Development and Validation of College Level Academic Retention Scale

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Abstract

Research regarding academic retention has been advancing, however, a universally accepted, standardized, and reliable method to predict academic retention has not been developed. This study proposes a relatively new concept of academic retention exploring extrinsic and intrinsic measures of academic constructs rather than the more widely accepted classification of academic retention as an attitude. This paper also introduces a newly developed instrument of measurement, the Academic Retention Scale (ARS), seeking to measure academic retention as a personality trait. The purpose of the study is to a) illustrate that academic retention can be defined as coming back to pursue a college degree, b) to validate the ARS, and c) to assess whether the scale is an internally reliable metric of academic retention. This paper evaluates the ARS construct validity using factor analytic methods and tests of reliability.

Keywords: Retention, scale, factor analysis, validity, reliability and research.

Introduction

The most vexing measurement issue in higher education research is related to a standardized formula for the measure of college student retention. The often cited, Vincent Tinto (1987) agrees that, measuring academic retention is complicated, confusing, and context dependent. Further adding to the complexity, the National Center for Education Statistics (2014), defines "retention" as an institutional measure and uses the term "persistence" as a student measure. In other words, institutions retain and students persist. Although, research regarding academic retention has made significant strides, a universally accepted, standardized, and reliable method to identify predictive factors of academic retention or persistence, has not been developed. While Tinto (1987) and Bean (2005) remain the early pioneers in the retention research and model arena, the importance of the issues brought on a virtual explosion in the subsequent years. In spite of the plethora of published articles and books on the topic, the concept of retention and its appropriate measurement tools remain cloaked in a significant level of ambiguity (Carey, 2005).

It is noteworthy, however, that all colleges and universities are required to submit retention figures to federal and state governments. This task is disproportionately more difficult for community colleges due to their higher turnover rates and more diverse student enrollments including many who attend more than one institution at a time. Despite the difficulty, maintaining an appropriate account of student reenrollment and graduation is of the utmost importance because an institution's reputation and sometimes its funding levels depends on its ability to retain and graduate a significant level of its students as proof of academic success (Hagedorn & Castro, 1999; Tichenor & Cosgrove 1991).

This study proposes a relatively new concept of academic retention exploring external and internal measures of retention predicting factors rather than the more widely accepted classification of academic retention as a personality traits or academic skills. This paper also introduces a newly developed instrument of measurement, the Academic Retention Scale (ARS), seeking to measure academic retention through a dualistic factor model: Externalresources (things that other people provide for students) and internal resources (things that develop within the students themselves). This dualistic factor model is related to important roles that families, schools, neighborhoods, opportunities, skills, relationships, values, and self-perceptions that all students need in their lives in order for them to succeed in their academic endeavors (de Carvalho & Schumacker, 2012).The overall purposes of this study are to illustrate that academic retention can be defined as coming back to pursue a college degree, validate the ARS, and assess whether the scale is an internally reliable metric of academic retention. Thus, this paper evaluates the ARS construct validity using factor analytic methods and tests of reliability.

Related Research

The National Center for Education Statistics (NCES) operationally defines academic retention by including only first-time bachelor's degree-seeking students from the previous fall who either re-enrolled or successfully completed their program by the current fall. The federal formulas and discussion presuppose that retention exists in one selection, which describe students as either remaining at the university or simply not. The truth is that retention comes in multiple varieties such as, institutional, system, in the major and in a particular course.A plethora of retention research projects using quantitative measurement tools remain cloaked in a significant level of ambiguity as a standard formula has not yet been universally recognized (Astin, 2005; Bean, 2005; Braxton, 2000; Daempfle, 2003; Seidman& Tinto, 2005; Hagedorn, 2004; NCES, 2014; Noel-Levitz, 2004).

The development of a comprehensive and valid retention measurement scale can lead to the identification of predicting factors associated with academic achievement, graduation, and social/economic upward mobility. According to the U.S. Census Bureau, the average household income raises $14,354 to a yearly average of $37,874 when the householder educational attainment increases from high school graduate to associate degree holder or bachelor degree holder respectively. Lower incomes generally correlate with many social problems often leading to lower living standards. The current literature showed that higher levels of retention are positively associated with higher levels of family wellness and neighborhood efficacy, which produces a positive ripple effect on the postsecondary institutions, the work force, and the economy (Adelman, 2006; Bean, 2005; McMahon, 2000; Noel-Levitz; 2004; U.S. Census Bureau (2014).

