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ABSTRACT

Both business leaders and parents pressure policymakers to legislate new initiatives to improve schools. One improvement strategy has been to reduce class sizes; another has been to allocate larger school budgets. This paper presents findings of a study that examined the relationship between class size and student achievement and between expenditure per student and student achievement. Data from "The Factbook on Elementary, Middle, and Secondary Schools 1993" (Mattson 1993) were analyzed. The study correlated expenditures per student, student-to-teacher ratios, and mean Scholastic Aptitude Test (SAT) scores for the 50 states and the District of Columbia using a computer program that calculated Pearson Product Moment correlation coefficients. The study found a small but insignificant relationship between class size and performance on the SAT, and a significant negative correlation between expenditures per student and SAT achievement. Four tables and six graphs are included. (Contains nine references.) (LMI)

STUDENT TO TEACHER RATIOS, EXPENDITURES PER STUDENT, AND MEAN SCHOLASTIC APTITUDE TEST SCORES FOR THE UNITED STATES

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ABSTRACT

This study attempted to show that a negative relationship exists between class size and achievement scores and that a positive relationship exists between the amount of money spent on each student and achievement scores. Expenditures per student, student to teacher ratios, and mean Scholastic Aptitude Test scores for the fifty states and the District of Columbia were found and correlated using a computer program which calculated Pearson Product Moment correlation coefficients. A small but insignificant relationship was found between class size and performance on the Scholastic Aptitude Test, and a significant negative correlation was unexpectedly found to exist between expenditures per student and achievement on the Scholastic Aptitude Test.

Background

Achievement test scores of students in the United States have been declining for a number of years, and this decline is of great concern to professional educators, parents, business leaders, and politicians alike. Business leaders want better educated graduates to maintain an adequate work force to compete in the world market. Parents also want their children to receive the skills needed to be productive members of society. These two groups then apply pressure to politicians to legislate new initiatives to improve our schools. Consequently, programs, often with hefty price tags, are constantly being proposed and instituted to improve our education system; unfortunately, when these approaches are evaluated, they rarely appear to improve student achievement.

One program that has often been tried in many states to improving student achievement is to reduce class sizes. One of the rationales for lowering student to teacher ratios is that teachers should be able to individualize instruction more effectively. Teacher unions lobby for smaller class sizes, because many professional secondary and elementary educators believe that small classes not only promote learning but also improve discipline. The notion that small class sizes should improve learning appeals to many on a common sense level, so parents usually prefer to have their children in small classes. In fact, often statistics showing low student to teacher ratios are used by chambers of commerce and realtors to attract new businesses or home buyers to a given area, and school districts as well as state Departments of Education brag about having small class sizes in their district or states. Unfortunately, reducing class size is very expensive, and programs to reduce class size must compete for money with many other programs.

Another common notion is that schools with larger budgets are able to provide better and more diverse learning opportunities, usually because these schools have better facilities, newer equipment and technology, more money to attract quality teachers, and better staff development systems. This perception has lead to class action suits being filed in many states by poorer schools challenging current funding formulas to get a more equal distribution of state funds. The high cost of class size reduction exacerbates the competition for limited funds.

Critics and proponents of the effectiveness of smaller classes at improving achievement have been debating for many years with little ground being given by either side. In fact a study was conducted on the influence of small classes on performance as early as 1909 in which no effects were discovered (Small Is Beautiful, 1990). One thing both sides will agree upon is the high cost associated with reducing student to teacher ratios, although proponents of smaller classes rarely mention the money involved. One educator estimated that reducing class size down to 14 or 15 students, an often cited optimal class size, would cost over $69 billion a year (Chandler, 1988). Another research study estimated that decreasing class size by one third would increase the cost of educating a single student by one third (Folger, 1989). Although supporters and detractors both admit the large drain on funds required to reduce class size, little agreement upon cost effectiveness can be found between the two opposing sides of this issue.

One research project concluded that raising teacher salaries was significantly more cost effective than decreasing class sizes (Stern, 1987). The rationale provided was that teacher morale would improve and indirectly improve instruction and learning, although improvement in teacher morale is also used as a rationale for smaller classes (Bennett, 1987 and Chandler, 1988). Stern (1987) also argued that higher salaries for teachers would also attract quality teachers and allow them to remain in education. Stern also found that schools in higher socioeconomic districts spent more per pupil and higher achievement scores, but this connection between money spent per student and achievement was not strong when socioeconomic backgrounds of students were statistically controlled.

Other opponents of reduced class sizes found that other instructional programs were significantly more cost effective. Peer tutoring and computer aided instruction (CAI) were found to be much more effective at increasing student performance and a great deal cheaper (Chandler, 1988). Proponents believe the improvements on achievement realized are worth price.

Gilman, Stone, and Swan (1988) expressed the logic that most advocates of reduced class size consistently use. Teachers will have more energy and interest and will in tern give more concerned care and attention to each student. Classroom management is more effective in smaller classes, allowing teachers to spend more time with each student and keep better track of individual progress. A wider variety of instructional strategies and learning activities can be utilized in small classes. As previously stated, teachers' attitudes and morale are positively effected. Better use of added time and space occurs in smaller classes. Teachers are afforded more planning time to individualize instruction (Bennett, 1987). The learning environment is more conducive to learning.

Proponents of small class size such as Bain and Jacobs (1990) have shown an increase in student performance associated with smaller class size. Bain and Jacob's findings occurred during their analysis of Tennessee's experiment in class size reduction known as project STAR. They found that kindergarten reading readiness was significantly improved in smaller classes, and also improved more than in regular classes when full-time aides were used in large classes. They also found that children from inner city and lower socioeconomic groups improved more in smaller classes. Similar studies of Indiana's project Prime Time (Gilman, 1988) also showed an improvement an improvement of primary student's achievement in smaller classes, although increased accountability placed upon teachers being, the Time on Task program, the Hawthorne effect, as well as other factors were offered as possible outside explanations for these results (Gilman, McGiverin, and Tillitski, 1989).

