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Pittsburg State University

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A Field-Based Introduction to Urban Education at the Middle School

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Abstract

Middle school teachers developed objectives and suggested activities for a pilot early field experience to introduce freshman teacher candidates to urban education at the middle school level. This paper presents these objectives and activities plus data about the effects of their use by 15 teachers and 22 freshmen; an additional 30 freshmen placed in a traditional (tutoring) early field experience formed a comparison group. Project freshmen demonstrated higher sense of personal teaching efficacy and flexibility among people in a multicultural setting. In their journals, project freshmen reported more awareness of the urban environment; however, comparison group freshmen were more likely to report a sense of accomplishment. The project experience seems to have provided a "big picture" introduction to urban education, while the traditional experience gave students a taste of success at one small teaching task.

The needs of urban schools have made headlines, prompted national and state funding initiatives, and caused changes in teacher education requirements, especially in the area of multicultural education (Houston & Newman, 1982). School-university collaboration can be a powerful strategy for educational renewal (Sirotnik & Goodlad, 1988). Because of the high priority of both collaboration and urban education in the field at the present time, there is a sizeable descriptive literature on these topics. However, educators are just beginning to develop a research base in these areas. This study contributes to that research base.

Changes in current field experiences are necessary in order to better prepare teachers for urban settings (Meade, 1991). This project had practicing teachers at an urban middle school design objectives and activities to help freshmen at an urban university learn about "understanding what it means to be committed to education," as the principal remarked. The rationale behind this collaborative project was that the teachers' collective expertise was an excellent source for an answer to the question, "What should entering teacher candidates see, do, and learn in an early field experience?" Desired student outcomes included professed willingness or desire to teach in an urban setting, understanding of culturally diverse pupil populations, and appreciation of methods and teaching skills appropriate for urban middle school pupils.

This paper reports on the project's effects. The study was guided by the following research questions:

1. What objectives and activities did the urban middle school teachers design for the early field experience?
2. What were the (a) level of commitment to teaching, (b) willingness to work in an urban setting, (c) sense of teaching efficacy, and (d) flexibility in a multicultural setting among freshmen who participated in the collaborative program? Did these levels differ from freshmen who participated in the regular field experience, a tutoring assignment in the same district?
3. What learnings/benefits and difficulties/problems did the collaborating teachers report, after the early field experience project, for (a) the participating freshmen, (b) the middle school pupils, and (c) the teachers themselves? What did the freshmen describe as their learnings and difficulties?

Until the mid-1970s, early field experiences were not very common (Houston & Newman, 1982). Students were not placed in the field until student teaching. Early field experiences are now quite common, both for the professional training they offer and for their usefulness in career guidance. In many places, they are required for licensing the teacher education program. In principle, students can decide whether they really do want to be teachers and can begin to develop professional skills.

But early field experiences differ considerably (Applegate & Lasley, 1983), and the substance of field experience is more important than the length of time spent in the field (McIntyre, Byrd, & Foxx, 1996). School-university collaboration is not as common at the early field experience level as at the student teaching level (Sirotnik & Goodlad, 1988). Therefore, the first research question called for a simple description. It was instructive to find out what successful urban middle school teachers defined as the important "first points" to introduce to freshmen and how they proposed to proceed.

The effects of early field experiences on general attitudes are positive (Samson, Borger, Weinstein, & Walberg, 1984). Preservice teachers expect to gain practical insights and enjoy student contact during early field experiences (Applegate & Lasley, 1983). It is not clear what effects, if any, early field experience has on career choice (Anderson, 1987; Willems, Brown, & Arth, 1982). There is evidence that multicultural content courses effectively change both knowledge about diversity and attitudes toward persons who represent various racial or ethnic groups (Bennett, Niggle, & Stage, 1990).

Two studies reported the effects of school-university collaborative urban teacher training programs at the student teaching level on willingness to teach in an urban setting. McCormick (1990) reported 47% of graduates of one midwestern university who had participated in the Cooperative Urban Teacher Education Program in Kansas City were currently teaching, and 46% of those were teaching in cities of more than 50,000 people. Stallings and Martin (1988) reported that urban Teaching Academy graduates were more likely than comparable graduates of the regular teacher education program to want to teach in an urban setting. This variable, willingness to teach in an urban setting, is also important at the career choice level and is appropriate to examine in the early field experience.

Sense of teaching efficacy has been included as a variable in this study. There is evidence that teachers who expect their teaching to make a difference in student learning are those who are, in fact, effective teachers (Ashton & Webb, 1986). Teachers who do not believe they can make a difference are not likely to trust students or support student problem-solving, but they are likely to believe that external rewards are necessary to control student behavior (Woolfolk, Rosoff, & Hoy, 1990). These beliefs are antithetical to a classroom environment where all students can maintain dignity and develop self-esteem. One reason urban teaching may be difficult is that it is hard to develop a sense of teaching efficacy in the face of urban poverty and alienation. One of the goals of this early field experience was to expose students to committed urban teachers, to help develop commitment and a sense of efficacy among the teacher candidates.

Method

Sample

The urban middle school chosen for this study was selected because it had an enthusiastic teaching staff and principal and a diverse student body, and it was located in an inner-city neighborhood near the university. The school served about 860 students, approximately 60% African-American and 40% white, with a staff of 64 teachers and over 40 administrators and support staff. The investigator secured the commitment of the school principal before beginning the study.

In February, nine teachers and the investigator met for a two-hour workshop. The teachers volunteered to participate in the project and were compensated for their work. All had at least two years of experience at the school. The teachers did brainstorming, then prioritizing, and finally summarizing activities; the results were 3 objectives and 7 suggested activities for 22 freshmen Introduction to Education students who would make 10 2-hour visits (in March and April) to the middle school as part of their assigned course work. These freshmen constituted the project group.

The comparison group consisted of 30 freshmen enrolled in the same Introduction to Education course, who made 10 2-hour visits to other schools in the same urban district, Pittsburgh Public Schools. These students were placed mostly in fourth or fifth grades at elementary schools; the logistics of placement made it impossible to confine the entire cohort of freshmen to middle schools. All of the elementary schools in which the comparison group freshmen were placed had diverse student populations. For their early field experience, comparison group freshmen were assigned to work as tutors at the discretion of the host teacher or principal. Typically, freshmen would be assigned one or two students at a time and given a place in a hallway or empty room. The teacher would provide materials on which the pupils required remediation: stories or text chapters the pupils had difficulty reading, homework or worksheets the pupils could not complete, and the like. The purpose of most of the comparison group's tutoring assignments was to help the pupils keep up or catch up with the class, or at least to make progress in that direction.

This study thus had two samples: (a) 15 middle school teachers, 9 of whom designed the project field experience (8 white and 7 minority, 11 female and 4 male), and (b) 52 freshmen enrolled in Introduction to Education who were assigned a field experience in a large urban school district (51 white and 1 minority, 44 female and 8 male).

Data Sources and Analysis

Data to answer the first research question consisted of the newsprint brainstorm sheets used in the teacher workshop and the summary objectives and activities on which the teachers agreed. The brainstorm session was driven by the questions: "What should entering teacher candidates learn in an early field experience in an urban middle school?" and "What activities and experiences should help them accomplish these objectives?"

Data to answer the second research question included quantitative indicators of (a) level of commitment to teaching, (b) willingness to work in an urban setting, (c) sense of teaching efficacy, and (d) flexibility in a multicultural setting. The freshmen responded to paper-and-pencil surveys before and after their field experience; 50 provided complete enough data for analysis. The commitment and willingness indicators were single items on the Entering Teacher Candidates Survey (Freeman, 1983; West & Brousseau, 1987). The efficacy measures used were two scaled items, measuring general and personal teaching efficacy, respectively, developed by the RAND corporation (Ashton & Webb, 1986; Berman & McLaughlin, 1977; Woolfolk et al., 1990). The measures of flexibility in a multicultural setting were two five-item scales (Flexibility in Instruction and Flexibility with People) developed for this study from the Edwards Personal Preference Scale (Edwards, 1953). Reliability (alpha) for the Flexibility in Instruction scale was .80 for the pretest and .82 for the posttest. Reliability for the Flexibility with People scale was .72 for the pretest and .87 for the posttest. Each of the scaled indicator variables was analyzed with a two-factor, mixed design ANOVA: factors were time (pretest/posttest) and site (project site/other site). Multiple choice indicators were analyzed with chi-square tests of homogeneity by site.

Data to answer the third research question came from verbatim transcripts of audiotaped exit interviews of the 15 middle school teachers and from written field site logs the freshmen were assigned to keep. Content analysis was done by category of comment (learning/benefit or difficulty/problem) and category of reference (teacher, freshman, or middle school pupil), thus forming six cells for analysis. Within these categories, subcategories were developed using the constant comparative method (Glaser & Strauss, 1967). Two researchers, the author and a graduate assistant, coded the data and discussed discrepancies to achieve consensus.

Results

Objectives and Activities

Table 1 shows the objectives and activities the teachers planned. These objectives are notably broad and comprehensive. The teachers were concerned that students experience interpersonal relations with a diverse group of pupils, and they listed this as the first and most important objective. Additionally, they wanted students to be introduced to some instructional, practical, and management concepts. These teacher-written objectives are remarkably similar to the recommendations of Meade (1991) for reshaping the clinical portion of teacher education to better prepare teachers for urban settings.

Table 1

Objectives and Activities Planned by Nine Teachers for introducing Early Field Experience Students to an Urban Middle School

Objectives:

1. The early field experience candidate will recognize the importance of genuine concern for each student as a person and participate in interactions with students.
2. The early field experience candidate will observe the organizational aspects of the school and teaching and the relationship of organization to content area proficiency.
3. The early field experience candidate will have some "hands-on" experience in the classroom, including an orientation to the concept of discipline with dignity.

Suggested Activities (a partial list of things the early field experience candidates might do to achieve these objectives):

1. observe different classes and students in different groups, make anecdotal notes
2. make notes on teacher-student interactions
3. observe an academic class, noting the objective on the board, classroom activities, and student reactions
4. make a list of possible ways to handle discipline in a positive way
5. keep a journal of observations of positive discipline
6. tutor an individual student or a small group
7. assist in the classroom, then get feedback from the teacher and an opportunity to ask questions

What the teachers meant by "organizational" matters were the practical, daily, operational routines: taking attendance, grading, completing paperwork, scheduling, collecting and duplicating materials, etc. What they meant by "hands-on" experience was that the freshmen were to perform some of these functions, not just observe the teacher doing them. These clarifications came from the workshop session.

Outcome Variables

Level of commitment to teaching was high both before and after the field experience for both project and comparison group freshmen (Table 2). No differences were found for site, time, or their interaction.

Table 2

Level of Commitment to Teaching, Project and Comparison Group Students Combined

Item: Which of the following best describes where teaching fits into your current career plans?

Choice	Pretest	Posttest
1. Classroom teaching is the only career I'm considering	19 (40%)	19 (38%)
2. First choice of careers I'm considering	25 (53%)	25 (50%)
3. Has some appeal but not first choice	3 (6%)	3 (6%)
4. I do not intend to become a classroom teacher	0 (0%)	3 (6%)
Total	47	50

Willingness to work in an urban setting was low both before and after field experience for both project and comparison group freshmen (Table 3). There were no differences between project and comparison group responses for either pretest or posttest measures.

Table 3

Willingness to Work in an Urban Setting, Project and Comparison Group Students Combined

Item: Which of the following best describes the school setting in which you would prefer to work?

Choice	Pretest	Posttest
1. Inner city/Urban	4 (9%)	6 (13%)
2. Suburban	27 (60%)	24 (53%)
3. Rural	2 (4%)	2 (4%)
4. No preference	12 (27%)	13 (29%)
Total	45	45

Sense of teaching efficacy was measured with two items (Table 4). Sense of general teaching efficacy was measured by responses to "When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment;" the scale for this item was 1=strongly agree through 5=strongly disagree. Sense of general teaching efficacy was moderately high for both groups and unchanged after the field experience. Sense of personal teaching efficacy was measured by responses to "If I try really hard, I can get through to even the most difficult or unmotivated students;" the scale for this item was 1=strongly disagree to 5=strongly agree. Sense of personal teaching efficacy was high for both groups. This variable was higher after the field experience for the project group and unchanged for the comparison group, although the statistical significance of this interaction was marginal.

Table 4

Means (Standard Deviations) and ANOVA Results for Sense of Teaching Efficacy

Site	Pre	Post	n
General Teaching Efficacy			
Other	3.89 (.8)	3.89 (1.1)	26
Project	3.74 (.8)	3.79 (1.4)	19
Effect for Site:	F(1,43) = .29		
Effect for Time:	F(1,43) = .02		
Site X Time	F(1,43) = .02		
Personal Teaching Efficacy			
Other	3.96 (.7)	3.89 (1.1)	26
Project	3.74 (.9)	4.16 (1.0)	19
Effect for Site:	F(1,43) = .92		
Effect for Time:	F(1,43) = 1.62		
Site X Time:	F(1,43) = 3.40, p=.07		

Note: Scale: 1=low, 5=high

Flexibility in a multicultural setting was measured with two different summated rating scales (1=never true of me to 7=always true of me) of five items each (Table 5). Flexibility in Instruction items included "I like to try new and different instructional methods," "I like to present the same classroom topics several different ways," and the like. Flexibility with People items included "I like to meet new people in school," "I feel comfortable in classes with people from different ethnic groups," and the like. Flexibility of both kinds was moderate for both groups of freshmen. Flexibility in Instruction rose slightly after field experience, in the same manner for both groups, although this main effect did not reach statistical significance. Flexibility with People rose slightly for project freshmen and dropped slightly for comparison group freshmen. This interaction effect also did not reach statistical significance. Since these effects were in expected and explainable directions and statistical power was low, they will be discussed. Conclusions should be avoided until results can be replicated.

Table 5

Means (Standard Deviations) and ANOVA Results for Flexibility in a Multicultural Setting

Site	Pre	Post	n
Flexibility in Instruction			
Other	25.54 (4.9)	26.81 (5.0)	26
Project	26.11 (4.9)	26.95 (4.4)	19
Effect for Site:	F(1,43) = .08		
Effect for Time:	F(1,43) = 2.11, p=.15		
Site X Time	F(1,43) = .09		
Flexibility with People			
Other	29.69 (4.0)	28.85 (5.8)	26
Project	29.74 (3.9)	30.95 (3.0)	19
Effect for Site:	F(1,43) = .85		
Effect for Time:	F(1,43) = .08		
Site X Time:	F(1,43) = 2.53, p=.12		

Note: Scale: 5=low, 35=high

Reports on the Process and Content of the Project

Teacher interviews. Comments from exit interviews with project teachers are summarized in Table 6. A category is reported if at least three out of 14 teachers made remarks to that effect. One teacher was dropped from the analysis because his interview transcript indicated he was a negative case. He had not implemented the objectives and activities for the program but rather had his students observe his classes. Only two of the remaining 14 teachers did not state directly that the project had merit, and all of the teachers made at least one favorable comment about the freshmen.

