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ABSTRACT

The relationship between class size and students' evaluations was examined in two experiments conducted at a public and a private university. Results indicated that the relationship between course enrollment and students' evaluations--with the exception of the quality of Group Interaction factor score--tended to be small, with both very small and very large classes being rated more highly than classes in between. The initial decline in students' evaluations, as course enrollment increased, was not considered large enough to warrant separate norm groups based on the first experiment. In the second experiment, the magnitude of the relationship was sufficient for the Group Interaction factor to make enrollment important in interpreting the student ratings. (Author/LBH)

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CLASS SIZE AND STUDENTS' RATINGS OF INSTRUCTION: A CLARIFICATION OF RELATIONSHIP

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ABSTRACT

The relationship between class size and students' evaluations was examined in experiments conducted at a public and a private university. In Experiment 1, a curvilinear relationship where very small and very large classes were evaluated more favorably than medium sized classes provided the best description of the data; linear and log relationships accounted for smaller proportions of the variation in the ratings. This relationship was reasonably consistent across six academic departments representing the physical and social sciences, and the humanities. In Experiment 2, students' evaluations of classes in the Division of the Social Sciences were summarized by eight evaluation scores: six evaluation factors identified through factor analysis and two overall summary rating items. All eight relationships were curvilinear, but were equally well described by a second degree polynomial equation similar to that found superior in Experiment 1, or by a log function. In summary, the two experiments indicated that the relationship between course enrollment and students' evaluations--with the exception of the quality of Group Interaction factor score--tended to be small, with both very small and very large classes being rated more highly than classes in between. The initial decline in students' evaluations, as course enrollment increased, was not considered large enough to warrant separate norm groups based on Experiment 1. However, in Experiment 2, the magnitude of the relationship was sufficient for the Group Interaction factor to make enrollment important in interpreting the student ratings.

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CLASS SIZE AND STUDENT RATINGS OF INSTRUCTION: A CLARIFICATION OF RELATIONSHIP

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Student ratings of instruction are influencing faculty personnel and promotional matters at an increasing number of colleges and universities. Despite the benefits and rationales offered to justify use of such ratings, many faculty members have hesitantingly warmed to the concept. While interested in receiving periodic feedback on perceptions of their teaching effectiveness, some faculty argue that there are important variables impacting on both the classroom environment and student perceptions of instruction over which they have little control. Until the influence of these variables is accounted for, they contend, a cautious use of these ratings in faculty advancement decisions is essential.

Because of the inconclusive nature of current research, the increasing use of student ratings in promotional decisions, and rising faculty concern about the impact of class size on ratings, the present investigations were initiated. In brief, the purpose of this study was to investigate--in two separate university settings--the nature of the relationship between class size and student ratings of instruction. The results of this study have implications for the use of students' evaluations and for administrative decisions concerning the significance of course enrollments. If magnitude of course enrollment produces a bias in students' evaluations, then separate norms should be established to neutralize this bias before ratings are used for self-improvement or administrative purposes. If no relationship between the two variables exists, then the widely held speculation that a higher quality of instruction is perceived by students in smaller classes needs to be reconsidered.

Reviewing research on this relationship, McKeachie (1969) reported several studies with conflicting results in his summaries of research on teaching. He contrasted the positive relationship found by Lovell and Haner (1955) with the negative relationship found by Remmers (1927) and Riley, Ryan and Lifshitz (1950). In a later review, Costin, Greenough and Menges (1971) pointed to the investigations of Heilman and Armentrout (1936), and McDaniel and Feldhusen (1970) as supporting the existence of a positive relationship. A study by Bausell (1976) presented similarly consistent positive relationships. Little if any relationship between class size and student ratings was found in studies conducted by Goodhartz (1948), Guthrie (1954), Hildebrand, Wilson and Dienst (1971), Jiobu and Pollis (1971), and Solomon (1966). Trent and Cohen (1973) report that a study by Gage (1961) suggests the relationship to be curvilinear. The existence of such a non-linear relationship was reconfirmed by Kohlan (1973) and Wood, Linsky and Straus (1974).

Marsh, Overall and Thomas (1976) found small but statistically significant relationships between course enrollment and 10 components of effective instruction. Linear correlations with course enrollment accounted for 13% of the variance in the effectiveness of student-teacher interaction factor, but less than 5% of the variance in any of the other nine scores including overall ratings of the course and instructor.