In support of this Dualistic Model of Retention, the Academic Retention Scale ((ARS), was developed and substantiated through validity and reliability analyses. Construct validity and reliability are the hallmark concepts in the psychometric literature. Construct validity and reliability contains the evidence and basis for the support or confidence of score interpretation that explain the concepts that make up both assessment performance and score relationships with the other variables. Subsequently, this paper introduces a newly developed instrument of measurement, the Academic Retention Scale (see Appendix A) seeking to measure factors associated with academic achievement and retention from an external and internal student resources perspectives (Andrade, 2002; Cronbach&Meehl,1955; Seidman, 2005; Seidman & Tinto, 2005; Schumacker & Lomax, 2004).

Methods

Participants

The study used a data set drawn from surveys administered by a student worker of Prairie View A&M University in Texas. The data collection took place in February 2016, and contained no identifiable personal information from any of the participants. The sample for this pilot research study included 46 male and female students. The study participants (n=46) were randomized and sample size guidelines for pilot studies were followed. The current research method literature indicated that a sample size for a pilot study should be between 30 to 50 participants, which provide sufficient effect size to evaluate estimates precise enough to meet a variety of possible aims. Their responses to the initial version of the ARS provided the foundations to initially judge the scale construction effort and to make later revisions (Duckworth & Quinn, 2009; Pedhazur & Pedhazur, 1991; Rubin & Babbie, 2016; Schumacker & Lomax, 2004).It is worth mentioning, that despite the agreement that sample size is a key determinant for reliable use of factor analysis, there is much debate as to the number of subjects required for reliable results. The relevant literature shows two primary sampling patterns in the debate over sample size: minimum total sample size and subject to item ratio.

The primary debate against absolute sample size recommendations lies in the complexity of scales for which factor analytic methods are used. There are no stipulations based on scale size, complexity of component structure, or magnitude of correlations. For this reason, many authors have recommended focusing more on subject to item ratio. Nunnally‟s (1967) 10:1 ratio is a widely-accepted rule, which recommends 10 subjects for each item in the PCA. Gorsuch (1983) and Hatcher (1994) both report specific guidelines when ratios as small as 5:1 can be used, but both note that higher ratios are generally more advisable.

Instrumentation

The newly developed Academic Retention Scale (ARS) was used in the data collection for the study. The ARS was developed to measure retention within the context of four External Resources categories (***Support, University Environment***, ***Mentoring*** and ***Resources / Opportunities Before College***) and four Internal Asset Categories (***Commitment to Learning, Adaptability, Values Congruency, School Success, Reenrollment)***. Reliability of scores for this instrument was established using Cronbach's coefficient alpha. The original scale had 62 items and the Cronbach alpha test indicated an acceptable internal consistency (a =.785*)* for the eight item domains comprised of resources categories (de Carvalho & Schumacker, 2012; Search Institute, 2004).

The scale questionnaire was based on the Developmental Assets Profile (DAP)model in which the Search Institute endeavors to measure young peoples' external supports and internal strengths in key areas of their growth including their commitments, values, skills, and identity. All of the subscales are based on a seven-point Likert scale (Rubin & Babbie, 2016; Search Institute, 2004). Furthermore; a standardized script was developed to inform participants of the study and how to complete the two surveys. The informed consent explained the nature of the study and included information regarding the respondents' participation, confidentiality, how to contact knowledgeable people regarding their participation, level of potential harm, and if necessary how they may contact the institutional review board.

Design and Analysis

The study examined the new scale's metric qualities and its relationships with other self-report measures. The scale was designed to measure student's college retention and preparedness based on a dualistic model comprised of two latent variables (constructs) using sets of observed variables. Construct validity was determined through exploratory factor analysis, leading to aneight-factor solution. Two factors were eliminated with high cross-factor loadings finally leaving the modified scale with six factors and a 23-item measure. Principal Component Analysis (PCA) was used to reduce items to relevant subsets, while reliability of scores for this instrument was established using Cronbach's coefficient alpha. PCA is the default method of extraction in the Statistical Package for Social Science (SPSS). This statistical designed aim to understand the underlying data structure and to reduce the data into a smaller set while forming uncorrelated linear groupings of observed variables with maximum variability, using orthogonal transformations (Rubin & Babbie, 2016).

