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ABSTRACT

A national survey of college faculty provided data for an analysis of class size norms in postsecondary institutions, and the institutional and academic variables associated with class size differences. Institutional characteristics considered include public versus private control, Carnegie classification, and institution size. Course academic characteristics include academic discipline, classified according to the A. Biglan (1973) model, instructional level, and principal method of instruction. Only lower division courses were considered, and the one percent of classes at each extreme of size were eliminated. Results showed class size to be a function of both institutional and course characteristics. Classes demanding active participation and those at smaller, liberal arts, and two-year institutions were smaller. Classes were also smaller in applied fields and fields focusing on living organisms. Other factors (e.g., private/public control, discipline paradigms) explained little variance. A resulting series of class size distributions is presented. (Contains 4 tables of data and 15 references.) (MSE)

LOWER DIVISION CLASS SIZE AT U.S. POSTSECONDARY INSTITUTIONS

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Jean Endo
Editor
AIR Forum Publications

LOWER DIVISION CLASS SIZE AT U.S. POSTSECONDARY INSTITUTIONS

The *1992-93 National Survey of Postsecondary Faculty* (NSOPF) provides a unique opportunity to examine class size and the institutional and academic factors associated with class size differences. The institutional characteristics examined in this paper include public or private control, Carnegie classification, and institutional size. The course academic characteristics considered include academic discipline as described by Biglan (1973a), student level, and principal method of instruction. The results support the formation of normative distributions for class size comparison and better understanding of institutional and course characteristics associated with class size differences.

INTRODUCTION

The goal of this paper is to offer comparative standards for class size to aid administrators faced with reduced funding and increased scrutiny. With very few exceptions (i.e., Bloom, 1983; Chatman, 1995) there are no empirically derived comparative standards for postsecondary instructional production that recognize even the most simplistic distinctions of academic discipline and course level or type of course. This lack of valid normative information severely limits the ability of administrators facing a public that demands more while offering less. In the absence of comparative class size norms and academic measures that might provide a direction for change and a foundation for dialogue, public demands are logically expressed in simple efficiency goals -- requiring that we do more with the same resources or the same with less. This situation was generally described by Zemsky and Massy (1995) as the inevitable result of Bowen's law of revenue and expense in times of economic contraction. If "an institution of higher education will

get all the money it can and spend all that it gets" then "the best way to make colleges and universities less costly is to give them less money" (p. 44). In the absence of standards of good practice or even comparative standards, institutions have little defense against reductionist efficiency goals that consider only production costs.

Institutional researchers who would try to respond to efficiency concerns using valid, externally recognized standards for class size are hamstrung. They are forced to rely on crude student/faculty ratios, student credit hour weighting schemes of assumed validity; decades old state formula standards, or local historical practice. Assuming that normative or comparative standards would serve a useful function by providing direction for improvement, how might they be gathered? One solution would be to interview randomly selected faculty nationwide about the classes they teach and compile that information according to factors demonstrated to be associated with class size.

A project to gather comparative national information about course sections taught would require Herculean effort, be expensive, and demand strong support from faculty and administrators across the country if a reasonable sample were to be identified and interviewed. These characteristics would make such a study practically unlikely and, if the purpose were described as forming normative standards for class sizes, politically unlikely as well. Fortunately, that information can be gleaned unobtrusively from a project that has been completed for other purposes, the *1992-93 National Survey of Postsecondary Faculty*. Because the survey gathered specific information about each course section the randomly selected faculty taught, the extent to which institutional and course characteristics were associated with class size can be used to create comparative distributions.

1992-93 National Survey of Postsecondary Faculty

The *1992-93 National Survey of Postsecondary Faculty* was the second cycle of the U.S. Department of Education's National Center for Education Statistics (NCES) study of U.S. faculty at public and independent, not for profit, institutions. Specifically, the 1987-88 and 1992-93 surveys were to provide a national profile of the professional background, responsibilities, workloads, salaries, benefits, and attitudes of postsecondary faculty. The first cycle was in 1987-88 when information was gathered from a sample of over 480 institutions, 3,000 chairpersons, and 11,000 faculty. The 1992-93 cycle was limited to institutions and faculty but was expanded to include samples of 974 institutions and 31,354 faculty. Of these, 817 institutions and 25,780 faculty participated for response rates of 85% and 87%, respectively.

