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Differences in Elementary Math Instruction and Achievement Among Districts of Varying Size in the State of Washington

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The purpose of this article is to describe similarities and differences in the teaching of elementary mathematics in a sample of elementary schools in districts of varying size in the state of Washington. A total of 999 teachers from 135 elementary schools responded to a questionnaire (an 85% return rate). The findings suggest that instruction in elementary schools of varying size districts is more similar than different. In general the differences related to: 1) how Student Leaning Objectives and math instructional materials were selected and the extent of teacher involvement in the selection process; 2) how teachers measured student progress; 3) student achievement; 4) the number of years teachers had taught elementary math; and 5) whether teachers had attended a math inservice program or workshop within the last five years.

The data for this article were derived from a state-wide study of elementary mathematics education in Washington [4]. The purpose of the state study was two-fold: 1) to describe how math was being taught in Washington; and 2) to identify factors that related to math instruction and achievement. One factor observed in this state study was district size. The intent of this article is to report the findings regarding this factor.

District size was investigated as a factor due to current concerns in rural areas about the movement toward consolidation of small schools, based on the contention that larger districts are cheaper to operate and can provide higher quality, more comprehensive programs. An Oregon study [2] pointed out potential weaknesses in this contention and indicated a need for further research regarding the effect of district size on instruction and academic achievement.

For purposes of the study reported here, it was hypothesized that students may be exposed to different kinds of instruction in math in smaller and larger districts due to differences in district policies and procedures for curriculum and staff development. Mehaffie [2] reported that some differences in environmental conditions exist in smaller and larger districts which may affect the educational experiences of students in those schools. Mehaffie cited differences such as relationships and community support, as well as the availability of resources.

METHODOLOGY

Six research questions were asked to assess the effect of district size on math instruction and achievement: Is there a significant difference among districts of varying size relative to:

1. The development and implementation of Student Learning Objectives (SLOs)?
2. The selection and implementation of math instructional materials?
3. Techniques used to instruct students in math?
4. Student achievement in math?
5. Teacher demographic characteristics?

District size was defined in terms of district enrollment. Four district size categories (A, B, C, and D) were used for this study: 1) A included districts with enrollments of up to 2,000; 2) B included districts with enrollments ranging from 2,001 to 7,000; 3) C includes districts with enrollments ranging from 7,001, to 14,000; and 4) D includes districts with enrollments greater than 14,000. The A catagory was based on the state of Washington's definition of "second class" districts as being districts with enrollments of 2,000 or less [3]. The remaining district size categories were established by observing a frequency distribution of district enrollments in the state. Categories were established where there seemed to be a natural break (e.g. there were few districts with enrollments between 6500 and 7500) and where the categories would contain an approximately equal proportion of students relative to the total state student population. Based on this process for establishing district size categories, the proportion of state student population contained in each size category was as follows: Size A = 17%; Size B = 28%; Size C = 24%; and Size D = 31%.

Sampling Procedures

Schools within each of the four district size categories were randomly selected from the *1982-83 Washington State School Directory*. A total of 206 elementary schools were selected and it was determined that those schools selected for each of the four size categories had student enrollments that were approximately equal to the enrollment proportions each category represented of the total

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state student population. The proportion of students enrolled in schools selected from each district size category was as follows: A = 18%; B = 28%; C = 23%; and D = 31%.

Data Collection Procedures

The district superintendent for each elementary school selected was contacted by phone for approval for the study to be conducted in that district. Of the 206 schools selected, permission was granted for 158 schools. A packet of surveys was sent to the principal of each elementary school selected. The number of teacher surveys sent to each school was based on the estimate average class sizes of 25. The principal survey contained 12 questions—eight were close-ended and four were open-ended in format. The teacher survey contained 51 questions—39 were close-ended and 12 open-ended.

Description of Respondents

Surveys were returned from a total of 135 schools (a 85% return rate based on the 158 schools surveyed). The range of district enrollments for those schools participating in this study were: Size A = 09-1,890 (with an average of 581); Size B = 2,150-6,616 (with an average of 4,033); Size C = 7,100-13,494 (with and average of 10,627); and Size D = 15,451-46,477 (with an average of 27,140).