Table 6

Teachers (n=14) Report of Benefits and Difficulties of the Urban Middle School Early Field Experience Summary of Categories (and number of teachers reporting)

Learning/Benefits	Difficulties/Problems
For Teachers	
general "good" comments enjoyed helping freshmen begin a career(5)	scheduling (3)
help in class, get more accomplished, e.g. more cooperative learning, more time for other students (5)	one student per teacher (3); more structure (3)
no extra work (4)	better match of students to subjects (3)
For Freshmen	
overall "good" experience (12)	overwhelmed by student behavior (5)
conversations with cooperating teacher (6)	too young/ should be junior project (4)
opportunity to grow from "shy" to "comfortable" with setting (6)	too short a time (3)
exposed to "real" situation and variety of experience (4)	
opportunity to show enthusiasm/ work (3)	
For Pupils	
achievement up (9)	(none reported)
displaying enthusiasm, asking questions, feeling special (8)	
motivitated to turn in work (4)	

The benefits that the project teachers reported for freshmen were related to opportunities to interact with both the teacher and pupils. After a general "good experience" report, the most cited benefits for freshmen were the opportunities to converse with the teacher and opportunities to become comfortable in the setting. The opportunities for interaction with students were so great that five teachers reported their freshmen were overwhelmed at first.

Student logs. Freshman site logs were coded twice, once for what activities students reported doing and once for reflective comments. All of the 30 comparison group freshmen did observation and individual tutoring. Activities reported by project freshmen were more varied and reflected the range of activities listed above. Reflective comments were coded as learnings/benefits or difficulties/problems for the freshmen; within these categories, particular learnings or difficulties arose as themes in the freshman logs. Table 7 presents a summary of the reflective comments.

Table 7
Students' Reflections on Their Early Field Experience Benefits and Difficulties, by Site

Theme	Project Group (n=22)	Comparison Group (n=30)
Learnings/Benefits		
observe pupil/teacher interactions	21 (95%)	6 (20%)
pupils respond positively, respectfully to freshmen	18 (82%)	15 (50%)
confidence/ease in new situation	13 (59%)	25 (83%)
teacher a positive, directive force	9 (41%)	13 (43%)
understand city environs, city pupils, and cultural differences better as a result of the experience	8 (36%)	0 (0%)
interest in teaching	8 (36%)	23 (77%)
learn that teacher sets tone, directly affects learning	8 (36%)	8 (27%)
helped pupils learn	7 (32%)	22 (73%)
nurturing/understanding pupils	7 (32%)	13 (43%)
sense of accomplishment	4 (18%)	25 (83%)
observe pupils atypical of what freshmen expected in that grade	3 (14%)	3 (10%)
opportunity to observe "real world" situation	2 (9%)	4 (13%)
appreciate the need for patience	1 (5%)	4 (13%)
exercise authority	1 (5%)	2 (7%)
Difficulties/Problems		
disliked physical plant, esp. open classrooms	7 (32%)	1 (3%)
teacher not interested in freshmen, uncooperative	6 (27%)	0 (0%)
general uncertainty or nervousness	4 (18%)	11 (37%)
pupils disrespectful of freshmen	3 (13%)	2 (7%)
pupils nervous, uncertain about freshmen	0 (0%)	2 (7%)
freshmen unreceptive to teacher style/personality	0 (0%)	8 (27%)
No reflections	1 (5%)	5 (17%)

The differences in reported benefits between project and comparison freshmen fell into two general categories. Project freshmen wrote much more often than did comparison group freshmen about observing pupil/teacher interactions, receiving positive responses from pupils, and understanding the urban setting. This cluster of reflections is related to the observations of teachers (see Table 6), lending strength to the claim that one of the project's biggest contributions was the opportunity it gave freshmen to have positive interactions with pupils and teachers in an urban setting.

Comparison group freshmen wrote much more often than project group freshmen about a sense of accomplishment, helping pupils learn, or an interest in teaching. This cluster of reflections contrasts with the results for the personal teaching efficacy measure, which was marginally higher for the project group (see Table 4). The only group difference in reported difficulties was about the physical plant. The middle school had open classroom architecture. Seven freshmen, used to walled classrooms, did not like the open design.

Some comments from the project group's site logs illustrate how the project's objectives were addressed. The freshmen did have opportunities to recognize the importance of genuine concern for each middle school pupil and to participate in interactions with them.

- I had a talk with one girl about her grades -- she wasn't doing well and I gave her some "uplifting" words.
- I just kept telling him he could do it if he tries and that I was there to help him out.
- (from a science class) The kids seem to like to ask me questions...They wanted to hear what I have dissected in high school. They seemed fascinated that I dissected cats, sharks, and pigs.
- (from an English class) Today, I got up in front of the class, for the first time, to teach simple and complete sentences. I was really nervous at first, but began to feel more comfortable after a while. The kids weren't very responsive at first, they were hardly listening to me. I asked them to treat me with the same respect they would give Mrs. W.
- I went around the circle and listened to each one's opinion. I enjoyed hearing their comments and I think they did too. It made them feel important.
- Today was "Self Esteem Day" in the homeroom periods. I found this to be quite interesting...The students were more honest and less embarrassed than what I would have been at that age.
- (from a math class) The last day. It seems silly, but I feel kind of sad. I'd like to think I made a difference, not only in their math class, but in their lives as well...None of the students know it's my last day. I just hope they remember that mode is the number that occurs most often -- for some reason, they had trouble with that.

There were, of course, a few problems and difficulties reported. One particular teacher from the school had some difficulties with her own pupils as did the freshmen teacher candidates. But the log entries reflected that the freshmen saw the difficulties in the larger context of the whole school atmosphere, in which pupils and their development were important.

The freshmen also observed the organizational aspects of classroom work. The most frequent paperwork activity was grading papers, as might be expected.

- Mrs. C. gave me a pile of papers to correct...I was greatly horrified to see most of the students got D's and E's. There were a few C's, fewer B's, and no A's. I realize how different students are in inner cities [from where I went to school] and how much the teachers have to deal with.

- I think I graded too easy; I gave everyone A's. Mr. S. asked me why and I thought that being that all the drawings [diagrams of the circulatory system] were neat and all the labels were in the right places, it was only right to give them an A.

The paperwork assignments came in the context of ongoing classroom work in which the students had participated. In class on campus, students discussed pupil differences and the importance of not stereotyping pupils.

The concepts of discipline with dignity, respect, and classroom management in general were the topics of some of the most interesting freshmen log entries. Many of the freshmen were seeing new things; their own high schools, with contrasting climates, were fresh in their memories.

- Each student read aloud and I purposely called on those students falling asleep...it annoyed me to see students falling asleep [while I was teaching].
- The teachers I observed had control over the students because they were friends with them. One teacher I observed had a hard time with her students because she didn't treat them as friends. Most of the teachers work their control by establishing mutual respect.
- (during a period when a class was moved to accommodate testing) One boy slipped out a side door to leave before the bell. I went after him and brought him back.
- Two girls came to class arguing. Ms. Y. put them on opposite sides of the classroom to keep them from fighting. Ms. Y. taught the lesson for the day, then gave them the ditto sheets to work on. Just when Ms. Y. turned her back, the two girls started to physically fights. Immediately we broke them up. Three other teachers came over to help. After class, Ms. Y. said that she thought the fight (verbally) was over when she split them up, obviously it wasn't...Ms. Y. definitely has control over her class, even when a fight broke out between two girls. The students listened when she spoke, and they showed respect to her.

In this pilot project, the freshmen learned to see episodes of classroom management as opportunities to contribute to pupil development. The freshmen did non focus on "discipline" for its own sake, as do some early field experience students. Their logs showed the project freshmen thought misbehavior needed to be curtailed so that the pupils were respectful and respectable and so that classroom lessons could continue effectively.

Discussion

The field-based introduction to urban education at the middle school served to introduce freshmen to the urban setting and to the complexities of the urban classroom. The comparison group tutoring experiences, in contrast, served to introduce freshmen to one dimension of teaching. The project freshmen were more likely than the comparison group to report learning from observing pupil/teacher interactions and reported a better understanding of the urban setting. The quantitative results suggest the project experience had a positive effect on the freshmen's flexibility in instruction, flexibility with people, and sense of personal efficacy; these effects will lay helpful foundations for developing confidence and abilities in future situations. The comparison group freshmen, however, were more likely to report an interest in teaching, a sense of having accomplished some teaching, and an interest in helping students learn. This difference is probably attributable to the fact that the comparison group students were tutors, and teaching individual students formed the bulk of their experience.

There is an interesting contrast between sense of personal efficacy ("I can make a difference"), which was higher for the project group, and sense of accomplishment ("I did make a difference"), which was reported more often in the comparison group tutors' logs than in the project group's logs. Why was the broad exposure of the project experience more related to differences in the efficacy scores than the feelings of actually having accomplished something reported by the tutors? One possible explanation is that project objectives specified a broad range of exposure and immersion in the urban middle school classrooms. Teachers reported in their interviews that some students were overwhelmed at first. But the broader exposure may have given project students the perception of being introduced to the big picture and some sense of life and work in the urban classroom. In contrast, the smaller scope of the comparison group's tutoring experiences may have left these students with a sense of having helped one or two pupils but without a coherent vision of the enterprise of urban education.

The benefits reported for this project are those one might hear from teachers and teacher educators in most settings: developing positive relationships with students; learning about the practical, daily matters involved in teaching; and respecting individuals. The difference lies in the diversity of students with whom one must form relationships. The instructional methods the teachers had the freshmen use to accomplish the objectives included observation with written reflection, observation with verbal feedback, interactions with one or a few students, and interactions with a group of students. The teachers saw opportunity to reflect, especially in writing, as important to development for the freshmen. These methods are also ones many teacher educators would use.

The difference between introducing freshmen to education in general and to urban education, in this project, was a difference in context. Diversity of pupil backgrounds made interactions with students, presentation of lesson content, class organization, grading, and classroom management more multidimensional activities than they would be if the pupil population were more homogeneous. This pilot field experience illustrated one way to structure an introduction to this multidimensionality. The freshmen teacher candidates did learn and grow from their experiences.

An important limitation of these results is that the project school was a middle school, and most of the comparison group freshmen tutored in the fourth or fifth grades at elementary schools. Replication of the study with both project and comparison groups at the middle school level would be helpful. A further suggestion for refining the introduction to urban education at the middle school project would be to increase the amount of time allotted, although this poses the practical problem of removing something else from the already crowded teacher preparation curriculum. An interested future research question is which effects are more beneficial for developing and sustaining teacher interest and abilities in urban teaching: the feelings of accomplishment associated with a tutoring experience or the feelings of broad exposure to and beginning understanding of complex, multicultural classrooms associated with the project objectives and activities.

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Elementary Teachers' Pedagogical Content Knowledge of Mathematics

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Abstract

The purpose of this study was to characterize and compare novice and experienced elementary teachers' pedagogical knowledge and pedagogical content knowledge of three major topics in mathematics: whole number operations, fractions, and geometry. Twenty-six preservice elementary teachers and 28 experienced kindergarten through sixth grade teachers participated in this study. Data were collected via the Survey on Teaching Mathematics (Rich, Lubinski & Otto, 1994), a researcher-designed instrument that assists in describing pedagogical content knowledge. The results indicate that experienced teachers possess a greater conceptual understanding of whole number operations than do novice teachers, but that both novice and experienced teachers possess primarily a procedural knowledge of fractions. In addition, the results indicate that both novice and experienced teachers think that a good teacher is one who shows and tells students how to do the work.

When it was in its infancy, teacher education primarily focused on a teacher's knowledge of subject matter content (Shulman, 1986). However, for the past decade or more, teacher education research has emphasized the effectiveness of general pedagogical methods independent of subject matter content, such as how teachers manage their classrooms, organize activities, allocate time and turns, structure assignments, ascribe praise and blame, formulate the levels of their questions, plan lessons, and assess student understanding (Ball & McDiarmid, 1990; Onslow, Beynon, & Geddis, 1992; Shulman, 1986, 1987, 1988). In addition to teachers' subject matter (content) knowledge and their knowledge of general instructional methods (pedagogical knowledge), Shulman (1986, 1987, 1988) has suggested that teaching expertise should be described and evaluated in terms of pedagogical content knowledge. According to Shulman (1986), pedagogical content knowledge

> include[s] . . . the most useful forms of representation of . . . ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations - in a word, the ways of representing and formulating the subject that make it comprehensible to others . . . [It] also includes an understanding of what makes the learning of specific concepts easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning (p. 9).

Pedagogical content knowledge is the synthesis or integration of teachers' subject matter knowledge and their pedagogical knowledge into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction (Gudmundsdottir, 1987; Shulman, 1986, 1987, 1988). It is that form of knowledge that makes teachers rather than subject area experts, for teachers differ from biologists, historians, writers, or mathematicians, not necessarily in the quality or quantity of their subject matter knowledge, but in how that knowledge is organized and used. The teaching process requires teachers to "transform" their subject matter knowledge for the purpose of teaching (Gudmundsdottir, 1987; Shulman, 1986, 1987). This transformation occurs as the teacher engages in the act of "pedagogical reasoning", i.e. examines and critically interprets instructional materials in terms of the teacher's own understanding of the subject matter; thinks through the key ideas and identifies alternative ways of representing them to students as analogies, metaphors, examples, demonstrations, simulations, etc.; adapts the material to students' characteristics such as ability, gender, language, culture, prior knowledge, conceptions, misconceptions, expectations, difficulties, strategies, etc.; and finally tailors the material to the specific students in a classroom (Shulman, 1987).

Studies indicate that novice teachers have major concerns about pedagogical content knowledge and that they struggle with how to transform and represent concepts and ideas in ways that make sense to the specific students they are teaching (Ball & Wilson, 1990; Borko et al., 1992; Onslow, Beynon, & Geddis, 1992). Onslow, Beynon, and Geddis (1992) described the developing pedagogical content knowledge of two student teachers enrolled in a one-year elementary teacher education program. They focused on a dilemma faced by the student teachers as they attempted to transform their understanding of a topic in mathematics into a form that could be understood by their students.

At this point in their career, student teachers' understanding of pedagogy is gradually being molded to fit a style of teaching with which they feel comfortable. Often the style of teaching advocated by university faculty is in conflict with the style of teaching remembered by student teachers during their own

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schooling (Onslow, Beynon, & Geddis, 1992). Many student teachers remember mathematics classrooms in which the teacher tells and the students remember. Taking on the role of facilitator to help learners to construct conceptual knowledge emerges as an exciting and rewarding alternative. This style of teaching, however, involves the transformation of subject matter knowledge, and so requires a firm grasp of various components of pedagogical content knowledge.

Herein lies the student teachers' dilemma. When novice teachers become frustrated with the difficulties inherent in teaching mathematics meaningfully, the time constraints involved in covering the content of the curriculum, and the need to cope with individual differences, they often resort to teaching the way they were taught despite their desire to do otherwise. One student teacher wrote:

> I found that it was difficult to compromise my new views about presenting mathematical concepts with my old memories about how I learned the same material. Perhaps I was surprised and even a little annoyed at how much my own education may influence how I now educate (or attempt to educate!) others. I intended to let or allow students to discover or develop the concept . . . on their own as much as possible. What interfered with this intent were time constraints and the relative difficulty of this approach as opposed to simply presenting the "rules" for students to follow and apply (Onslow, Beynon, & Geddis, 1992, p. 308).