Crittenden, Norr and LeBailly (1975) also reported that the magnitude of the relationship between students' ratings and course enrollment varied for five different evaluation dimensions plus a summary rating item focusing on student learning. They found a logrithmic, generally monotonic, relationship in which the log of course enrollment accounted for 14% of the variance in terms of such items as "encourages students to become actively involved in learning," but only five or six percent of the variance in other sets of items such as "knowledge and command of subject matter," "good choice of readings and other assignments," and "organized and systematic presentation of material."

Wood, Linsky and Straus (1974) looked at the relationship between students' overall evaluations and class size for over 4000 courses representing 16 different campuses. The lack of comparability in evaluation instruments used at the different schools and the lack of precise enrollment figures forced the authors to use several arbitrary assumptions. However, a clear curvilinear relationship was found in which evaluations started out favorably and gradually declined as enrollment reached about 250; these evaluations then became increasingly favorable for even larger classes. The authors speculated that the low point represented the enrollment at which faculty stopped trying to apply small class teaching techniques to large classes and began developing procedures more uniquely suited to the specific requirements of very large classes. These authors proposed the intriguing possibility that, at least in some situations, quality of education as evaluated by students themselves may be superior in very large courses.

Several sources of potential confusion complicate any possible generalizations about the effect of course enrollment on students' evaluations. First, the magnitude of the relationship needs to be considered as well as the statistical significance. A small relationship may be insignificant when based upon a small sample size and significant, though of little practical importance, when based upon a large sample size. Second, the relationship may be non-linear (Gage, 1961; Kohlan, 1973; Wood, Linsky and Straus, 1974).

Studies based upon simple correlation generally assess only the linear relationship while studies based upon analysis of variance often assess both linear and non-linear components of the relationship. Third, students' evaluations can be used to measure separate components of effective instruction and the relationship will vary depending upon which component is being evaluated (Hildebrand, Wilson and Dienst, 1971; Marsh, Overall and Thomas, 1976; Crittenden, Norr and LeBailly, 1975). Finally, almost all research is based upon correlational data which cannot be used to infer a causal relationship. If less effective instructors are assigned to teach larger classes, then the less favorable evaluations that they receive may not be a function of enrollment alone. Furthermore, the empirical relationship will vary if different procedures for assigning instructors are used.

Experiment I

Methodology

During the 1971-72 academic year at the University of California, Los Angeles (UCLA), students' evaluations of instructional effectiveness were conducted and results were summarized in a student course guide (Overall, 1972). Evaluations of courses from the six academic departments (Anthropology, Chemistry, Economics, History, Physics, and Psychology) having the broadest coverage served as the basis for this study. A total of 410 undergraduate classes were evaluated in these six academic departments. Course enrollments ranged from 5 to 409 students, with an average of 88 (median = 55). Twelve percent of the classes had enrollments larger than 200. Students' evaluations for each class were represented by the class average response to an overall summary rating item: "How strongly would you recommend this instructor to others"? Responses to this item were made along a five-point response scale varying between "1 = not at all" to "5 = very strongly".

A polynomial trend analysis was used to determine the relationship between students' evaluations and course enrollment. First, a simple linear trent was used to describe the relationship. Added variance accounted for by quadratic and cubic components was then tested for statistical significance (Nie and Associates, 1975, p. 369). Then, the polynomial trend analysis was repeated for two different log transformations of the enrollment data: 1) a log to the base 10 transformation, and 2) a categorization of enrollments into approximately equally space log units--less than 11, 11 to 20, 21 to 40, 41 to 100, 101 to 200, and over 200. Finally, a "categories of enrollment" x "academic department" analysis of variance was performed on the students' evaluations. The academic department by enrollment interaction provided a test of whether the relationship between students' evaluations and enrollment was consistent across different academic departments. This analysis was performed with the classic experimental design in which variation due to the interaction effect, and variation unique to each main effect were tested separately (Nie and Associates, 1975, p. 405).

Results

The linear relationship between the overall instructor rating and course enrollment ($r = -.01$) did not even reach statistical significance. However, the quadratic, cubic, and cuartic components of enrollment each added significantly to the variance explained by enrollment (see Table 1) though even the fourth order-equation accounted for only 7.4% of the variance in the overall instructor rating. The quadratic function showed an initial decline in favorableness of evaluations as enrollments increased to about 200, then showed an increase in favorableness for even larger enrollments (see Figure 1). The fourth order polynomial function was quite similar.

