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ABSTRACT

This paper examines the relationship between school size and funding levels in North Carolina secondary schools. Data included information from 94 secondary schools concerning classes offered, school enrollment and staffing, school size and location, funding levels, and student achievement in eight selected subjects; principal and teacher interviews in selected secondary schools and feeder elementary schools; and supportive data from state and census archives. The results are organized into two sections: the relationships of school size and funding level to depth of curriculum, and variances in student achievement across levels of school size and levels of funding. School size appears to be the most important factor in variety of curriculum and specialized courses, with larger schools providing more course offerings. In addition, funding appears to make a difference when special equipment is needed to offer a course. Regression analyses indicate that funding level was a predictor of student achievement in algebra, biology, chemistry, and geometry, while school size was a predictor of achievement in biology and physics. (LP)

North Carolina Rural Initiative Study of Secondary Schools: Funding Effects on Depth of the Curriculum

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Introduction

Purpose of this report. Data collection is often one of the most costly activities in the conduct of research. Data bases are often developed to meet a set of study requirements and to permit secondary analyses to go beyond original study aims. Such is the case of the rural initiative study that is being completed by the Public School Forum of North Carolina, an organization of government representatives, public school and university educators and business leaders. The data base which includes secondary school program descriptions, teacher behaviors, student participation rates and student achievement averages was developed for the simple comparisons that will be reported in this document. However, this data base represents one of the more comprehensive data bases for curriculum study and for potential explicative power with regard to schooling.

What is the rural initiation and the education forum. The rural initiative grew out of three concurrent movements, one in demography, one in education and one in economics. In demography half of the North Carolina's future work force and future taxpayers are currently living in rural areas. In education there is growing recognition that answers to many of today's social problems must come from the improvement of our present education system. And in economics the rising cost of education and growing concerns for civil rights and equity have resulted in litigation challenging the formulae for funding education in thirteen states.

Questions concerning the equity of educational funding have reached a new peak in interest and in depth. In three states, Kentucky, Texas and Montana, courts have ruled against state formulae and their parallel systems of funding education. In the last two states where litigation is in process the equity issue has grown beyond equity based on simple expenditure issues tc the more complex issues of equity of educational opportunity. In North Carolina the issue of equity of educational opportunity is compounded by rural/urban characteristics, school size and complexity of program demands. Recent data compiled by the North Carolina Rural Economic Development Center suggests the emergence of a "dual economy" in North Carolina and much of the southeastern United States. This "dual economy" is characterized by the coexistence of a "rich state" and "poor state" within the single government, divided by wealth, capacity to be taxed and educational opportunity.

Can the notion of equity be expanded to include the more complex issues of opportunity? Is the state of being rural a determinant of opportunity or lack of opportunity? Is the condition of being small a determinant of opportunity or lack of opportunity? Does Rural/Urban or Large/Small compound the issues of equity? The study as a major part of the rural initiative was developed to provide insight into these questions and to form the basis for the recommendation of education reform legislation. Selected analyses from the data base of the study has been used in two related reports, All That's Within Them, and Local School Finance in North Carolina: A Status Report. But, these selected analyses are not even the tip of the iceberg. In this report is featured the total complex of simple relationships of school size and funding level with the milieu of the secondary school.

Research Questions

For many years educational researchers concentrated on the improvement of individuals as learners. Tools of learning such as memory, logical thinking, abstract symbol retention, etc. attracted the attention of research psychologists. They in return responded with findings that led to cognitive dissonance, operate conditioning, token economies, etc. Student performances in school achievement did

improve, but tests got harder; there became more to learn. Educators (perhaps, even some non-educators, also) persist in adding to the curriculum, but they never want to take anything out of the curriculum (perhaps, there are exceptions - soap making and churning).

