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MEASURING THE COGNITIVE DOMAIN OF THE QUALITY OF LIFE OF UNIVERSITY STUDENTS

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ABSTRACT. The purpose of this study is to develop an instrument for measuring the cognitive domain of the quality of life of university students, and to report the validity and reliability of the scales that are created. The study uses a representative sample of undergraduate students from the faculty of education at a major Canadian university. The construct validity of the scales is assessed by Thomas Piazza's procedures for analyzing attitudinal items. The findings support conceptualizing the cognitive domain in terms of *Structural* and *Functional* dimensions. The *Structural Dimension* includes the *Knowledge* and *Comprehension* dimensions from Bloom's taxonomy and the *Functional Dimension* includes the *Application, Analysis, Synthesis,* and *Evaluation* dimensions. The alpha reliability coefficients of the two scales are 0.88 and 0.85, respectively. Some potential applications of these scales for understanding educational attainments, as well as for the evaluation of university departments and faculties, are suggested.

INTRODUCTION

At present, universities are under considerable pressure to become more accountable to both taxpayers and students. A useful way of thinking about the accountability of universities is in terms of the changes that students are expected to make during their university education. Specifically, universities are expected to enhance the cognitive development of students, an outcome that Pascarella (1985, p. 3) and many other people note is "central to the traditional mission of the university".

The interests of the university and its students most frequently converge in classrooms where a considerable amount of the teaching and learning takes place. The research literature on socialization and the literature on effective teaching suggests that two conditions are required for optimal learning. First, the educational content must be

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cognitively demanding, and second, these demands must take place in a supportive social environment (Austin and Garber, 1985; Clifton and Roberts, 1993; Coser, 1979).

Kleinfeld (1975) labels teachers who create these conditions as "warm demanders". In a previous article we reported on the development of an instrument to measure the affective ("warmth") domain of the quality of life of university students (Roberts and Clifton, 1992). In this article we report on the development of an instrument to measure the cognitive ("demanding") domain.

CONCEPTUALIZATION

During the last thirty years, quality of life has been studied in a variety of organizational contexts (see Burt, Wiley, Minor and Murray, 1978; Larson, 1993; Palys and Little, 1980). After reviewing hundreds of studies, Michalos (1986) found that only one percent of these studies were conducted in educational organizations, and after a similar review, Fraser (1986, p. 29) found that while several studies were conducted at the elementary and secondary school levels, "surprisingly little analogous work has been conducted at the higher education level". Given these findings, we have focused our research on developing instruments for measuring the quality of life of students at the university level.

In order for students to be successful in universities, they must have a meaningful relationship with "their" university. In other words, effective education requires that students not be alienated from the organization (see Clifton, Mandzuk and Roberts, 1994). Instruments designed to measure the quality of life provide a meaningful way for students to express the degree to which they are integrated into the university. Quality of life refers to the degree of satisfaction, or the sense of well-being, people experience in organizations, such as universities (Schuessler and Fisher, 1985). The quality of life that students experience in a department, faculty, or university increases when they believe their needs are aligned with the goals of the organization, and as they perceive that the organization is responsive to their needs. From our theoretical perspective, university students should experience demanding cognitive challenges within warm social environments.

The cognitive domain of Bloom's taxonomy of educational objectives (Bloom, Engelhart, Furst, Hill and Krathwohl, 1956) provides the conceptual foundation for our scales. The dimensions of this taxonomy are well known and can be translated into indicators that students readily understand. Briefly, the six dimensions in this taxonomy are:

1. *Knowledge*, which refers to students' ability to recognize and recall basic information;
2. *Comprehension*, which involves students accurately translating and interpreting information;
3. *Application*, which requires students to translate abstract concepts and principles into appropriate ways of understanding and solving concrete problems;
4. *Analysis*, which requires students to decompose arguments into their constituent components and identify relationships among the parts;
5. *Synthesis*, which involves students ability to put facts, concepts, and principles together in new ways; and
6. *Evaluation*, which refers to students' ability to judge the internal consistency and external validity of arguments.

Bloom conceptualized the taxonomy as being hierarchical in which the more complex cognitive skills (*Application, Analysis, Synthesis*, and *Evaluation*) subsume less complex skills (*Knowledge* and *Comprehension*) (see Raths, Wasserman, Jonas and Rothstein, 1986; Seddon, 1978). We think that this conceptualization is a good way (but not the only way) of defining the cognitive domain of the quality of life of university students. Our task in constructing an instrument involved translating the six dimensions of the taxonomy into meaningful items, and then using empirical evidence to assess the conceptualization and establishing the validity and reliability of the scales.