A total of 40 principals and 243 teachers from Size A, 27 principals and 268 teachers from Size B, 20 principals and 258 teachers from Size C, and 30 principals and 230

TABLE 1

An Overview of Variables Found to be Similar for the Four District Size Categories

Variable Category	Findings
The development and implementation of Student Learning Objectives (SLOs).	a. 71% of the example SLOs teachers included on the returned surveys were rated by the researcher to be "very specifically" stated. 8% of the SLOs were rated "very broadly" stated. b. Most teachers (81%) considered their SLOs to be well sequenced across grade levels. c. 67% of the teachers reported their school had specified minimum competencies for each grade level.
The selection and implementation of math instructional materials.	a. The average number of years districts had been using their current math instructional materials was 4.81 years. b. A basal text was used as a primary source of instruction by 79% of the teachers. Skill sheets and teacher-made materials were used most often by teachers as supplemental sources for instruction (69% and 64% respectively).
Instructional techniques used in math.	a. The average time spent teaching math per day was 47.9 minutes, with a range of from 20 minutes to 90 minutes per day. b. 46% of the teachers reported they taught math to a group of students of mixed abilities; 37% taught math to a large group of students with similar skills; and, 17% taught math to small groups of students with similar skills. c. Few teachers (13%) team taught math with another teacher. d. 90% of the teachers were able to provide remedial assistance and 85% were able to provide enrichment activities to students in their classrooms. (However, the kinds of remedial and enrichment activities used by teachers and the frequency with which they were used is not known). e. About half of the teachers (57%) gave students credit for using the correct procedures for solving a math problem. f. About half of the teachers (58%) seldom or never encouraged students to use estimation or guessing when working math problems. g. Appropriately, the same amount of time was spent on 22 instructional activities (such as teach math concepts, teach problem solving skills, give unit or skill tests, etc.). h. 92% of the teachers used daily work as a means for measuring student progress.
Teacher demographic characteristics.	a. 6% of the teachers had earned a major in science or math and 12% had earned a minor in science or math. b. The average number of classes in math taken as an undergraduate was 2.37 and the average number of those classes that related to methods of teaching math was 1.14. The average number of classes in math taken beyond the Baccalaureate degree was 1.29. c. 23% of the teachers had earned their Masters degree. d. 42% of the teachers felt their college training to teach math was adequate.

teachers from Size D districts completed the questionnaires.

RESULTS

Chi-square and analysis of variance (ANOVA) were used to assess differences among the four district size categories regarding the math instructional variables included in this study. The major intent of this study was to identify educational variables that differed or did not differ by district size. Thirty discrete instructional variables were examined. Of these, 17 were found to be the same across all four district size categories. Table 1 presents an overview of the variables found to be the same among the four district size groups. A total of 12 variables were found to vary in some way by district size. Table 2 presents the chi-square values obtained for 11 of these 12 variables. Differences found among districts of varying size are explicated in the following sections.

Differences Regarding Students Learning Objectives (SLOs)

Chi-square analyses were used to identify variables related to the development of the SLOs (see Table 2). There were significant differences among the district size categories relative to how SLOs were developed. Although the majority of teachers in most district size categories reported their SLOs were developed by a district level teachers curriculum committee, there was a greater tendency for the smaller districts (Size A) to use building grade level teams or individual teacher recommendations for development of the SLOs compared to districts with larger enrollments. Also, the larger the district size, the less likely an individual teacher was to be involved in the development of SLOs.

Differences Regarding Instructional Materials

Table 2 reports the results of chi-square analyses for differences by district size relative to the selection of math instructional materials. The majority of teachers in each category indicated that the instructional materials they currently were using had been selected by a district teacher curriculum committee; however, proprotionately more teachers in Size A districts (small) reported their materials were selected by building grade level teams or individual teacher recommendations than in the other size categories. In addition, a higher proportion of teachers

TABLE 2

Chi-square Results for Variables Significantly Related to District Size ($p<.05$)

Variable	X^2	Response Categories	Percent of Teacher Responses Size A	Size B	Size C	Size D
How SLOs were developed	179.9	District administration	7%	6%	8%	20%
		District teacher curriculum committee	45%	77%	85%	73%
		Building or individual teacher recommendation	48%	17%	7%	7%
Whether teachers were involved in SLO development	180.4	Yes	64%	39%	19%	11%
How instructional materials were selected	122.6	District administration	3%	9%	10%	15%
		District teacher curriculum committee	56%	69%	87%	72%
		Building or individual teacher recommendation	42%	21%	3%	14%
Whether teachers were involved in the the selection of instructional materials	103.4	Yes	55%	30%	16%	20%
Whether teachers used procedures for measuring student progress:						
a) Standardized tests	22.05	Yes	39%	33%	20%	30%
b) District developed tests	59.14	Yes	7%	34%	30%	24%
c) Building developed tests	9.49	Yes	11%	10%	7%	4%
d) Textbook tests	13.53	Yes	92%	81%	85%	84%
e) Homework assignments	8.23	Yes	47%	45%	39%	51%
Math achievement	58.34	High achievement	52%	39%	83%	26%
		Low achievement	47%	61%	17%	74%
Whether teachers had attended a math inservice within the last five years	18.76	Yes	42%	46%	52%	61%

in Size A districts (35%) reported they were likely to be involved in the process of selecting instructional materials than teachers in the other district size categories.