Other opponents to class size reduction have shown other flaws with this concept. One study showed that achievement levels drop back down by 50%

after the first year a student is back in a regular class after being in smaller classes (Folger, 1989). Researches have also shown that no single class size is optimal for all grades and subject areas (Bennett, 1987). One comment made in virtually every discussion of the class size debate is that achievement and learning will not improve by reducing class size alone, but changes in instructional techniques and strategies are needed to benefit from the smaller class size.

The questions still remain to be answered as to whether or not achievement is improved by smaller class sizes or achievement is increased by spending more money on each student. If class size reductions do not improve student achievement, then children in smaller classes should not have higher achievement scores. If spending more money on students improves student performance, then increasing expenditures per student will improve achievement scores. This study looks at these questions.

Statement of the Problem

How can student achievement be improved? Would student achievement improve with smaller class sizes? Is increasing the amount of money spent on each student a viable alternative that will increase student performance? One way to examine these questions is to look at the relationships between class size and expenditures per pupil and achievement. Does a relationship exist between class size and student achievement, and does a relationship exist between money spent per student and student achievement?

Two directional hypotheses were tested in this study:

1. There is a significant negative relationship between class size and achievement.

2. There is a significant positive relationship between money spent per student and achievement.

Methodology

This study used students in the elementary and secondary public schools in the fifty states and Washington, D.C. as the sample group. Data on the average student to teacher ratio and the average amount of money spent each year on each student was obtained for each individual state and Washington, D.C. from The Factbook on Elementary, Middle, and Secondary Schools 1993 (Mattson, 1993). Data about mean SAT scores for a subgroup of college bound secondary students from this sample was also taken from this book. Because of the size and nature of this sample, it could reasonably be concluded that this sample is representative of the students found in the public schools in this country. The subgroup from which mean SAT was taken provided the only concern, because this subsample only includes college bound students; however, another alternative achievement measurement which applied to the entire sample was not found.

This study had a correlational design and was an Ex Post Facto descriptive research study which used the data to compute Pearson product moment correlation coefficients. An apple computer with software that computed these correlation coefficients was the only piece of equipment needed.

This correlation used a critical value of 0.2428 at the 0.05 level for a one tailed test with 45 degrees of freedom. This particular number for the degrees of freedom was chosen, even though 50 and 51 pairs of numbers were correlated, because 45 was the closest number to use for degrees of freedom of 48 and 49.

Results

The student to teacher ratio, mean SAT score, and average amount of money spent each year for each state and the District of Columbia are shown in Table 1 and Table 2. Table 1 has the data in alphabetical order by state, while Table 2 has the data in order of achievement.

Insert Tables 1 and 2 about here

Graphs 1, 2, 3, 3A, 4, and 4A provide graphical representations of the data provided in Tables 1 and 2. Graph 1 shows the data for each state and the District of Columbia in order of achievement, while Graph 2 shows the same data but in alphabetical order. Graphs 3 and 3A show only the values for student to teacher ratios and SAT scores. Graph 3 has the values in order of achievement for each state, while graph 3A has the values plotted in alphabetical order by state. Graphs 4 and 4A are in the same format as Graphs 3 and 3A but they show values for SAT scores and expenditures per student, although Graph 4 has the data in alphabetical order and 4A has the data in order of achievement by state.

Insert Graphs 1, 2, 3, 3A, 4, and 4A about here

Fifty pairs of values were used to compute the Pearson product moment correlation coefficient between class size and mean SAT scores for each state because no data on class size was available for Louisiana. The mean class size was 16.862 and the standard deviation was 2.322. The mean Sat score for all of the states was 943.10 and the standard deviation was 67.23. The correlation coefficient that was calculated between these values was 0.1261 with a significance for a one tailed test of 0.1970. This was a positive correlation that was not greater than the critical value of 0.2428 at the 0.05 level. Instead, this correlation was significant only at the 0.1970 level. These values are provided in Table 3. Graph 5 represents this insignificant positive relationship.

Insert Table 3 and Graph 5 about here

Another Pearson product moment correlation coefficient was calculated between the average amount of money spent each year on a single student and the mean SAT score for each state. Fifty-one pairs of values were used to compute this coefficient because data for all the states and the District of Columbia was available. The mean expenditure per student was $5105.76 and the standard deviation was 1358.86. The mean SAT score was 944.10 and the standard deviation was 66.93. The correlation coefficient was -0.4954. These results were also significant to the 0.0002 level. Therefore, the null hypothesis was rejected, but unfortunately the this negative relationship was unexpected and opposed our hypothesis. These values are provided in Table 4. Graph 6 represents this significant negative relationship.

Insert Table 4 and Graph 6 about here

Discussion, Conclusions, and Recommendations

The two relationships found between class size and SAT scores and expenditures per student and SAT scores were unexpected, one more so than the other. Class size and SAT scores were expected to have a negative relationship but was discovered to have a small positive correlation, although these results were not significant and did not cause the hypothesis for these values to be rejected. The results of the correlation of money spent per pupil and SAT scores were even more unexpected. A positive relationship was predicted for these values, while the calculated correlation was significantly negative and caused the hypothesis for this data to be rejected. Several factors could have caused these results.

One factor that could have impeded the expected results was the sample used in the study. The data for class sizes was from the 1989-90 school year, while the statistics for money spent per student and SAT scores were taken from the 1990-91 school year. This could have allowed students included in the calculation of the average class sizes the previous year to be effected by new instructional methods or strategies that may have actually influenced the results more than class size.