Similar results were found by Borko et al. (1992), who focused on a single episode in one student teacher's experiences. When confronted with a student's question that required a conceptual explanation, the student teacher attempted to provide a concrete example. However, she made an error and ultimately decided to abandon the attempt, though she believed that good mathematics teaching primarily involved making mathematics relevant and meaningful for students. She then focused on computational procedures by demonstrating the use of the algorithm and providing guided and independent practice.

This concern about pedagogical content knowledge is present even in new teachers who possess substantial subject matter knowledge. Ball and Wilson (1990) focused on the underlying assumptions of "alternate route" teacher certification programs. First, it is assumed that college graduates who majored in liberal arts have, in general, more subject matter knowledge than do their teacher education counterparts since they have received an education "uncluttered" with professional course work. Second, it is assumed that subject matter knowledge is the only professional knowledge one needs to acquire in formal university or college settings. Other types of knowledge necessary to teaching, e.g., pedagogical knowledge or pedagogical content knowledge, can and should be acquired through practical experience as a full-fledged teacher.

In order to examine these assumptions, Ball and Wilson (1990) collected data on two groups of novice secondary mathematics teachers. The first group consisted of 22 undergraduate students preparing to teach and majoring in mathematics at one selective private college, one mid-sized university, and one research institution. The second group consisted of 21 postbaccalaureate mathematics majors entering teaching through an urban school district's alternate certification program. Little difference was found in the mathematical understandings between novices in the alternate route program and teacher education candidates, either when they entered their program or when they finished. These results not only revealed that both groups possessed minimal knowledge of elementary topics, but also that the novice teachers were often aware that all they had learned were rules and procedures, which they had memorized and learned to use in algorithmic ways. No one had helped them develop meaningful understandings of the rules and procedures. One of the teacher education mathematics majors remarked:

> . . . here I am supposedly this math wizard and I've got a lot of knowledge and I've probably made more connections than a lot of people, but there are a lot of connections that I haven't made. I haven't seen these things before and I don't know where I was supposed to learn them — in high school? Or middle school? (p. 11)

To analyze the validity of the second assumption, two aspects of the novice teachers' developing ideas about teaching were examined: their notions about the teacher's role in helping students learn about mathematics, and their pedagogical perspective on the content. With respect to role, Ball and Wilson (1990) saw little difference in the teachers' views as a group. When the teachers entered their programs, both groups thought that a teacher who shows and tells students exactly how to do the work is most likely to help students learn mathematics. By the end of the program, more novices in both groups had shifted to describing good teaching in terms of "leading" and "guiding" students rather than telling. But in neither group did more than one or two people favor a more facilitative, constructivist-oriented style.

Ball and Wilson (1990) saw similar trends in responses to interview questions which posed pedagogical problems (e.g., a student suggests a nonstandard algorithm, asks a question, presents an error on a paper) and asked respondents how they would deal with the situation. In every case, teacher candidates and teacher trainees alike said they would respond directly to the student, telling the student if the idea was correct, showing him or her what to do, answering questions directly. And there was virtually no change in this over the course of their programs. Ball and Wilson (1990) claim that teachers who themselves are tied to a procedural knowledge of mathematics are not equipped to represent mathematical ideas to students in ways that will connect their prior and current knowledge and the mathematics they are to learn, a critical dimension of pedagogical content knowledge.

While this literature indicates that novice teachers have major concerns about pedagogical content knowledge and that they struggle with how to transform and represent concepts and ideas in ways that make sense to the specific students they are teaching (Ball & Wilson, 1990; Borko et al., 1992; Onslow, Beynon, & Geddis, 1992), the assumption that pedagogical knowledge or pedagogical content knowledge can be acquired through practical experience warrants further investigation.

The purpose of this study was to characterize and compare novice and experienced elementary teachers' pedagogical knowledge and pedagogical content knowledge of three major topics in mathematics: whole number operations, fractions, and geometry.

Method

Participants

Twenty-six preservice elementary teachers and 28 experienced kindergarten through sixth grade teachers participated in this study. The preservice teachers were elementary education majors at a mid-sized midwestern university. The experienced teachers are employed in eight schools located in or near one midwestern city. The schools include one parochial school and seven public schools.

All teachers in the sample, preservice and inservice, self-selected to participate in a five-year research project[1] that provided information about mathematics, mathematics learning, and mathematics teaching. Extending pedagogical content knowledge was a major focus of the project. The goal of the project was to establish learning environments with experienced teachers that reflect current research findings on how children learn mathematics and to create within these learning environments a cooperative teaching team of an experienced teacher and an inexperienced teacher, in order to produce a better novice teacher. In the Spring of 1993, interested experienced teachers from four school were asked to submit a statement reflecting their reasons for wanting to participate in such a project. Selection was based on recommendations from the on-site advisory board. The intent of the selection process was to provide a group of experienced teachers that was representative of the population in relation to teaching experience, background in mathematics, gender, and ethnicity. In the Spring of 1994, the same procedure was used to select a group of inexperienced teachers from a pool of students who volunteered to participate during their senior year in the university's elementary education program. Again, the intent of the selection process was to obtain a representative group of inexperienced teachers.

Data Collection

Baseline data regarding pedagogical content knowledge were collected in the Spring of 1993 for the inservice teachers and in the Spring of 1994 for the preservice teachers. Data for each teacher were gathered using the Survey on Teaching Mathematics (Rich, Lubinski, & Otto, 1994), a researcher-designed instrument that assists in describing pedagogical content knowledge. The survey consists of 12 questions primarily involving whole number operations, fractions, geometry, number sense, and mathematical reasoning. The open-ended questions, which focus on the instructional decisions a teacher would make in regard to specific classroom situations involving mathematics, are intended to extract information regarding the participants' own knowledge and beliefs about mathematics. This data provided the data set for the study. In order to simplify data analysis, one survey question was selected from each of the following topics: whole number operations, fractions, and geometry. The three questions were chosen based on the type of information elicited. That is, each of the selected questions presented a classroom situation in which the students had made a "common" error and the teacher was asked how he or she would respond and why. These questions seemed particularly appropriate for examining the teachers' knowledge of instructional methods (pedagogical knowledge) in addition to their pedagogical content knowledge.

Data Analysis

The data were analyzed using qualitative research methods. The teachers' pedagogical content knowledge was analyzed using Shulman's (1987) description of "pedagogical reasoning." According to Shulman (1987), the process of pedagogical reasoning involves comprehension and transformation. Teachers much first comprehend the content of instruction and then transform the comprehended ideas in some way for the purpose of teaching. Consequently, the teachers' interpretations, representations, and adaptations of the content were examined. It appears that teachers who possess only a procedural knowledge of mathematics are unable to transform and represent mathematical concepts and ideas in ways that make sense to their students (Ball & Wilson, 1990; Borko et al., 1992; Onslow, Beynon, & Geddis, 1992). Therefore, the participants' interpretations, representations, and adaptations of the content were and the responses coded in order to determine the degree to which their knowledge was procedural. Four main categories were used to classify responses: procedural only, both procedural and conceptual, conceptual only, or neither procedural nor conceptual.

The teachers' pedagogical knowledge was analyzed in terms of their approach to teaching mathematics as identified by Kuhs and Ball (1986). Thus, within each main category, responses were further classified using the following three categories. In the learner-focused approach to teaching mathematics, the teacher's role is to stimulate student learning by posing problems, designing experiences, and asking questions and to facilitate student learning by listening, probing, accepting, restating, and encouraging. The learner actively participates in the exploration of ideas, i.e. the learner is a creator of mathematics. In the content-focused with emphasis on understanding approach to teaching mathematics, the teacher's role is both to organize the content and to guide student learning. The learner is considered to be a discoverer of the mathematics presented by the teacher via the problems posed for investigation. In the content-focused with emphasis on performance approach to teaching mathematics, the teacher's role is to present material in an expository style, explaining concepts and demonstrating skills. The learner listens, responds to teacher questions, and does exercises using procedures that have been modeled by the teacher, i.e. the learner's role is to imitate the teacher.

Results

Given below are the results of one survey question from each of the following topics: whole number operations, fractions, and geometry.

Whole Number Operations

> *One day your students finish working on addition and subtraction with regrouping. On a written test, many of them "forget" to regroup when they need to in subtraction. Instead they do this:*
>
> $$\begin{array}{r} 60 \\ \underline{-28} \\ 48 \end{array}$$
>
> *a) What would you do and why?*
> *b) Why is this an appropriate thing to do?*
>
> *(NCTM, 1991)*

The results for the question involving whole number operations are summarized in Table 1. Fifteen of the preservice teachers and four of the experienced teachers focused exclusively on the procedure. A common response for this group of teachers was to "review how to subtract from back to front with a 0. Tell them to make the zero into a ten, turn the 6 into a 5, and then subtract." These teachers' approaches to teaching mathematics seem to fit with the content-focused with emphasis on performance approach described by Kuhs and Ball (1986), since most responded that they would tell or show the students what to do. Nearly all of the teachers in the study interpreted this as a "straightforward" regrouping problem. Only two of them, both preservice teachers in this group, responded directly regarding their interpretation of the content. One teacher claimed that "we . . . show that the zero in 60 is a 10 and 8 have to be taken away from it." The other responded that "I'll illustrate how to make the zero a 10 and the 6 a 5. I'll explain to them how the 10 is borrowed from the 6." The teachers in this group tended to rely primarily on the symbolic or algorithmic representation of the content. However, one experienced teacher did indicate that he or she would also "have them tell me if the answer is reasonable."

Five of the preservice teachers and 13 of the experienced teachers provided both procedural and conceptual responses to this question. It is interesting to note that all of the experienced teachers in this group except two said that they would "go back to manipulatives" first and "then bring [the students] back to pencil and paper," whereas only one of the preservice teachers expressed this idea and, in fact, three of them said that they would "review the process" and then "try hands-on methods" if necessary. One preservice teacher claimed that using base ten blocks "gives the child a physical explanation of why you cancel the six and make the zero a ten." While all of the teachers in this group mentioned the use of manipulatives as a way to represent the content in addition to the algorithm, four of the preservice teachers and ten of the experienced teachers responded that they "would [use the manipulatives to] model the procedure." One experienced teachers also mentioned the use of a problem solving context. Nevertheless, this approach to teaching mathematics also seems to fit with the content-focused with emphasis on performance approach (Kuhs & Ball, 1986), since the teacher is the one who is actually doing the manipulating. Just one preservice teacher and three experienced teachers in this group mentioned having the students use the manipulatives, either to do more problems involving regrouping or to check the problem above, "because it allows the student to discover his/her own error." Therefore, these teachers' approaches to teaching mathematics therefore seem to fit with the content-focused with emphasis on understanding approach described by Kuhs and Ball (1986), though only the preservice teacher mentioned the use of cooperative learning groups.

Six of the preservice teachers and eight of the experienced teachers gave only conceptual responses to this question. Like the previous group, almost all of the teachers in this group mentioned the use of manipulatives as a way to represent the content. Three of the preservice teachers and two of the experienced teachers said something like, "I would get out the [manipulatives] and demonstrate over how to do this problem and more like it. Evidently my first demonstration was too abstract. It needs to be more visual." Again, this approach to teaching mathematics seems to fit with the content-focused with emphasis on performance approach (Kuhs & Ball, 1986), since the teacher is the one using the manipulatives and the students are only observers. Two preservice teachers and five experienced teachers in this group mentioned having the students use the manipulatives instead, because "they would understand why they need to regroup." Of these, one preservice teacher and one experienced teacher mentioned the use of cooperative learning groups and one experienced teacher mentioned the use of a problem solving context. Rather than using manipulatives, one experienced teacher's conceptual explanation involved the use of estimation in a problem solving context. These teachers' approaches to teaching mathematics seem to fit with the content-focused with emphasis on understanding approach described by Kuhs and Ball (1986). Just one participant in the entire study, a preservice teacher in this group, mentioned having the "students . . . explain their thinking to better understand where and why they were making this mistake." Thus this teacher's approach to teaching mathematics seems to be the only one to fit with the learner-focused approach described by Kuhs and Ball (1986).

Finally, three of the experienced teachers' responses could not be categorized as either procedural or conceptual. One teacher simply stated that he or she would "go back and reteach with different strategies." Another teacher in this group said that, "I may go on to another unit and come back to it (subtraction) later as the students are obviously not ready for subtraction with regrouping." The third teacher discussed how he or she would assign grades for this test.

Table 1
Results for Question Involving Whole Number Operations

Response Categories	Procedural Only	Procedural and Conceptual	Conceptual Only	Neither Procedural nor Conceptual
Interpretation of the Content	"Straightforward" regrouping problem	"Straightforward" regrouping problem	"Straightforward" regrouping problem	"Straightforward" regrouping problem
Common Response	"Review how to subtract from back to front with a 0. Tell them to make the zero into a ten, turn the 6 into a 5, and then subtract."	Preservice Teachers: "Review the process" and then "try hands-on methods" if necessary. Inservice Teachers: "Go back to manipulatives" first and "then bring [the students] back to pencil and paper."	"I would get out the [manipulatives] and demonstrate over how to do this problem and more like it. Evidently my first demonstration was too abstract. It needs to be more visual."	"Go back and reteach with different strategies." "Go on to another unit and come back to it (subtraction) later as the students are obviously not ready for subtraction with regrouping."
Number of Preservice Teachers	15	5	6	0
Number of Inservice Teachers	4	13	8	3
Approaches to Teaching Mathematics	Content-focused with emphasis on performance (most responded that they would tell or show the students what to do)	Content-focused with emphasis on performance (4 preservice and 10 inservice teachers responded that **they** "would [use manipulatives to] model the procedure") Content- focused with emphasis on understanding (1 preservice and 3 inservice teachers)	Content-focused with emphasis on understanding (2 preservice and 6 inservice teachers mentioned having **students** use manipulatives) Content- focused with emphasis on performance (3 preservice and 2 inservice teachers)	

Fractions

Suppose you are working with a group of students on addition and subtraction of fractions. Several of them are solving problems as shown below:

$$1/2 + 1/3 = 2/5$$

When asked about their solution they respond, "Jane made one out of two free throws in the first half and one out of three in the second. So, she made two out of five in the game."

a) What do you respond?
b) Why do you respond this way?