Insert Table 1 and Figure 1 about here

The two non-linear transformations of this enrollment data--log to the base 10 and the discrete categorization into six enrollment groupings (with approximately equal log spacing)--both accounted for about 3.3% of the variance in the overall instructor rating. The second degree polynomial equation, accounting for a greater portion of variance, provided a better description of the relationship between students' evaluations and course enrollment. This conclusion is further supported by the fact that even for the log transformations, a quadratic component added significantly to the variance explained, as was the case for the untransformed enrollment data described earlier.

The six "enrollment categories" by six "academic departments" analysis of variance indicated that differences because of enrollment ($F(5,375) = 5.93$, $p < .001$) and academic department ($F(5,375) = 5.29$, $p < .001$) were statistically significant. The interaction between these two main effects, however, barely reached statistical significance ($F(5,375) = 1.78$, $p < .05$). This small interaction effect suggested that the form and the magnitude of the relationship between students' evaluations and course enrollment did not vary substantially for the six academic departments considered in Experiment I.

Experiment II

Methodology

The evaluation instrument used in Experiment II was developed for use in the Division of Social Sciences at the University of Southern California

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(USC). The instrument consisted of 27 evaluation items, the majority of which were derived from the research of Hildebrand, Wilson and Dienst (1971). Factor analysis (Marsh, 1976a) supported the existence of six evaluation factors that the instrument was designed to measure. The median reliability of the evaluation items, based on a set of 20 responses, was .84; the median reliability of the six evaluation factors was .89 (Marsh, 1976b).

Students' evaluations were summarized by eight evaluation scores--six evaluation factors and two overall summary items. The six factor scores were based on weighted averages of the evaluation items, while the two overall summary ratings were based on responses to single items. The six factor scores were computed by taking a weighted average of standardized scores and substituting the mean for any missing values. These factor scores were then standardized to have a mean of 100 and a standard deviation of 15. The evaluation factors and a brief description follow:

Breadth of Coverage--presentation of a broad background encompassing alternative approaches to the subject and emphasizing analytic ability and conceptual understanding.

Organization--well organized and prepared; explanations and answers are clear.

Group Interaction--class discussions encouraged; students invited to share their own ideas or be critical of instructor's.

Individual Interaction--friendly and interested in students; accessible to students.

Instructor Enthusiasm--displayed enthusiasm, energy and humor; held student interest.

Learning/Value--a valuable, intellectually demanding learning experience was encountered.

Overall Instructor--a single item asking students "How does this instructor compare with other instructors you have had at this school?"

Overall Course--a single item asking students "How does this course compare with other courses you have had at this school?"

This experiment was conducted in all classes offered in the ten academic departments of the Division of Social Sciences at the University of Southern California. Evaluations were collected in a total of 420 undergraduate courses taught by regular faculty during the fall and spring semesters of academic year 1975-76. Enrollments in these courses varied between 4 and 675. However, the average enrollment of 39.5 (median = 25.5) was much smaller than in Experiment I; only 2% of these classes had enrollments over 200. Statistical analysis for this experiment was essentially the same as described in Experiment I; however, the analyses were performed separately on each of the eight evaluation factor scores described above, rather than on the overall instructor ratings item alone.

Results

In Experiment II, statistically significant relationships were found between course enrollment and seven of the eight evaluation scores; the relationship with Instructor Enthusiasm was not significant (see Table 2). Each of these relationships involved some non-linearity. The second order component accounted for a significant proportion of variation in all relationships, while the third and fourth order components of the relationship with quality of Group Interaction were also statistically significant.

Insert Table 2 about here

Only the relationship between quality of Group Interaction and course enrollment was large enough to be of practical significance, even though other relationships were statistically significant. Course enrollment accounted for about 20% of the variance in the Group Interaction score, but accounted for less than 5.5% of the variance in any of the other evaluation scores. All eight relationships showed a gradual decline in favorablness of evaluations as enrollments increased to about 250 or 300, and then showed an increase for even larger enrollments.

The proportion of variance separately accounted for by each of the two log transformations (see Table 2) was approximately the same as was accounted for by the polynomial functions. While both the log functions and the polynomial functions showed an initial decline in evaluations as enrollment increased, the log functions simply leveled off while the polynomial functions began to rise. The relatively few number of very large classes in Experiment II did not provide an adequate basis for selecting which description, the log function or the polynomial function, was best.