A second related factor that could have erroneously influenced the correlation between class size and SAT scores is the data for class size. Most efforts to reduce class size probably occur in the primary grades, and most students who take the SAT are college bound juniors or seniors; unfortunately, the values for class size used were calculated using public school students in the primary and secondary grades. Thus the pairs of values correlated were not tabulated from the exact same sample. This problem was discussed briefly in the Methodology section of this paper, and as mentioned earlier, sources of data for this study were limited.

This problem with the sample could have produced misleading results for other reasons as well. As stated above, class size reduction generally happens at the primary level and is very expensive, and the cost of such reductions would have effected the values used for expenditures per student to rise. Although these larger values were correlated with SAT scores of secondary students, older students would not actually have this much money spent upon them each year. If this money would have been spent on instructional programs or strategies targeted for older students, would this negative relationship have been found?

Finally, usually only college-bound secondary students take the SAT, so our sample might not be representative of the general population. A similar argument as that stated above could be applied. Does money spent on at-risk students or other programs that do not directly effect members of the sample group for SAT scores falsely increase the money spent per student values correlated with the SAT scores?

In order to effectively answer these questions, a this study should be repeated with a different sampling method which will account for these differences between subgroups of the sample used.

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TABLE 1

STATES & D.C.	STUDENT/ TEACHER RATIOS	MEAN SAT SCORES	$ SPENT PER STUDENT
AK	16.8	991	695.2
AL	18.1	896	364.8
AR	17.0	1005	341.9
AZ	18.9	920	419.6
CA	22.4	897	482.6
CO	17.6	959	470.2
CT	13.1	897	845.5
DC	13.4	840	822.1
DE	16.4	892	601.6
FL	17.0	882	500.3
GA	18.3	844	485.2
HI	19.1	833	500.8
IA	15.7	1093	487.7
ID	20.1	968	321.1
IL	16.9	1006	506.2
IN	17.5	865	439.8
KS	15.0	1039	504.4
KY	17.7	993	439.0
LA	N/A	994	404.1
MA	14.0	896	635.1
MD	16.8	904	618.4
ME	14.1	879	589.4
MI	19.7	980	525.7
MN	17.2	1023	536.0
MO	15.8	1002	447.9
MS	18.2	997	332.2
MT	15.7	982	479.4
NB	14.7	1024	408.0
NC	17.1	844	463.5
ND	15.1	1073	368.5
NH	16.2	921	547.4
NJ	13.5	886	845.1
NM	18.3	996	444.6
NV	20.4	919	467.7
NY	14.7	881	868.0
OH	17.4	946	526.9
OK	16.2	997	383.5
OR	18.4	922	529.1
PA	15.7	876	653.4
RI	14.5	880	698.9
SC	17.0	832	384.3
SD	15.5	1047	373.0
TN	19.1	1015	370.7
TX	16.7	874	432.6
UT	24.8	1031	276.7
VA	15.9	890	533.5
VT	13.8	890	574.0
WA	20.1	913	504.2
WI	15.9	1023	594.6
WV	15.1	926	469.5
WY	14.5	980	525.5

TABLE 2

STATES & D.C.	STUDENT/ TEACHER RATIOS	MEAN SAT SCORES	$ SPENT PER STUDENT
IA	15.7	1093	487.7
ND	15.1	1073	368.5
SD	15.5	1047	373.0
KS	15.0	1039	504.4
UT	24.8	1031	276.7
NB	14.7	1024	408.0
MN	17.2	1023	536.0
WI	15.9	1023	594.6
TN	19.1	1015	370.7
IL	16.9	1006	506.2
AR	17.0	1005	341.9
MO	15.8	1002	447.9
MS	18.2	997	332.2
OK	16.2	997	383.5
NM	18.3	996	444.6
LA	N/A	994	404.1
KY	17.7	993	439.0
AK	16.8	991	695.2
MT	15.7	982	479.4
MI	19.7	980	525.7
WY	14.5	980	525.5
ID	20.1	968	321.1
CO	17.6	959	470.2
OH	17.4	946	526.9
WV	15.1	926	469.5
OR	18.4	922	529.1
NH	16.2	921	547.4
AZ	18.9	920	419.6
NV	20.4	919	467.7
WA	20.1	913	504.2
MD	16.8	904	618.4
CA	22.4	897	482.6
CT	13.1	897	845.5
AL	18.1	896	364.8
MA	14.0	896	635.1
DE	16.4	892	601.6
VA	15.9	890	533.5
VT	13.8	890	574.0
NJ	13.5	886	845.1
FL	17.0	882	500.3
NY	14.7	881	868.0
RI	14.5	880	698.9
ME	14.1	879	589.4
PA	15.7	876	653.4
TX	16.7	874	432.6
IN	17.5	865	439.8
GA	18.3	844	485.2
NC	17.1	844	463.5
DC	13.4	840	822.1
HI	19.1	833	500.8
SC	17.0	832	384.3

TABLE 3

[illegible]	[illegible]	SCORE 2
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	67.23
correlation	0.1261	
significance one-tailed	0.1970	

