DOCUMENT RESUME

ED 344 879 SP 033 791

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TITLE	Math Student Teachers: How Well Prepared Are They?
PUB DATE	Apr 92
NOTE	21p.; Paper presented at the Annual Conference of the National Council of Teachers of Mathematics (Nashville, TN, April 1, 1992).
PUB TYPE	Speeches/Conference Papers (150) -- Reports - Research/Technical (143)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Classroom Techniques; Educational Technology; Higher Education; *Instructional Effectiveness; *Majors (Students); Mathematical Applications; *Mathematics; *Mathematics Instruction; Required Courses; Secondary Education; *Student Teachers; Teacher Education Programs; Teaching Methods; Writing Across the Curriculum

ABSTRACT

This study was conducted to find out how well mathematics majors at the University of Northern Iowa were prepared in the foundations of effective teaching practices and how well they performed during the student teaching experience. Data were gathered from mathematics student teachers (N=22) who were observed, interviewed and asked to keep daily journals. Results suggest that mathematics teacher education students: (1) be required to create practical problems for pupils for every mathematics course in grades 7-12; (2) be required to take a course that deals with writing across the curriculum so they can better incorporate English into their classroom instruction; (3) spend time working with and investigating the use of technology in classroom instruction; and (4) enroll in course work outside the department of mathematics that focuses on the general methods of effective teaching. (LL)

Math Student Teachers: How well prepared are they?

by
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This paper was presented at the National Council of Teachers of Mathematics National Conference in Nashville, TN on April 1, 1992.

About the presenter

Dr. Richard Stahlhut is an Associate Professor who is the director of a regional student teaching center located 125 miles from the University of Northern Iowa (UNI) campus in Cedar Falls. Because of his training and interest in mathematics teacher training he has opportunities to supervise mathematics student teachers each semester. As a part of his position he visits public school classrooms daily, interacts frequently with mathematics teachers, and often has conferences with mathematics teacher trainees.

Introduction

How soon will it be before the media reports another crisis on how well prepared pupils are in mathematics? Distinguished commissions continue to point out how unsuccessful United States pupils are in comprehension and problem solving. Why are pupils weak in mathematics? Could part of the answer be found in the instructional practices being used? Perhaps a commission should be appointed to investigate how teacher trainees in mathematics are prepared to teach. Only if future mathematics teachers know and understand the needs of mathematics learners can they provide instructional practice that will improve pupil's skills.

If instruction in mathematics is to improve some problems must be solved. One problem is too many people do not consider mathematics to be all that important. Yes, many pay pious lip service but few appreciate the value of mathematics as it impacts the economic and social aspects of their lives. As mathematics teachers, all of us have frequently been asked by people to identify "practical" reasons for studying mathematics. People expect us to give them a list of economic reasons. But they also need to know social reasons that mathematics can help people become more effective and informed citizens. Knowing many "practical" applications of mathematics should be one requirement for any student training to become a mathematics teacher.

A second problem concerning mathematics instruction in society is the mistaken view that mathematics and English are dissimilar activities. One part of this misconception is people believe mathematics is basically computation and English is knowing rules of grammar. Hence, their only common factor is both subjects are structured. Both subjects have hierarchical structures. But it is not true that you must learn these basics before you can learn to do higher order thinking. Another aspect of this problem is the belief that mathematics dulls an individual's ability for expression while English promotes creative expression. Appreciation of the beauty in numbers does not make one unresponsive to, say, the ecstasy of a mountain view. A final contributing factor that separates math from English is parents perpetuating their beliefs and aptitudes concerning the two subjects. They believe from the way they were taught there is a definite difference. From their observations few people are good in both areas. From the research we know by the time girls get to junior high school their language skills are superior to their mathematic's skills. Many girls believe there is a difference in the two subjects. The truth is, "story telling" is an effective educational tool that puts topics into context, shows limits, and succinctly tells salient ideas (Paulos, 1991). Every teacher trainee in mathematics must learn to explain and capitalize on the ways mathematics and English work in concert together.

Technology should help replace the distaste many pupils have for some aspects of mathematics. The current curriculum anesthetizes pupils because of all the boring, tedious arithmetic and other computational activities. Mathematics has been subordinated to an experience in drill. Using calculators, graphing calculators, computers, and video tape recordings (V.T.R.) should challenge pupils to think, estimate, and look for alternatives. Greater knowledge and familiarity with technology and software should help mathematics teachers free-up their classroom time for more conceptual matters like problem-solving, inference, and analysis. Every beginning mathematics teacher should have experience and training on campus with ways to include technology into their classroom instruction.