SAMPLE

The proposed indicators of the cognitive domain of the quality of life of university students were tested on a representative sample of undergraduate students in the faculty of education at a major Canadian university. Since this instrument is designed for use in a variety of faculties and schools, it is appropriate to test its validity in a particular faculty. Moreover, the socio-demographic characteristics of the students in this particular faculty are very similar to the characteristics of the population of undergraduates in the university.

The sample of students was selected using a stratified random cluster procedure. This procedure involved identifying the mandatory courses in each year of the undergraduate programs and selecting a random sample of classes from these programs. A total of 363 students were enrolled in the 27 classes, representing approximately 20 percent of the undergraduates in the Faculty. Questionnaires were distributed to students who were in class during a selected class period. Two hundred and sixty-nine students completed questionnaires, representing approximately 74 percent of the students enrolled in the classes. This response rate is typical for survey research, and is adequate for developing and validating an instrument to measure the quality of life of students (Singleton, Straits, Straits and McAllister, 1988).

CONTENT VALIDITY

We began by writing a set of items for each dimension of this domain and then assessing the content validity of these items. Content validation involves two issues, face validity and sampling validity (Nachmias and Nachmias, 1987; Smith and Glass, 1987). Face validity is concerned with whether or not items seem to be plausible measures of each dimension, and sampling validity is concerned with whether or not a sufficient number and variety of items are used to capture the meaning of each dimension. A panel of judges representing undergraduate students, graduate students, and faculty members assessed and reassessed the content validity of our items. After a series of revisions, the judges agreed on a parsimonious set of six items for each of the six dimensions of our proposed cognitive domain.

The thirty-six items that we wrote are presented in Table I. On the questionnaire, all of the items were prefaced by the phrase, "In the Faculty of Education, I have been challenged to . . . " [e.g. "remember an extensive number of new terms"]. Other meaningful phrases, such as "In the Faculty of Arts" or "In the Department of Genetics" may be substituted for our phrase. The numbers on the left-hand side of the items refer to the order in which the items were arranged in the questionnaire. Specifically, the first item represents the *Knowledge Dimension*, the next represents the *Comprehension Dimension*, the third represents the *Application Dimension*, and so on.

The next step in scale construction involved empirically assessing the items to determine if they, in fact, represent the dimensions. The process of empirically testing items to determine if they represent dimensions of a domain is called construct validity.

CONSTRUCT VALIDITY

Assessing the construct validity of items and dimensions potentially involves both theoretical and methodological difficulties, making the interpretation of traditional validity tests problematic. If, for example, the empirical findings of a validity test do not support the theoretical perspective, the source may be either methodological, such as poorly worded items, or theoretical, such as multidimensional concepts. As a result, this study requires a procedure for testing the construct validity of the dimensions, and the relationships between the items and the dimensions, that takes both theoretical and methodological concerns into account. Fortunately, Thomas Piazza (1980) has developed a set of procedures for considering both of these issues.

Piazza's procedures provide a rigorous assessment of the degree to which items reflect a single concept and have consistent relationships with theoretically important exogenous variables (see Carmines and Zeller, 1979, pp. 22–26). In fact, most research instruments that have been developed in the social sciences are not subjected to such stringent assessments of construct validity (see Stinchcombe and Wendt, 1975, p. 59). Thus, applying these procedures in assessing the dimensions of the cognitive domain of the quality of life of university students represents a substantial improvement over the way that many other instruments have been developed. The procedures that Piazza has developed involve progressively more rigorous requirements.

TABLE I
The items designed to measure the six dimensions of the cognitive domain

Item #	**In the Faculty of Education, I have been challenged to ...**
	Knowledge
1.	remember an extensive number of new terms.
7.	recall a substantial number of new concepts.
13.	recall a lot of factual information.
19.	remember a significant number of facts.
25.	recall a significant number of facts.
31.	remember complex facts.
	Comprehension
2.	translate complicated ideas into everyday language.
8.	translate difficult concepts into my own words.
14.	interpret the meaning of new facts and terms.
20.	understand difficult ideas.
26.	translate a variety of technical terms into ordinary language.
32.	interpret the meaning of complicated charts and graphs.
	Application
3.	demonstrate how theories are useful in real life.
9.	use theories to address practical questions.
15.	illustrate abstract ideas with concrete examples.
21.	use theoretical ideas to address practical problems.
27.	apply theories to new situations.
33.	apply theoretical principles in solving problems.
	Analysis
4.	identify organizing principles in my courses.
10.	analyze complex interrelationships between concepts.
16.	identify assumptions underlying theories.
22.	identify the reasoning underlying theories.
28.	identify the basic ideas in theories.
34.	illustrate how the different aspects of my discipline are related.
	Synthesis
5.	design my own plans in completing assignments.
11.	organize ideas into themes.
17.	develop new ideas based on theories.
23.	solve problems by integrating theories.
29.	make original contributions to classroom discussions.
35.	organize ideas in new ways.