A key difference between the 1987-88 and 1992-93 surveys was the criteria for inclusion. Both the 1987-88 and 1992-93 surveys included faculty who regularly had teaching assignments but the 1992-93 survey also included: faculty and administrators with faculty positions who did not regularly teach and employees who taught whether or not they were considered to be "faculty." Specifically excluded were those with instructional duties outside the U.S., if not on sabbatical, temporary replacements, faculty on unpaid leave, military personnel teaching only ROTC courses, instructional personnel supplied by independent contractors, and teaching assistants. Of these inclusions and exclusions, the one that most limits use of NSOPF 1992-93 in developing normative class size distributions for all instruction is the exclusion of graduate teaching assistants from the sample universe. In spite of this limitation, NSOPF 1992-93 remains a valid source of class size information for classes taught by all faculty. This issue will be discussed in more detail in the results section.

This study focuses on a series of data supplied by faculty in response to Section C of the questionnaire, Institutional Responsibilities and Workload, where faculty described the characteristics of up to five courses that they taught in the fall of 1992. The class characteristic items included academic discipline, credit hour value, number of teaching assistants, students enrolled, primary level of students, and primary instructional method used. In all, faculty described 56,959 classes. While the class characteristic data were collected to support study of faculty workload, they also provide a normative base for the study of class size.

METHODOLOGY

It is asserted that the exploratory nature of this study should justify reasonable leeway in analytical procedure to accomplish the goal of simplifying the variable structure of the database. The first restriction was to limit analysis to lower division courses. It was assumed that course level would have a large explanatory effect that could be controlled by restriction to a single level. Lower division courses were selected because they were the more numerous across institution types and were less likely than upper division or graduate courses to be affected by student demand for courses required in the major. Other restrictions were to eliminate courses with credit values less than one or greater than five, to remove institutions without NCES identification codes, and to remove the top and bottom one percent of class sizes by instructional method. The credit value, NCES code, and size restrictions were to remove exceptional or extreme cases that were likely outliers. The extreme one percent of class sizes by method of instruction were removed as follows: lectures less than 5 or greater than 150, seminars less than 2 or greater than 100, discussion sections less than 5 or greater than 75, lab or clinical courses less than 3 or

greater than 75, field experience courses less than 2 or greater than 100, performance courses less than 2 or greater than 100, television or radio courses less than 5 or greater than 100, group projects less than 5 or greater than 50, and cooperative learning less than 5 or greater than 55. With these restrictions, the distribution of class size was subjected to a series of main effects general linear models to find categorical variables that explained differences observed in lower division courses and to reduce the complexity of categorical variables. The general linear model was used to accomplish the analysis of variance solution because of the large differences in cluster sizes for some variables.

To simplify the data structure, the obviously skewed distribution of class enrollment size was converted to its natural logarithm to produce a symmetric distribution before the main effects models were tested. This phase of the analysis, main effects models testing, sought to eliminate irrelevant variables from further study and to reduce the levels of important variables. Independent variables considered included Carnegie classification, public or private control, institutional size, and Biglan classification of the academic material of the course along the three dimensions: pure versus applied, hard paradigm versus soft paradigm, and life versus non-life or inanimate. The first two of these measures, Carnegie classification and public or private control are straightforward. The third variable, institutional size, used the classification scheme employed by NCES of institutions according to undergraduate full-time equivalent enrollment with breakpoints at 631, 1,485, 3,564, and 7,788. The last measure, or more accurately, the last series of measures were Biglan academic classification of the course. The classification scheme was asserted as necessary due to the specificity and associated small sample size at which course academic content was identified. The Biglan structure was selected over other disciplinary categorizations, like two-digit

CIP clusters, because previous research has shown it to be a valid system and its use would maintain large numbers of classes in all clusters.