Escalante (1991) believes mathematics teachers must be better trained in the science of effective teaching practices. He admits the art of teaching, a person's imposing personality, will make the person more or less effective, but only if she/he also knows the science of teaching. What he is saying is, mathematic's teacher trainees must learn how to teach pupils about mathematics. Currently too many of them only teach the subject. Graduates know mathematics's content but most do not know how pupils learn. Every beginning mathematics teacher must know some of the foundations of effective teaching practices.

The objective of this study was to find out how well student teachers at UNI in mathematics were prepared concerning the issues mentioned above. Some literature and demographic data were reviewed, but a greater amount of effort was spent observing, interviewing, and reading student teacher journals. Therefore, this paper represents the results of a study designed around qualitative research methods.

Findings and Discussion

To determine the academic qualifications of mathematics's teacher education majors ACT composite scores and grade-point-averages for 10 different majors were analyzed. In addition, data for males vs. females, traditional vs. non-traditional students, and transfer vs. non-transfer students were also examined. A total of 3,425 scores were isolated.

The overall mean ACT composite score for all teacher education majors was 22.21. Non-transfer students scored 22.60 while transfer students scored 21.43. (See appendix, table #1). Of the 10 majors, the 141 math/computer science majors ranked #1 with a mean ACT score of 24.86. Within this category males scored 25.19 while females scored 24.43. It was also observed the younger, traditional mathematics majors (age 24 or less) scored 24.92 while older, non-traditional students (age 25 or more) scored 23.60.

When grade point averages (See appendix, table #2) were examined the overall cumulative g.p.a. for all teacher education majors was 2.87 on a four point scale. Mathematics majors ranked #2 with a mean of 2.97. Contrary to ACT composite scores females earned a mean g.p.a. of 2.99 while males earned a mean g.p.a. of 2.85. For all teacher education majors other than in foreign language, females earned a higher g.p.a. than males. Another contrast was older, non-traditional mathematics students averaged a 3.16 g.p.a. while younger, traditional students averaged a 2.95 g.p.a.

The statistical data clearly demonstrates that math/computer science majors have superior academic potential when their capabilities and success in academic tasks are compared to other teacher education majors. The brightest teacher education graduates become mathematics teachers.

To discover how well mathematics majors actually performed during their student teaching experience in comparison to some other majors a cursory examination of 1,069 student teacher final examinations was conducted. The mean score for all teacher education majors was 4.33 on a five point scale. Mathematics majors scored 4.29 mean. Elementary majors emphasizing special education averaged 4.57 to earn the #1 ranking. Stahlhut (1990) clearly demonstrated student teachers who were evaluated by cooperating teachers who had less than a master's degree tended to be evaluated higher in the final evaluation than student teachers who had cooperating teachers with advanced degrees. He also demonstrated that mathematics student teachers who were supervised by the paradigm below (see figure #1) received higher final evaluations (Stahlnut, 1988).