TABLE I
Continued

Item #	**In the Faculty of Education, I have been challenged to ...**
	Evaluation
6.	logically defend a course of action.
12.	evaluate alternative solutions to problems.
18.	detect missing parts in arguments.
24.	judge the logic of written arguments.
30.	identify the strengths and weakness of arguments.
36.	identify bias in written material.

Factor analysis

The first analysis is a confirmatory factor analysis of the thirty-six items. Factor analysis examines patterns of covariation among the items to determine if these patterns are congruent with the theoretically specified constructs (Harman, 1967; Kim and Mueller, 1978a, 1978b). In other words, to be consistent with the theoretical conceptualization, the items selected as measures of the six dimensions of the cognitive domain should load on six different factors. In addition, because the dimensions were conceptualized by Bloom and his colleagues as being interrelated, the factors should be correlated with each other. In our first factor analysis of the items we used a principal component analysis to extract six factors from the correlation matrix of thirty-six items, and then we rotated the factors to an Oblimin criterion, which allows the factors to be correlated.

Table II reports the results of this factor analysis. In order to facilitate interpretation, we only report factor loadings that are at least 0.30, explaining approximately 10 percent (0.30^2) or more of the covariance between an item and a factor. In this table, we observe that eleven of the thirty-six items, more than 30 per cent, load on two or more factors. For example, Item 7 loads on Factor 2 with a coefficient of 0.50 and on Factor 3 with a coefficient of −0.35. Moreover, many items do not load on the appropriate factors. The items we designed as measures of the *Synthesis* and *Evaluation* dimensions, for example, clearly do not load on single factors though a majority of these items load on Factor 4. On the other hand, the items we designed as measures of the *Knowledge* dimension load on

Factor 2, and the items we designed as measures of the *Application* dimensions load on Factor 1. Overall, these results do not support the conceptual framework underlying the items that we wrote to represent the six dimensions of the cognitive domain.

In addition, the correlations between the six factors, reported in Table III, shows that Factor 1 is positively related to Factors 2, 4, and 6 and negatively related to Factors 3 and 5. In turn, Factors 3 and 5 are positively related to each other. These correlation coefficients, along with a scree plot, which is not reported, suggest that a two factor solution should be considered.

Consequently, exploratory factor analyses were used to search for empirical patterns that would help us reconceptualized the cognitive domain. After several more factor analyses, the most interpretable result was a principal components analysis extracting two factors that were rotated to the Oblimin criterion. In order to have the results conform to the criteria of simple structure and parsimony, we eliminated three items (8, 20, and 26) that were uninterpretable because they continually loaded on at least two factors. The results of the factor analysis of the remaining 33 items are reported in Table IV.

An examination of the items that loaded on each of the two factors show that Factor 1 contains twenty-four items from the *Application, Analysis, Synthesis*, and *Evaluation* dimensions and Factor 2 contains nine items from the *Knowledge* and *Comprehension* dimensions of Bloom's taxonomy (Bloom et al., 1956). In addition, the two factors are moderately correlated (0.28). We labelled Factor 1 the *Functional Dimension* and Factor 2 the *Structural Dimension*. We were not too surprised to discover these two dimensions because they are supported by the work of other researchers who have empirically examined Bloom's taxonomy (see Raths, Wasserman, Jonas and Rothstein, 1986; Seddon, 1978).

Overall, these results suggest that the theoretical distinctions that Bloom and his colleagues have made between the six dimensions of the cognitive domain are not recognized by students who are assessing the quality of their intellectual lives in universities. However, in making these assessments, students recognize two dimensions, a *Structural Dimension* representing the less complex skills of knowing and comprehending, and a *Functional Dimension* representing

TABLE II
Pattern matrix for the items on six factors after oblique rotation

	Item #	F1	F2	F3	F4	F5	F6
Knowledge	1.		0.66				
	7.		0.50	−0.35			
	13.		0.86				
	19.		0.93				
	25.		0.91				
	31.		0.89				
Comprehension	2.					−0.70	
	8.					−0.64	
	14.		0.42				
	20.		0.36		0.31	−0.31	
	26.					−0.68	
	32.		0.36				0.66
Application	3.	0.55					
	9.	0.71					
	15.	0.52					
	21.	0.82					
	27.	0.68					
	33.	0.57					0.34
Analysis	4.			−0.79			
	10.	0.44					
	16.	0.57					
	22.	0.60					
	28.	0.57					
	34.				0.36		
Synthesis	5.			−0.75			
	11.				0.36		
	17.			−0.32			0.40
	23.	0.80					
	29.				0.73	0.34	
	35.				0.57		
Evaluation	6.			−0.45	0.31		
	12.	0.32			0.48		
	18.				0.33		0.54
	24.					−0.34	0.47
	30.				0.57		0.33
	36.				0.48		