Orthogonal (Varimax) rotation was used as a method of transformations to identify uncorrelated components. All components were statistically independent of one another. Varimax orthogonal rotation minimizes the complexity of components by maximizing the variance of loadings on each component. An item loading of ≥.40 was used as a cut-off for retaining items (DeVellis, 1991; Tabachnick & Fidell, 1996; Rubin & Babbie, 2016).

Results

A factor analysis was performed using the extraction method of Principal Component Analysis in SPSS. The first principal component showed a maximum variance, which accounted for as much of the variability in the data as possible. Each successive component explained progressively smaller portions of the variance with the highest possible variance under the constraint that it was uncorrelated with the prior components. A second exploratory factor analysis was conducted resulting in a23-item measure with a six factor solution of External Resources (Three-item subscale) and Internal Resources (three-item subscale). A test of reliability reflected satisfactory levels of internal consistency for *External Resources* (a = .889), *Internal Resources* (a = .817). Internal consistency usually coincides with Lee J. Cronbach's (1951) coefficient alpha, *a,* calculated from pair wise correlations between items. It is defined as the proportion of a scale's total variance attributable to the true score of the latent variable: the measure of the relationship between the squared correlations of observed scores and the true score. Reliability coefficients of 0.70 or higher are considered acceptable in most social science research.

The ARS yielded high values of alpha coefficients, which implied that the items measure an underlying latent construct. Reliability testing of the ARS (total 23-items) yielded a Cronbach's alpha of 0.918 (a = 0.918) demonstrating the scale have a relatively high inter-item reliability (Rubin & Babbie, 2016).SPSS displays the eigenvalues in terms of the percent of variance explained. Table 1.1 shows the Total Variance Explained and lists the eigenvalues associated with each factor before and after extraction. -It can be observed that the first factor explains a significant amount of total variance, 37.5 %, (see Table 1.1**)** with each succeeding factor explaining progressively less amounts of variance. Since SPSS extracts all factors with eigenvalues greater than 1, six factors were extracted and displayed in column Extraction Sums of Squared Loadings. However, since the first factor accounts for most of the total variance, it suggests that the scale items are unidimensional (Schumacker & Lomax, 2004).

Table 1.1.**Total Variance Explained**

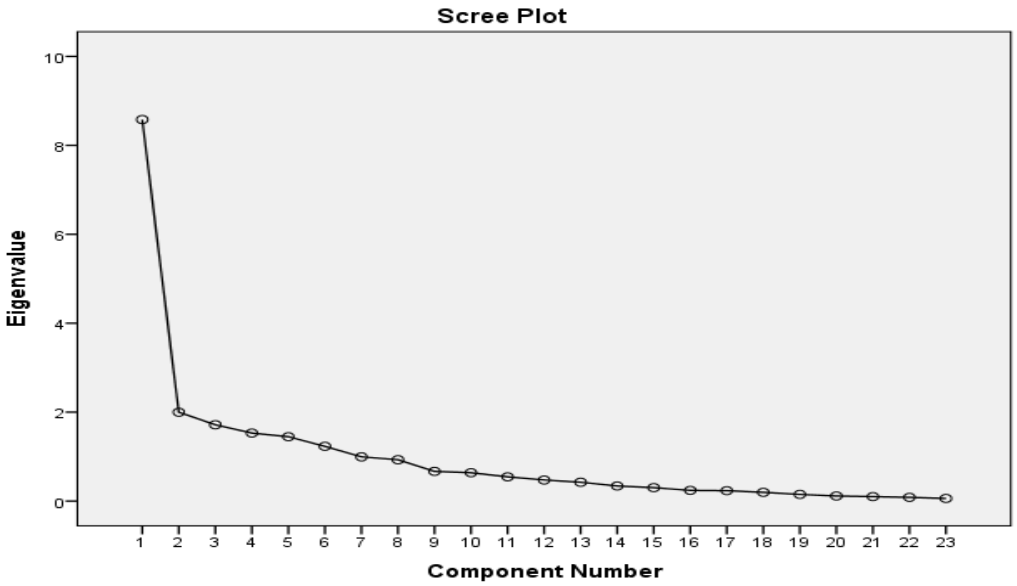
Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	8.580	37.303	37.303	8.580	37.303	37.303	3.174	13.802	13.802
2	1.998	8.688	45.991	1.998	8.688	45.991	2.904	12.624	26.426
3	1.715	7.458	53.449	1.715	7.458	53.449	2.721	11.828	38.255
4	1.530	6.651	60.100	1.530	6.651	60.100	2.607	11.336	49.591
5	1.448	6.296	66.395	1.448	6.296	66.395	2.561	11.135	60.726
6	1.232	5.355	71.751	1.232	5.355	71.751	2.536	11.025	71.751
7	.994	4.324	76.075						
8	.930	4.044	80.119						
9	.668	2.902	83.021						
10	.638	2.772	85.794						
11	.546	2.374	88.168						
12	.474	2.063	90.231						
13	.424	1.845	92.075						
14	.339	1.475	93.550						
15	.302	1.312	94.862						
16	.241	1.050	95.912						
17	.234	1.018	96.930						
18	.198	.859	97.789						
19	.150	.652	98.441						
20	.115	.502	98.943						
21	.100	.435	99.378						
22	.084	.365	99.743						
23	.059	.257	100.000						