Table 2 summarizes the results for this fractions question. Thirteen of the preservice teachers and 11 of the experienced teachers focused solely on the procedure by relying primarily on the algorithmic representation of the problem, again taking an approach to teaching mathematics that seems to fit with the content-focused with emphasis on performance approach described by Kuhs and Ball (1986). This group provided four different interpretations of this problem. Ten preservice teachers and six experienced teachers gave responses involving or related to the idea that "when adding and subtracting fractions, you must find a common denominator." Two preservice teachers equated this with "shooting" the same "number of shots in each half." One preservice teacher stated that "the denominator must be the same because you are adding two parts of a whole and not two separate parts of two separate wholes." Similarly, one experienced teacher wrote "we need to look at the total number of shots as our denominator so that one out of five and another one out of five gives us a total of two out of five." One preservice teacher and two experienced teachers commented that they "would explain the difference between ratios and fractions." One preservice teacher responded that "1/2 could also be used to represent three out of six or five out of ten [which] would not [give] the same answer." And finally, one experienced teacher gave the following explanation: "Jane made 1/2 of her free throws in the first half and 1/3 of her free throws in the second half. What fraction of her free throws did she make during the game? Did she make more than 1/2 of them or less than 1/2 of them." One preservice teacher and two experienced teachers in this group avoided interpreting the problem by offering comments like "I would have to agree that their logic makes sense, but I would suggest we take another look at the process of adding fractions and the steps we needed to take."

Four of the preservice teachers and four of the experienced teachers provided both procedural and conceptual responses to this question. In addition to using the algorithm, three of the preservice teachers and two of the experienced teachers in this group said that they would draw pictures or use manipulatives to represent the problem, taking an approach to teaching mathematics that also seems to fit with the content-focused with emphasis on performance approach (Kuhs & Ball, 1986). The other three teachers in this group stated that they would have the students draw a picture or try using manipulatives in order to “lead them to discover you have to have a common whole,” thereby taking an approach to teaching mathematics that seems to fit more with the content-focused with emphasis on understanding approach (Kuhs & Ball, 1986). This group also provided four different interpretations of the problem. Three preservice teachers and two experienced teachers claimed “that in order to add fractions, the denominators must be the same.” One preservice teacher mentioned that “[fractions are] parts of a whole . . . they need to learn the difference between ratio and . . . fraction.” One experienced teacher claimed “that this answer would show percentage rather than the solution to the fraction problem.” Another experienced teacher said that he or she “would . . . show the student that . . . ½ is not necessarily one out of two but may be two out of four.”

Four of the preservice teachers and eleven of the experienced teachers gave only conceptual responses to this question. This time three preservice teachers and six experienced teachers in this group mentioned drawing pictures or showing with manipulatives, an approach to teaching mathematics that seems to fit with the content-focused with emphasis on performance approach (Kuhs & Ball, 1986). The remaining six teachers in this group suggested having the students draw pictures or use manipulatives in order to “find their mistakes,” an approach to teaching mathematics that, as previously stated, seems to fit with the content-focused with emphasis on understanding approach (Kuhs & Ball, 1986). This group provided three different interpretations of this problem. One preservice teacher and four experienced teachers gave responses like “ratios work differently than fractions [which are] parts of a whole.” One preservice teacher and one experienced teacher claimed that “we must combine like things.” Two preservice teachers and five experienced teachers offered responses related to the idea of using the same whole. One experienced teacher in this group avoided interpreting the problem.

Five of the preservice and two of the experienced teachers’ responses could not be categorized as either conceptual or procedural. Four preservice teachers and one experienced teacher believed that the student’s solution was correct. In fact, one preservice teacher commented, “If this is an easy way for students to remember how to add fractions, then I would use “fun” examples like this when I explain the addition of fractions.” One preservice teacher admitted that he or she did not know how to respond, since “the logic is rational” but the answer is wrong. One experienced teacher responded mysteriously, “I wonder what Jane would say about you saying that she made only two out of five shots? I think she might be a bit upset. See if you can figure out why I am saying this.”

Table 2
Results for Question Involving Fractions

Response Categories	Procedural Only	Procedural and Conceptual	Conceptual Only	Neither Procedural nor Conceptual
Interpretation of the Content	10 Preservice and 6 Inservice Teachers: "When adding and subtracting fractions, you must find a common denominator." 1 Preservice and 2 Inservice Teachers: Ratios and fractions are different.	3 Preservice and 2 Inservice Teachers: "In order to add fractions, the denominators must be the same." 1 Preservice Teacher: "[Fractions are] parts of a whole ... ratio[s] and fraction[s]" are different.	2 Preservice and 5 Inservice Teachers: Offered responses related to the idea of using the same whole. 1 Preservice and 4 Inservice Teachers: "Ratios work differently than fractions [which are] parts of a whole."	4 Preservice and 1 Inservice Teacher: Believed that the student's solution was correct. 1 Preservice Teacher: "The logic is rational" but the answer is wrong.
Number of Preservice Teachers	13	4	4	5
Number of Inservice Teachers	11	4	11	2
Approaches to Teaching Mathematics	Content-focused with emphasis on performance (relied primarily on the algorithmic representation of the problem)	Content-focused with emphasis on performance (3 preservice and 2 inservice teachers responded **that** theywould draw pictures or use manipulatives to represent the problem, in addition to using the algorithm) Content- focused with emphasis on understanding (1 preservice and 2 inservice teachers)	Content-focused with emphasis on performance (3 preservice and 6 inservice teachers) Content-focused with emphasis on understanding (1 preservice and 5 inservice teachers mentioned having students draw pictures or use manipulatives)	

Geometry

> *The following problem is posed to a group of students. "Suppose you had 64 meters of fence with which you were going to build a pen for your large dog, Bones. What are some different pens you could make if you use all the fencing? What is the pen with the least play space? What is the biggest pen you can make - the one that allows Bones the most play space? Which would be the best for running?" After considering the problems, the students explain that it doesn't matter since all the pens will have the same perimeter - 64 meters.*
>
> *a) Explain why they gave this response.*
>
> *b) How would you respond to their solution?*
>
> *c) Explain.*
>
> *(NCTM, 1991)*

Table 3 shows the results of this geometry question. Just one experienced teacher provided a response to this question that was both procedural and conceptual, since he or she was the only one that specifically mentioned an area formula. "I would first of all draw a picture showing the different areas that have a perimeter of 64 meters. I would point out how to find area — length x width." This teacher's approach to teaching mathematics seems to fit with the content- focused with emphasis on performance approach (Kuhs & Ball, 1986). Though all of the other teachers attempted only conceptual responses, 18 of the preservice teachers and seven of the experienced teachers mentioned that they themselves would draw pictures or use manipulatives to demonstrate, an approach to teaching mathematics which also seems to fit with the content-focused with emphasis on performance approach (Kuhs & Ball, 1986). One preservice teacher claimed that "an example from the teacher . . . lights up the bulb! Then the students are off and running." Eight of the preservice teachers and 18 of the experienced teachers instead suggested having the students engage in these sorts of activities, thereby taking an approach to teaching mathematics that seems to fit with the content-focused with emphasis on understanding approach (Kuhs & Ball, 1986). One experienced teacher did not respond to this question at all and one experienced teacher's response could not be categorized. He or she stated that "the students didn't want to go to the work of figuring this problem."

There were three different interpretations given. Though 19 preservice teachers and 12 experienced teachers specifically mentioned something to the effect that "[the students] were confusing perimeter with area," 13 preservice teachers' and 15 experienced teachers' responses were limited to the consideration of rectangular pens only. One preservice teacher claimed that of these, the "square produces [the] most area." Five preservice teachers and one experienced teacher at least included the possibility of a circular pen and three preservice teachers and one experienced teacher also mentioned the use of other polygonal figures. One experienced teacher focused in part on definitions of perimeter and area, by "explain[ing] to them that area is the amount of space an object covers and the perimeter is the length and width of an object." Finally, two experienced teachers claimed that the solution was correct. For example, "While they are correct I would encourage them to look at . . . what would be an interesting and creative way to use an area." Only four teachers mentioned using cooperative learning groups.

Table 3

Results for Question Involving Geometry

Response Categories	Procedural Only	Procedural and Conceptual	Conceptual Only	Neither Procedural nor Conceptual
Interpretation of the Content		1 Inservice Teacher: Offered response limited to the consideration of rectangular pens only.	13 Preservice and 15 Inservice Teachers: Offered responses limited to the consideration of rectangular pens only. 5 Preservice and 1 Inservice Teacher: Included the possibility of a circular pen. 2 Inservice Teachers: Believed that the student's solution was correct.	1 Inservice Teacher: Did not respond to this question at all. 1 Inservice Teacher: "The students didn't want to go to the work of figuring this problem."
Number of Preservice Teachers	0	0	26	0
Number of Inservice Teachers	0	1	25	2
Approaches to Teaching Mathematics		Content-focused with emphasis on performance (1 inservice teacher responded that "I would ... draw a picture showing the different areas that have a perimeter of 64 meters. I would point out how to find area--length x width.")	Content-focused with emphasis on performance (18 preservice and 7 inservice teachers responded that theywould draw pictures or use manipulatives to demonstrate) Content- focused with emphasis on understanding (8 preservice and 18 inservice teachers suggested heaving students demonstrate)	

Discussion

Approximately one-half of the preservice teachers' responses to the questions involving whole number operations and fractions (57.7% and 50% respectively) were procedural only, somewhat supporting the findings which seem to indicate that novice teachers possess primarily a procedural knowledge of mathematics (Ball & Wilson, 1990; Borko et al., 1992). The research results suggesting that novice teachers think that a good teacher is one who shows and tells students how to do the work (Ball & Wilson, 1990; Borko et al., 1992; Onslow, Beynon, & Geddis, 1992) were also supported, since more than two-thirds of the preservice teachers' responses to all of the questions (84.6% for whole number operations, 73.1% for fractions, and 69.2% for geometry) fit with the approach to teaching mathematics that emphasizes performance (Kuhs & Ball, 1986).

Unlike the preservice teachers, very few of the experienced teachers (14.3%) gave strictly procedural responses to the question involving whole number operations. The fact that 75% of them as opposed to only 42.3% of the preservice teachers suggested the use of manipulatives seems to indicate that experienced teachers possess a greater conceptual understanding of whole number operations than do novice teachers. However, many more experienced teachers (about the same number as preservice teachers -- 39.3%) gave strictly procedural responses to the question involving fractions. This seems to suggest that experienced teachers have a greater conceptual understanding of whole number operations than they do of fractions. In addition, more than one-half of the experienced teachers' responses for the questions involving whole number operations and fractions (57.1% and 67.9% respectively) fit with the approach to teaching mathematics that emphasizes performance (Kuhs & Ball, 1986). Together these results seem to indicate that neither pedagogical knowledge nor pedagogical content knowledge is necessarily acquired through practical experience.

Though nearly all of the teachers provided conceptual responses to the question involving geometry, the fact that a great many of their interpretations were limited to the consideration of rectangular pens only seems to suggest that their understanding of this topic is severely restricted. One wonders whether more procedural responses would have been given if the teachers had thought of other possibilities. One also wonders what effect this limited interpretation has on the teacher's approach to teaching mathematics, since more experienced teachers gave responses to this question that fit with the approach which emphasizes understanding than with the approach which emphasizes performance (Kuhs & Ball, 1986).

To become a good mathematics teacher requires thoughtful reflection. Both novice and experienced teachers, themselves the products of traditional mathematics classrooms, need to revisit and extend their own mathematical understandings. They need opportunities to explore, identify, and challenge their assumptions about the teacher's role, as well as to develop pedagogical content knowledge.

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Book Review

Dismantling Desegregation

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Readers are asked to review recently published or classic books in education and research. In his review of Dismantling Desegregation, *Watras acknowledges the authors' contribution to the discussion of urban education but challenges their indirect approach to addressing abstract considerations underlying the complex issue of racial integration in schools and communities.*

Orfield, G. & Eaton, S. E. (1996). *Dismantling desegregation: The quiet reversal of Brown v. Board of Education*. New York: New Press. Pp. 424.

In 1993, the National School Boards Association issued a report from the Harvard Project on School Desegregation citing an increase in racial segregation. For example, from 1986 to 1991, the proportion of Black students attending schools with more than half minority students rose to the level that had existed before the U.S. Supreme Court's first busing decision in 1971. During the same period, the share of Black students in schools with 90-100 percent minority students rose.

Calling the trend the "quiet reversal" of *Brown v. Board of Education,* Gary Orfield, Susan E. Eaton, and the Harvard Project on School Desegregation build on the data they presented in 1992. Their new book, *Dismantling Desegregation*, is a series of eleven essays written by eight people. Orfield and Eaton wrote six of the chapters, and they revised the others to harmonize their structure, analysis, and conclusions. Some chapters are better written than others. Often, the same information appears in several places, and the book suffers from such editing problems as different dates cited for the same U.S. Supreme Court decision and misspelled words. Nonetheless, the arguments proceed logically.

Orfield begins with a description of the cases on which the U.S. Supreme Court built federal desegregation law. He claims the Detroit case, *Milliken v. Bradley*, was the first major blow against school desegregation. He contends that in *Milliken,* the Supreme Court restricted desegregation in the North by making it more difficult for a court to join suburban and urban districts. However, Orfield believes that the Supreme Court used three decisions to allow even Southern states to return to such segregative practices as neighborhood schools. The cases were: *Board of Education of Oklahoma City v. Dowell* in 1991, *Freeman v. Pitts* in 1992, and finally *Missouri v. Jenkins.* Orfield says that these decisions require only that school officials claim that their policies will improve education.

In the next chapter, Orfield argues that efforts such as compensatory education to improve segregated schools recall *Plessy v. Ferguson's* inadequate standard of separate but equal. This occurs because courts have held that private decision making and economics may cause racial segregation. In such cases, segregation appears to be a normal state of affairs. The unfortunate result is that blame for the failure of minority children in segregated schools falls on the children, their families, or the school teachers. But the teachers of segregated classes cannot easily create a curriculum that compensates for the students' deficiencies. More frequently, the teachers feel they must "water down" the curriculum. Citizens may blame urban school administrators, who are usually Black, for the low test scores of their students. As a result of public pressure, urban administrators lose their positions after an average of three years and rarely have time to carry out any reasonable reforms.

According to Orfield and Eaton, segregation is dangerous because racially integrated schools have better resources than segregated facilities. Further, students in racially integrated schools bring fewer problems to the buildings than do the students in segregated settings. As a result, despite efforts to make segregated schools effective, African American or Latino students who attend racially integrated schools have a better chance of finishing college than the same type of students with similar test scores from segregated high schools.

Some sociologists blame federal desegregation efforts for the rising tide of racial isolation. From 1972 to 1992, the enrollment of White students in public schools fell 14 percent while the number of Black students rose 3 percent and Latino enrollments soared 89 percent. Citing this trend, some sociologists contend that White students fled public schools to avoid busing. Orfield and Eaton disagree, however, because White enrollments in private schools fell over the same twenty-year period. For Orfield and Eaton, the causes of increasing segregation were more basic. First, from 1968 to 1986, the total number of white students fell sharply as birth rates dropped. Second, most White students attended suburban public schools rather than urban ones. Each year from 1985 until 1990, central cities lost 1.6 to 3.0 million residents while the surrounding suburbs gained 1.9 to 3.2 million persons. Most of the expansion in suburban communities was due to increased numbers of middle class and White residents. Furthermore, contrary to popular belief, the presence or the absence of an urban school desegregation plan did not alter the migration. New York, Chicago, and Houston never had busing plans, yet the White population declined in those cities. Los Angeles had a limited busing plan for a few months. When the busing ended, White flight continued.