Among the evidence validating Biglan's assertion of three inclusive dimensions are the following. There was Biglan's first reported research where he stated that the classification scheme helped to explain differences in social connectedness of faculty; commitment to teaching or research; scholarly output (number of journal articles, monographs, and technical reports published by the faculty); quality of first positions after completing degrees; and number of dissertations sponsored (1973b). This first work has been followed by much validation by other authors supporting the typology as a reasonable system by which to cluster higher education academic content. For example, Biglan categories differentiate disciplines by faculty salaries and staffing patterns (Muffo & Langston, 1979; Smart & McLaughlin, 1978), departmental goals and activities (Smart & Elton, 1975), instructional objectives (Smart & Ethington, 1995), job satisfaction (Eison, 1976), professional development needs (Creswell, Seagren & Henry, 1979), and in research productivity and interest (Creswell & Bean, 1981). A good introduction to the Biglan typology and its uses is available in Creswell & Roskens's 1981 article in *The Review of Higher Education.*

The classes were categorized along Biglan dimensions by applying Biglan's own placement of 35 academic departments (1973a), and Malaney's extension to 114 graduate degree programs (1986). The very few remaining cases not easily placed by Biglan's or Malaney's examples were placed by their strong association with known instances or were dropped. (The classes dropped because of academic field were mostly vocational and technical.)

RESULTS

As described in the methodology section, general linear model solution to analysis of variance was performed to determine whether any of the main effects variables could be dropped from further study and whether the variable class levels of the remaining main effects could be combined to simplify study. Seven main effects were examined: instructional method, institutional size, Carnegie classification, institutional control, and the three Biglan topology dimensions.

Simple descriptive statistics for the seven main effects appear in Table 1. Overall, the mean class size was 28. By instructional method, the largest classes were lectures (31) and radio or TV courses (28). These two were followed by the other seven methods whose means differed by less than three students. The percentile distributions for these instructional methods clearly show great overlap. In fact, the figures presented show only about a 25% shift in percentiles from the smallest to largest instructional methods. This large overlap in distributions is similar across all comparisons and obviously limits the ability of statistical treatments to find important explanatory variables.

For the other main effects variables the following was true: classes were smaller on average at smaller institutions; liberal arts institutions had smaller classes than public two-year institutions and public two-year institutions had smaller classes than comprehensive, doctoral and research institutions; classes were smaller at private institutions; classes in applied disciplines were smaller than in pure; inanimate disciplines had smaller classes than life sciences; and classes with hard and soft paradigms were the same in size. However, these statements were based on analysis of the raw numbers of these obviously skewed distributions. Analysis of variance demands the more symmetric distributions that can be created by analyzing the distribution of natural

logarithms. The results of this nonlinear transformation of class size are in Table 2. Analysis of variance examination of mean differences for natural logarithms shows that the observations made about the untransformed distributions were generally true.

Class sizes at smaller institutions were smaller and the relationship between institutional size and class size was positive and monotonic. Classes were also smaller at private institutions, in applied and inanimate disciplines, and disciplines with hard and soft paradigms did not differ in mean size. The picture for instructional method and Carnegie classification was less clear because several variable levels were equivalent in size. In these two areas, the number of levels was reduced by combining similar class levels. For the remaining four main effects variables, institutional size accounted for 6.3% of variance in class size, pure versus applied accounted for 3.9%, life versus inanimate for 1.7%, and institutional control for 1.2%.

Instructional Method and Class Size

All other things being equal, the type of classroom interaction that occurs between teachers and students should logically limit class size. In fact, instructional method should probably be the most important variable in determining class size and should exceed disciplinary content, type and size of institution, student level, and all other relevant descriptive information in creating logical, pedagogical ceilings. Based on this assumption, the first data reductive technique employed was one to determine where and to what extent different teaching methods were associated with class size differences. Faculty responding to the interview form identified the primary instructional method employed in each class among nine alternatives: lecture; seminar; discussion group or class presentations; lab, clinic or problem solving; apprenticeship, internship, field work, or field trips; role playing, simulation, or other performance (e.g., art, music, drama);

TV or radio; group projects; or co-operative learning groups.

As anticipated, instructional method was the most informative descriptive variable in explaining class size differences. Overall, it accounted for 8.3% of variance. Using an extremely conservative Tukey's Standardized Range test with an alpha level of .0001 to compare size by instructional methods and find types that did not differ significantly, three clusters of similar sizes were identified (see Table 2). The first cluster of classes that were not significantly different was composed of seminars, labs, clinical activities, apprenticeships, internships and other instructional methods relying on student activity. The second cluster was of group projects, cooperative learning groups, discussion or class presentation, and TV or radio courses where the instructional interchange is more likely shared by faculty and students. The third cluster was of only one type of instruction, lecture, where the faculty clearly direct the interchange. A second main effects analysis by these three clusters found none to be equivalent in size. Actually, the three clusters were not perfectly mutually exclusive. The TV or radio courses were few in number with large variance and were not significantly different from any of the other methods. TV and radio courses were placed in the second cluster based on mean size. The mean size of group projects classes was only significantly different from lecture classes because of the small number of group projects classes reported. Group projects were also placed in the second cluster based on mean class size. This reduction in variable class levels from nine to three was associated with only a very slight loss of explanatory power (from 8.3% to 8.2%).