The results outlined above indicated that, at least in Experiment II, the categorized log transformation adequately described the relationship between students' evaluations and course enrollments. The "categories of enrollment" by "academic department" analysis of variance indicated that there were generally significant differences due to enrollment: F-ratios varied from (F)5,363) = 20.2, $p < .001$) for Group Interaction to the one non-significant $F(5,363) = 1.86$ for Instructor Enthusiasm. There were also some statistically significant differences in the evaluation of courses in different academic departments. The interaction between course enrollment and academic department was small, however, reaching statistical significance for only two of the eight evaluation factors: $F(32,363) = 1.65$, $p < .05$ for Group Interaction and $F(32,363) = 1.64$, $p < .05$ for Breadth of Coverage. These small interaction effects implied that both the form and the magnitude of the relationship between course enrollment and each of the evaluation scores did not vary substantially across the different academic departments.

The above research has identified several important findings in two different institutional settings. Course enrollment was found to be related to students' evaluations of instructional effectiveness; however, a simple linear representation was not an adequate description of the relationship in either experiment. Students' evaluations showed an initial decline as enrollment increased, leveled off, and began to increase for even higher enrollments. The results of Experiment II showed that the magnitude of the relationship between students' evaluations and course enrollment varied for different evaluation factors. Course enrollment, which accounted for more than 20% of the variance in quality of Group Interaction, was not significantly related to Instructor Enthusiasm, and accounted for no more than 6.2% of the variance in any of the other evaluation scores. There were significant differences in students' evaluations of different academic departments in both studies, but the interactions between course enrollment and departments were small or non-significant. This suggests that the form and magnitude of the enrollment/rating relationship is reasonably consistent across departments.

Polynomial and log functions explained a much greater percentage of the variance in the enrollment/rating relationship than did the linear function. In Experiment I, the polynomial function provided the best description of the data. In Experiment II, neither function was clearly superior, although the small number of classes with very large enrollments--relative to Experiment I--did not provide an adequate basis on which to judge the polynomial function. The curvilinear relationship reported by Wood, Linsky and Straus (1974)--an initial decline in ratings followed by a subsequent increase to the point that very large classes are rated even higher than small ones--was similar to the relationship between Overall Instructor ratings and course enrollment found in both Experiments I and II. Crittenden, Norr and LeBailly (1975) recently argued that a log function provided a better description of the enrollment/rating relationship. However, these authors did not attempt to fit a polynomial function to their data, their actual data plots do suggest some quadratic trend, and--as with Experiment II--their data contain too few very large classes to adequately test the function.

Experiment II demonstrated that the magnitude of the relationship between course enrollment and students' evaluations varied with the particular component of evaluations being considered. While course enrollment was substantially related to quality of Group Interaction, its relationship with other components was much smaller. The same conclusions were drawn by Marsh, Overall and Thomas (1976) in a study using a similar evaluation instrument at the public institution involved in Experiment I. The fact that Group Interaction was the only evaluation factor strongly related to course enrollment offered support for the construct validity of the ratings. Construct validity requires that a construct be related to variables with which it is logically connected and unrelated to other variables. Indeed, if course enrollment were not more closely related to the quality of Group Interaction than to other components, the construct validity of the student ratings would be suspect.

It is important to look at possible explanations for the curvilinear relationship between enrollments and ratings. In these experiments, faculty who taught moderately large classes--150 to 300 students--tended to receive relatively lower evaluations--on the average--than did faculty teaching very small or very large classes.

To further investigate the practical implications of the initial decline in student ratings as enrollment varies from small to moderately large, representative "small classes" (enrollment of 20) and "moderately large classes" (enrollment of 200) were compared in each experiment. In Experiment I, the average overall instructor rating for a class size of 20 students was 3.98 (corresponding to the 51st percentile), while the average rating for a class of 200 was 3.63 (35th percentile). The change in percentile units--16 in this case--would be much smaller for ratings of either more effective or less effective teachers whose ratings did not fall near the middle of the distribution. These findings suggest that the practical implications of this relationship are small and that there is little need to consider the construction of separate norm groups.