Despite these dismal findings, schools do not have to remain segregated. Orfield and Eaton believe that metropolitan desegregation would provide urban minority students access to suburban schools with middle class students. Further, with metropolitan plans, people from an entire area may participate in the reform of public schools.

Next, Orfield examines four misconceptions that justify lifting a desegregation order, thus allowing a return to neighborhood schools and resegregation. The first misconception is the view that segregated classrooms can be effective with the proper administrative or instructional model. Anecdotal evidence for this view derives from such highly publicized success stories as Marva Collins or Jaime Escalante. However, segregated classrooms function worse than do integrated ones. A second misconception is that Whites will remain in a city or return to it if the courts lift a desegregation order. According to Orfield, this simply does not happen. A third misconception arises when school districts present themselves as free from discrimination. The increase in the number of Black administrators seemed to bolster this view. However, Black administrators cannot solve the systemic problems of city schools. Finally, officials often present a claim that costs will go down when desegregation mandates end. However, if popular innovations such as magnet schools persist, costs may actually increase.

Chapters five through ten present case studies of such cities as Norfolk, Virginia; Detroit, Michigan; Little Rock, Arkansas; Charlotte, North Carolina; Kansas City, Missouri; and Prince George's County, Maryland. These show the problems associated with monetary compensation for disadvantaged schools, with local control of schooling, and with magnet schools.

In the last substantive chapter, Orfield returns to discuss housing segregation. Although the Nixon and the Carter administrations considered some housing dispersal programs, Orfield contends that these programs ended before they could prove their utility. The Clinton administration has been unable to overcome congressional resistance to such intrusions in local affairs.

In his conclusion, Orfield offers several policy suggestions to make desegregation a step in the transformation of segregated institutions into integrated communities. These include asking lawyers and citizens' groups to represent the rights of minority children in courts. He calls for the careful monitoring, evaluation, and improvement of desegregation plans. Orfield asks the media to engage in careful analysis rather than to accept official statements uncontested. However, he acknowledges that accurate information is not readily available in part because neither the federal government nor private foundations offer to support research about racial desegregation. Finally, Orfield suggests that school officials and housing agencies work together to foster integration. One example of the way this could happen is to build neighborhood schools only in integrated neighborhoods.

In all, Orfield and Eaton seem to believe that good social science can help people reform society. As a result, they make a moral plea for desegregation without delving into abstract considerations. Unfortunately, I do not share their faith. I think the moral or religious considerations of racial integration deserve much more direct attention. In general, from 1954 until 1963 the battle to racially integrate schools and society followed a legal route. For example, in Little Rock, Arkansas, the desegregation of Central High School was termed a question of state's rights. When Martin Luther King, Jr. expressed his disappointment with legal solutions, he encouraged people to resist evil without violence. However, this aim did not offer clear direction. People engaged in nonviolent marches to advance segregationist policies saying they wished to fight the evil they saw in court ordered racial integration.

Orfield and Eaton observe how the aims of multiculturalism and meritocracy can reinforce segregation. However, simply showing that something causes segregation will not convince people that they should live in integrated settings. Nor does it help to show that minorities suffer under racial segregation. For example, from 1964 to 1974, all sides in the controversy about racial desegregation claimed to be advancing human rights. Even social scientists could not straighten out these conflicting claims. More important, the federal government reinforced each type of claim at one time or another. Liberals asserted that Black children have a right to attend racially integrated schools, and the 1964 U.S. Civil Rights Act reinforced those views. Conservatives argued that children had a right to attend a neighborhood school, and the U.S. Congress tried to block court ordered busing. Black activists said that minority parents have the right to control their children's schools, and the U.S. Department of Health, Education, and Welfare offered Model Cities grants to develop such programs. In this light, it is possible to read *Milliken* as showing that the U.S. Supreme Court did not block desegregation as Orfield believes. The decision could reflect the unwillingness of the justices to reinforce anyone's rights. Instead, the justices chose to correct only illegal acts.

My bias is that if we are to have racial integration, people must think that it benefits the society as a whole and them in particular. On the other hand, Orfield and Eaton see policies as more important than philosophy. They point to Charlotte, North Carolina, as a city that voted out the plans of a superintendent to resegregate the schools. The authors contend that the 1971 court ordered busing convinced the community that desegregation and academic achievement went together. Subsequent conservative criticisms of busing weakened this faith but never destroyed it.

From such histories, Orfield and Eaton seem to believe that good information can convince people that there are a variety of potentially successful techniques to desegregate schools or communities. I think that most people know that those methods could work. Consequently, I feel that it is most important to express clearly and completely the reason for applying these strategies. Whichever perspective you hold, Orfield and Eaton's book is an important contribution to the discussion of urban education.

Explorations of Preservice Teachers' Learning Strategy Use

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Abstract

The objectives were to identify learning strategy strengths and weaknesses of preservice teachers (n = 90) in an entry level educational psychology course that incorporated strategy instruction. Strategy use was assessed at the beginning and end of the course by the Learning and Study Strategies Inventory (LASSI), a diagnostic inventory of 10 scales. A comparison of mean percentiles with LASSI norms on all scales indicated need for remediation by students. The results indicated that learning strategy scores varied according to student GPA and final course grade. Implications for preservice teachers as learners and potential teachers of strategies were discussed.

What do we know about strategy use of college students and preservice teachers? With the onset of the research on cognition, the role of the learner in acquisition of content has received increased emphasis (Weinstein & Mayer, 1986), that is, the student's activities or strategies are seen as a key component in successful learning. This in turn has led to an increased interest in learning strategy instruction (Chipman & Segal, 1985; Phye & Andre, 1986) including increased research about the strategy use of postsecondary students and programs to train strategy use at this level (McKeachie, 1987; Weinstein & Underwood, 1985).

The initial concern for the need for strategy instruction at the postsecondary level was focused primarily on the underprepared or at-risk student (McKeachie, 1987; Weinstein & Underwood, 1985). There is increasing evidence that many college students, not just those categorized as "at-risk," are in need of strategy instruction if they are to perform well. Simpson (1984) reported that college freshmen were deficient in several areas: possessed restricted range of strategies, lacked an understanding of why a strategy was important to their own learning processing, and used one strategy for most learning tasks regardless of the content area. In a study of 514 college freshmen, Hulick & Higginson (1989) found: students scored lower than the normed sample on a measure of learning strategy use, the Learning and Study Strategies Inventory (LASSI); students who used strategies had higher grades at the end of the freshman year; and students who scored lower on several subscales judged college to be more difficult. In support of the need for strategy instruction at the college level, only 24% reported they had even minimal training in the use of learning strategies prior to college.

This concern with learning strategy proficiency extended to the learning strategy use of students who are enrolled in teacher education programs in this university. From observations and informal assessment of student strategy use, it was inferred that many students had a limited repertoire of strategies. On this basis weekly "mini-lessons" in strategy use and student learning logs were included in an undergraduate educational psychology course. Descriptive data gathered through student learning logs gave a clearer picture of the preservice teachers as learners (Alderman, Klein, Seeley & Sanders, 1993). The students were categorized as successful, improving, and less successful. Students identified as successful and improving reported more use of specific as opposed to general strategies, set specific as opposed to general goals, and engaged in more self monitoring behavior. From these data, the authors concluded that there is a need to identify, through assessment, more specific strategy needs in order to provide more effective instruction.

The present approach to learning strategy assessment is a reflection of the cognitive research of recent years. Focus of cognitive research in the seventies and eighties was on remediation of learning deficits in academically underprepared students (Weinstein, 1988). This led to a need to identify a means of assessing student deficiencies in order to provide appropriate remediation.

Prior assessment approaches focused on traditional "study skill" areas such as notetaking and test taking and tended to use a "correlational design" (Svensson, 1977). Since items were created on the basis of how well they distinguished between students with high and low grade point averages, they provided little information about how students study or learn. In contrast, a "functional approach" to assessment identifies differences in how students learn, which directly affects learning and academic outcomes (Svensson, 1977).

The Learning and Study Strategies Inventory (LASSI) (Weinstein, Palmer, & Schulte, 1987) was developed as a functional approach. The LASSI consists of ten scales: attitude -- attitude and interest in college; motivation -- willingness to work hard and take responsibility for own effort; time management -- organization and scheduling of time; anxiety -- degree of worry about school and performance; concentration ability to pay close attention to academic tasks; information processing -- imaginal and verbal elaboration; selecting main idea -- ability to pick out most important ideas; study aids -- use of support techniques or materials; self-testing -- comprehension monitoring; test-taking strategies -- preparation for exams. The scoring manual provides norms for the subscales with suggestions that students above the 75th percentile do not need remediation; those between 75th and 50th percentiles should consider improving relevant strategies in order to optimize performance, while those below the 50th percentile need to improve in order to have a chance of success in school (Weinstein, 1987).

The functionality of the LASSI as a measure is supported to some degree by Hulick & Higginson (1989). It was found that low and high GPA (above and below 2.75) students differed significantly on six subscales: attitude, motivation, anxiety, concentration, information processing, and test taking skills.

Our purpose in this exploratory study was to determine the learning strategy proficiency of preservice teachers to determine if course success could be predicted by strengths and weaknesses of reported learning strategy use. If differences existed between successful and unsuccessful student scores, a second purpose was to identify strategies used by the successful students. The specific research questions addressed were:

1. What learning strategy patterns are reported by preservice teachers and how do these compare to the established norms of the LASSI?
2. How do learning strategy patterns of preservice teachers vary according to specified GPA groups?
3. What were relationships between learning strategy patterns and course grade?
4. Do gain scores from entry to exit vary according to GPA group membership?

Method

Subjects and Assessment

The subjects (n=90) were enrolled in two sections of a sophomore level educational psychology course in an open-admission university. Approximately 68 percent of these students were female. The course is required for all preservice teachers although most students had not applied for admittance to the College of Education prior to taking the course. The GPA breakdown for all sections are shown in Table 1.

Table 1
Subjects by GPA Categories

GPA Category	Percentage of Class
3.6–4.0	12.2
3.1–3.5	23.9
2.6–3.0	36.1
2.1–2.5	22.4
< 2.0	5.4

Instruments

Survey. During the first week of the semester, students were given a preassessment which consisted of questions about their perceived expectations for performance in the course, course difficulty (Likert scale ranging 1-7 with 1 low) adequacy of learning strategies for making an A or a B (Likert scale 1-7), and GPA.

LASSI. The LASSI (Weinstein, Palmer, & Schulte, 1987) was administered the first week of the course and the last week. The test consists of 77 items distributed across ten scales. Students respond to each item from “not at all typical of me” to very much typical of me.” Items are scored on a likert scale of 1-5. Total scores are not used since the instrument was designed as a diagnostic one. Test-retest reliability coefficients on each of the scales run from .64 to .81. Several of the scales have been validated against performance measures. Scores on the “selecting main idea” scale have been compared to student’s scores on selecting main ideas from texts and other readings (r=.40). The scoring manual provides a graph for raw scores on subscales to be converted to established norms in order to use established norms for comparisons (Weinstein, 1987).

Course Description

This course consisted of two large group sessions per week and one small group session. Major goals of the course were for students to learn the course content at application level and become effective learners themselves. The two primary evaluation criteria were five multiple choice exams and seven case studies. The grading system was criterion based allowing the first four exams to be retaken with the two grades averaged together. Learning strategy instruction was built into the course and consisted of:

*Weekly strategy mini-lessons***.** These were presented in the large group sessions and were about fifteen minutes in duration. The lessons included: PQ4R (preview, question, read, recite, reflect, review) (Thomas & Robinson, 1972), goal setting, summarization, keyword and other mnemonics, and test taking tips.

STEPS To Successful Performance Manual (Alderman, 1989). This was a motivation and learning strategy manual developed for the course, providing expectations for performance and suggestions for motivational and cognitive strategy improvement.

Learning strategy labs. These were voluntary adjunct labs offered weekly to provide more extensive strategy training for students who opted to do this.

Learning logs. The purpose of the logs was to foster metacognitive awareness. Students wrote weekly about their learning strategies and received feedback every two weeks from their instructor.

Results

Survey

The preassessment data of rankings of course difficulty (1-7) and adequacy of learning strategies for making an A or B (1-7) found that the three upper GPA categories (from 2.6 - 4) rated course difficulty as 4.5 with the lower two groups rating it 4.7 and 4.9 respectively. All GPA groups except those below 2.5 rated adequacy of study skills for attaining an A or B above 5.5. Those below 2.6 rated adequacy 4.8 and 4.3 respectively.

Norm comparisons - patterns. What learning strategy patterns do preservice teachers report and how do these compare to the established norms of the LASSI? Entry and exit group mean percentiles are displayed in Figure 1 as they compare to the norms for the LASSI. Group means for the LASSI pretest showed that these students scored near the 50th percentile as compared to the norms presented on the LASSI graph. Group means for this population ranged between the 45th percentile and the 60th percentile. As a group the highest scores were on the Attitude and Concentration subscales followed by Time Management, Use of Study Aids, and Self Testing strategies. The lowest subscale score was Information Processing. Motivation, Anxiety, and Selecting the Main Idea subscale scores fell around the 50th percentile.

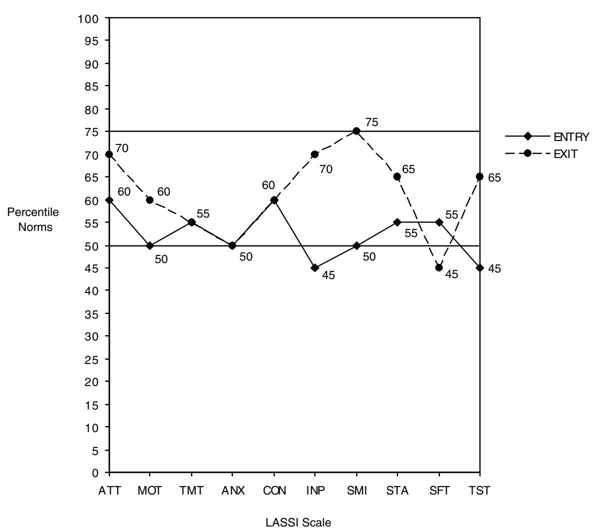

Figure 1. LASSI entry and exit mean percentile scores.

LASSI patterns by GPA categories. At course entry, do learning strategy patterns of preservice teachers vary according to specified GPA groups? A MANOVA was conducted to determine if there were significant differences among the four GPA groups on the 10 scales of the LASSI. The results indicated significant differences on six of ten scales. The Wilk's lambda approximate *F* value was significant $\underline{F}$ (4, 69) = 7.60, $\underline{p}$ < .0001.

