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ABSTRACT

Historically, teaching has been considered an art, not a science, and therefore not subject to scientific analysis. However, there now exists a body of knowledge and a fresh set of conceptions about teaching upon which to base teacher education. Recent and numerous advances in pedagogical knowledge can now be used to provide teacher education with a scientific foundation. Over the last decade or two, the scientific approach to the study of education has been unusually fruitful, though not all of that research has yet been incorporated into teacher education programs. Schools of education at the major state universities should be leading the way in developing new programs of teacher preparation based on research on teaching. Research having implications for teacher preparation is cited in the areas of: time factors in learning; success and positive reinforcement; structuring behavior; pedagogical decision making; classroom management and achievement; and effects of expectations on student performance. (CB)

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TO: The Governor's Task Force on Teacher Education, Meeting at the College of Education, University of Arizona, February 16, 1984.

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I am pleased to be given a few minutes to express opinions that I have also shared recently with a commission convened by Governor Kean in New Jersey, and provided to State Regents, Boards of Education and legislators in a few other states. My goal with each of them as it is with you this morning, is to focus concern on the national trend to drop many educational methods courses, or reduce the number of credit hours for teacher preparation. I am bothered by this trend because it is occurring at the worst possible time. I must emphasize that I do not intend to defend teacher education programs and courses either in this institution or anywhere else. What I do believe, rather passionately, is that there now exists a body of knowledge and a fresh set of conceptions about teaching on which to base teacher education. Recent and numerous advances in pedagogical knowledge can now, for the very first time, be used to provide teacher education with a scientific foundation. What I hope to convince you of is that what we need now is great reform in teacher education. What we least need is a deletion or a reduction of teacher preparation programs. To understand my beliefs you need to know some history about research on teaching.

In the United States of America the first piece of empirical research on classrom practices was performed just before the turn of the century by Joseph Mayer Rice, a physician and muck-raking editor interested in children. He found spelling to be taught in the most abysmal ways, and for much too long, ensuring only boredom among students, rather than the competence that was

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desired. When he presented his scientific findings to the annual school administrators meetings, just after 1900, he was, literally, booed off the stage and could not finish his presentation. The belief of the school people at the turn of the century, a belief that is still pervasive in education, was that teaching was an art, not a science, and therefore not subject to scientific analysis. To overcome that kind of bias has taken about 70 years. To be sure, that is much faster than chemistry replaced alchemy and astronomy replaced astrology (if it ever did). But it has been a long battle. At least now, finally, some educators are willing to admit that although teaching is an art, it is also a craft where skilled performances are needed; and it is also a profession, where numerous complex decisions must be made, usually on the basis of insufficient information. Teaching is now seen the way surgery might be seen: Part art, part craft, and part professional decision-making.

Over the last decade or two, the scientific approach to the study of education has been unusually fruitful, though not all that research has yet been incorporated into teacher education programs. Our new conceptions of teaching have arisen out of studies about, for example, how time is allocated to subject matter and how content areas are chosen by teachers. Enormous variability in content choice and in time allocation across different classrooms, even in the same district or school, is the rule. To find out why one teacher allocates, say, zero time to fractions and another teacher allocates, say, 14 hours of classroom time to fractions, has occupied many researchers over the past few years. We have, now, also, some knowledge about how attention rate or time-on-task is maintained in some classes. In one class we might see a 90% time-on-task level, and in another class, in the same district or school, we might notice a 50% time-on-task level. What this research on allocated time,

content choice, and engaged time means, of course, is that the curriculum that is actually delivered to the children in particular classrooms may vary in magnitu by factors of 4 or 10 or 28 to 1 due to teacher decisions about these issues.

What is important for this group to think about is whether it is possible to produce teachers capable of delivering equality of educational opportunity, one of our nation's goals, without teaching them how to make wise decisions about what areas of the curriculum need to be addressed, how much time to devote to different curriculum areas, and how to maintain attention in classrooms.

We have learned, too, from recent research, how school districts and states fail school teachers by picking achievement tests that do not match the curriculum that they teach. For example, if a district used the Addison-Wesley mathematics series in fourth grade instruction, and the district or state chooses to use the Stanford Achievement test as a measure of mathematics achievement, only 47% of the test items will have been familiar to students. Since the test is not matched to the curriculum, 53% of the items the students are facing in this achievement test have probably not been covered in the school curriculum that was used. The mindful teacher, faced with such a stupid situation, must create curriculum materials to help students learn what is on the test that the state department and the school district uses to measure achievement. My concern with this research about how teachers allocate time, maintain attention, pick content areas, and try to create curriculum and tests that match is to ask where these teachers are supposed to learn such analytic skills? I do not believe that we can ever talk about effective teaching without talking about the content choices, the timing choices and the testing choices that teachers

must make. Sensible decisions about these issues are learned over a relatively long period of time in classrooms and also in negotiations between teachers and school districts. This is precisely the kind of professional decision-making for which coursework in education should be directed.