However, the situation is not so clear in Experiment II. Looking at the overall instructor rating, the average rating for a class of 20 students was 3.92 (47th percentile), while the average rating for a class of 200 was 3.36 (25th percentile). But, the difference is much larger for the evaluation factor most closely related to course enrollment--the quality of Group Interaction: 102 (52nd percentile) for a class of 20 and 78.3 (10th percentile) for a class of 200. The data in Experiment II, particularly ratings of the quality of Group Interaction, may suggest the need for separate norm groups.

Several possible explanations exist for the higher evaluations received for courses with very large enrollments. First, instructors may have been assigned to the very large classes on the basis of demonstrated success or expressed interest in these courses. Second, class size--particularly in the introductory or prerequisite courses which have no upper enrollment limits--may be determined by teaching effectiveness. For example, students who learn about very effective teachers through other students or through published summaries of instructor ratings, are more likely to enroll in their classes, and less likely to enroll in courses taught by less effective teachers. Third, instructors in the very large classes may be more motivated or challenged. It is very rewarding to have a favorable impact on a large number of students, while it is very embarrassing to do a poor job in front of a large audience. Finally, as suggested by Wood, Linsky and Straus (1974), instructors of moderately large classes may have tried to adapt inappropriate teaching techniques from small classes, but were forced to develop better "large class" techniques as enrollments became even larger.

In summary, non-linear relationships were found between course enrollment and student ratings of instructional effectiveness in two separate institutional settings; both very small and very large classes were rated higher, on the average, than classes in between. Since the percent of variance in ratings accounted for by enrollment was 6.3% or less for all but the Group Interaction factor, the construction of separate norm groups may be unwarranted. However, for the relationship with Quality of Group Interaction, class size is a very potent variable and clearly needs to be considered in making any interpretation of these student ratings.

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FOOTNOTES

[1]Requests for reprints of the paper should be sent to

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TABLE 1

Relationship Between Course Enrollment and Overall Instructor Rating
(n=410 Courses)

Evaluation Scores	r^2 (% Variance Accounted for by 1st Order Component)[1]	R^2 (% Variance Accounted for by 1st & 2nd Order Comp.)[1]	R^2 (% Variance Accounted for by 1st, 2nd, & 3ed Order Comp.)[1]	R^2 (% Variance Accounted for by 1st, 2nd, 3ed, & 4th Order Comp.)[1]	r^2 (% Variance Accounted for by Log to Base 10 Function)[2]	r^2 (% Variance Accounted for by Linear Func. of Log Cat.)[2]
Overall Instructor	0.4 ns	5.2**	6.3**	7.4**	3.2**	3.3**

* p .05
** p .01
ns - not significant

[1]Statistical significance refers to the total proportion of variance explained by the entire function rather than by any specific component. However, each component added significantly to the percentage of variance explained by the lower order function that did not contain the component.

[2]Quadratic components of the two log transformations added significantly to the proportion of variance in overall instructor rating which was explained by the log transformations of enrollment, strengthening the conclusion that the relationship is non-linear.