Following a significantly different MANOVA, univariate analyses of variance were performed on each scale to determine which variables displayed significant mean differences. The variables with significant differences were: Attitude, $\underline{F}$ (4, 69) = 4.91, $\underline{p}$ < .0015; Motivation, $\underline{F}$ (4, 69) = 3.21, $\underline{p}$ < .018; Time Management, $\underline{F}$ (4, 69) = 3.16, $\underline{p}$ < .02; Anxiety, $\underline{F}$ (4, 69) = 4.99, $\underline{p}$, < .0014; Concentration, $\underline{F}$ (4, 69) = 5.18, $\underline{p}$ < .0010; Test Strategies, $\underline{F}$ (4, 69) = 7. 60, $\underline{p}$, < .0001. Scheffe post hoc tests, with an alpha level of .05, were performed on variables showing significant differences. These tests indicated upper GPA groups scored higher than lower groups in all cases. On the Attitude scale, GPA 3.1- 3-5 had higher scores than 2.1 - 2.5; on Anxiety, GPAs from 3.1 to 4.0 were higher than 2.0 - 2.5 ; on Concentration 4.0 scored higher than 2.1-2.5; on Test Strategies, 4.0 was higher than the two lowest categories, 2.1 - 3.0.

Of major interest to us is how means for each GPA category compare with LASSI norms. When means were placed on the normed graph (see Figure 2) each GPA group had a different pattern of learning strategy use. A very exaggerated pattern difference can be seen between students above and below a GPA of 3.0. This is consistent with results from the MANOVA.

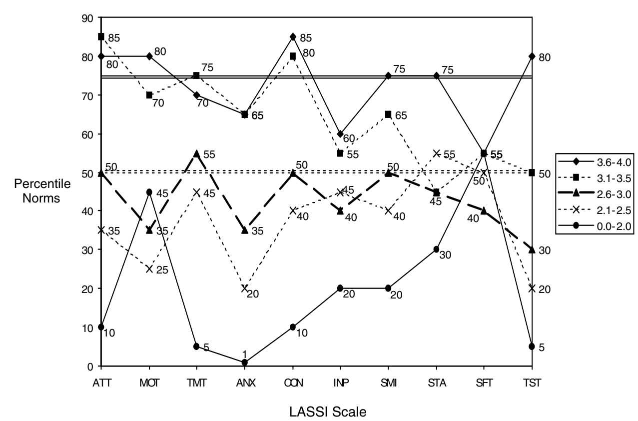

Figure 2. LASSI mean entry percentile scores for each college GPA level.

LASSI patterns and relationships to final course grade. What were relationships between entering LASSI patterns and course grade? A MANOVA was conducted to determine if there were significant differences among the course grade groups (A, B, C, D) on the 10 scales of the LASSI. The results indicated significant differences on three of ten scales. The Wilk's lambda approximate *F* value was significant $\underline{F}$ (3, 63) = 3.60, $\underline{p}$ < .016.

Having found significant differences using the MANOVA, univariate analyses of variance were performed on each scale to determine which variables displayed significant mean differences. To determine where these differences were, i.e. between which course grade groups, post hoc analyses using the Scheffe test were performed on variables where significant F-tests had been found. Those scales with significant F's follow: Motivation, $\underline{F}$ (3, 63) = 6.22, $\underline{p}$ < .0009; Concentration, $\underline{F}$ (3, 63) = 3.42, $\underline{p}$ < .022; Test Strategies, $\underline{F}$ (3, 63) = 3.69, $\underline{p}$, < .016. For each of the significant differences (alpha 05), students who scored higher in the course had higher LASSI scale scores. On the Motivation scale, the A students had higher scores than both the C and D students; the difference in means were 6.064 and 7.014 respectively. For both Concentration and Test Strategies, A students had scores significantly higher than C students; the difference in means were 6.107 and 4.893 respectively.

Predictors of final grade. To determine which variable accounted for the most variance in final grade, each of the LASSI entry scores was regressed on the final grade. The only variable which accounted for a significant amount of variance was Motivation, $\underline{F}$ (3, 63) = 9.763, $\underline{p}$ = < 0.0027. No other LASSI variable contributed enough variance within the final grade to be significant.

When each of the LASSI exit scores was regressed on the final grade, this changed. Test Strategies accounted for a significant amount of variance in final grade, $\underline{F}$ (3, 63) = 31.657, $\underline{p}$ < = 0.0001; the R2 full model = 0.5482 and the R2 restricted model = 0.3857. When the regression procedure was used to test the amount of variance college GPA accounted for, it, too, was significant, $\underline{F}$ (3, 63) = 17.6428, p = 0.0001. R2 full = 0.4835 and R2 restricted = 0.3048.

Do gain scores from entry to exit vary according to GPA group membership? When pre- and posttest scores were plotted on the normed graph, students appeared to separate at the 3.0 level. GPA groups were then collapsed to two categories, greater and less than 3.0. To determine whether one GPA group or other gained more from entry to exit, multivariate pair-wise t comparisons was conducted. None of the scales produced a significant t indicating that neither category gained more than the other from entry to exit.

Discussion

What learning strategy patterns were reported by this population of preservice teachers and how do these scores compare with national norms? Weinstein (1987) reports that the 75th percentile is a common cutoff score for determining which students need intervention. Students between the 50th and 75th percentiles should consider improving relevant strategies in order to optimize performance, while those below the 50th percentile need to improve in order to have a chance of success in school. When LASSI subscale scores for this population were compared to the national norms, percentile mean scores ranged from the 45th to the 60th percentile. This indicates that, as a group, students are in need of some learning strategy improvement. The students were weakest in: Motivation - willingness to work hard and take responsibility for their own learning; Anxiety - degree of worry about school and performance; Information Processing - imaginal and verbal elaborations; Selecting The Main Idea - ability to pick out most important ideas; and Test Strategies - preparation for exams.

What do these scores mean for a group of predominantly sophomore preservice teachers? From survey of strategy adequacy and entry LASSI score, it appears that, as a group, these students were somewhat unaware of their learning strategy strengths and weaknesses in relation to course difficulty. On the survey, they rated adequacy for making an A or B as 4.3 or higher while 65 percent had a GPA below a 3.1. They tended to underrate course difficulty while overestimating their strategy proficiency. Although we did not determine previous learning strategy instruction of these students, in the Hulick and Higginson (1989) study, only 24 percent reported having had even limited instruction in any learning strategies prior to college.

In the present study, group means appeared to mask informative data. How did students vary across GPA groups? Once the entry scores were plotted by GPA group, variability among groups was evident. It appears that these students tended to separate into two groups, at the 3.0 GPA level. Although clear differences can be seen between these two groups on the motivational scales, the actual learning strategy means are more erratic and less definitive as seen in Figure 2. The erratic pattern on learning strategies may be an indication that students coming into this course lack a core set of learning strategies.

Which LASSI scores indicated differences by final grade? Three scales which showed significant differences by final grade were Motivation, Concentration and Test Strategies. On each of these three scales, students making an A had higher entry scores than other grade levels. According to descriptions of scales, these students are described as willing to work hard, accept responsibility for performing tasks related to course success, focus their attention on the task at hand, and know about characteristics of tests, test items, and test preparation.

How do end of course LASSI scores compare to beginning scores? For the whole group, all scales increased except Time Management, Concentration, Anxiety, and Test Strategies and no scales decreased. One important finding is that students above and below 3.0 GPA gained equally on the LASSI. Thus high and low GPA categories are in need of learning strategy instruction.

The patterns described in this study reveal that students entering teacher education cannot be assumed to possess a repertoire of effective learning strategies. Who needs intervention? From this data, it appears that almost all preservice teachers in this open admission university were in need of some degree of strategy intervention. For students at the upper GPA levels, more effective strategies will enable them to optimize performance as they proceed to upper level courses. Students at the lower GPA levels need more effective strategies to improve chance of success in college and to do more than "get through" their teacher education program. If preservice teachers are to become teachers of learning strategies, teacher educators must help them develop this repertoire.

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Presidential Address 1995

Minds-on and Hands-on Activity: Improving Instruction in Science for All Students

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Abstract

This paper briefly reviews evidence on gender inequities in science education. It argues that making science instruction more effective is one way in which greater equity can be achieved. A line of research conducted in my laboratory dealing with conceptual change (CC) approaches to science instruction is discussed. CC instruction explicitly activates students' pre-existing conceptions, leads students to be dissatisfied with less than adequate conceptions, and helps students construct more effective conceptions. Across several studies, CC instruction was found to be more effective than didactic instruction. CC features added to science text and science lessons facilitate learning for both males and females. Finally, I argue that in adopting new mathematics and science curriculum standards, it is important to recognize the need to promote CC and that "minds-on' as well as "hands-on" approaches are essential to effective learning.

Once upon a time, a quantitatively oriented cognitive educational psychologist set off on a journey to investigate and contribute something to research in science education. On that journey, he probably became a little less "objectivist," more appreciative of alternative research approaches, more aware of problems in teaching science, and of reasons for the under-representation of women and minorities in some domains of science. This paper is, in part, a story of that journey.

I have three purposes in this paper: (a) to highlight the problems of under-representation in some domains in science, (b) to discuss some of my research on the conceptual change (CC) model in science education, and (c) to highlight the need to include CC approaches in the emerging constructively oriented, activity- and manipulative-focused science curricula.

Let me begin by highlighting some data on under-representation in science. Because my research only involves gender, I will focus on gender under-representation, but I recognize that ethnic under-representation deserves equal emphasis.

A common stereotype is that women show less interest in science and that women perform less well in science. Like most common stereotypes, this one has a grain of truth but is less than entirely accurate. Matthews (1990) reported that women comprise about 45% of the bachelor's degrees in the life sciences and mathematics. Thus, gender differences are not large in these areas. However, women only receive about 35% of the bachelor's degrees in computer science, 30% in physical science, and 15% of in engineering. Clearly, a more serious under-representation occurs in the latter areas. Astin and Astin (1992) reported that about 50% of first year students and graduates in biology are women, but only about 35% of first year students and graduates in physical science and 20% of first year students and graduates in engineering are women. Vetter (1988) reported that approximately 12% of employed physical scientists are women, 22% of individuals employed in mathematical fields are women, and 25% of individuals employed in computer programming or scientist positions are women. The reason is not because there are no women applicants. Vetter (1988) reported that a higher proportion of women than men are seeking employment in these fields.

The math/science "pipeline" data also support gender under-representation. Berryman (1983) used the pipeline metaphor to represent the flow of students into careers that require substantial education in mathematics and science. Leakage from the pipeline was large. Of the 20% of all students who report some interest in science/mathematics careers early in high school, only 5% complete bachelor's degrees in these fields and only 0.2% complete doctoral degrees (Task Force on Women, Minorities, and the Handicapped in Science and Technology, 1988). Hilton and Lee (1988) reported gender related pipeline data from the "High School and Beyond" studies. About 20-25% of the males are in the pipeline in grade 12; this drops to about 5% of males graduating college in the sciences and 2-3% in graduate school. For females the comparable numbers are 7%, 2-3%, and 1-2%. Clearly, females represent a smaller proportion of the pipeline than do males. In one of the most sophisticated of the pipeline studies, Brookhart (1994) examined individuals who left, entered and persisted in the math/science/engineering pipelines. By the first year of college, only about two thirds as many females (10%) as males (15%) remained in the pipeline. Clearly, women are underrepresented in physical science occupations because fewer traverse the pipeline.

Why is it important that women elect not to pursue physical science or engineering fields? Here are three important reasons:

1. Physical sciences fields are correlated with higher paying positions in our society; thus, under-representation of women contributes to gender inequities in salaries paid to men and women.
2. It is likely that at least part of the under-representation of women represents structural biases that inhibit women from selecting physical science fields.
3. Science loses women's perspectives women's perspectives that may yield advances on some problems.

Why are there fewer women in science? Much research supports the notion that women receive less encouragement in the physical sciences and that the climate and approaches to knowledge in the physical sciences may be less consistent with the average woman's characteristics than the average man's. Several sources report that both male and female teachers interact differently with boys and girls when teaching science and math. They call on boys more than girls. Compared to boys, girls are more likely to receive lower level questions and feedback that implies lower ability and provides excuses for mediocre performance (See Kahle & Meece (1995) for a comprehensive summary of research on gender differences in science education.) Keller (1982), Rosser (1986, 1990), and Rosser and Kelly (1994) argued that structural biases inhibit women from pursuing science and engineering. These biases included glass ceiling labor practices that prohibit women from reaching decision making levels, diminishing of "women's" scientific problems (e.g., menstrual cramps, breast cancer), use of males to represent the species, and sexual" harassment.

Rosser (1990) argues that the epistemological approach of science is inconsistent with women's approaches to knowledge. As a result, the intellectual atmosphere of science is chilly to women. She argues for differences between typical women's and typical men's approaches to science (Figure 1).

I disagree partially with Rosser. The gender differences in ways of doing science are far less absolute than she implies and variance within genders is far greater than between genders (see pipeline argument below). However, she does make a case that typical differences exist and that many women, particularly in higher education, stop taking science because of incompatibilities in ways of knowing. Overall, the research literature is sufficiently strong to support the conclusion that differences in educational treatment, coinciding with differences in social expectations, contribute substantially to the under-representation of women in physical science.

As an aside, I will comment on one interpretation of the pipeline data. Rosser (1990) and others (e.g., Anderson, 1992; Bowen, 1990), have argued that the science education pipeline supports the hypothesis of differences in men's and women's ways of knowing. While there may be average gender differences in ways of knowing, differences between the genders are small relative to individual differences within the genders. Moreover, the pipeline data make clear that the overwhelming majority of both female and male students never enter or leave the science/math pipeline. How can the fact that over 90% of both males and females elect non-science/math careers be evidence of gender incompatibilities in ways of knowing? Perhaps the 90% plus of males who avoid science also prefer women's ways of knowing. If so, what justification is there for gender labeling such ways of knowing? I think Tobias' (1990) view, that both women and men in the "second tier" prefer alternative classroom approaches to those typically used in the physical sciences and engineering, is probably closer to the truth. But I don't want to belabor this point; a more important question to me is how to help all students understand science better and how to remove artificial barriers that may prohibit female students from considering or pursuing careers with mathematical or scientific underpinnings.

Women	Men
♦ Expansion of the types of observations used in science	♦ Fewer types of observations used in science
♦ Increasing the length of the observational period	♦ Shorter observational periods
♦ Acceptance of personal experience as part of scientific data	♦ Rejections of personal experience as part of scientific data
♦ Deeming women's problems worthy of research	♦ Focusing on problems related to men
♦ Including gender as part of scientific hypotheses	♦ Using men to represent the species, excluding gender as part of scientific hypotheses
♦ Adopting a more holistic approach to scientific problems	♦ Adopting a more narrow, less contextual approach to scientific problems
♦ Combining qualitative and quantitative methods	♦ Focusing on quantitative methods
♦ Greater use of cross-disciplinary research	♦ Less emphasis on cross-disciplinary research
♦ Including females as research participants	♦ Excluding females as research participants
♦ Awareness of race, class, sexual orientation, and religious biases	♦ Ignoring possible race, class, sexual orientation,and religious biases
♦ Theories that are relational, interdependent and multi-casual, instead of hierarchical and reductionist	♦ More reductionist, less situated theories
♦ Less competitive models of interaction between scientists	♦ More competitive models of interaction between scientists
♦ Greater emphases on research methods that emphasize participants/researcher interaction	♦ Emphasis on research methods that minimize research/participant interaction

Figure 1. Differences between typical women's and men's approaches to science.