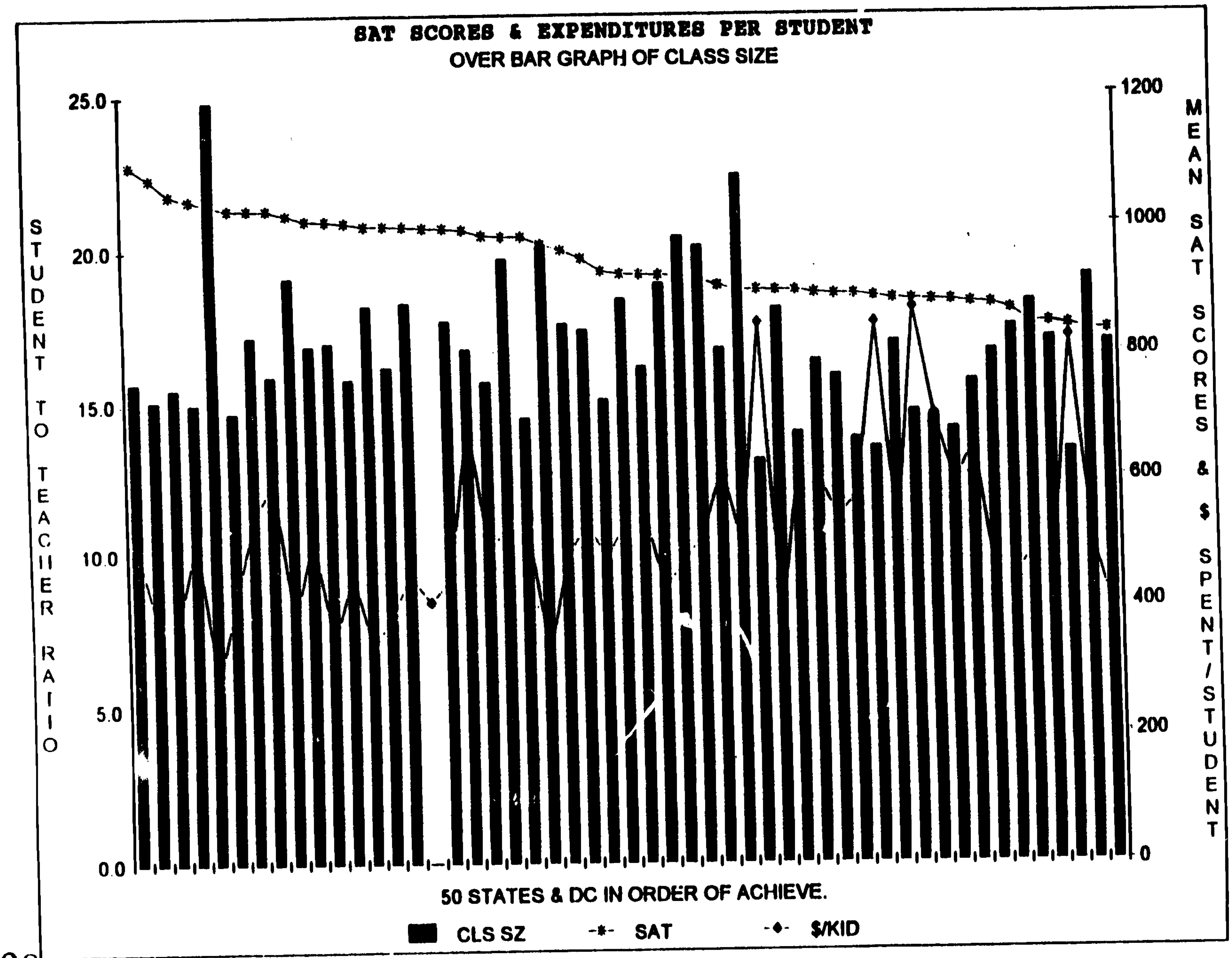
Results of Pearson Product Moment Correlation of class size and achievement.

TABLE 4

ITEM	SCORE 1	SCORE 2
number	51	51
mean	5105.76	944.10
standard deviation	1358.86	66.93
correlation	-0.4954	
significance one-tailed	0.0002	

Results of Pearson Product Moment Correlation of expenditures per pupil and achievement.

GRAPH 1


SAT SCORES & EXPENDITURES PER STUDENT
OVER BAR GRAPH OF CLASS SIZE
STUDENT TO TEACHER RATIO
25.0
20.0
15.0
10.0
5.0
0.0
MEAN SAT SCORES & $ SPENT/STUDENT
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50 STATES & DC IN ORDER OF ACHIEVE.
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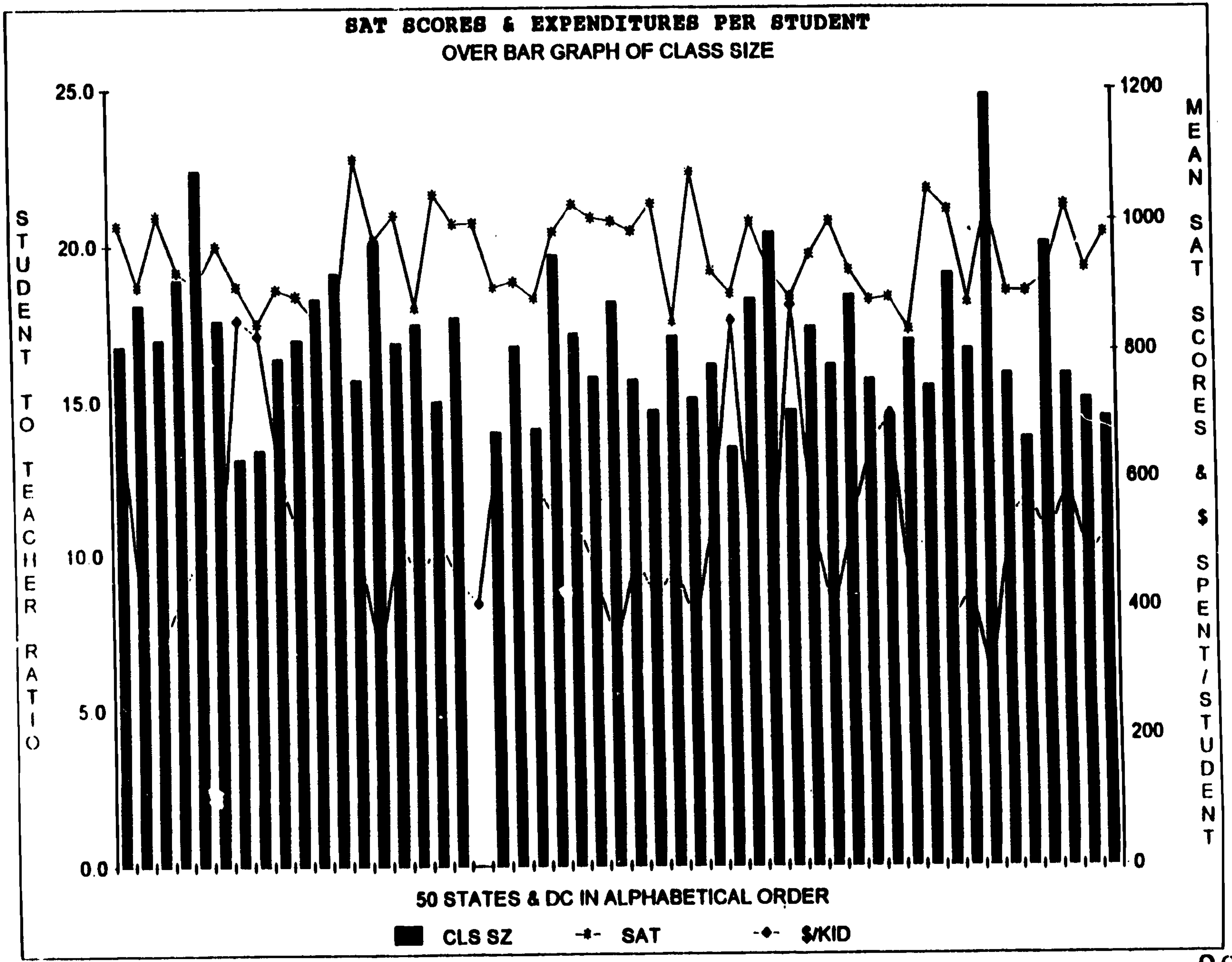
GRAPH 2