Extraction Method: Principal Component Analysis.

The PCA analysis resulted in the extraction of twenty-three components reflecting the same amount of inputted variables as the eigenvalues showed the variances of the principal components.

The variables were standardized, meaning that each variable had variance of 1 and the sum of total variance was equal to the number of variables, 23. The Scree Plot of the factor analysis, displayed in figure 1.1 is a two-dimensional plotted graph with factors on the horizontal axis and eigenvalues on the y-axis further indicating of how many factors were generated.

Figure 1.1 Scree Plot



A clear point of inflexion, or elbow, can be observed in the scree plot from the first component to the sixth component. Visually, it can be assumed that there are six factors to be retained from the analysis. Another means of determining the number of factors is analyzing the factor loadings, the loadings of each variable onto each factor. Table 1.2 shows the Component Matrix of the corrected factor loadings.

Rotation

The principle components were factored utilizing orthogonal rotations. Two stages of Factor analyses were conducted on the ARS, factor extraction, and factor rotation. The first stage, factor extraction was conducted to determine the number of underlying factors in the ARS. Initially, eight factors were extracted with eigenvalues greater than one (see Table 4). Inspection of the equivalences and scree plot suggested a six-factor solution (Tabachnick & Fidell, 1996).

Due to the low component loading scores on component 2 and subsequent components, a second PCA was conducted which resulted in the retention of six components and 23 items. A six-component structure with varimax rotation was forced to reflect this design in the examination of the component loadings of the items (Table 1.2). All 23 items had component loadings of ≥ 0.40 in the resulting component pattern as loadings below the threshold of 0.4 were considered to too low and discarded. After varimax rotation the first component accounted for 37.3% of the total variance, the second components accounted for 8.6 of the variance explained and the other components accounted for much less of the total variance. These results indicate that the first component structure offers the best fit for the scale in the current form accounting for the strongest variance in retention factors among this sample (Hatcher, 1994).