TABLE III
The correlation matrix for the six factors

Factor	1	2	3	4	5
2	0.18	–			
3	−0.38	−0.19	–		
4	0.45	0.07	−0.22	–	
5	−0.35	−0.31	0.31	−0.22	–
6	0.23	0.11	−0.06	0.16	−0.13

the more complex skills of applying, analyzing, synthesizing, and evaluating.

It is common in the social sciences to use only factor analyses in the construction of scales. Piazza (1980) notes, however, that this practice masks a potentially serious difficulty. Specifically, even though all the items that load on a single factor may be indicators of a common dimension, the character of their relationships with other theoretically relevant variables may bring a "hidden contaminant into the scale and distort the relationships of the scale to those other variables" (Piazza, 1980, p. 588). The strategy recommended to prevent such distortion involves a test of construct validity (Carmines and Zeller, 1979, p. 26); that is, the strategy implies that only those items that have a consistent relationship to other theoretically relevant variables should be selected for the final scale. Consequently, the next two steps for selecting items involve examining the construct validity of the items by using proportionality of correlations and canonical correlation procedures, two statistical procedures that support each other.

Proportionality of correlation

In this procedure we examine the correlations between the thirty-three items that have, to this point, been identified as measures of the two dimensions of the cognitive domain, and a set of exogenous variables. Based on previous research in higher education (see Astin, 1993; Pascarella and Terenzini, 1991), five exogenous variables were chosen that are theoretically relevant and have hypothesized relationships with the items. Three variables, years of university (Years), credit hours (Hours), and grade point average (GPA) are related

TABLE IV
Pattern matrix for the items on two factors after oblique rotation

	Item #	F1	F2
Application, *Analysis*	3.	0.62	
Synthesis, and *Education*,	4.	0.46	
	5.	0.39	
	6.	0.61	
	9.	0.62	
	10.	0.62	
	11.	0.58	
	12.	0.66	
	15.	0.56	
	16.	0.68	
	17.	0.66	
	18.	0.57	
	21.	0.72	
	22.	0.73	
	23.	0.72	
	24.	0.55	
	27.	0.74	
	28.	0.60	
	29.	0.46	
	30.	0.64	
	33.	0.63	
	34.	0.57	
	35.	0.60	
	36.	0.53	
Knowledge and	1.		0.74
Comprehension	2.		0.40
	7.		0.65
	13.		0.87
	14.		0.52
	19.		0.90
	25.		0.90
	31.		0.89
	32.		0.39

to the investment students have made in their university education and represent their responses to the cognitive challenges they have experienced. Years refers to the number of years completed in university and is reported as a continuous variable ranging from 0 to 10. Hours refers to the amount of time students are involved in university courses and is reported as a multiple of three from 3 to 39 hours. GPA is measured on a six-point scale ranging from 2.0–2.4, coded as 3, to 4.0–4.5, coded as 8. Two other variables, gender and father's education, reference two important background characteristics of students that are related to their success in university. Gender is measured on a dichotomous scale, coded 1 for females and 2 for males, and father's education is measured on a nine-point scale ranging from completed elementary school, coded as 1, to completed a graduate degree, coded as 9. The correlations between each of the items and the five exogenous variables are reported in Table V.

At this point in the assessment of the construct validity of the two scales, our task is to search for consistent patterns of correlations between the sets of items and the five exogenous variables. Because each dimension is measured by a number of items, it is difficult to detect similarities and differences in the pattern of the correlation coefficients. To simplify this task, Piazza (1980, pp. 591–595) developed a statistical procedure called the Index of Proportionality (P^2). The central argument for using this procedure is that because "all the items need not measure the underlying construct with the same degree of efficiency, it is not necessary that each row of correlations be the same. One would expect, however, that the rows would be proportional" (Piazza, 1980, p. 592). In other words, items with construct validity would have proportionally similar relationships with the set of exogenous variables. The P^2 statistic has a conventional interpretation: it equals +1 if two items have exactly proportional correlations with the exogenous variables, it equals -1 if the correlations are proportional but with the opposite sign, and it equals 0 if there is no consistent pattern (Piazza, 1980, p. 592).