Differences Regarding Instructional Techniques

Instructional techniques found to be related to district size involved methods used to measure student progress (See Table 2). Proportionately more teachers in Size A districts were likely to use standardized tests to measure student progress than teachers in larger districts. Teachers in Size A districts were not as likely to use district developed tests to measure student progress. Teachers in Size C districts were less likely to use homework assignments as assessments of students progress.

Differences Regarding Math Achievement

The principal from each school was asked to report the national percentile score in math obtained for the fall, 1983 state-wide fourth grade testing. Approximately 100 principals reported their math percentile scores. Thirty schools with the highest scores (upper ⅓) and 30 schools with the lowest scores (lower ⅓) were identified. The high achieving group of schools included those schools that had scores in the upper ⅓ and had scores the principal claimed were the "same as" or "below" what was usually obtained for other grade levels within their building. The lower achieving group of schools included schools in the lower ⅓ that had scores the principal considered to be the "same as" or "above" what was obtained for other grade levels in their building.

A chi-square analysis was used to compare district size to level of school achievement (high achieving schools vs. low achieving schools). Results of this analysis are presented in Table 2. A higher proportion of schools in the Size A and C districts were among the high achieving schools than schools in the B and D sized districts.

Differences Regarding Teacher Demographic Characteristics

Table 2 reports the results of chi-square analyses for teacher characteristics found to differ significantly by district size. A significantly high proportion of teachers in the Size A district were male than in the Size B, C and D districts. Also, the larger the district size the greater the proportion of teachers who had attended an inservice program or workshop in math within the last five years.

Analysis of variance indicated a significant difference among the districts regarding the number of years teachers has taught elementary mathematics ($F = 11.21$ with 3/949 df at $p \leq .05$). The mean number of years of teaching reported for each district size follows: Size A = 11.23 years; Size B = 11.71 years; Size C = 12.66 years and Size D = 14.75 years. Scheffee post hoc analyses identified significant differences in the mean number of years between Size A and D districts and between Size B and D districts.

CONCLUSIONS

The instruction of elementary mathematics in schools of small districts is more similar than dissimilar to instruction of math in schools in larger districts. Seventeen variables were found to be the same for schools across the four district size categories; and twelve variables were found to be different. Furthermore, the differences found were not necessarily ones which reflect negatively on the smaller school districts. In many instances, the results could be interpreted as favoring instruction in the smaller districts. The general areas in which teachers are similar, regardless of the size of district in which they teach, included: 1) the format of the Student Learning Objectives they use; 2) the time they spend teaching math; 3) the grouping techniques they use to teach math; 4) the frequency with which they use specific instructional techniques in math class; and 5) the education they have received in preparing them to teach elementary math.

The differences found among the four district size categories are summarized as follows:

1. Teachers in smaller districts (below 2000 students) are more likely to have SLOs developed by individual teachers or building teams of teachers and teachers are more likely to be involved in the development process than teachers in larger size districts.
2. The instructional materials in smaller districts are more likely to be involved in the process of selecting instructional materials. Instructional materials in the larger districts are more likely to be selected by district administrators.
3. Teachers in small districts are more likely to use standardized tests and textbook tests to measure student progress than teachers in larger districts.
4. Teachers in districts with enrollments between 7,000 and 14,000 are less likely to use homework to measure student progress than teachers in other size districts.
5. A greater proportion of high achieving schools are in districts with enrollments under 2000 and between 7,000 and 14,000.
6. The larger the district size, the more experience the average teacher will have had in teaching math.
7. Teachers in small districts are less likely to have received inservice training in the last five years than teachers in larger districts.

The intent of this article was not to make absolute claims regarding the effects of district size on elementary math variables; rather, the intent was to identify variables that seem to be affected by district size. Further research needs to be conducted to validate the findings obtained in this survey research and to identify, in more specific terms, the similarities and differences in math instruction in schools within different size districts.

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