Stahlhut's Mentoring Model

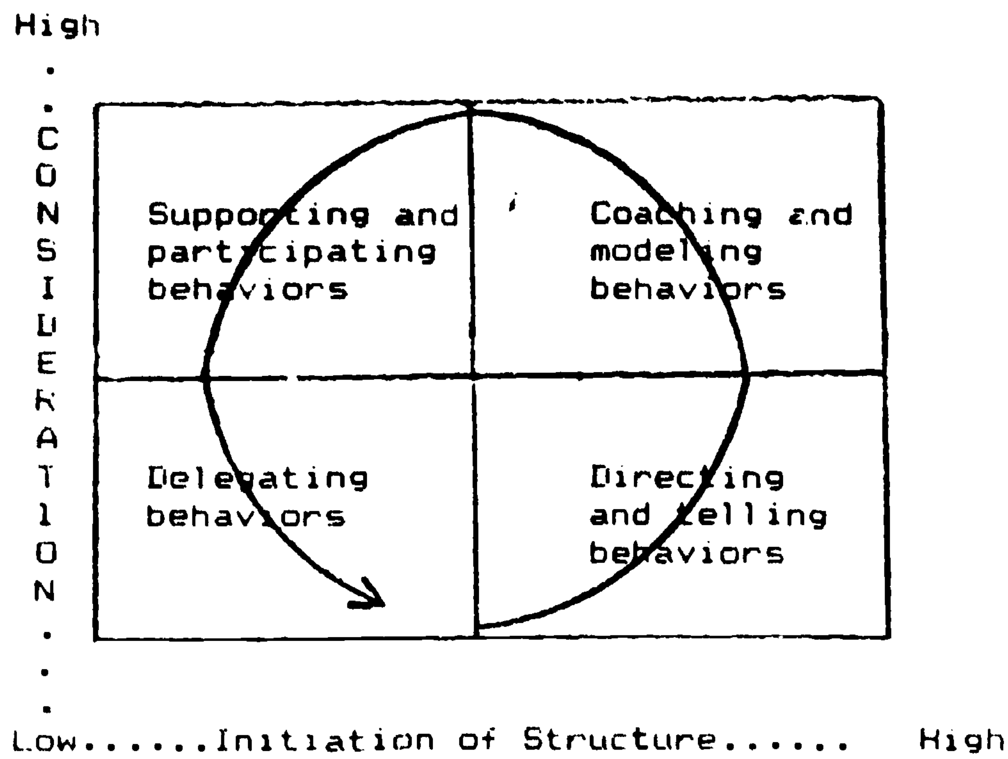

Fig. #1

During weeks 1 and 2 cooperating teachers should tell student teachers exactly what classroom procedures must be duplicated. During this time student teachers should practice these procedures. During weeks 3 and 4 cooperating teachers need to show student teachers a variety of effective teaching practices, to use with pupils. Student teachers should try these techniques. Direct supervision is needed at this time. During weeks 5 and 6 cooperating teachers should encourage student teachers to modify previously learned effective teaching practices so there is a better match with the student teacher's personal style of teaching. During weeks 7-9 cooperating teachers need to allow student teachers to work on their own to refine their instructional practices. Cooperating teachers are a consultant/facilitator for the student teachers during the final weeks of the practicum.

Of the 22 mathematics student teachers observed and interviewed it was noted that few student teachers could identify "practical" ways for their pupils to use mathematics in their daily lives. Common journal entries were: "I am unable to come up with examples (real world) in my Algebra II class." "I don't know what 14 year old people do so my examples are too adult for them." "I wish I could find a way to relate content to their daily lives." Student teachers teaching general mathematics or at the junior high school level did use economic situations that had practical implications. Those teaching algebra I did not have pupils make up their own word problems to enhance topics being taught. Student teachers teaching higher level mathematics courses almost never incorporated real world examples except when they taught units on probability or in statistics. As a general rule, assignments only came from the text.

Discussions with the student teachers demonstrated mathematic's teacher trainees had not been required during their university training program to create practical problems that could be used in instructional settings.

The teaching of English in a mathematic's classroom happened rarely, but student teachers recorded they saw a need. "I taught pupils how to take notes today. I assumed they would be able to do that." "My pupils have difficulty reading. I need to find a way to teach them how to read word problems. I need to become a reading teacher." "My pupils cannot translate an English sentence into a mathematics sentence." "Both mathematics and English are symbol systems. Why don't my pupils recognize this commonality?" Only 1 student teacher in 22 observed taught pupils how to read word problems. One suggestion the student teacher gave was to read the whole problem and identify the question being asked before any of the facts were examined. See the big picture before you get involved with details was his message. Also, as a part of this student teacher's assignment he created some mathematical statements that he asked pupils to rewrite into English narratives. He tried to demonstrate the translation of English and mathematics could go both ways. It was further observed that student teachers did not effectively use oral language. As a general practice, student teachers did not use speech to describe the mental processes they were going through as they solved a word problem. They did not tell their pupils how they were converting English language into mathematics sentences. Yes, they did some explaining, but far too often they made assumptions and took mental short cuts. They did a great deal of board work that was not auditorilly discussed. After these observations were presented to the student teachers in post-observation conferences the student teachers admitted they had not considered or planned ways mathematics and English language could be incorporated into their classroom presentations.