The P^2 matrix of the twenty-four items in the *Functional Dimension* is reported in Table VI and the P^2 matrix of the nine items in the *Structural Dimension* is reported in Table VII. In the *Functional Dimension*, eight items (4, 9, 10, 17, 22, 27, 33, and 35) seem to have relatively high P^2 coefficients, while the other sixteen items (3,

TABLE V
Correlation coefficients for the items with the five exogenous variables*

	Item #	Years	Hours	GPA	Gender	Father's education
Functional	3.	−0.20	−0.13	−0.23	−0.13	−0.01
Dimension	4.	−0.05	−0.04	−0.08	−0.17	−0.04
	5.	0.08	0.00	0.07	−0.02	−0.02
	6.	0.10	−0.08	−0.09	0.00	0.00
	9.	−0.08	−0.03	−0.11	−0.06	0.01
	10.	−0.05	−0.06	−0.13	−0.08	−0.08
	11.	0.09	0.02	−0.02	0.01	−0.05
	12.	0.01	−0.01	−0.05	−0.07	0.01
	15.	0.02	−0.07	−0.04	0.01	0.00
	16.	0.01	−0.06	0.07	−0.04	−0.01
	17.	−0.05	−0.16	−0.18	−0.06	−0.02
	18.	−0.01	−0.07	−0.08	−0.08	−0.04
	21.	−0.12	0.03	−0.05	−0.04	0.06
	22.	−0.07	0.01	−0.08	−0.04	0.02
	23.	−0.03	0.00	−0.03	−0.06	0.05
	24.	−0.02	−0.03	0.00	−0.09	−0.03
	27.	−0.09	−0.05	−0.12	−0.06	−0.02
	28.	−0.09	−0.11	−0.02	−0.08	−0.03
	29.	−0.05	−0.03	−0.10	0.01	0.10
	30.	−0.10	−0.10	−0.13	−0.12	0.03
	33.	−0.03	−0.01	−0.09	−0.11	0.04
	34.	0.04	−0.06	−0.05	−0.10	0.04
	35.	−0.05	−0.05	−0.25	−0.12	0.01
	36.	−0.11	−0.02	−0.02	−0.10	0.02
Structural	1.	0.11	−0.22	−0.14	0.00	−0.04
Dimension	2.	−0.02	−0.11	−0.04	−0.03	−0.13
	7.	−0.03	−0.13	−0.06	−0.04	−0.12
	13.	0.06	−0.04	−0.04	0.03	−0.04
	14.	0.05	−0.09	−0.04	−0.09	0.01
	19.	0.09	−0.13	−0.14	0.02	−0.05
	25.	0.06	−0.07	−0.10	0.06	−0.02
	31.	0.09	−0.08	−0.13	0.04	−0.02
	32.	−0.01	0.01	−0.07	−0.05	−0.10

* The number of cases used in calculating these coefficients range from 223 to 260 depending on the missing data. Coefficients that are 0.13 or greater are statistically significant (2-tailed test) at the 0.05 level, and coefficients that are 0.16 or greater are statistically significant at the 0.01 level.

5, 6, 11, 12, 15, 16, 18, 21, 23, 24, 28, 29, 30, 34, and 36) do not. In the matrix of nine items in the *Structural Dimension*, five items (1, 13, 19, 25, and 31) seem to have relatively high P^2s, while the other four items (2, 7, 14, and 32) do not. Obviously, it is very difficult to interpret trends in these two tables. Consequently, prior to making a final decision on the items that belong to the scales, Piazza recommends that the examination of P^2 coefficients be supplemented with canonical correlation analyses of the items and the set of exogenous variables.

Canonical correlations

Canonical correlation techniques permit the computation of coefficients that express the maximized linear relationship between two sets of variables. For this reason, the technique helps determine if a set of items measuring a dimension, has one, and only one, systematic relationship to the set of exogenous variables. Specifically, canonical correlation analyses generate a number of variates equal to the number of variables in the smallest set, with each successive variate being orthogonal to the previous one and explaining successively less of the variation between the two sets. Each of the variables "are combined to produce, for each side, a predicted value that has the highest correlation with the predicted value on the other side" (Tabachnick and Fidell, 1989, p. 193). As in factor analysis, coefficients of 0.30 and above, explaining 10 percent or more of the variance, are conventionally interpreted as part of the variate (Tabachnick and Fidell, 1989, p. 217).