Table 1.2Rotated Component Matrix

	Component					
	1	2	3	4	5	6
I have a deep sharing relationship with a number of friends.	.572	.483	-.167	.212	.236	. 321
My friends are good at helping me solve problems.	.630	-.183	.476		.301	
I can count on my class peers for support.	.661.	.288		.198		. 402
I feel valued and appreciated by others	.603.			230	.449	.217
The university seems like a warm and caring place to me	.461		.103	.155	.648	.221
Class sizes here at the university are conducive for learning.	635	.427	.197		242.	
There are lots of opportunities to get involved in sports, clubs, and other school activities outside of the classroom.	.605	.309	.611	.488	.187	
My teacher's notices when I am doing a good job or failing behind and let me know about it.	.504		.338	.386		.365
Teachers who urge me to develop and achieve	.785				.310	.212
Faculty have been available to help me make course choices.	.885				.100	
Faculty provides practical suggestions for improving my academic performance.	.691	.187	.403	.188		.309
My primary caregivers are able to help me to resolve school related challenges.	.899			.238		
I have somebody that provides ongoing support about the work I do in my classes.	.553	.138	.137	.615	.196	.158
I have somebody that helps me carefully examine my degree options.	.796	.174	.157	.159	.330	
I care about my education	.602	.565	.599			
I know how to deal with upsetting problems	-.173	.255		.286	.403	.393
I am confident this is the right university for me	.658		.135		.395	.159
I am fitting well in this university now	.595	.144	.186		.355	.364
I feel accepted at this school	.742	.134	.162	.104		
This university will help me to improve my intellectual capacity.	.786	.228			.221	.110
I always do my readings before coming to class	.797	.210	.273			.137
I am satisfied with the extent of my intellectual development since enrolling in this university.	.775		.343	.151	-.182	.215
I am satisfied with my academic experience at this university	.753	.220	.293			.247

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Implications for Practice

It is paramount that universities develop and implement reliable measures and services that are specific to college student retention. Although, the Reliability testing of the ARS yielded a Cronbach's alpha of .918 (a = 0.918) demonstrating the items have a relatively high inter-item reliability it is still a tool that needs further testing of its validity and reliability. Repeated testing of the ARS should be conducted with larger andmore diverse sample populations. Participants of this study were mostly students enrolled in higher-level education, possibly limiting the generalizability of the facture structure. In addition, the scale was validated with a relatively small sample further validation of the scale should be conducted with a larger sample and a more wide-ranging, comprehensive, and representative sample population (Floyd & Widaman, 1995).Since psychometric testing is mostly reliant on self-reporting items, the determination of the number of factors and the interpretation of the factors are considerably subjective and highly dependent on the quality of data. Future studies should continue to ensure the generalizability of the scale through careful sampling scheme and item analysis. The generalizability aspect of a measure is the extent to which properties and interpretation of scores need to be generalized across populations, groups, settings and tasks (Cook & Campbell, 1979; Messick,1995; Shulman, 1970).

Results indicated support for the ARS as a valid and reliable instrument that could be applied in the identification of resources associated with retention and graduation of students in diverse settings. It is much more feasible to collect data from students that persist toward a degree versus those that dropped out. Thus, the ARS can be a suitable instrument to measure factors responsible for their academic achievement, retention and graduation.

References

Andrade, S.J, Stigall, S. Kappus, S.S., Ruddock, M. &Oburn, M. (2002).*A Model Retention Program for Science and Engineering Students: Contributions of the Institutional Research Office.*U.S.;Texas.

Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school throughcollege.*Washington,D.C.:U.S. Department of Education.(www.ed.gov/rschstat/research/pubs/toolboxrevisit/index.html)

Astin, A. W. (2005). Making sense out of degree completion rates.*Journal of College Student Retention, 7*(1-2), 5-17.

Bean, J. (2005). *Nine themes of college student retention.* In Alan Seidman (Ed.), Student Academic Services (pp. 215-243). Westport, CT: Praeger.

Braxton, J. M.(ed) (2000). *Reworking the Student Departure Puzzle*. Nashville, TN: VanderbiltUniversity Press

Cook, T. D. & Campbell, D. T. (1979). *Quasi-Experimentation: Design and analysis issues for fieldsettings.*Chicago: Rand McNally.

Cronbach, L. J., &Meehl, P. E. (1955). Construct validity in psychological tests.*Psychological Bulletin, 52,* 281-302.

De Carvalho, J. &Schumacker, R. (2012).Developmental Assets Model of High Risk Behaviors,

Thriving Behaviors and Juvenile Delinquency. *American International Journal of Contemporary Research, 4*(1-2), 6-11.

Daempfle, P. A. (2003). An analysis of the high attrition rates among first year college science, math, and engineering, majors. *Journal of College Student Retention*, *5*(1), 37-52.

DeVellis, R.F. (1991). *Scale Development: Theory and Applications*. London: Sage.

Duckworth, A. L., & Quinn, P. D. (2009). Development and validation of the short gritscale (Grit-S). *Journal of Personality Assessment, 91(2),* 166-174.