Carnegie Classification and Class Size

Carnegie classification was the only variable other than instructional method where variable class levels did not differ significantly in some comparisons. Carnegie classification was

reduced to three levels based on these post-hoc comparisons. The first cluster was composed of only liberal arts institutions. The second cluster was of institutional classifications "other" and "public two-year". The third cluster "comprehensive, doctoral, and research" institutions was formed by combining doctoral institutions with the two types that did not differ from doctoral institutions, comprehensive and research, even though the two types differed from each other. As was true for the reduction of instructional method types, the reduction in Carnegie classification levels from six to three was associated with only a slight reduction in explanatory power (from 3.2% to 3.0%). In addition, the three clusters were significantly different from each other.

Multiple Analysis of Variance

Based on the results of data reduction and simplification from the main effects models, the resulting six variables were asserted as main and interactive effects in a general linear model analysis of class size (natural logarithm). The results are presented in Table 3. Table 3 displays variance explained by the variable independently (as a single main effect), cumulatively and incrementally (Type I SS), and uniquely (Type III SS). Also shown in Table 3 are the associated F values, degrees of freedom, and probability levels. Of course, the very large degrees of freedom produce highly significant differences of almost all comparisons. If instead, variance explained independently and incrementally is used to identify the most important factors, the analysis might stop where the line has been added to the list, after Carnegie classification and before institutional control. That means that instructional method, the Biglan dimensions of pure versus applied and life versus inanimate, institutional size, and Carnegie classification help to explain class size differences. It should also be noted that interactive terms were collectively unimportant as a complete factorial model accounted for 2.5% more variance than the simple multiple model.

The order of entry respected pedagogical issues before parochial issues. If it is recognized that the size of a class is a variable under the control of the institution, then differences in size beyond those dependent on the content of the course and the instructional method selected to deliver that content are differences under the control of the institution. In other words, institution size was a significant variable after method of instruction and Biglan dimensions. That means that smaller institutions have decided to offer smaller classes. Similarly, the fact that liberal arts and two-year public institutions have smaller classes means that they have decided to offer smaller classes. Residual variance at the lower division level after course content and instructional method is partially explained by institution size and Carnegie classification -- two variables related to size with no pedagogical basis.

Table 4 displays descriptive statistics and percentile distribution for class size by instructional method and the Biglan dimensions of pure or applied and life or inanimate studies. Sorted by mean size the general multiple variable patterns support the main effects results, but extend the trends to a point where the largest mean classes are twice as large as the smallest. The largest classes are lectures in theoretical life systems disciplines like botany, physiology, psychology and sociology. The smallest classes are labs or seminars in applied inanimate fields like engineering, computer science and economics. Between these extremes is a pattern generally reflecting the pattern of life systems being larger than inanimate systems, theoretical fields being larger than applied fields and lectures being larger than discussions that are larger than seminars.

Graduate Teaching Assistants

The exclusion of teaching assistants could have been associated with a systematic exclusion of classes taught at doctoral and research institutions. Especially at the lower-division

level, many classes at large research institutions are taught by graduate teaching assistants. Based on study of class sizes at a large public research institution in the Midwest, a majority of lower-division lecture, recitation, seminar, discussion and laboratory classes are taught by graduate teaching assistants. Furthermore, the classes taught by graduate teaching assistants tend to be smaller (Mullen, 1994). For the NSOPF survey data overall, about 26% of lower-division classes at research universities and 18% of lower-division classes at doctoral universities were reported to have teaching assistants. Teaching assistants were also common at liberal arts institutions (11% of lower division classes), comprehensive institutions (7% of lower division classes), and public two-year institutions (4% of lower division classes). Furthermore, this pattern might suggest different definitions of teaching assistants at different institutional levels. Considered collectively, these results suggest that comparisons of class size by institutional type will probably inflate mean class size at research institutions. The extent of this inflation is unknown.