Let me take another example. In our recent research we have learned about the power of success rate in young children. Until recently we believed that young childern needed challenges. We thought moderate levels of difficulty, where a child sometimes succeeds and sometimes fails, was what was needed. We thought children needed curriculum that "stretched" them. Perhaps you feel that you learn best that way. But, in fact, most young children seem to need massive doses of high success experiences to develop numeracy and literacy. Young students may need to get things right 90% of the time while doing seatwork or workbook activities and during homework. They also need 80% or higher correct responding in recitation/question-and-answer type activities. These data appear to be more impressive with lower social class children. And the data also appear to be more impressive where the nature of the curriculum is hierarchical (That is, unless a child has extremely heavy success experiences in addition, there will be trouble in learning multiplication, and unless there was great success in subtraction, there will be difficulty in learning long division.) Moreover, the necessity for high success experiences for young students, where curriculum has been carefully matched to the student so that the student can succeed at it, seems to be the precursor for development of a positive academic self-concept. The evidence from educational research appears to be quite clear: Positive self-concept as a learner <u>follows</u> success experiences as a learner. An attempt to build a child's self-concept as a learner without

providing experiences of success as a learner seems doomed to failure. The issue to consider here is how the teacher is ever to learn to provide each member of a classroom with educational experiences like this? I do not think on-the-job training is the place for learning how to create this kind of environment for children.

To further this argument, how is the teacher to learn that structuring behavior (the provision of clear directions, objectives, reviews, and advance organizers for material to be presented) improves classroom achievement? Research now shows this to be true. Where does one learn to practice such structuring? Where is the teacher to get feedback about whether that structuring was done well or poorly? I believe one learns these skills best in pre-service programs of teacher training. It is in such programs that teachers must learn to provide academic feedback, or to engage in monitoring during seatwork, or provide contingent reinforcement, or introduce people to tasks in ways that are positively motivating. Each of these characteristics (academic feedback, monitoring behavior, contingent reinforcement, etc.), and dozens more, have now been found by empirical research to be teacher behaviors that regularly affect achievement. Where is the teacher going to get the chance to practice these behaviors in a safe environment for them, and in an environment where they cannot harm children while they are learning their pedagogical skills?

With this question in mind let us turn to a consideration of the teacher who might choose to work in small groups on a lesson, say, in Secondary Biology. He or she may have to use many different techniques, simultaneously, in order to have successful instruction. The techniques of modern cognitive science have been used to explore teachers' decision-making during such interactive group work. We have found that teachers who engage in small group instruction seem to be simultaneously attending to five principles of teaching: Teachers often

use the compensation principle, to favor the shy, the quiet, the dull, or the culturally different. They also make decisions based on the principle of strategic leniency, so that they can ignore some of the inappropriate behavior of special children. Another guiding principle used to make decisions during interactive teaching is power sharing, whereby the teacher selectively reinforces certain students in order to enlist their aid in sharing responsibility. The fourth principle is called progressive checking, where the teacher makes a special effort to check the problems and progress of low ability students. Finally, we see teachers following the principle of suppressing emotions. Many teachers feel that emotion during certain kinds of teaching is inappropriate. Their reasoning is that it could lead to higher levels of emotionality among the students, which creates management problems in some of the curriculum areas. Thus, the apparently simple task of running a small group is, when examined from a cognitive science perspective, a task requiring complex decision-making about the application of many principles; and this kind of decision-making makes considerable cognitive demands of a teacher.

The development of these kinds of principles for pedagogical decision-making in group work takes years to develop. We are first learning how to uncover such principles of classroom instruction in our research and we are only now beginning to develop training programs to help teachers develop such strategies. So that you may get a flavor for the complexity of the job we are talking about, I must add that researchers have found that teachers make about 10 non-trivial decisions per hour. These are real decisions, not decisions about whether Johnny can go to the bathroom. Rather, they are decisions about whether Johnny should stop fractions and go on to decimals, or whether Jane should be moved into the fast mathematics group. These complex, professional, non-trivial decisions show rates of 10 per hour and take place in environments

where teachers have about 1,500 distinct interactions per day with different children on different issues, in classes where 30 students need to be supervised all the time, all day long. The ability to handle such incredibly complex environments comes with training and experience. We are just beginning to understand the complexity and just learning to design better courses to teach novice teachers how to make decisions in the face of such complexity.

Other knowledge provided recently by researchers has to do with teacher behavior that produces cooperation among students. In the last decade we have created the technology for producing in students cooperative behavior between the students and between the students and teachers. These techniques have also given rise to higher self esteem for the learners, as well as higher rates of pro-academic behavior and, even more astounding, higher academic achievement. These recent experiments in cooperative learning environments have required the use of thousands of students in thousands of classrooms. In the process we have learned how certain teaching techniques can help to integrate handicapped children into the mainstream of the classroom, help to integrate minority members into the majority culture, and help to produce more nearly equal performance for students of different social classes. Such technology has been developed and field tested only in the last 10 years. This is the kind of technology to be taught in colleges of education throughout the country.