SAT SCORES & EXPENDITURES PER STUDENT
OVER BAR GRAPH OF CLASS SIZE
STUDENT TO TEACHER RATIO
25.0
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MEAN SAT SCORES & $ SPENT/STUDENT
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50 STATES & DC IN ALPHABETICAL ORDER
CLS SZ
SAT
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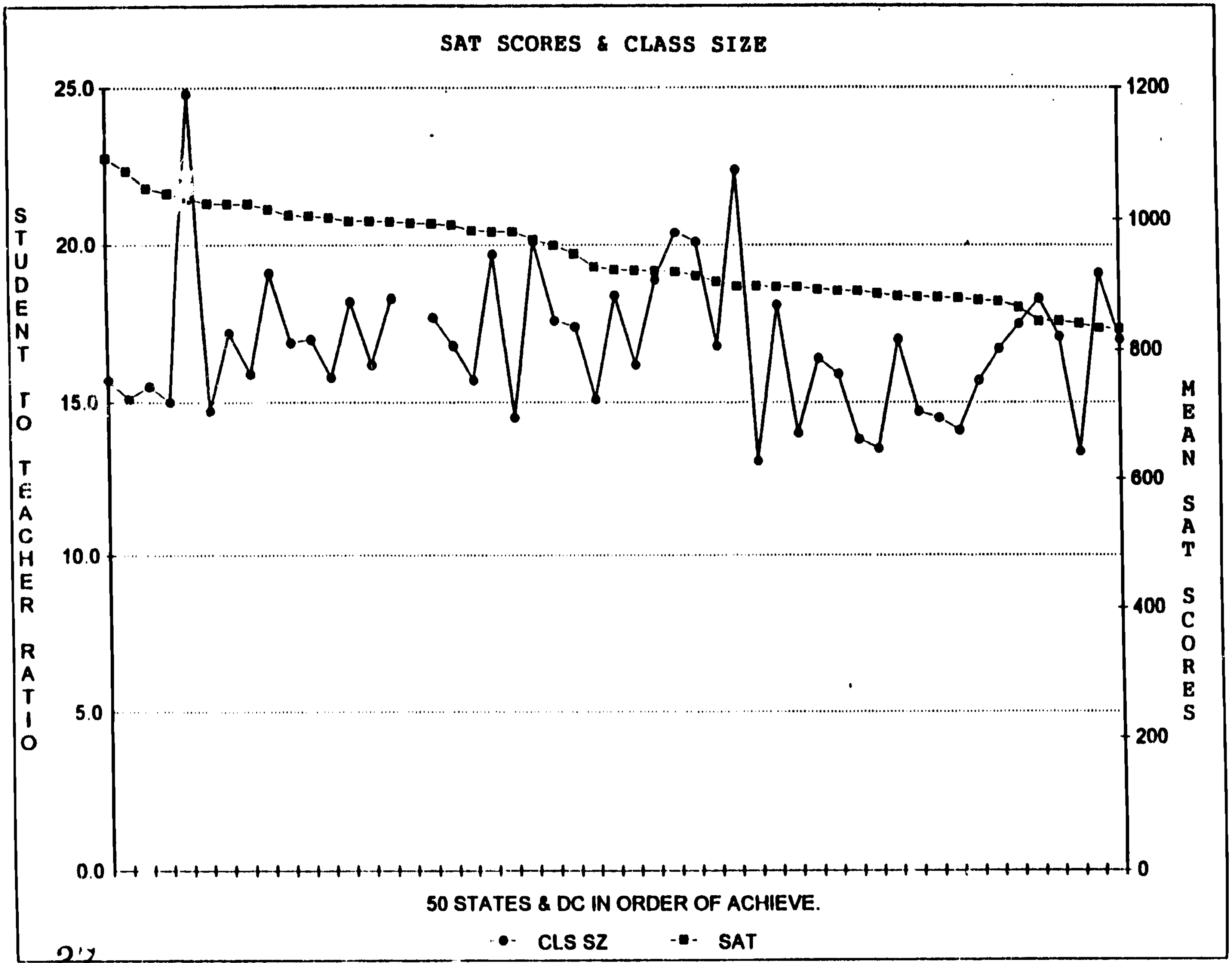
GRAPH 3