The canonical correlation analysis, for both dimensions of the cognitive domain, are reported in Table VIII. Since the five exogenous variables comprise the set with the fewest items, each canonical analyses generated five canonical variates. We report the first variates for two separate analyses of the items used to measure each of the two dimensions. In other words, we report four analyses, the first and the final analyses for each of the two dimensions. In addition, we conducted a number of other analyses in which items were systematically dropped and added on the basis of their loadings on the first variate, but these analyses have not been reported. The reason we only report the first variate in each analysis is because it contains all the information that is necessary to supplement the P^2 coefficients

TABLE VI

Matrix of P^2s for the items measuring the functional dimension

Item #	3	4	5	6	9	10	11	12	15	16	17	18	21	22	23	24	27	28	29	30	33	34	35
4	0.61																						
5	0.57	0.07																					
6	0.03	0.02	0.01																				
9	0.96	0.62	0.61	0.02																			
10	0.78	0.69	0.26	0.10	0.75																		
11	0.16	0.02	0.30	0.31	0.13	0.00																	
12	0.44	0.74	0.06	0.16	0.55	0.47	0.00																
15	0.21	0.04	0.03	0.73	0.13	0.21	0.02	0.08															
16	0.03	0.02	0.38	0.00	0.10	0.03	0.02	0.01	0.01														
17	0.78	0.43	0.29	0.35	0.69	0.73	0.01	0.41	0.65	0.01													
18	0.68	0.77	0.08	0.27	0.62	0.85	0.00	0.63	0.38	0.01	0.81												
21	0.40	0.17	0.67	0.20	0.50	0.10	0.57	0.15	0.05	0.16	0.06	0.03											
22	0.72	0.42	0.74	0.01	0.86	0.47	0.19	0.42	0.00	0.29	0.33	0.28	0.77										
23	0.39	0.49	0.20	0.00	0.51	0.15	0.26	0.65	0.00	0.00	0.16	0.21	0.59	0.57									
24	0.29	0.82	0.00	0.00	0.25	0.38	0.03	0.44	0.00	0.26	0.18	0.52	0.04	0.10	0.29								
27	0.98	0.60	0.61	0.03	0.97	0.83	0.11	0.45	0.16	0.08	0.74	0.66	0.41	0.78	0.37	0.25							
28	0.29	0.09	0.11	0.02	0.13	0.14	0.38	0.01	0.14	0.22	0.23	0.14	0.04	0.02	0.00	0.16	0.21						
29	0.42	0.05	0.65	0.05	0.50	0.10	0.23	0.21	0.15	0.24	0.33	0.09	0.51	0.55	0.42	0.01	0.40	0.02					
30	0.92	0.71	0.39	0.05	0.89	0.65	0.19	0.61	0.22	0.00	0.74	0.72	0.38	0.63	0.59	0.41	0.86	0.25	0.43				
33	0.60	0.75	0.20	0.06	0.73	0.49	0.04	0.93	0.05	0.03	0.42	0.57	0.37	0.65	0.81	0.40	0.61	0.00	0.36	0.75			
34	0.25	0.52	0.00	0.31	0.28	0.22	0.00	0.80	0.22	0.06	0.36	0.53	0.02	0.12	0.52	0.41	0.21	0.00	0.15	0.49	0.67		
35	0.76	0.57	0.39	0.19	0.86	0.75	0.00	0.73	0.22	0.17	0.72	0.70	0.25	0.70	0.42	0.18	0.81	0.01	0.44	0.73	0.79	0.42	
36	0.60	0.61	0.29	0.12	0.58	0.31	0.53	0.32	0.00	0.02	0.20	0.28	0.62	0.55	0.64	0.53	0.54	0.30	0.18	0.67	0.51	0.19	0.28

TABLE VII
Matrix of P^2s for the items measuring the structural dimension

Item #	1.	2.	7.	13.	14.	19.	25.	31.
2.	0.41	–						
7.	0.48	0.97	–					
13.	0.67	0.32	0.28	–				
14.	0.57	0.22	0.29	0.11	–			
19.	0.94	0.39	0.44	0.79	0.40	–		
25.	0.73	0.19	0.22	0.82	0.12	0.87	–	
31.	0.81	0.18	0.22	0.79	0.24	0.93	0.96	–
32.	0.08	0.47	0.44	0.10	0.06	0.15	0.05	0.07

reported in Tables VI and VII to help us make a decision about the items that can be used to construct the two scales.

The first panel of Table VIII reports the first and the final analyses of the items that we think may measure the *Functional Dimension*. All twenty-four items were included in the first analysis resulting in a canonical correlation of 0.26, representing approximately 7 percent of the common variance. After a series of additional analyses, eleven items with coefficients of 0.30 or greater were retained (items 3, 4, 9, 10, 17, 27, 29, 30, 33, 35, 36), and the other thirteen items were dropped. The coefficients for these eleven items are reported in the second column. In this analysis, the canonical correlation has increased to 0.50, explaining 25 percent of the common variance. Comparing these results with the results of the P^2 analysis confirms that the eleven items that have been retained have good construct validity in representing the *Functional Dimension* of the cognitive domain.