Still, the segments of students who traditionally had trouble with schools continued to have trouble achieving in schools. As a following gale to civil rights concerns has come interests in improving whole communities-school systems-groups of children rather than individuals. The Elementary and Secondary Education Act provided the start and the enabling legislature. Entitlement programs targeted groups for mass improvement. And then, the "effective schools" research has continued the quest through another crusade. And now funding levels, tax efforts and variances have come under scrutiny. Economy of scale has gained new interest with the near-recession. Hence, the understanding of the effects of school size and funding level are critical for school reform and movement toward equity of educational opportunity.

Many states are currently having to reduce spending and to decrease the support of education due to the ailing economy. A Wise policy move would be to understand the effect of size and funding level; to have prepared a policy to meet potential state funding crisis; and to have a plan of reform developed with these factors considered. Secondary schools were chosen for this study because it is generally believed that the effects of size and funding level are most visible in the secondary school.

Four areas of inquiry are investigated relative to school size and funding level effects. These are as follows:

* Is the depth (levels of advanced courses in an area) of the high school curriculum in North Carolina related to the size of the school?

* Is the depth of the high school curriculum in North Carolina related to the funding level of the school?

* Is the student achievement in the high schools of North Carolina in selected subject areas related to size of school?

* Is the student achievement in the high schools of North Carolina in selected subject areas related to funding level of school?

Methodology

Sampling design. The sampling design called for taking the small schools with surety (small secondary school was defined as a school with less than 450 students) and for taking from the remainder of secondary schools a proportional stratified sample. The variable on which stratification was based is level of funding. Low funding was determined by the 1988-89 adjusted property tax base per average daily membership and was defined as the range from $85,326 (lowest) to $172,637 (highest of the low). The state average is $230,250 and the state highest is $972,148. An additional selection consideration was equality of cell sizes. In Figure 1 is shown the sampling design by cell and in Figure 2 is shown the sample return received.

Figure 1

Stratified Sample Design by Size and Funding

	Small School SS	Large School LS	Row Totals
High funding (HF)	26/30	33/168	63/198
Low Funding (LF)	24/24	26/101	50/125
Columns Totals	54/54	59/269	113/323

Figure 2

Survey Return results by Size and Funding

	Small School (SS)	Large Schools (LS)	Row Totals
High Funding (HF)	26/30	26/168	52/198
Low Funding (LF)	18/24	24/101	42/125
Column Totals	44/54	50/269	94/323

Confidence intervals on proportions in the sample can be estimated using the following formula.

$$b = 1.96\sqrt{\frac{1}{N^2}\sum_i^2 \frac{1-n_i}{N_i}(pqn_i)}$$

where $N=323$, $N_1=30$, $N_2=24$, $N_3=168$, $N_4=101$

Figure 3
Confidence bound Values obtained using the formula:

Proportion	p =.5 q =.5	p =.4 q =.6	p =.3 q =.7	p =.2 q =.8	p =.1 q =.9
SS HF	0.07	0.07	0.06	0.06	0.04
SS LF	0.12	0.11	0.11	0.09	0.07
LS HF	0.17	0.17	0.16	0.14	0.10
LS LF	0.17	0.17	0.16	0.14	0.10
Total	0.01	0.01	0.01	0.01	0.10

The sample return percentage was 83.2%. Weights have been developed so as to permit the sample to be treated as a simple stratified sample and so as to take into account the non- responses. The reported univariate and bivariate analyses were conducted with out using these weights.

Data base contents. The data collected for the Rural Initiative Study consists of: 1. school reports on curriculum (classes offered), enrollment, staffing, etc.; 2. school district reports on financial data; 3. state reports of student achievement in eight selected subjects; 4. principal and teacher interviews in selected secondary schools; 5. principal and teacher interviews from feeder elementary schools; and supportive data from state and census archives.