CONCLUSIONS

This article began with the assertion that there are very few comparative standards for postsecondary education that recognize even the most simplistic distinctions of academic discipline and course level or type of course. Furthermore, it was asserted that this lack of information severely limits the ability of administrators to defend current practice or identify a direction for change. In the absence of standards, the 1990s is as described by Zemsky and Massey (1995), a time of making institutions less costly by giving them less money. Perhaps the results presented here can help to establish reasonable performance standards.

Class size was determined to be a function of both institutional and course characteristics.

Classes that demanded active student participation were smaller as were classes at smaller institutions, liberal arts and two-year institutions. Classes were also smaller in applied fields and fields that focused on living organisms. Other factors were relatively unimportant. Notably, public or private institutional control and whether discipline areas assert clear central paradigms (hard) explained little of the differences in class size observed. Likewise, more complicated models involving interactions were unnecessary. Based on these results, a series of class size distributions were reported to help administrators evaluate local course offerings. The results also raised the question of why classes were smaller at smaller institutions and liberal arts and public two-year institutions.

There are problems with this study. First, it is clear that there was tremendous overlap in all class size distributions even after the top and bottom 1% were excluded and even when important variables were controlled. This may have been the result of much subjective judgment in assigning the instructional method label and that discretion likely contributed to overlap and error variance. However, there is exceedingly little known about the interplay of instructional method, course content and class size so that the tremendous overlap may be valid. A second problem with this study is the exclusion of graduate teaching assistants. Because they were excluded, size and Carnegie class comparisons may suffer from inflated class sizes at large research universities and perhaps doctoral institutions. In any event, the sizes reported were those for classes taught by a broadly described faculty and there were relatively few faculty from these institutions included. Third, course and institutional characteristics were able to explain only about 20% of variance in class size. Much remains to be explained.

REFERENCES

Biglan, A. (1973a). The characteristics of subject matter in different academic areas. *Journal of Applied Psychology, 57*, 195-203.

Biglan, A. (1973b). Relationship between subject matter characteristics and the structure and output of university departments. *Journal of Applied Psychology, 57*, 204-213.

Bloom, A.M. (1983). Differential instructional productivity indices. *Research in Higher Education, 18*(2), 179-193.

Chatman, S.P. (1995). Comparable standards for credit hour production. Paper presented at the 35th Annual Forum of the Association for Institutional Research, Boston.

Creswell, J.W. & Bean, J.P. (1981). Research output, socialization, and the Biglan model. *Research in Higher Education, 15*(1), 69-91.

Creswell, J.W. & Roskens, R.W. (1981). The Biglan studies of differences among academic areas. *Review of Higher Education, 4*(3), 1-16.

Creswell, J.W., Seagren, A.T. & Henry, T.C. (1979). Professional development training needs of department chairpersons: A test of the Biglan model. *Planning and Changing, 10*, 224-237.

Eison, C.I.. (1976). The measurement of satisfaction in departmental association at Western Kentucky University testing the Holland and Biglan models. Unpublished doctoral dissertation, University of Kentucky.

Malaney, G.D. (1986). Differentiation in graduate education. *Research in Higher Education, 25*(1), 82-96.

Muffo, J.A. & Langston, I.W. (1981). Biglan dimensions: Are the perceptions empirically based? *Research in Higher Education*, *15*(2), 141-159.

Mullen, R. (1994). *On-Campus Teaching Load Responsibility Fall, 1994*, 12-28. Office of Planning and Budget, University of Missouri-System, Columbia.

Smart, J.C. & Elton, C.F. (1975). Goal orientations of academic departments: A test of Biglan's model. *Journal of Applied Psychology*, *60*, 580-588.

Smart, J.C. & Ethington, C.A. (1995). Disciplinary and institutional differences in undergraduate education goals. Paper presented at the annual meeting of the Association for the Study of Higher Education, Orlando.

Smart, J.C. & McLaughlin, G.W. (1978). Reward structures of academic disciplines. *Research in Higher Education*, *8*(1), 39-55.

Zemsky, R. & Massy, W.F. (1995). Toward an understanding of our current predicaments. *Change*, *27*(6), 40-49.