The second panel of Table VIII reports the first and the final analyses of the items measuring the *Structural Dimension*. In the first analysis, all nine items are included and a canonical correlation of 0.41 is obtained, explaining approximately 17 percent of the common variance between the two variates. However, the loadings for items 2, 13, and 32 are lower than the conventional level of 0.30, and suggests that these items are not contributing to the principal linear relationship between the items and the exogenous variables. This interpretation is also supported by the P^2 analysis.

TABLE VIII
Canonical Correlations for the Items and the Five Exogenous Variables

	Item #	First analysis	Final analysis
Functional	3.	0.65	−0.86
Dimension	4.	0.29	−0.41
	5.	−0.16	–
	6.	0.05	–
	9.	0.31	−0.42
	10.	0.27	−0.38
	11.	−0.08	–
	12.	0.16	–
	15.	0.06	–
	16.	−0.07	–
	17.	0.36	−0.54
	18.	0.20	–
	21.	0.22	–
	22.	0.20	–
	23.	0.13	–
	24.	0.11	–
	27.	0.30	−0.43
	28.	0.20	–
	29.	0.25	−0.32
	30.	0.43	−0.60
	33.	0.27	−0.31
	34.	0.14	–
	35.	0.47	−0.62
	36.	0.24	−0.33
Exogenous variables:	Years	−0.42	0.41
	Hours	0.03	0.02
	GPA	−0.60	0.53
	Gender	−0.31	0.47
	Father's education	−0.76	0.77
Canonical Correlations (R)		0.26	0.50
Eigenvalue (R^2)		0.07	0.25

Consequently, these items were dropped and the canonical correlations were recomputed.

The results of the final analysis are reported in the second column of this panel and show that the remaining six items have consistently

TABLE VIII
Continued

	Item #	First analysis	Final analysis
Structural	1.	0.78	0.87
Dimension	2.	0.22	–
	7.	0.25	0.32
	13.	0.19	–
	14.	0.39	0.44
	19.	0.58	0.64
	25.	0.36	0.38
	31.	0.49	0.53
	32.	0.09	–
Exogenous variables:	Years	−0.06	−0.12
	Hours	0.08	−0.04
	GPA	0.46	0.51
	Gender	−0.70	−0.72
	Father's education	−0.59	−0.51
Canonical Correlation (R)		0.41	0.56
Eigenvalue (R^2)		0.17	0.31

high loadings with the exogenous variables. Specifically, the coefficients for these items range from 0.32 to 0.87, and the canonical correlation has increased from 0.41 to 0.56, explaining approximately 31 percent of the common variance. Thus, we conclude that these six items, representing the *Structural Dimension* of the cognitive domain, have good construct validity.

RELIABILITY ASSESSMENT

To this point, the content validity and construct validity procedures have resulted in the selection of 17 items measuring two theoretically distinct, but correlated, dimensions of the cognitive domain of the quality of life of university students. The procedures that have been used to assess the validity of these two scales are more rigorous than the conventional techniques that mainly rely on factor analyses. Consequently, we are quite confident that the two scales contain relatively little non-random error. In addition, compared to previous research using these procedures, our results are encouraging. Piazza

(1980, p. 602), for example, notes that these rigorous procedures have rarely resulted in the retention of more than four items per scale. Consequently, the eleven items we have retained in the *Functional* scale and the six items we have retained in the *Structural* scale are both above average.

The quality of scales is typically summarized by reporting reliability coefficients. Cronbach's alpha reliability coefficient is a commonly used, but lower-bound, measure of reliability (Carmines and Zeller, 1979, p. 44). This statistic ranges from 0, indicating no internal consistency, to +1.0, indicating perfect internal consistency. The acceptability of particular reliability coefficients depends, of course, on the way the scales are to be used. For research purposes, Smith and Glass (1987, p. 106) suggest that moderate reliability coefficients, those over 0.50, are sufficient. Other researchers recommend we "strive for indices with coefficients of 0.70 or higher" (Bohrnstedt and Knoke, 1982, p. 106), while remembering that it is very difficult to obtain reliability coefficients above 0.80 (Nunnally, 1967, p. 226).

The items selected for these two scales, along with the alpha reliability coefficients, are reported in Table IX. The two scales hold up well in terms of the conventional standards. The alpha reliability coefficient for the eleven items in the *Functional Dimension* is 0.85 and the alpha reliability coefficient for the six item in the *Structural Dimension* is 0.88. Clearly, these coefficients are well above the acceptable standards for research purposes (see Larson, 1993) and confirm that we have been able to construct scales with considerable construct validity and reliability. Finally, at this time it is important to remember that these items were prefaced with the phrase, "In the Faculty of Education, I have been challenged to ... ", but this phrase can be changed to reflect any meaningful organizational unit in a university as we have indicated in this table.