Report data and archives have been collected from 94 secondary schools. Interview (teacher and principal) and elementary school data have been collected from approximately one-third of these districts. The secondary school level data include the following variables: rural/urban; high/low funding; size of (large/small) school; course offerings (separate for basic to most advanced) in mathematics, science, computers, journalism, speech, drama, English, foreign language, history, humanities, social studies, social sciences, dance, music, art, band, agriculture, machine shop, forestry, horticulture, aquaculture, business, accounting, data processing, office occupations and skills, marketing, distributive education, health, industrial arts, manufacturing, communications, wood technology, metal technology, carpentry, masonry, architecture, electricity trades, plumbing, aerospace, auto mechanics, cabinet and furniture making, textiles, electronics, welding, drafting, cosmetology, home economics, clothing, food processing, child care, human services, team sports, individual sports, conditioning and extracurricular activities; instructional practices, instructional strategies, student participation by study area; student achievement by study area; technology support; support staffing; special programs; demography; and community characteristics. Interview data include the following variables: instructional practices, instructional strategies, student participation by study area; technology support; support staffing; special programs.

Data files. The data are stored in four ascii files in an Ms-Dos system that were developed using StatPac, a commercially available statistical system. The files include an academic program file which contains academic program descriptions, participation data and achievement data; a vocational program file which contains offering descriptions and participation data; a miscellaneous file that contains information on extracurricular activities, teaching strategies and support information and an interview file containing data collected through interviews of teachers and principals at both secondary and elementary school levels. The data have been edited and corrections have been made.

Analytic Design. Four primary statistical techniques have been chosen for the treatment of the data. They are crosstabulations with the chi square statistic, two way analysis of variance, standard crossbreak analysis and stepwise multiple regression analysis. Overall, 260 crosstabulations, 77 two-way analysis of variance procedures, eight crossbreaks and eight stepwise multiple analyses were conducted to address the ten research inquiries. Many of these analyses were made necessary by the number of subject areas in the curriculum, however, it is recognized that the type I error grows in complexity in cases such as this one. To attempt to adjust "alpha level" for an argued amount of interdependence between analyses would most likely distract from the utility of the information produced without adding greatly to the certainly of the predicted outcomes.

To address questions one and two a composite variable was generated from the two dichotomous sampling frame designations of school size and funding level. This variable was then crossed with a variable designating the offering of a given course. Course designation variables were classified as academic, vocational and physical educational. After each crosstabulation had been completed, the chi square statistic was then computed. Responses to the questions one and two were then generated.

Areas of inquiry three and four, depth of curriculum or layers of advanced course work, was addressed using a two-way analysis of variance model. This fixed effects analysis of variance model used the dichotomous representation of school size as one classification and the dichotomous representation of funding level as the second classification. The dependent variables used in the models were of three types: counts of offerings of a specific and special course, counts of levels of prerequisite courses so as to indicate layers of advanced course offerings and counts of courses so as to include both layers and branches.

Student achievement data in eight areas were gained from the state department and added to the data base. The relationship of school size and level of funding to student achievement was investigated using two analytic models; one a direct approach and the other an indirect approach.

Crossbreak analysis was used to provide the direct approach to the investigation of the relationship. The direct approach involved the calculation of weighted means for each of the four types of schools: small, low funded schools; larger, low funded schools; small, higher funded schools; and larger, higher funded schools for each subject area investigated. A discussion of observed differences replaced the testing for significance.

The indirect approach utilized the dichotomous representation of school size and level of funding along with reported teacher strategies, school participation reports, student participation reports and curriculum offerings to predict achievement through stepwise regression. Eight applications of this basic model were made with slight tailoring to each subject matter achievement tested.

Results

The results of the high school analyses as part of the rural initiative study are organized in this report into two topical sections: the relationships of school size and funding level to depth of curriculum; and variances in student achievement across the two levels of school size and the two levels of funding. Specific data analyses appear in the appendices and their results are reported in summary tables. These summary tables are the basis for discussion in this report.

Depth of Curriculum.

In Table 4 are reported the results of the twenty-eight analyses of variance that were conducted in the academic curriculum area to relate depth of curriculum to size of school and funding level. In Table 4 are reported the results of thirty-three two-way analyses of variance performed in the analysis of the vocational curriculum.