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TABLE 2

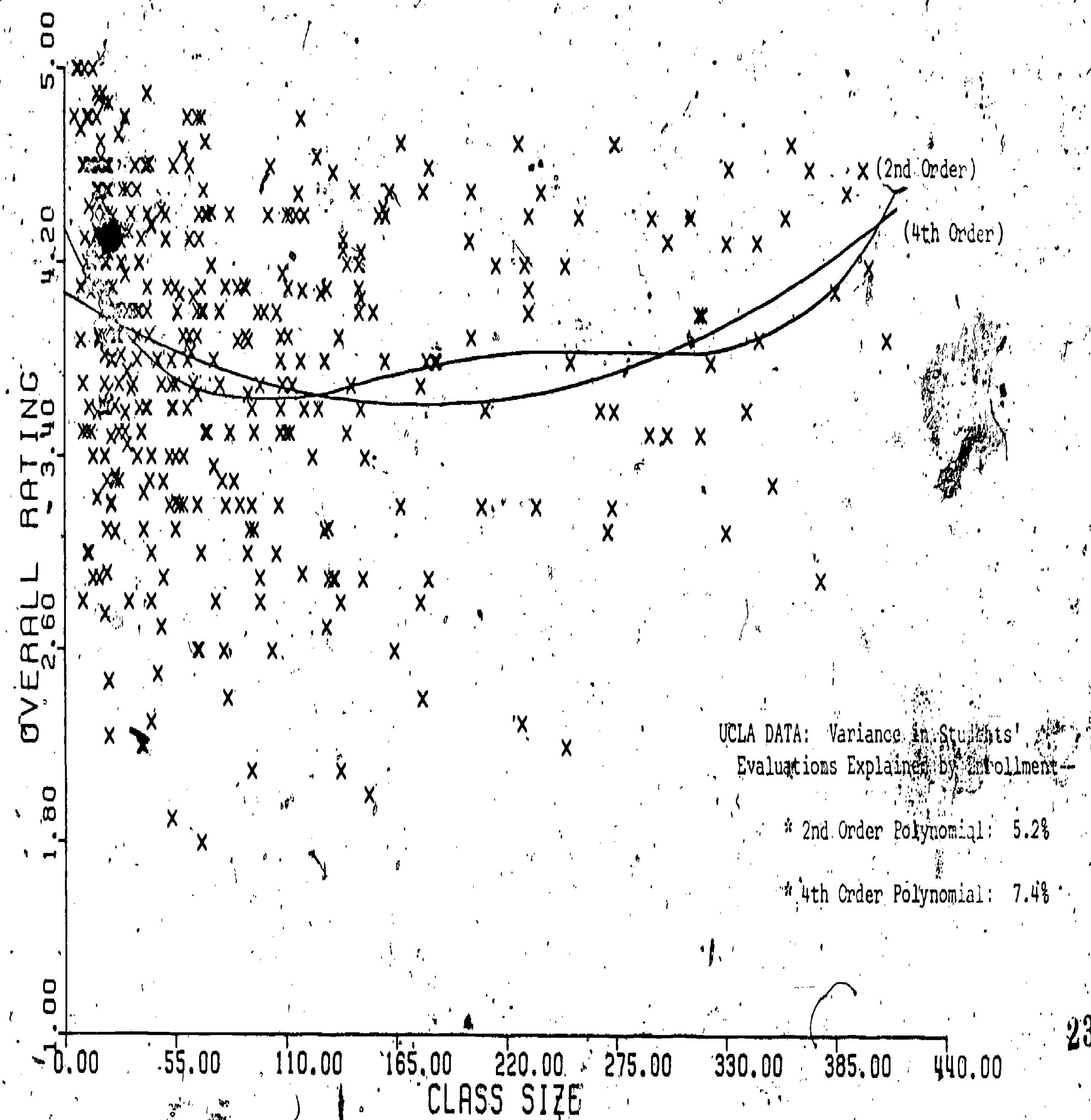
Relationship Between Course Enrollment and Students' Evaluations
(n=420 Courses)

Evaluation Scores	r^2 (% Variance Accounted for by 1st Order Component)[1]	R^2 (% Variance Accounted for by 1st & 2nd Order Comp.)[2]	R^2 (% Variance Accounted for by 1st, 2nd, & 3ed Order Comp.)[2]	R^2 (% Variance Accounted for by 1st, 2nd, 3ed, & 4th Order Comp.)[2]	r^2 (% Variance Accounted for by Log to Base 10 Function)	r^2 (% Variance Accounted for by Linear Func. of Log Car.)
Breadth	0.8% ns	1.5%	-	-	0.8% ns	1.4%**
Organization	0.9 ns	1.3**	-	-	2.6**	3.2**
Group Interaction	12.8**	18.1**	20.4**	22.2**	21.2**	20.3**
Individual Interaction	3.5**	5.4**	-	-	5.3**	5.4**
Enthusiasm	0.1 ns	1.2 ns	-	-	0.5 ns	0.8 ns
Learning/Value	1.0*	3.3**	-	-	2.6**	4.0**
Overall Instructor	1.2*	3.9**	-	-	2.9**	3.6**
Overall Course	1.9**	5.5**	-	-	4.8	6.2**

* p .05
** p .01
ns - not significant

[1]Linear relationships between enrollment and students' evaluations were negative for all eight evaluation scores.

[2]If quadratic or cubic components did not add significantly to the proportion variance already accounted for the term was not considered. Statistical significance refers to a test of total proportion of variance accounted for by the function rather than any particular component of the function.