Table 1: Descriptive Statistics for Lower Division Class Sizes

	Mean	SD	N	Percentile 10%	25%	50%	75%	90%
Total	28	16	29,252	12	18	25	33	44
Instructional Method								
1 Apprenticeship, Internships, Field Work or Field Trips	21	16	160	6	12	19	25	36
2 Role Play, Simulations or Other Performance Activities	21	13	1,146	8	12	20	25	33
3 Seminar	21	12	897	9	15	20	25	35
4 Lab, Clinical or Problem Solving	21	11	3,202	10	14	20	25	34
5 Group Projects	23	9	104	12	15	22	28	35
6 Cooperative Learning Groups	23	8	743	12	18	23	27	33
7 Discussion Groups or Class Presentation	24	9	3,536	12	18	24	28	35
8 TV or Radio Courses	28	20	77	9	15	24	35	50
9 Lecture	31	18	19,387	15	20	27	35	48
Instructional Method Collapsed								
Lab, Performance and Seminar (5,6,4,2)	21	12	5,405	9	14	20	25	35
Discussion (8,9,3,7)	24	9	4,460	12	18	24	28	35
Lecture	31	18	19,387	15	20	27	35	48
Institutional Size								
1 - 631	21	13	1,329	8	12	18	25	35
632 - 1,485	23	13	3,990	10	15	21	29	37
1,486 - 3,564	26	14	9,106	12	18	25	30	40
3,565 - 7,788	29	16	9,262	15	20	25	35	45
Above 7,788	33	21	5,565	15	22	29	38	52
Carnegie Classification								
1 Liberal Arts	24	14	2,153	10	15	22	30	39
2 Other	26	16	2,063	10	15	24	31	42
3 Public Two-year	26	12	16,557	12	18	25	30	40
4 Comprehensive	31	19	5,901	15	20	26	36	50
5 Doctoral	35	25	1,525	14	20	27	40	65
6 Research	38	30	1,053	14	20	27	47	82
Carnegie Classification Collapsed								
Liberal Arts	24	14	2,153	10	15	22	30	39
Public Two-year and Other (2,3 above)	26	13	18,620	12	18	25	30	40
Comprehensive, Doctoral & Research (4,5,6 above)	33	22	8,479	15	20	27	38	56
Private	25	17	5,730	10	15	22	30	40
Public	28	16	23,522	13	20	25	35	45
Applied	25	15	12,427	10	15	22	30	40
Pure	30	17	16,825	15	20	26	35	45
Inanimate	26	15	7,964	12	18	25	30	40
Life	31	19	21,288	13	20	28	38	50
Hard	28	18	9,826	12	18	25	33	45
Soft	28	16	19,426	12	19	25	33	43

Table 2: Variance Explained by Main Effects Measures

	Natural Log Mean	SD	N	R2	F	DF	Pr>F	NSD*
Instructional Method				8.3%	329	8	0.0001	
1 Apprenticeship, Internships, Field Work or Field Trips	2.80	0.75	160					8, 5,4,3,2,1
2 Role Play, Simulations or Other Performance Activities	2.87	0.62	1,146					8, 5,4,3,2,1
3 Seminar	2.91	0.59	897					8, 5,4,3,2,1
4 Lab, Clinical or Problem Solving	2.91	0.52	3,202					8, 5,4,3,2,1
5 Group Projects	3.04	0.40	104					8,7,6,5,4,3,2,1
6 Cooperative Learning Groups	3.06	0.40	743					8,7,6,5
7 Discussion Groups or Class Presentation	3.09	0.42	3,536					8,7,6,5
8 TV or Radio Courses	3.13	0.66	77					9,8,7,6,5,4,3,2,1
9 Lecture	3.29	0.59	19,387					9,8
Instructional Method Collapsed				8.2%	1,309	2	0.0001	
1 Lab, Performance and Seminar (1,2,3,4 above)	2.90	0.56	5,405					1
2 Discussion (5,6,7,8 above)	3.08	0.42	4,460					2
3 Lecture	3.29	0.52	19,387					3
Institutional Size				6.3%	493	4	0.0001	
1 1 - 631	2.85	0.60	1,329					1
2 632 - 1,485	3.01	0.55	3,990					2
3 1,486 - 3,564	3.12	0.52	9,106					3
4 3,565 - 7,788	3.26	0.48	9,262					4
5 Above 7,788	3.36	0.53	5,565					5
Carnegie Classification				3.2%	191	5	0.0001	
1 Liberal Arts	3.01	0.57	2,153					1
2 Other	3.10	0.57	2,063					3,2
3 Public Two-year	3.15	0.48	16,557					3,2
4 Comprehensive	3.30	0.54	5,901					4,5
5 Doctoral	3.35	0.63	1,525					4,5,6
6 Research	3.39	0.71	1,053					5,6
Carnegie Classification Collapsed				3.0%	453	2	0.0001	
1 Liberal Arts	3.01	0.57	2,153					1
2 Public Two-year and Other (2,3 above)	3.14	0.49	18,620					2
3 Comprehensive, Doctoral & Research (4,5,6 above)	3.32	0.58	8,479					3
Institutional Control				1.2%	366	1	0.0001	
1 Private	3.06	0.59	5,730					1
2 Public	3.21	0.52	23,522					2
Pure versus Applied -- Biglan Dimension				3.9%	1,201	1	0.0001	
1 Applied	3.06	0.56	12,427					1
2 Pure	3.27	0.50	16,825					2
Life versus Inanimate -- Biglan Dimension				1.7%	506	1	0.0001	
1 Inanimate	3.14	0.52	21,298					1
2 Life	3.30	0.56	7,964					2
Hard versus Soft Paradigm -- Biglan Dimension				0.0%	0	1	0.9844	
1 Hard	3.18	0.55	9,826					1
2 Soft	3.18	0.52	19,426					2