SAT SCORES & CLASS SIZE
25.0
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15.0
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STUDENT TO TEACHER RATIO
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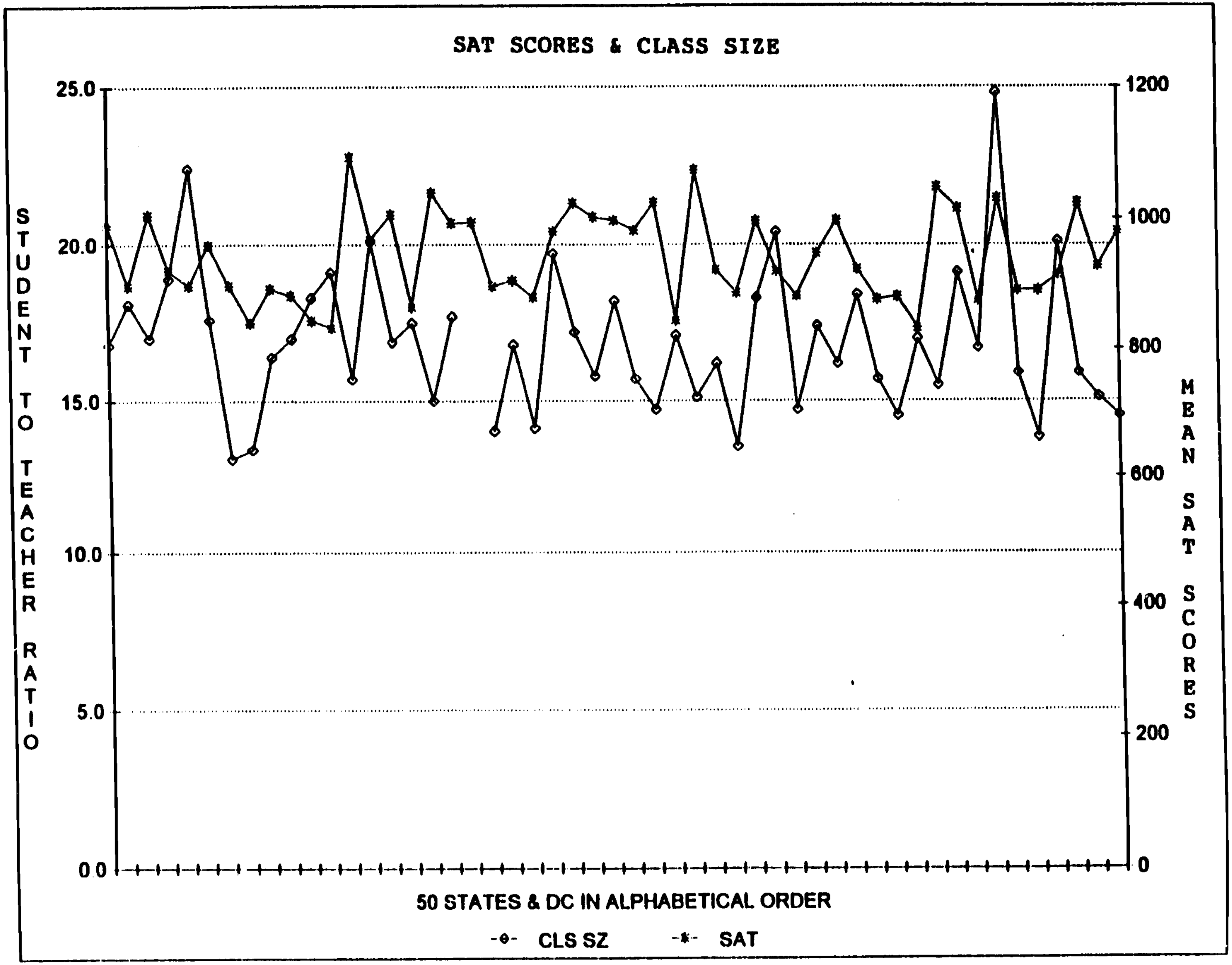
MEAN SAT SCORES
50 STATES & DC IN ORDER OF ACHIEVE.
CLS SZ
SAT