OVERALL RATING
5.00
4.20
3.40
2.60
1.80
.00
.00
55.00
110.00
165.00
220.00
275.00
330.00
385.00
440.00
CLASS SIZE
(2nd Order)
(4th Order)
UCLA DATA: Variance in Students' Evaluations Explained by Enrollment
* 2nd Order Polynomial: 5.2%
* 4th Order Polynomial: 7.4%

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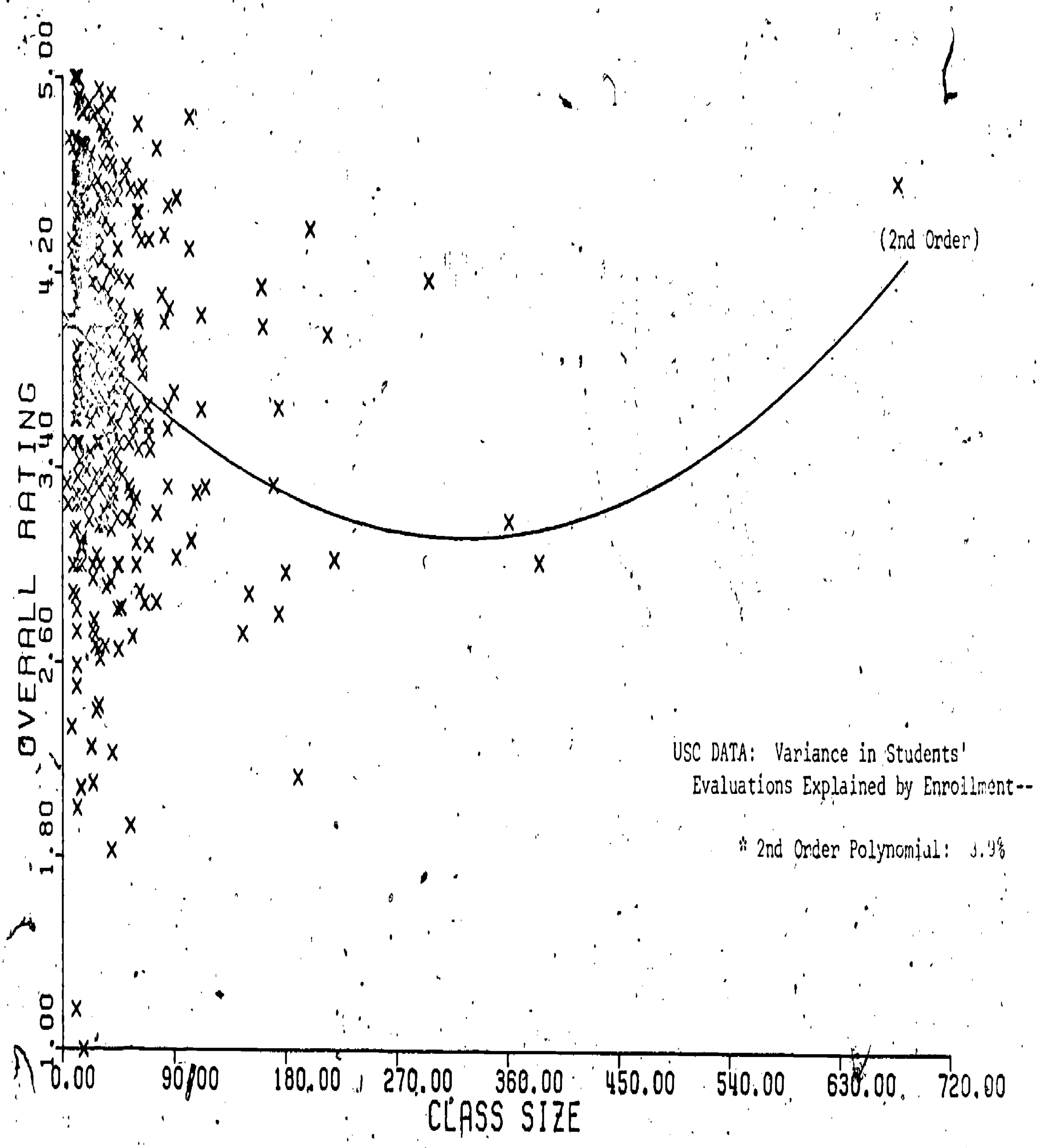
OVERALL RATING
5.00
4.20
3.40
2.60
1.80
.00
0.00
90.00
180.00
270.00
360.00
450.00
540.00
630.00
720.00
CLASS SIZE
(2nd Order)
USC DATA: Variance in Students'
Evaluations Explained by Enrollment--
* 2nd Order Polynomial: