that has been missing from some mathematics

programs in recent years, plus daily homework. The idea is promoted that how time is spent is as important as having more time to spend.

ESSENTIAL 1: UNDERSTAND THE IMPORTANCE OF INSTRUCTIONAL TIME AND HOW TO USE TIME EFFICIENTLY AND EFFECTIVELY.

2. Questioning

Questioning consumes up to 40% or so of instructional time. This sounds reasonable: interaction between students and teacher is desirable. However:

- 80% of the questions asked in one study were related to knowledge and comprehension -- the two lowest levels of questions.
- Almost no questions involved the higher levels of questions -- application, analysis, synthesis, or evaluation. (Meckes, 1972)

Yet we know from other research that most students do not achieve that which they have not been taught. If they are not given opportunities to apply, analyze, synthesize, or evaluate, how can they learn these processes?

Some recent research has indicated other techniques used by better teachers (i.e., those whose students have higher achievement). These more effective teachers:

- Posed more questions to the total group. (Evertson et al., 1980a)
- Asked more process questions (calling for explanations) and more product questions (calling for explicit answers).
- Asked more new questions after correct answers had been given.
- Encouraged students to ask questions and request help. (Evertson et al., 1980b)

Thus, a connection seems apparent between questioning procedures and student achievement. To increase questioning skills, consider using questions to motivate, challenge, provoke student interaction, get students to evaluate, focus on process, guide, diagnose, review, encourage exploration, invite student questions, enhance transfer. (Didactics and Mathematics, 1977)

ESSENTIAL 2: DEVELOP A RANGE OF QUESTIONING SKILLS AND PROCEDURES.

3. Management

Controlling the classroom is important -- and related to achievement. Some ideas related to classroom management have come from recent research; again, these concern what more effective teachers do:

- State concern for academic achievement more often, and give more academic encouragement.
- Give homework regularly and more frequently.
- Are more encouraging and more receptive to students' input.
- Expect students to learn. (Evertson et al., 1980b)

It also appears from research that:

- The beginning of the year is a crucial time for establishing effective classroom management -- that is, behavior patterns, expectations, and procedures that persist. (Evertson and Emmer, 1982)

Even by the end of the first week, a difference was apparent between teachers who were effective (and thus whose students had higher achievement at the end of the year) and those who were not effective. A teacher could still manage to attain effective management patterns during the second week -- but by the end of the third week, poorer management patterns were so well established that they persisted throughout the year -- and student achievement was lower.

What did those teachers who were more effective do? Observed most often among more effective managers in mathematics classes in grade 3 were that they tended to:

- Have more workable systems of rules.
- Teach rules and procedures systematically and thoroughly.
- Monitor pupil behavior carefully and react quickly to stop inappropriate behavior.
- Seem more in touch with student needs, anticipated problems, and concerns.

- Have stronger instructional skills, including clearer directions.

More effective managers in junior high school mathematics classes tended to:

- Provide differing assignments for different students.
- State desired attitudes and behaviors more frequently.
- Present clear expectations for use of materials.
- Give consistent responses to appropriate and inappropriate behaviors.
- Stop disruptive behavior sooner and ignore it less often.
- Use classroom rules more frequently to deal with such behavior.

ESSENTIAL 3: LEARN TECHNIQUES FOR DISCIPLINE AND CONTROL, AS WELL AS FOR PLANNING AND EXECUTING LESSONS.

4. Differentiation

Most teachers express a belief that instruction should be differentiated for students with different needs and abilities. But consider these findings:

- Teachers had different perceptions and expectations for classes at different ability levels -- but their behaviors did not differ for classes at different ability levels. (Strickmeier, 1971)
- Virtually no differentiation in instructional activity patterns was found among mathematics teachers -- and the same patterns were used for both higher and lower ability classes. (Evertson, 1982)

The reasons why this is so can be conjectured. Among them is the difficulty that many teachers have with groups of low-achieving students.

Consider, therefore, these findings about planning for low achievers:

- Periods of intensive instruction, interspersed with opportunities to practice the material, seem most effective.
- A pattern of discussion/seatwork/discussion/seatwork/etc. in small periods of time was remarkably effective. (Evertson, 1982)

The attention spans of low achievers seem shorter, so that both long periods of direct instruction and extended seatwork activities become very difficult with low-achieving classes. Breaking up the time has helped many teachers to keep both interest and control.

Consider also how teachers communicate with differing students:

- Teachers communicated with allegedly bright students in a friendlier, more encouraging and accepting manner. As students' positive communication to the teacher increased, teachers' communications became increasingly positive, and they spent more time communicating with those students. (Kester, 1969)

In contrast, low achievers are:

- Seated farther from the teacher or in a group.
- Given less attention in academic situations.
- Called on less often.
- Given less wait-time.
- Given fewer clues and asked fewer follow-up questions when they answer incorrectly.
- Praised less frequently after correct answers.
- Praised more for marginal or inadequate answers.
- Given less accurate and less detailed feedback -- less frequently.
- Required to do less work and put forth less effort.
- Interrupted more frequently. (Good, 1981)

Thus, teachers tend to communicate an impression not designed to improve their self-images.