Exposure and experience hopefully will increase the use of technology in mathematic's classrooms. Student teachers said, "I have no experience using an overhead projector." "In methods we looked at a graphing calculator one day." I've seen a computer connected to an overhead projector but I've never used it." "I'm not familiar with V.T.R. series or software programs that I could use to supplement or enhance my teaching." These responses were typical. These statements are not meant to be critical because many of the cooperating teachers have limited experience too. In Iowa, there are Phase III funds allocated to each school district from the Department of Education which are intended for teacher and curriculum development. The use of technology is rapidly being piloted in Iowa schools because of these funds. For example, graphing calculators are definitely being used and student teachers are learning right along with their pupils. Cooperating teachers are attending national NCTM meetings and they are seeking out the vendors for overhead calculators, V.T.R., and software programs that enhance teaching and record keeping. Perhaps an initial solution would be for mathematics departments to promote a series of independent study one semester hour credit courses that encourage teacher education students to become familiar with technology applications in mathematics's classrooms.

Familiarity with the science of effective teaching is lacking. General teaching strategies are not being required or stressed in secondary training programs. "I need to remember to smile, to circulate, to incorporate multiple learning channels into my presentations, to let kids know I am having fun teaching them mathematics..." "I am boring my pupils because I am teaching math and I should be teaching pupils about math." "I don't know much about kids growth and development or their preferred learning styles." According to the Myers-Briggs Type indicator (1987) mathematics teachers tend to be classified as "Introverted, Sensing, Thinking, Judgmental" types of people. This means they are self-sufficient, dependable, realistic, accurate, calm, and systematic in ways they handle personal and public situations. However, in a heterogeneous classroom of 35 students there are only 7 pupils that match this type. The other 28 view the world differently. A successful teacher must provide opportunities for every learner. Many student teachers in mathematics have not examined learning styles' literature. Jaime Escalante's MATH Program (1990) should be required reading for all mathematics teacher trainees. He has some ideas about how to teach teachers. The mathematics student teachers are familiar with methods of teaching math concepts, but they know little about the general science of effective teaching practices. Greater opportunities to work in practitioner's classrooms should help resolve this situation.

Conclusions

It is suggested that these ideas be added to the requirements for all mathematics teacher trainee majors.

1. Mathematics teacher education students should be required to create "practical" problems for pupils for every mathematics course in grades 7-12.
2. Mathematics teacher trainees should be required to take a course that deals with writing across the curriculum so they can better incorporate English into their classroom instruction.
3. Mathematics education majors should spend a minimum of 45 contact hours working with and investigating the use of technology in classroom instruction.
4. Teacher trainees in mathematics education should enroll in course work outside the department of mathematics that focuses on the general science of effective teaching.

Recommendations

To accomplish the above conclusions course work in mathematic's curriculum should be reduced by 2 to 4 semester hours. It is further recommended the mathematics's department must approve course work their majors select as replacements for the course work dropped from the mathematics teacher training major.

APPENDIX

Table 1

ACT COMPOSITE SCORES ' ' SELECTED GROUPS
UNI Teacher Education Program
Fall 1991

Group Description	Males			Females			Non-Trad			Traditional			Total		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Elementary Educ (All)	224	21.34	3.31	1467	21.43	3.38	104	20.37	3.62	1587	21.48	3.35	1691	21.41	3.37
Elem. Ed. (Math Minor)	43	22.23	2.57	101	22.89	3.65	8	22.37	3.67	136	22.71	3.36	144	22.69	3.38
Fine Arts (Art, Music)	87	23.64	3.76	108	22.78	3.89	9	20.22	2.53	186	23.21	3.86	195	23.16	3.86
For. Lang. (incl. TESOL)	12	25.33	4.40	63	23.79	3.28	2	29.00	2.00	73	23.90	3.46	75	24.16	3.41
Lang. Arts (Eng., Comm., Theatre, Journalism)	49	24.22	3.61	169	23.34	3.63	11	22.55	2.74	207	23.59	3.68	218	23.54	3.65
Math/Computer Science	72	25.19	3.63	69	24.43	3.70	10	23.60	3.85	131	24.92	3.65	141	24.86	3.67
Natural Sciences (All)	81	24.88	3.53	42	24.48	3.34	12	23.58	3.33	111	24.86	3.46	123	24.74	3.47
P.E./Health	99	20.33	3.61	59	20.37	3.08	13	18.77	4.21	145	20.49	3.30	158	20.35	3.42
Psychology	8	22.63	3.20	29	22.10	3.50	2	20.50	2.50	35	22.31	3.54	37	22.22	3.51
Social Sciences (All)	184	23.12	3.44	98	24.19	3.49	24	22.87	3.97	258	23.55	3.44	282	23.49	3.50
Voc. Educ. (Bus., Home Ec., Ind. Tech.)	39	22.90	3.35	41	22.46	2.94	11	23.00	2.41	69	22.62	3.25	80	22.67	3.15
All Tchr. Educ. Majors	872	22.75	3.83	2188	21.99	3.58	227	21.33	3.83	2833	22.28	3.64	3060	22.21	3.67
Transfer Students													1019	21.43	3.86
Non-Transfer Students													2041	22.60	3.50