Floyd, F. J., &Widaman, K. F. (1995).Factor analysis in the development and refinement of clinical assessment instruments.*Psychological Assessment,* 7(3),286-299.

Hagedorn, L.S. (2004, April). *Speaking Community College.A glossary of appropriate terms*. Paper presented at the meeting of Council for the Study of Community Colleges (CSCC), Mineapolis, MN.

Gorsuch, R.L. (1983). *Factor Analysis* (2nd ed.). Hillsdale, NJ: Erlbaum.

Hatcher, L. (1994).*A Step-by-Step Approach to Using the SAS system for Factor Analysis and Structural Equation Modeling.* Cary, N.C.: SAS Institute, Inc.

McMahon, W. W. (2000). *Education and Development: Measuring the Social Benefits.* OxfordUniversity Press, London.

Messick, S. (1995).Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning.*American Psychologist,* 50, 741-749.

NationalCenter for Education Statistics (2014).The Integrated Postsecondary Education Data System (**IPEDS**). Retrieved May 1, 2016, from http://www.nces.ed.gov/ipeds/

Noel-Levitz (2004).Retention Savings Worksheet. Retrieved February 15, 2004 from http://www.noellevitz.com/pdfs/RetSvgsWkst.pdf

Nunnally, J. C. (1967). *Psychometric theory.*New York, NY: McGraw-Hill.

Pedhazur, E. &Pedhazur, L. (1991).*Measurement, Design and Analysis.* Lawrence EblaumAssocialtes, Publishers: Hillsdale, New Jersey.

Rubin, A. &Babbie, E. (2016).Empowerment Series: Research Methods for Social Work 9thEdition**.**Belmont, CA: Wadsworth/Thomson Press**.**

Schumacker, R. Lomax, R. (2004). *A Beginner's Guide to Structural Equation Modeling 2nd Ed.* Mahwah, NJ: Lawrence Erlbaum

Search Institute (2004). *Developmental assets: A profile of your youth.*Minneapolis, MN: Search Institute.

Seidman, A. (2005). *Where we go from here: A retention formula for student success*. In A.

Seidman (Ed.), College student retention: Formula for student success (pp. 295-316). Westport, CT: Praeger.
Seidman, A., & Tinto, V. (2005).*College student retention: Formula for student success*.Greenwood: Oryx.
Shulman, L. S. (1970). Reconstruction of educational research.*Review of EducationalResearch*, 40, 981-396.
Tabachnick, B.G., &Fidell, L.S. (1996) *Using Multivariate Statistics* (3rd Ed.) New York:
HarperCollinsCollege Publishers.
Tichenor, R. & Cosgrove, J. J. (1991). Evaluating Retention-Driven Marketing in a Community College: An Alternative Approach.*New Directions for Institutional Research*, *18*(2), 73-81.
Tinto, V.(1987).*LeavingCollege: Rethinking the Causes and Cures of Student Attrition.*Chicago: The University of Chicago Press.
U.S. Census Bureau (2014). Retrieved January 13, 2004 from http://www.census.gov

Appendix A

Academic Retention Scale

1. I have a deep sharing relationship with a number of friends.
2. My friends are good at helping me solve problems.
3. I can count on my class peers for support.
4. I feel valued and appreciated by others.
5. The university seems like a warm and caring place to me.
6. Class sizes here at the university are conducive for learning.
7. There are lots of opportunities to get involved in sports, clubs, and other school activities outside of the classroom.
8. My teacher's notices when I am doing a good job or failing behind and let me know about it.
9. My teachers urge me to develop and achieve.
10. Faculty has been available to help me make course choices.
11. Faculty provides practical suggestions for improving my academic performance.
12. My primary caregivers are able to help me to resolve school related challenges.
13. I have somebody that provides ongoing support about the work I do in my classes.
14. I have somebody that helps me carefully examine my degree options.
15. I care about my education.
16. I know how to deal with upsetting problems.
17. I am confident this is the right university for me.
18. I am fitting well in this university now.
19. I feel accepted at this school.
20. This university will help me to improve my intellectual capacity.
21. I always do my readings before coming to class.
22. I am satisfied with the extent of my intellectual development since enrolling in this university.
23. I am satisfied with my academic experience at this university.