ESSENTIAL 4: LEARN HOW TO RECOGNIZE INFLUENTIAL DIFFERENCES AND DEVELOP TECHNIQUES FOR DIFFERENTIATING INSTRUCTION IN A POSITIVE FASHION.

5. Materials

There is evidence that:

- Lessons using manipulative materials have a higher probability of producing greater mathematical achievement than do lessons in which manipulative materials are not used.

- This was true across a variety of mathematics topics, at every grade level, at every achievement level, at every ability level. (Suydam and Higgins, 1977)

Nevertheless, we know from surveys that, while teachers at all levels say they believe students should use manipulative materials, actual use declines sharply after grade 1 and fades almost to non-existence by grade 4. Perhaps more teachers need help with techniques for managing the use materials.

There is also evidence indicating that:

- Children need not necessarily manipulate materials themselves for all lessons. Watching the teacher use the materials in a demonstration was at times as effective as having students manipulate the materials themselves.

The reason for this may lie with the fact that, for some lessons, it is easier to direct students' attention to important points, and to the mathematical idea, when the teacher is in control of the materials.

ESSENTIAL 5: DEVELOP TECHNIQUES FOR USING MATERIALS WITH STUDENTS.

6. Attitudes

Research has linked student achievement and attitudes with teacher attitudes at the .20 to .40 level, thus accounting for 4% to 16% of the variance in student achievement and attitudes. This is a seemingly low level -- nevertheless, most of us are convinced that attitudes are important -- and transmitted by teachers as well as by others with whom the student comes into contact.

ESSENTIAL 6: DEVELOP AND PORTRAY POSITIVE, INTERESTED ATTITUDES TOWARD MATHEMATICS AND TEACHING MATHEMATICS.

7. Strategies

The NCTM's Agenda for Action recommends that problem solving should be the focus of the mathematics curriculum and instruction. This implies use of a problem solving approach, as well as increased work with a variety of problems. Research has also indicated that students gain in problem solving achievement when they

are taught problem solving strategies, such as "draw a picture or diagram," "make a table," and so on. Having a repertoire of strategies helps them achieve in problem solving, and students using a wide range of strategies are able to solve more problems.

Teachers need an array of teaching strategies as well, ranging from whole-class instruction to individualized techniques, from guided discovery to direct instruction.

ESSENTIAL 7: TEACH CHILDREN A WIDE RANGE OF STRATEGIES TO SOLVE A WIDE RANGE OF PROBLEMS, AND DEVELOP A REPERTOIRE OF TEACHING STRATEGIES.

8. Technology

You have probably heard it said that schools may be the last place where paper-and-pencil computation is used -- while everyone in the "real world" uses calculators and computers. Certainly there has been opposition to the use of calculators -- but almost none to computer use.

In regard to calculators, there have been over 150 studies, most to ascertain whether or not the use of calculators would harm achievement.

- In all but a few instances, achievement scores were as high or higher when calculators were used for instruction (but not used on the test) as when they were not used.
- Moreover, some evidence indicates they are helpful in problem solving -- not necessarily in increasing scores, but in expanding the student's repertoire of strategies.
- They are also useful in teaching a variety of other mathematical ideas and content. (Suydam, 1982)

In regard to computers:

- From research of the past 20 years, we know that computers can be used effectively for problem solving, drill and practice, tutorial instruction (CAI), management, games, programming, and simulations.
- Thus far, there has been little published research on using microcomputers in mathematics instruction: people are busy forging ahead with program development, since

there is the general belief that they will not harm achievement and will enrich instruction.

ESSENTIAL 8: USE CALCULATORS AND COMPUTERS TO PROMOTE INSTRUCTIONAL GOALS.

9. Research

It should be clear by now that I believe that research is something with which all teachers should be acquainted. It won't answer all the questions, but it will provide some clues to resolving teaching problems.

Moreover, teachers should be involved in the research process -- in helping to generate and shape research objectives, in carrying out investigations, and in testing the results of research in the classroom.

ESSENTIAL 9: RECOGNIZE THAT RESEARCH CAN HELP, AND PARTICIPATE IN RESEARCH.

10. Change

Teachers often appear to feel as though what they are doing cannot and should not be changed and improved. There seems to be a prevailing belief that the curriculum is firmly set, too. Teachers need to expect change -- and to plan for change. The increasing prevalence of technology is demanding it -- and so are advances in what we know about mathematics, about the teaching process, and about how children learn.

ESSENTIAL 10: TEACHERS NEED TO KNOW THAT THEY HAVE BEEN PREPARED ONLY TO BEGIN TEACHING: CHANGE MAKES IT NECESSARY TO CONTINUE TO LEARN.

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