In the academic curriculum four of the twenty-eight analyses had ·nificant ($p<0.10$) interaction terms. They were: French and ·nish; physical science; speech and advanced French. All appeared to be the result of the occurrence of low frequencies in one or two cells and the over loading of one (usually the larger, higher funded

Table 4:
Analysis of Variance Results for Depth of Curriculum Academic

Course	Size	Funding	Interaction
French & Spanish I	0.01	n.s.	0.06
Adv. French & Spanish	0.01	n.s.	n.s.
Adv. German & Latin	0.01	0.05	n.s.
Arts & Graphics	0.01	0.05	n.s.
Instruments I	0.01	n.s.	n.s.
Photography I	n.s.	0.06	n.s.
Physical Science I	n.s.	n.s.	0.05
Adv. Physical Science	0.01	n.s.	n.s.
Journalism	0.01	n.s.	n.s.
Speech	0.01	n.s.	0 05
International Studies	0.01	0.07	n.s.
Psychology	0.09	0.01	n.s.
Adv. French	0.01	0.06	0.05
Theater Arts	0.01	n.s.	n.s.
Visual Arts I	0.05	n.s.	n.s.
Music	n.s.	0.05	n.s.
Algebra	0.01	0.09	n.s.
Biology	0.01	0.01	n.s.
Chemistry	0.01	0.09	n.s.
English	n.s.	0.07	n.s.
Geometry	n.s.	0.01	n.s.
History	n.s.	0.01	n.s.
Physics	0.01	n.s.	n.s.

school). Thirteen of the twenty-eight analyses had funding level as a source of a significant ($p<0.10$) main effect. Eighteen of the twenty-eight analyses had school size as a source of significant $p<0.10$) main effect. The courses having significant main effects include: advanced German and Latin, arts and graphics, photography, international studies, psychology, advanced French, algebra, biology

and chemistry which had main effects for both size and funding; music, English, geometry and history had main effects for funding levels; and French and Spanish, Advanced French and Spanish, Instruments, advanced physical science, journalism, speech, theater arts, visual arts and physics had main effects only for school size.

Table 5:
Table of Analysis of Variance Results for Depth of Curriculum: Vocational

Course	Size	Funding	Interaction
Marketing	0.01	n.s.	n.s.
Adv. Marketing	0.01	n.s.	n.s.
Intro to Marketing	0.01	n.s.	0.05
Marketing II	0.01	n.s.	0.03
Intro to Health Profession	0.01	n.s.	n.s.
Construction	0.01	n.s.	n.s.
Adv. Construction	0.06	n.s.	0.09
Masonry	n.s.	n.s.	0.03
Masonry I	0.02	n.s.	n.s.
Agriculture Production II	n.s.	0.05	n.s.
Intro. to Business	0.01	n.s.	n.s.
Recordkeeping II	0.05	n.s.	n.s.
Aerospace III	n.s.	0.07	n.s.
Cabinet Making II	0.02	n.s.	n.s.
Tech Drafting I	0.01	n.s.	n.s.
Tech Drafting II	0.01	n.s.	n.s.
Cosmetology I	n.s.	0.02	0.05
Cosmetology II	n.s.	0.05	0.08
Cosmetology III	n.s.	n.s.	0.03

Seven of the thirty-three analyses of the depth of the vocational curriculum produced a significant ($p<0.10$) interaction. They include: introduction to marketing, marketing II or advanced

marketing, advanced construction, masonry, cosmetology I, cosmetology II, and cosmetology III. Four of the thirty-three analyses had funding level as a source of a significant ($p<0.10$) main effect. Fourteen of the thirty-three analyses had school size as a source of significant ($p<0.10$) main effect. All main effects were unique. Courses having funding as a main effect include: Agriculture Production II, Aerospace III, Cosmetology I and Cosmetology II. Those having school size as a main effect include: Marketing, Advanced Marketing, Introduction to Marketing, Marketing II, Introduction to the Health Professions, Construction, Advanced Construction, Masonry I, Introduction to Business, Recordkeeping, Cabinet Making II, Tech Drafting I, Tech Drafting II and Advanced Home Economics.