In classroom management, also, we have new technology. This is the area that the press and the public love to criticize teachers about, and it is the area that teachers themselves have most fear about when they begin to teach. We have made unbelievable strides in the last decade. We have learned many of the teacher behaviors that result in the least amount of off-task behavior in a classroom and in the least amount of deviancy in classrooms. That work was

first reported only in 1970. It was investigated by others throughout the 1970s, and turned into teacher training materials during the early 1980s. Those materials, based on empirical research, have been field tested recently. In New York and elsewhere the results have been amazing. Teachers who had failed to meet the criteria of good management were, for the first time in their professional lives, in complete control of their classes. One 20-year veteran of the New York City schools said that the training produced nothing short of a miracle.

In another area of study the researchers on teaching have found, like American industry has found, that expectations for performance do actually affect performance. Just as successful corporations hold high performance standards for their workers, so do successful teachers hold high performance standards for their students. But research on teaching, unlike research in the industrial area, has shown us something very important to consider when thinking about teacher training. In comparison to students for whom teachers hold high performance expectations, the students perceived to be low performers are more often seated further away from the teacher; treated as groups not individuals; smiled at less; made eye contact with less; called on less to answer questions; given less time to answer those queations; have their answers followed up less frequently; are praised more often for marginal and inadequate answers; are praised less frequently for successful public responses; interrupted in their work more often; and so forth. This kind of treatment differential between students for whom teachers hold high and low expectations appears common. What I wonder is where teachers are supposed to learn about the power of high expectations and the problems that could occur when they hold low performance expectations? Where do they learn to examine and control their own behavior

in order to ensure that they are not endangering the growth of students, particularly those who are ethnically and culturally different?

My point in this brief talk has been to make clear that the research of the last decade has been very fruitful; I could go on reciting many more recent findings, but I will stop. What seems obvious to me is that the last thing we need to be doing now is to abandon or reduce the scope of teacher education programs. With a rapidly expanding knowledge base and a conception of the teacher as a decision-maker who handles a complex set of interacting variables in a dynamic social environment, we need, more than ever, high quality programs of teacher preparation. We need to change our programs and we need to modernize them. For example, we need to make the curriculum laboratories in which we train teachers into real laboratories. Nationally, most such curriculum laboratories, where one can learn the content in an area, the time allocations that might be necessary to teach particular parts of the curriculum, and the tests for specific curriculum materials, are really just "rooms" where one can go through materials and catalogues of different publishers. They are not laboratories in the sense of having live students to teach concepts to, where expert teachers can provide critiques of the lessons and where the peers of the novice teacher and the children themselves can join in the analysis of the teaching activities that have just occurred. We must provide our novice teachers with environments in which to experiment with producing cognitive and affective changes in children. We need laboratories in education, real laboratories, just as do chemists, biologists, and physicists who also must learn to experiment while they are in training.

We also need video cameras and the money to pay experts to analyze teaching performance, just as do the track and football coaches. If the average teacher

in training in the United States of America gets one hour of analysis of teaching with video tape I'd be surprised. The modal amount of time I do know. It is zero! Our physicians and our athletes are accorded funds for such equipment and funds to maintain the equipment after they get them. Schools of education are not usually thought of as needing such equipment.

We now have knowledge about student and teacher cognitive processes, and this knowledge can be used to simulate certain classroom events. I wonder if anyone knows of a single designer of software that has been lured from Atari or Mattel, to develop simulations and games to teach teachers complex decision-making? The military gets most of the computer assisted simulators they want. No one appears ready to support such devices in education. Just as the generals in a simulation of maneuvers learn the effects of different resource allocation decisions on success, so a teacher needs experience, in safe environments, to make equally complex decisions about the allocation of resources such as equipment, time, and personnel to accommodate children's needs. Inadequate training in decision-making by a military staff, or a teaching staff, could result in disaster for their nation. One is just more immediate than the other.

I believe that we certainly need creative thought to revitalize teacher preparation programs. But something else we need is money. Currently, we do not have much of either at the national level. Here at the University of Arizona we have found that it costs about $15,000 for the state to educate a liberal arts major, say in comparative literature, history, or psychology, over four years. For the honorable and vitally important profession of teaching, the state pays $2,000 less! I wonder what the state pays to train its medical doctors, nurses, computer scientists, and architects? Our State of Arizona

like 49 other states concerned with teacher preparation, is getting what it pays for. I think we have a unique role to play here at the University of Arizona in developing modern and possibly expensive programs of teacher education. Research and development is a proper function of a university faculty. There may be other institutions which are capable of training teachers. There are no other institutions in society except the great research universities for the study of the process. Schools of education at the major state universities should be leading the way in developing new programs of teacher preparation based on research on teaching. They must also evaluate the programs they develop and help in dissemination of such programs to other schools.

As I said at the beginning of this talk, this is the time for the reform of teacher education, both nationally and in our own wonderful state. It is not a time to abandon teacher education by providing certification to non-trained teachers. It really is a time for the nation and each state to pay the bills that are necessary for quality teacher education to take place.

Thank you for your attention.