What should we do about gender inequities? Many reforms urged by feminist writers on science should work effectively for both female and male students. This section will focus on one reform related to my research. That reform is to teach science more effectively. Science often is taught in a way that makes it difficult for students to understand. Obviously, many dedicated elementary and secondary science teachers lead exciting and intellectually challenging lessons. However, I think that many students drop out of the science pipeline because they don't find science either exciting or understandable as it is taught.

Science classes often consist of students memorizing formulae to compute answers to word problems. Because there is little emphasis on providing students with a conceptual understanding of the underlying theory or on addressing students' preexisting ideas, students often don't understand the formulae. So students adopt an approach that one of my undergraduate assistants called "plug and chug." She described her performance in science classes as grabbing numbers from the problems, plugging them into some memorized formula, and chugging out an answer.

Such classes don't help students focus on developing conceptuerts reason first from conceptual, qualitative models before applying quantitative reasoning. One way to help students understand science more effectively may be to help them develop better qualitative models. In the science education literature, the approach called conceptual change (CC) has focused on helping students change their conceptual qualitative models. During the last several years, I have been conducting research on CC and science learning and education (see Wandersee, Mintzes, & Novak (1995) for a review of the CC literature).

Within the science education area, conceptual change is jargon for an approach that has its roots in Piaget's concept of disequilibrium and philosophical studies of Zeitgeist change or paradigm shift. The fundamental notion is that the learner can have pre-existing conceptualizations or knowledge structures that may be inconsistent with the knowledge structures the cultures of the subject matter domain have constructed. These pre-existing knowledge structures may interfere with the learner constructing new knowledge consistent with the culture that defines the subject matter. Put more simply, the learner may have beliefs that are inconsistent with the knowledge beliefs of subject matter experts. In this case, CC theory postulates that learners do not meekly abandon beliefs. Instead, they may reinterpret the presented message in a way consistent with their beliefs. Alternatively, learners may engage in a kind of double think and hold to prior beliefs, but memorize sufficient of the subject matter knowledge to pass school-based, inauthentic tests.

For example, many students believe that heavier things fall faster than lighter things. According to CC theory, students do not simply accept the physics statement that objects fall at the same rate. Rather, students memorize a formula, $s= 1/2\ gt^2$, which allows them to calculate how far an object falls in a given amount of time or how fast it is falling after so many seconds. They answer quantitative test questions correctly, but still believe that heavier things fall faster than lighter things.

CC theory holds that it is necessary to produce what Piaget called disequilibrium to encourage the student to construct a revised conceptualization. Posner and associates, in what is probably the best known version of CC theory, argue that education needs to induce dissatisfaction in the learner (Posner, Strike, Hewson, & Gertzog, 1982). Once the learner is dissatisfied, the instruction presents a new conceptualization that the learner will find intelligible, plausible, and fruitful. An intelligible, plausible, and fruitful description will lead the dissatisfied learner to construct a revised conceptualization.

CC theory argues that traditional instruction does not directly try to address students' misconceptions, but should. Activating prior knowledge and explicitly addressing and challenging alternative conceptions is necessary for the student to construct a revised, understanding.

My students and I began to investigate how to use CC in facilitating learning from text. The work was influenced by the early work of Roth (1984). Most work on CC had involved small groups and in-class instructional activities. Working with Charles Anderson, Roth adapted the Posner et al. (1982) CC approach to text. She included CC features in existing texts on how plants produce food. Compared to students using the original text, students using the CC texts were more likely to adopt CC thinking and construct understandings of plant and food consistent with botanist culture.

Reasoning that text in some form will always be an important component of instruction, we began to investigate how CC features added to text might help students construct more complete understandings of series and parallel circuits in electricity. In an early study, Wang and I (1991) modified an existing middle school physical science text to contain CC features. Our modifications were straightforward. Fredette & Clement (1981), Osborne (1983), and Shipstone (1984) had identified common misconceptions students had about series circuits. For example, a developmentally early misconception is called the sink conception. Students believe a single wire connection between a battery and a bulb will light the bulb because electricity flows like water from the battery to the bulb. To activate and challenge the students' misconceptions, we created a prototypical situation such as a picture of a battery and bulb connected by a single wire connection, and asked students to predict if the bulb would light. This is shown in the Figure 2.

Next, we directly addressed the misconception in the text by asserting, "Some students believe that a single wire connection between a battery and bulb will cause the bulb to light. These students are wrong." Then, as indicated in Figure 3, we presented evidence that the bulb would not light. We repeated this basic approach for each of the identified misconceptions. (Subsequently, we found that Alvermann and her colleagues had developed a similar approach that they called refutational text; e.g., Hynd & Alvermann, 1986.)

To control ability variance, we assessed students' verbal ability and obtained a measure of their experience with electricity. Because of my past research interests, we also included or did not include adjunct questions in text that students had to answer. The adjunct questions focused on calculations. So our independent variables were: two types of text (traditional versus conceptual change), presence or absence of adjunct questions, and gender.

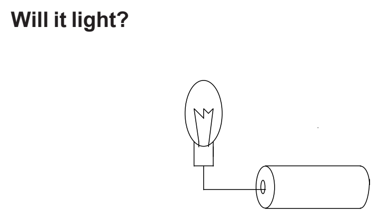

Figure 2. Question designed to elicit pre-existing conception from Wang and Andre (1991).

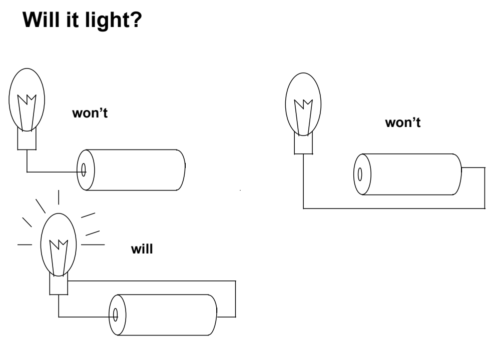

Figure 3. Example of dissatisfaction inducing text diagram.

What did we find? CC features produced a significant positive effect on conceptual understanding, but this main effect was modified by a Text Type X Question Type X Gender interaction. For men given adjunct questions and for women not given adjunct questions, the effect of CC text was positive. For women given adjunct questions and men not given adjunct questions, CC was neutral. We speculated that these effects were due to differences in motivation. Women have lower reported interest in physical science (Kahle & Meece, 1995). The adjunct question conditions imposed heavy task demands on students. Students with a lower level of interest may not have been sufficiently motivated to work very hard to meet those demands, but students with a higher level of interest may have been sufficiently motivated to meet the demands of processing adjunct questions and CC features. I wasn't satisfied with this explanation, but it led us to explore the relationship between interest and CC text.

In Chambers and Andre (1997), we replicated the Wang and Andre (1991) study but added a measure of interest in electricity along with the experience and verbal ability measures. The independent variables were gender and text type. We also modified the text and the posttest slightly.

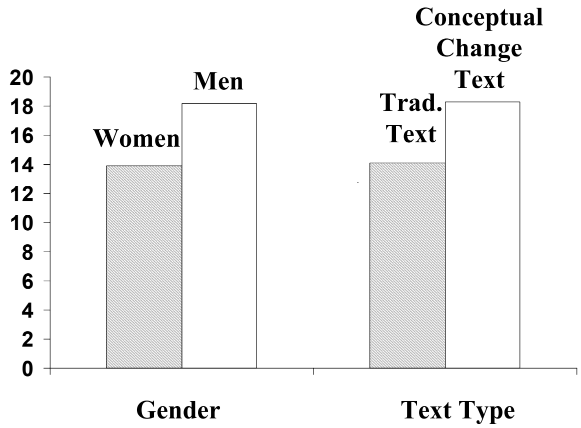

Figure 4. Gender and Text type main effects in analysis without covariates from Chambers & Andre, 1997.

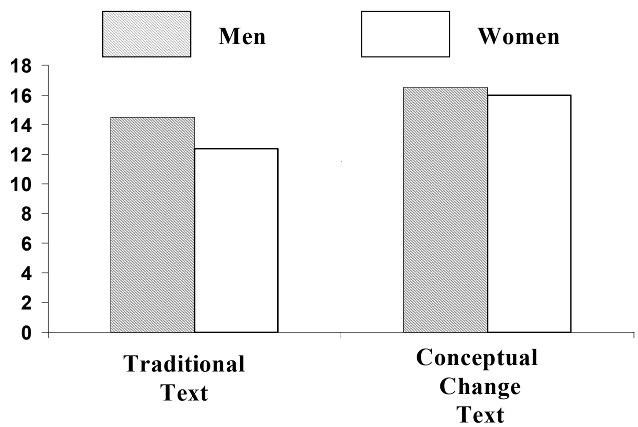

Figure 5. Adjusted means for men and women given traditional and conceptual change text in analysis with covariates (Chambers & Andre, 1997).

What did we find? We first analyzed the data without controlling for interest or experience. There were significant main effects of gender and text type. Figure 4 displays the means. Men apparently did better than women and CC text led to better performance than the traditional text. Next, we analyzed the data using a covariance analysis that controlled for verbal ability, experience, interest, and pretest knowledge. Only the main effect of text type remained significant (see Figure 5). CC text led to better performance than did traditional text for all students. In other words, when we did not control for interest and experience, men did better than women. When we controlled for pre-existing differences, women scored about the same as men.

We replicated these findings in a second study (Chambers & Andre, 1996). The same basic variables were included. Again, we first analyzed the data without controlling for pre-existing differences. This analysis yielded significant main effects for gender and for text type, again men apparently outperformed women and CC text led to superior performance.

When we controlled for preexisting differences, again only the effect of text type was significant. Again, gender differences in science learning seem to be due to differences in experience and interest.

In Chambers et al. (1994), we also found that controlling for the effects of verbal ability, prior experience, and interest eliminated a main effect for gender. In this study, we had five instructional conditions. The first was a traditional text on electricity. In the second condition, students received the traditional text augmented with more examples and diagrams. In the third condition, students received the CC text. In the fourth condition students received a CC text. However, instead of being told that circuits would or would not work, students were told to turn to a computer simulation that allowed them to build electrical circuits and to determine for themselves if the circuit would or would not work. Finally, in a fifth condition, students received CC text, but, after making predictions, were told to turn to actual light bulbs, batteries, and wires to test circuits.

On a delayed posttest, when interest and experience were not used as covariates, gender produced a significant effect. But when interest and experience were covaried, only the effect of CC condition was significant for females, but not males. Females receiving CC text did better. Figure 6 displays the means. The means for the men were quite high, and we might have failed to find an effect because of ceiling effects.

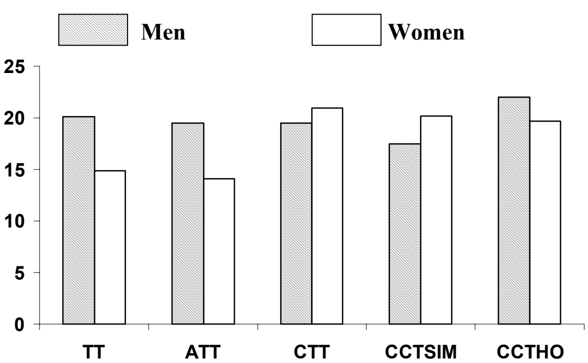

Figure 6. Adjusted means as a function of gender and condition from Chambers et al. (1994) TT-Traditional, Text, ATT-Augmented Traditional Text, CCT-Conceptual Change Text, CCTSIM-CCT with simulation, CCTHO-CCT with hands-on experience

One other of my studies supports these findings. Carlsen and Andre (1992) used CC texts in conjunction with computer simulations to help students learn about electricity. When prior experience was controlled, there were no gender differences and CC texts led to better performanc and women show similarities in how they learn science. In each of these studies, gender differences were found if pre-existing differences in knowledge, interest in, and experience with the subject matter were not considered in the analyses. When such differences were statistically eliminated, there were no gender differences in how men and women learned from CC text.

These results are consistent with the results of a study by Burbeles and Linn (1988). Burbeles and Linn found that boys and girls both profited from experiences that contradicted their prior expectations, but that, probably because of pre-existing experiential differences, girls required more contradicting experiences than did boys to reach the same level of understanding. Finally, a recent metaanalysis of CC approaches reported by Guzzetti, Snyder, Glass, and Garnat (1993) found significant and moderately strong effects of CC approaches. I think we can conclude that CC approaches do help both male and female students develop better conceptual understandings of physical science topics.

Recently NCTM and NSTA published new standards for science and mathematics teaching. These new standards argue that students should be involved in learning mathematics and science as a thinking activity. Learning to "mathematicize" or to "science", that is to use mathematical thinking to recognize patterns and solve meaningful problems or to use scientific procedures to investigate authentic problems, lie at the core of the new standards. Viewing the student as an active participant in the construction of his/her knowledge is central to the new standards.

I heartily encourage this approach and think that at least 50% of instructional time in science should be devoted to authentic investigative projects in which students do science. There are many lessons and curricula being developed which use this approach.

But I am concerned that we may miss the CC nugget in the gold rush to activity-oriented mathematics and science. Based upon their research with teachers, Anderson and Smith (1988) describe problematic activity-oriented and discovery-oriented teachers of science. Let me quote their descriptions.

The *activity-driven teachers* are "uncomfortable teaching science. These teachers focus primarily on the activities to be carried out in the classroom: textbook reading, demonstrations, experiments, answering questions, and the like. These teachers are unsure how specific activities contribute to student learning" (p. 100).

Discovery-oriented teachers "using activity-based programs try to avoid telling their students answers, encouraging them instead to develop their own ideas from the results of experiments. They ask their students to interpret their observations in open-ended ways, assuming that the performance of the experiments will eventually lead students to develop the appropriate scientific conceptions. In the absence of direct information and feedback from the teachers, however, students generally use their own misconceptions as the basis for interpretation of activities" (p. 100).

I am concerned that without an adequate understanding of conceptual change, the necessity to allow students opportunity and time to accommodate will not be given. Let me share a case reported by Champagne, Klopfer, and Gunstone (1985). Seventh graders were taught a unit on falling bodies using a conceptual change approach and much hands-on experience. But even after several weeks, some students continued to argue for their original preconceptions and propose other alternative experiments that might show that heavier bodies would fall faster than lighter bodies. It was not a simple matter for the students to give up or change their preconceptions. Champagne et al.'s results demonstrated that these students would not have given up their preconceptions by simply exploring falling bodies. The students needed to have the teacher or the instruction point out the contradiction between their belief system and the results of their experiments. The students needed to be encouraged to create alternative qualitative models that encompassed their new observations. Teachers needed to be somewhat directive in facilitating students' thinking towards construction of an appropriate new model.