* Not significantly different using Tukey's Studentized Range Test with alpha = .0001. Also note that class level labels are repeated.

Table 3: Variance Explained by Multiple Model Main Effects Measures

	Variance Explained						
	Independent	Cumulative	Incremental	Unique	F	DF	Pr>F
Instructional Method Collapsed	8.2%	8.2%	8.2%	6.1%	1,487	2	0.0001
Pure versus Applied -- Biglan Dimension	3.9%	10.5%	2.3%	2.2%	838	1	0.0001
Life versus Inanimate -- Biglan Dimension	1.7%	12.4%	1.8%	1.9%	665	1	0.0001
Institutional Size	6.3%	18.0%	5.7%	2.7%	514	4	0.0001
Carnegie Classification Collapsed	3.1%	19.0%	1.0%	1.2%	173	2	0.0001
Institutional Control -- Public versus Private	1.2%	19.3%	0.3%	0.3%	94	1	0.0001

Note: A complete factorial model, including all main effects and interactions, accounted for 21.8% of variance (2.5% more).

Table 4: Descriptive Statistics for Classes by Instructional Method and Disciplinary Characteristics

Instructional Method	Biglan Dimension: Pure or Applied	Biglan Dimension: Life or Inanimate	Mean	Percentile: 10%	25%	50%	75%	90%	N
Lecture	Applied	Life	29.3	12	20	25	35	48	1,901
		Inanimate	27.0	12	17	25	32	42	5,522
	Pure	Life	38.4	20	25	35	45	60	3,488
		Inanimate	30.0	15	21	27	35	45	8,476
Discussion	Applied	Life	23.9	12	17	24	30	35	743
		Inanimate	22.0	12	15	20	26	33	764
	Pure	Life	28.6	14	20	27	35	45	321
		Inanimate	23.5	14	19	24	27	34	2,632
Lab, Performance, Seminar	Applied	Life	21.7	10	12	20	26	37	1,047
		Inanimate	18.9	8	12	18	24	30	2,450
	Pure	Life	25.2	12	18	24	30	40	464
		Inanimate	22.5	10	15	22	26	35	1,444
Sorted by Mean Size									
Lecture	Pure	Life	38.4	20	25	35	45	60	3,488
Lecture	Pure	Inanimate	30.0	15	21	27	35	45	8,476
Lecture	Applied	Life	29.3	12	20	25	35	48	1,901
Discussion	Pure	Life	28.6	14	20	27	35	45	321
Lecture	Applied	Inanimate	27.0	12	17	25	32	42	5,522
Lab, Performance, Seminar	Pure	Life	25.2	12	18	24	30	40	464
Discussion	Applied	Life	23.9	12	17	24	30	35	743
Discussion	Pure	Inanimate	23.5	14	19	24	27	34	2,632
Lab, Performance, Seminar	Pure	Inanimate	22.5	10	15	22	26	35	1,444
Discussion	Applied	Inanimate	22.0	12	15	20	26	33	764
Lab, Performance, Seminar	Applied	Life	21.7	10	12	20	26	37	1,047
Lab, Performance, Seminar	Applied	Inanimate	18.9	8	12	18	24	30	2,450

Source: 1992-93 National Survey of Postsecondary Faculty
Note: The extreme 1% of cases by instructional method were eliminated.