DISCUSSION

This study set out to develop an instrument for measuring the cognitive domain of the quality of life of university students. A review of the literature revealed that no instruments had been developed to measure this important aspect of university work. In developing our instrument, we used a set of construct validity procedures

TABLE IX
Final items selected to measure the two dimensions of the cognitive domain

Item #	In the University or Faculty, I have been challenged to ...
	Functional Dimension (Cronbach's Alpha = 0.85)
3.	demonstrate how theories are useful in real life.
4.	identify organizing principles in my courses.
9.	use theories to address practical questions.
10.	analyze complex interrelationships between concepts.
17.	develop new ideas based on theories.
27.	apply theories to new situations.
29.	make original contributions to classroom discussions.
30.	identify the strengths and weaknesses of arguments.
33.	apply theoretical principles in solving problems.
35.	organize ideas in new ways.
36.	identify bias in written material.
	Structural Dimension (Cronbach's Alpha = 0.88)
1.	remember an extensive number of new terms.
7.	recall a substantial number of new concepts.
14.	interpret the meaning of new facts and terms.
19.	remember an extensive number of facts.
25.	recall a significant number of facts.
31.	remember complex facts.

recommended by Piazza (1980). These procedures are particularly useful in exploratory studies, like this one, that rely on the interplay between conceptualization and measurement. Our conceptualization of the cognitive domain of the quality of life of university students was based on the theoretical and empirical work of Bloom and his colleagues (Bloom et al., 1956) who suggested that this domain includes six dimensions. Our evidence, however, suggests that these six dimensions should be reconceptualized into two dimensions, a *Structural Dimension* and a *Functional Dimension*, which have both theoretical and empirical support. The *Structural Dimension* represents the less complex cognitive skills in the *Knowledge* and

Comprehension dimensions of Bloom's taxonomy, and the *Functional Dimension* represents the more complex skills in the *Application, Analysis, Synthesis*, and *Evaluation* dimensions.

Sophisticated techniques have been used recently to enhance the construct validity of research instruments. Although these procedures are primarily used by educators and psychologists (e.g. Gibson and Dembo, 1984; Jackson, 1981), sociologists are also showing greater concern for the construct validity of their instruments (e.g. Burt, Wiley, Minor and Murray, 1978; Williams and Batten, 1981). On this account, Piazza's procedures are useful for social and educational research.

Although the use of these sophisticated procedures is increasing, research scales are often created by using a three step procedure which includes establishing the content validity of items, factor analyzing the items to determine if they load on a principal component, and calculating reliability coefficients. The advantage of Piazza's (1980) procedures is evident by comparing our final scales to those that would result from following the less rigorous procedure. When we factor analyzed the original items, the results indicated that the two scales would have had content validity, loaded on two factors, and had high reliability coefficients. In short, using the conventional procedure we would have retained 33 of the 36 items (92%) in the two scales. The results of using Piazza's more rigorous procedures, however, showed that only 17 of the 36 items (47%) were adequate measures of the two dimensions.

These findings suggest that the conventional procedure for constructing social and educational indicators may result in the selection of items with ambiguous meaning. The rigor of Piazza's procedures can evidently help researchers create better instruments. As such, we recommend these procedures in educational, psychological, and social research where vague conceptual and operational definitions often lead to a great amount of unexplained variance and ambiguous interpretations (Piazza, 1980, pp. 590–91). Of course, further testing would strengthen our confidence in the reliability and validity of these scales. Despite the fact that the socio-demographic characteristics of our sample of students were remarkably similar to those of the university student population, it would be useful to corroborate the validity and reliability of these scales on other samples of students representing different departments, faculties, and universities. Only by replicating this work is it possible to determine how stable the results are in the student population.

Finally, the obvious application of these scales is in evaluation studies at universities. Given the growing concern for accountability, there is a need to systematically measure the quality of life of university students for diagnostic, formative, and summative evaluations. Additionally, now that very reliable and valid scales exist for measuring both the affective and the cognitive domains of the quality of life of students, the possibility exists for exploring the correlates, causes, and consequences of these scales. For example, researchers could investigate whether or not the quality of life of university students is affected by a variety of student, department, and faculty characteristics. In addition, research on the effects of both the affective and cognitive domains on the educational achievement and occupational expectations of students may be conducted. In short, the instrument reported here represents a step toward codifying an important property of effective university education, which we hope will serve as an impetus for further pure and applied research.

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