Conceptual change approaches can work in real schools. In 1993, with some colleagues, I conducted a workshop dealing with CC in the areas of motion and electricity for middle school teachers. After studying CC, teachers planned CC lessons for their students based upon the workshop materials (electricity and motion simulations and hands-on kits). In the following academic year, the teachers taught the lessons to their pupils. Their students displayed a more advanced conceptual understanding of motion and electricity compared to middle-school students taught with traditional lessons.

The CC approach is only one of many that can work to help students construct more adequate conceptual understandings in physical science. What features should lessons designed to promote conceptual understanding have? Such lessons should contain motivating and intellectually challenging activities that lead students to compare their preconceptions with the content being taught and direct student thinking towards constructing a revised conceptual model similar to the ideas of the culture of scientists. Such lessons emphasize developing the conceptual model before developing strength in quantitative analysis. Overall, the focus is on ensuring the instructional activities are minds-on as well as hands-on (I want to thank whoever first coined the wonderful minds-on phrase.) Certainly, authentic investigation activities are a critical component in reforming science education. But education should not adopt the obvious hands-on features of inquiry activity without incorporating the less obvious minds-on features. Effective instruction needs to incorporate CC features to achieve the full benefit of the proposed new standards. Instruction that incorporates these features can help to improve science education for all students and can thereby contribute to reducing gender and minority inequities in participation in science.

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Conversations in Education

From Tourists to Citizens in the Classroom: An Interview with H. Jerome Freiberg

Mary R. Sudzina
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H. Jerome Freiberg is Professor of Education, College of Education, University of Houston, and Director of the Consistency Management and Cooperative Discipline Project, Houston, Texas. Dr. Freiberg has published over 100 scholarly works including the books Freedom To Learn *(with Carl Rogers), and* Universal Teaching Strategies *(with Amy Driscoll), and is editor of the book* School Climate: Measuring, Improving, and Sustaining Healthy Learning Environments *(in press). He is also editor of the* Journal of Classroom Interaction*. Dr. Freiberg received the 1988-89 University of Houston's Teaching Excellence Award, and the College of Education's 1996 Research Excellence Research Award. Dr. Freiberg was recently named a John and Rebecca Moores University Scholar.*

***Q*: Dr. Freiberg, you've successfully applied Consistency Management & Cooperative Discipline (CMCD) with students in some urban schools. How does CMCD differ from other approaches to dealing with inner-city students?**

***A*:** CMCD challenges a number of assumptions about children and youth who live and go to school in the inner-cities. There are too many controls and not enough opportunities for students to build self-discipline.

The goal of most teachers is to encourage self-discipline, but the path many teachers take to this goal is misdirected. Too often the cooperation teachers seek from students to create order does not allow for real engagement in the learning process. Teachers find themselves imposing their requirements for order without relating to the student need to become members of a learning community. Discipline becomes mandated rather than developed. The differences between building self-discipline and imposing discipline is the balance point between the traditional classroom and a person-centered learning environment. A person-centered classroom benefits both teacher and student.

Too often classrooms are teacher-centered. When classroom are teacher-centered, students loose out on opportunities to have meaningful participation. I liken this to being "tourists" in the classroom. Students become tourists, passing through schools and classrooms without engaging in or positively influencing their learning environments. The CMCD program encourages students to become "citizens" of the their classrooms and school, taking responsibility for each other and the place of learning that they enter each day. The schools that foster academic and social citizenship have these qualities of active learning environments, and students become stakeholders in their own learning.

***Q*: What would that look like?**

***A*:** The following figure, which appeared in *Freedom to Learn*, shows the distinctions between the two types of learning environments (See Figure 1). A person-centered environment in the Rogerian sense is one that includes and benefits both teacher and students.

Teacher-Centered	Person-Centered
Teacher is the sole leader	Leadership is shared
Management is a form of guidance	Management is a form of oversight
Teacher takes responsibility for all paperwork and organization	Students facilitate operations of the classroom
More students are "tourists" than "citizens"	More students are "citizens" than "tourists"
Discipline comes mostly from the teacher	Discipline comes mostly from the self
A few students are the teacher's helpers	All students can become an integral part of classroom management
Teacher posts the rules	Teacher and students develop rules in the form of a classroom constitution or Magna Carta
Consequences are fixed for all students	Consequences reflect individual differences
Rewards are mostly extrinsic	Rewards are mostly intrinsic
Students are allowed limited responsibilities	Students share in classroom responsibilities
Students see only people who are paid to be in school	Schools recruit business and community members to enrich opportunities for students and present positive role models for students

Adapted from Freedom to Learn (3rd ed.) by C. Rogers and H. J. Freiberg (1994, p. 240) Used with permission of H. J. Freiberg (1997).

Figure 1. Teacher-centered classrooms vs. person centered classrooms.

Self-discipline is built over time and encompasses multiple sources of experiences. There is no one path, model, or program that will lead to self-discipline in all students. Self-discipline requires a learning environment that nurtures opportunities to learn from one's experiences, including mistakes, and to reflect on these experiences.

When students are engaged and involved and teachers and students see each other as partners, the instructional climate improves for both teachers and students. When students become more self-disciplined and teachers have greater management and discipline repertoires, referring students to the office becomes unnecessary or the last resort. The CMCD program changes the learning environment by asking students and teachers to collectively establish the climate in which they will teach and learn. We provide the organizational and instructional tools to help create this environment; it is up to the teachers and administrators to adapt and adjust to their own local needs.

***Q*: You've spent the last decade looking at learning environments in school and achievement with "at risk" youth. What are your conclusions? What works?**

***A*:** From my experiences working with urban schools, teachers, and students, I would suggest the following:

- Create smaller classes to better support children who have increasing social needs. Most secondary schools have 100-200:1 student/teacher ratio's which can lead to increased discipline and management problems.
- Implement much higher standards for the preparation, recruitment, and hiring of teachers. Most states have higher standards and training requirements for hairdressers and animal doctors. According to the 1996 National Commission Report on Teaching and America's Future, more than 12% of newly hired "teachers" enter the classroom without any preparation and 15% enter without having fully met state standards. Thirty percent of secondary mathematics teachers do not have a college minor let alone a major in their fields.
- Create safer and more caring learning and teaching environments. According to the 1996 U. S. Department of Justice, Office of Juvenile Justice and Delinquency Prevention Study juvenile homicide rates (12-17 year olds) have increased 95 percent from 1980 to 1994. In 1994, law enforcement agencies arrested 2.7 million youth under the age of 18. The study reports twelve percent of students in grades 6-12 reported being victims of bullying, physical attack or robbery and 56 percent of the students surveyed reported witnessing such acts. Democracy cannot grow or flourish when youth live in fear. A climate of violence, intolerance, apathy, isolation and dissolving families leads many youths to have a blank vision of the future.
- Refurbish school building infrastructures throughout the nation. Schools are literally collapsing. In Houston, it was the roof an elementary school which collapsed onto the cafeteria one week before school opened. In West Virginia, the exterior brick wall of a high school in Preston County collapsed one month prior to the start of the new school year forcing the school to be permanently closed.
- Encourage greater parental support in providing children that are self-disciplined and able to learn with other children. Babies don't come with a parents' guide. In Arkansas, new mothers who receive state aid also receive extensive support in acquiring the knowledge and skills needed for raising a healthy child. Child abuse has soared in the last decade. We have learned that early intervention is the key. There is a need for all parents to have the opportunity to receive education on raising healthy children.
- Balance reform so it is not always additive. Nothing is taken away from the impacted school curriculum — only added. Teachers by necessity either ignore the new reforms or begin reducing parts of the curriculum in a haphazard fashion. Changes in the curriculum need to be comprehensive rather than piecemeal.
- Reform efforts need time to occur. We tend to plant "trees of innovation," but not allow them time to take root. We keep pulling up the trees and are puzzled when they haven't taken. Veteran teachers quickly learn that they can outlast the latest "changes" because next year brings another program to reform schools.
- Most importantly, we must listen to the students; they have a keen sense of the problems and many of the solutions. In one inner-city middle school, students representing a wide range of views were asked about solving the graffiti problem in bathrooms. The students suggested that each wall be given to a different grade level to paint a mural. They also suggested a large panel be painted and placed over the wall, enabling new students entering each year to have their own wall to paint.
- Build reform on replicable research. Too often one study with limited generalizability or faulty design is used to support educational policy. Walberg (1986) cites the impact of a flawed study showing open education did not improve learning compared to traditional education. The study was reported in the *New York Times* and other media sources. The study findings were retracted, but only after significant damage had occurred and new policies were developed.
- Reduce the half-life factors of improving schools. A study we conducted of an improving inner-city elementary school that moved from the lowest 5 percent in the state in academic achievement to receiving the Governor's excellence award four years later lost its Chapter I Federal funds due to higher achievement scores. It also lost extra district funds for the same reason. Improvement for this school became a disincentive.

***Q*: AACTE recently targeted five promising practices in teacher education for 1996 and the CMCD program was one of them. A CMCD project was also highlighted**

in the front page of the *Houston Chronicle* in December, 1996. Can you tell me more about this?

***A*:** Both the AACTE recognition and the article which appeared in the front page of the December 1, 1996, *Houston Chronicle* ("Sparing the Rod: Student self-discipline shifts burden for classroom order") indicate a growing awareness of the importance of new ways to approach the realm of classroom environments. I received a request from AACTE to present an overview of the Consistency Management & Cooperative Discipline Program at the Education Commission of the States' 1996 National Forum and Annual Meeting July 2, 1996. I was to be at an international conference in Israel at the time and Dr. Alma Allen, an elected member of the Texas State Board of Education, presented on our program. She has been a strong advocate for the CMCD program.

The newspaper article reflects the realization of many in the city that before any reading and mathematics programs can be introduced a climate for active and productive learning must be in place. Most of the newer more contructivist curriculums emphasize an active interface between the students and the curriculum. However, the management system used in most classrooms reflects a teacher-centered model of order.

***Q*: Could you give me an example?**

***A*:** Yes, the following figure also appeared in *Freedom to Learn* and shows how classroom management must change to reflect changes in instructional models (See Figure 2).

Teacher-focused	
Teacher dimension: Teacher directs and externally controls student behavior.	Lecture Questioning
Teacher role is directive.	Drill and practice Demonstration
Cooperative dimension: Teacher/students cooperate in designing a positive classroom learning environment.	Discussion Cooperative groups
Teacher role is semi-directive/facilitative.	Guided discovery Contracts Role play
Self-dimension: Students are internally self-disciplined and need minimal direct adult supervision.	Projects Inquiry
Teacher role is non-directive/facilitative.	Self-assessment
Student-focused	

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Figure 2. Classroom management reflecting instructional models.

***Q*: How did you come to work on the book *Freedom To Learn* with the humanitarian and psychologist Carl Rogers? Why is the message of this book, first published over two decades ago, still contemporary today?**

***A*:** I worked with Carl Rogers on the second edition of *Freedom to Learn* in the early 1980's. I was asked to update his original 1969 edition with additional cases and current research. When he died in 1987 I was asked by the publisher and his daughter, Natalie Rogers, to revise *Freedom to Learn* into a third edition. The project took nearly three years. I visited secondary schools in Chicago, Philadelphia, Houston, and New Orleans, and I included a colleague's work in San Diego to form the first chapter: "Why Kids Love School". It is very evident that schools can build resilience in inner-city children. Many of Rogers' frameworks are evident in what learners in the inner cities need to be productive citizens in a democratic society.

***Q*: *Freedom to Learn* was translated into Spanish in 1996 and the Soros Foundation is providing resources for it to be translated into Russian and placed in 15,000 libraries. Why do you think there is an international interest in your and Rogers' work?**

***A*:** Many of the principles presented in *Freedom to Learn* are universal. Children across the world and their teachers have similar needs to enable them to work and learn in healthy learning environments.

***Q*: This past summer you were invited to speak in Israel with David Berliner, Lee and Judy Shulman, Martin Haberman and Eliot Eisner. Are other countries that you've visited confronting similar educational and social issues?**

***A*:** I have worked with educators in Italy, Spain, England Netherlands and Israel. These countries are beginning to see a deterioration of the family structure and subsequent problems with children. England, for example, has a higher child poverty rate than the United States. France has a similar child poverty problem as the U.S. Italian secondary teachers in small towns and rural schools cited student motivation and parent involvement as the their greatest concerns. I have also found a common thread of lowered expectations in inner-city schools throughout the world. Believing that children of poverty can learn is a prerequisite to learning. We have been asked to start our CMCD program in several European countries to help schools become resilient, rather than another risk factor in the lives of children.

***Q*: What is your educational prognosis for the future?**

***A*:** I actually have more hope now that we can improve learning for our youth as I see real change and improvement in some of our inner-city schools. What I know after spending much time in urban schools is that we need to think differently about students and their learning. We can't change for the better continuing to think in the old ways.

Teachers need to be given better tools for meeting the needs of children and youth and meet their own needs. Educational reforms must begin at the classroom or micro levels and work toward the broader messo and macro levels. Too much of what has occurred to date has had minimal impact on the classroom. If we refocus our efforts to make schools and classrooms a place for citizens, not tourists, then we will begin to see real and sustainable improvement.

Research Results

Consistency Management & Cooperative Discipline Program

H. Jerome Freiberg
University of Houston

We've conducted a series of longitudinal studies to determine outcomes of the Consistency Management & Cooperative Discipline program. The findings are very promising. For example, students of teachers using the program in low-performing inner-city elementary schools earned scores that are statistically significantly higher on national standardized tests and state-criterion reference tests than comparison students. Three years after their schools began the program, students with CMCD teachers gained on average three-quarters of a year's achievement over comparison students.

Four years after the program had been in use, we found statistically significant differences in how students viewed their learning environments. Based on survey data, students in the program perceived their environments to be more positive than comparison students. In addition, the following were all significantly higher for program students than for comparison students: student involvement, task orientation, class order and class rules, instructional learning environment, teacher expectations, and achievement motivation and academic self-concept.

Program schools also document significantly fewer classroom problems and discipline referrals to the principal's office. Before beginning the program, an inner-city elementary school with only 276 students had 109 student referrals to the office during the school year. A year after the program, there were 19 discipline referrals, 9 of which were from substitute teachers. Further, the rate of suspensions five years later of non-program students was double that of students whose teachers used the program.

A similar pattern is evident in two intermediate rural schools. Over three years, discipline referrals were down 40-60 percent, and students made statistically significant gains in achievement. Both schools won awards for academic excellence.

When implemented school wide and throughout a feeder pattern of schools (K-12), Consistency Management & Cooperative Discipline becomes a collaborative enterprise in which teachers and administrators help students move toward self-discipline as they progress through their school years. The program is currently being replicated with nine additional inner-city schools, including elementary, middle and high school. Two elementary schools have had the program since 1993-94. In these schools, student discipline referrals to the office are down 78 and 72 percent respectively. The middle school to which the elementary schools send their students also had the CMCD program. An external evaluation showed that skipping class, fighting, disruptions, defiance and disrespect and assaults dropped from 76 percent to 24 percent. The greatest drop was in assaults of students and teachers by students, which was reduced by 76 percent in one year.

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