27

GRAF. A


SAT SCORES & CLASS SIZE
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20.0
15.0
10.0
5.0
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STUDENT TO TEACHER RATIO
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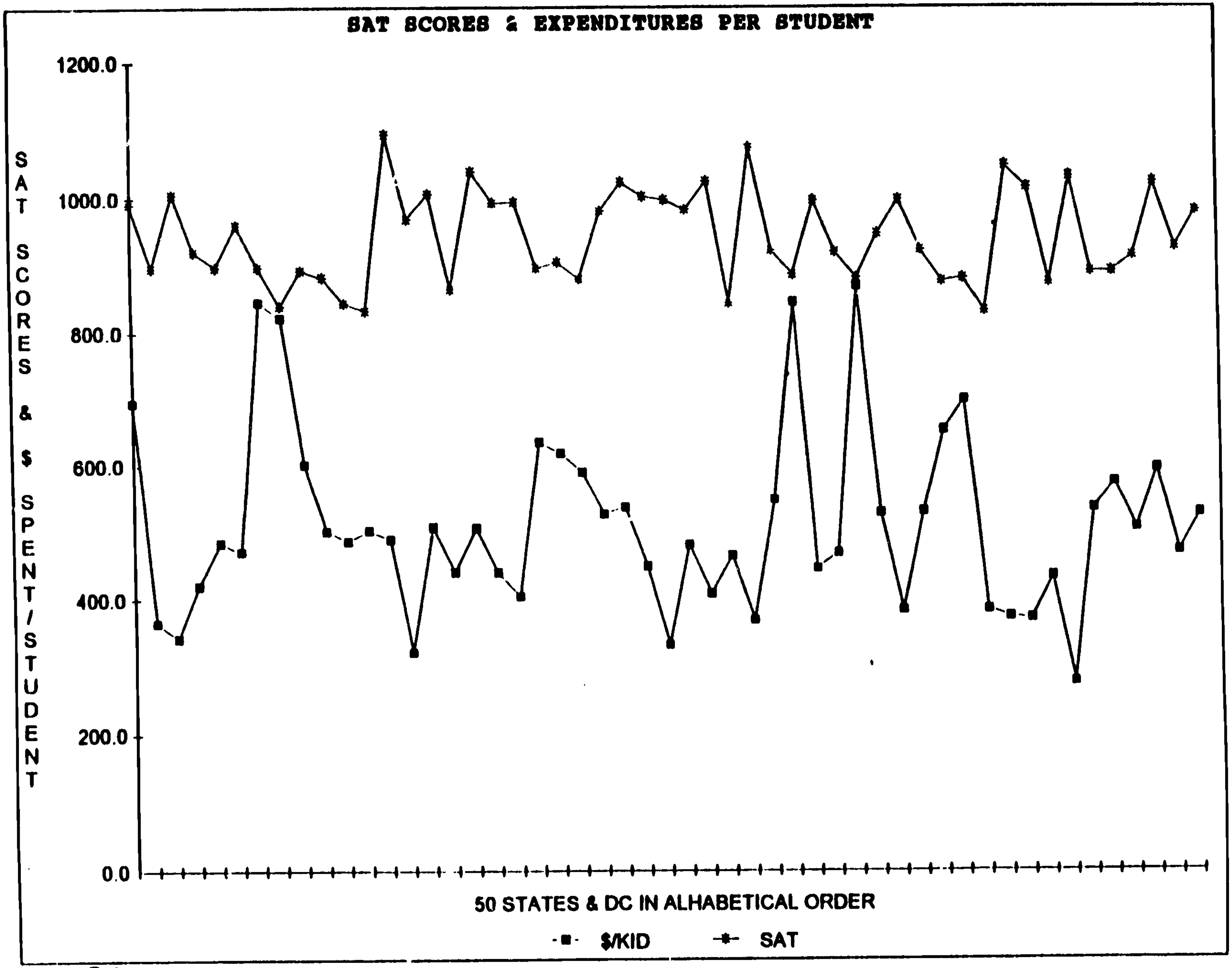
MEAN SAT SCORES
50 STATES & DC IN ALPHABETICAL ORDER
CLS SZ
SAT

GRAPH 4


SAT SCORES & EXPENDITURES PER STUDENT
SAT SCORES & $ SPENT/STUDENT
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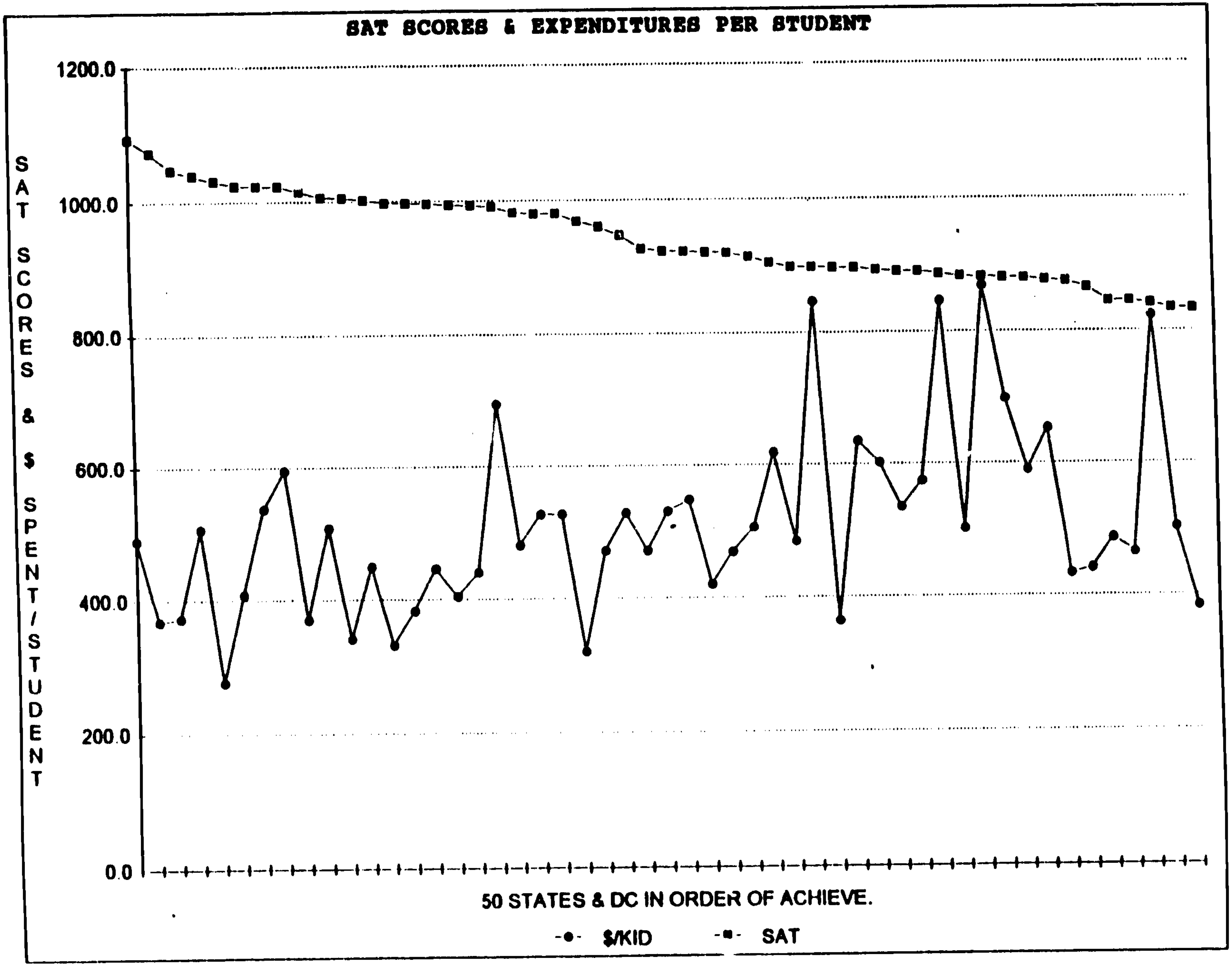
50 STATES & DC IN ALHABETICAL ORDER
$/KID
SAT