NOTE:

1 - These findings were drawn from a population of 3425 students enrolled for the fall semester of 1991 at the University of Northern Iowa who identified their intended majors as being in the area of teacher education. (ACT composite scores were available for 3060 of the 3425 students included)

2 - Non-traditional students were identified as those individuals aged 25 years and older by December 31, 1991; traditional students were identified as those aged 24 years or less at that time.

3 - Transfer students were identified as those who had earned 15 or more semester hours of credit from institutions other than the University of Northern Iowa--in effect, those who had completed one or more semesters of work at other institutions.

Table 2

GRADE POINT AVERAGES F SELECTED GROUPS
UNI Teacher Education Program
Fall 1991

Group Description	Males N	Males Mean	Males S.D.	Females N	Females Mean	Females S.D.	Non-Trad N	Non-Trad Mean	Non-Trad S.D.	Traditional N	Traditional Mean	Traditional S.D.	Total N	Total Mean	Total S.D.
Elementary Educ (All)	231	2.74	0.43	1345	2.89	0.50	186	3.01	0.58	1390	2.84	0.48	1576	2.86	0.50
Elem. Ed. (Math Minor)	43	2.72	0.39	102	3.07	0.46	11	3.27	0.48	134	2.94	0.46	145	2.97	0.47
Fine Arts (Art, Music)	75	2.92	0.43	99	2.99	0.49	12	2.87	0.53	162	2.97	0.46	174	2.96	0.46
For. Lang. (incl. TESOL)	12	3.26	0.45	64	3.06	0.56	7	3.33	0.55	69	3.06	0.54	76	3.11	0.54
Lang. Arts (Eng., Comm., Theatre, Journalism)	48	2.72	0.48	145	2.92	0.53	16	3.15	0.70	177	2.84	0.50	193	2.87	0.53
Math/Computer Science	69	2.85	0.54	88	2.99	0.51	19	3.16	0.55	114	2.95	0.56	133	2.97	0.56
Natural Sciences (All)	69	2.73	0.42	39	3.06	0.44	16	2.83	0.37	92	2.85	0.47	108	2.85	0.45
P.E./Health	102	2.55	0.44	63	2.72	0.36	21	2.78	0.47	144	2.59	0.41	165	2.62	0.42
Psychology	10	2.51	0.60	29	2.78	0.54	5	2.51	0.63	34	2.74	0.55	39	2.71	0.57
Social Sciences (All)	186	2.78	0.49	97	3.01	0.50	46	2.84	0.52	237	2.86	0.51	283	2.86	0.51
Voc. Educ. (Bus., Home Ec., Ind. Tech.)	42	2.64	0.52	48	2.89	0.45	25	2.99	0.60	65	2.69	0.42	90	2.77	0.50
All Tchr. Educ. Majors	855	2.75	0.48	2032	2.93	0.51	401	3.03	0.57	2486	2.85	0.49	2887	2.87	0.51
Transfer Students						UNI GPA-->	896	2.87	0.54		Total GPA-->		1219	2.89	0.45
Non-Transfer Students						UNI GPA-->	1639	2.86	0.56		Total GPA-->		1668	2.87	0.55

NOTE:

1 - These findings were drawn from a population of 3425 students enrolled for the fall semester of 1991 at the University of Northern Iowa who identified their intended majors as being in the area of teacher education. (Of the 3425 students included, 2887 had earned collegiate credits and had posted grade point averages; the remaining students may be assumed to be in the first semester of their collegiate careers.)

2 - Non-traditional students were identified as those individuals aged 25 years and older by December 31, 1991; traditional students were identified as those aged 24 years or less at that time.

3 - Transfer students were identified as those who had earned 15 or more semester hours of credit from institutions other than the University of Northern Iowa--in effect, those who had completed one or more semesters of work at other institutions.

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