In Table 6 are reported the results of the analyses for the investigation of the depth of physical education curriculum relative to class size and funding level. Two of the five analyses produced a significant ($p<0.10$) interaction. They were:fitness and junior varsity boys football. No main effects were found for funding level. Three of the five analyses produced a significant ($p<0.10$) main effort for school size. They were: junior varsity and varsity boys football and girls junior varsity cheerleading.

Table 6:
Table of Analysis of Variance Results for Depth of Curriculum: Physical Education

Course	Size	Funding	Interaction
Fitness	n.s.	n.s.	0.09
Football Boys (JV)	0.01	n.s.	0.06
Football Boys (Var)	0.01	n.s.	n.s.
Cheerleading Girls (JV)	0.04	n.s.	n.s.
Cheerleading Girls (Var)	n.s.	n.s.	n.s.

Student Achievement. Either of the representatives of school size or funding level may not appear as regression predictors because they are continuous variables reduced to dichotomies to accommodate their

role in the sampling. Hence, crossbreaks were used to provide a more direct address of the potential differences in achievement means. These observed differences, however, must not be interpreted as causal since several underlying conditions could have contributed to them.

Table 7: School Achievement Averages by Type and Subject

Subject	Size	Funding	Mean	Std. D	n
Algebra I	S	L	62.76	7.00	18
	S	H	67.34	8.09	26
	L	L	61.83	7.30	23
	L	H	66.51	7.77	25
Algebra II	S	L	61.82	8.5	17
	S	H	62.97	8.52	25
	L	L	64.83	7.78	22
	L	H	69.39	7.55	25
Biology	S	L	56.66	5.48	18
	S	H	59.87	4.95	25
	L	L	59.69	3.89	23
	L	H	62.47	4.15	25
Chemistry	S	L	61.27	6.39	18
	S	H	64.26	6.28	23
	L	L	62.50	6.14	21
	L	H	66.19	6.00	25
English	S	L	60.33	6.44	17
	S	H	62.65	7.47	26
	L	L	62.02	4.97	17
	L	H	64.65	4.72	23
Geometry	S	L	59.34	6.13	16
	S	H	64.05	6.37	26
	L	L	61.36	6.78	23
	L	H	65.50	6.33	25
History	S		67.35	6.39	18
	S		69.87	6.00	25
	L		68.01	3.47	23
	L		71.32	5.02	25
Physics	S		57.38	9.51	12
	S		61.59	8.03	22
	L		66.87	8.19	21
	L		64.78	8.53	24

Algebra I, Chemistry and Geometry appear to have differences across levels of funding. Physics appears to differ across size dimensions. Algebra II, Biology and English show differences in mean achievement across both size and funding level. History does not appear to have mean differences across either size or funding level.

In Table 8 is reported a summary of the regression analyses results for these eight content areas. Algebra I, Algebra II, Biology, Chemistry and Geometry included funding as a factor in the prediction. Biology and physics both included size in the prediction equations. Along with the two variables of interest, the use of mastery learning, Socratic instruction and a focus on critical thinking were repeat performers as predictors.

Table 8:
Regression Analyses of Achievement

Subject Predicted	Sign.	Var. Exp	Size factor	Fund factor	Other factors
Algebra I	0.01	0.20	no	yes	mastery language, critical thinking
Algebra II	0.01	0.30	no	yes	physics, algebra I, discriminate language, algebra II, remedial algebra I
Biology	0.01	0.33	yes	no	English, critical thinking, physics, group mastery integrated curriculum
Chemistry	0.01	0.26	no	no	physics, mathematics, critical thinking, AP math
English	0.01	0.18	no	no	Socratic, Group Mastery, Individual mastery
History	0.01	0.16	no	no	Physics, learning style
Geometry	0.01	0.14	no	no	Physics, group mastery

In Summary

Size appears to be the most important factor in variety in the curriculum and in specialized courses. Funding appears to enter when special equipment is needed to offer a course such as laboratory. In vocational educational this appears true for a number of the courses where interactions are obtained. Demography appears the key to performance.