GRAPH 4A


SAT SCORES & EXPENDITURES PER STUDENT
SAT SCORES & $ SPENT/STUDENT
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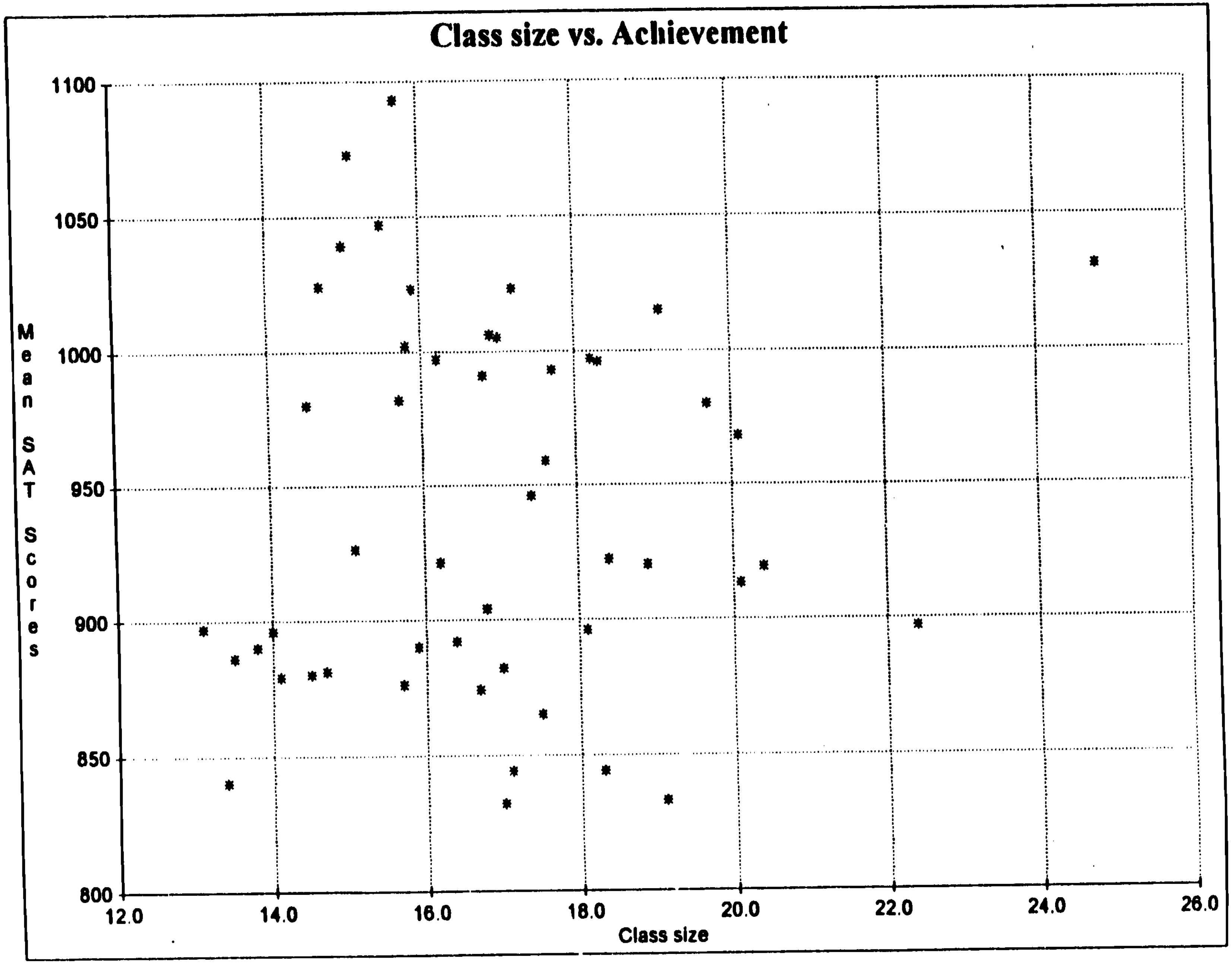
50 STATES & DC IN ORDER OF ACHIEVE.
$/KID
SAT

Graph 5


Class size vs. Achievement
Mean SAT Scores
1100
1050
1000
950
900
850
800
12.0
14.0
16.0
18.0
20.0
22.0
24.0
26.0
Class size

Graph 6

Money Spent Per Student vs. Achievement