Electronic Journal of Research in Educational Psychology
ejrep
EDUCATION & PSYCHOLOGY I+D+i
Ilustre Colegio Oficial de Psicología de Andalucía Oriental

Computerized Assessment System for Academic Satisfaction (ASAS) for first-year University Student.

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Abstract

Introduction. Computerized tests have become one of the most widely used and efficient educational assessment methods. Increasing efforts to generate computerized assessment systems to identify students at risk for drop out have been recently noted. An important variable influencing student retention is academic satisfaction. Accordingly, the present study aims to develop a Computerized Assessment System for Academic Satisfaction (ASAS).

Method. The ASAS evaluates different social-cognitive variables posited by a social cognitive model of academic satisfaction, including academic self-efficacy, outcome expectations, academic goal progress and academic satisfaction. We describe the computerization process of the ASAS based on guidelines proposed by the International Test Commission (ITC). Moreover, evidence of internal structure and internal consistency are provided (N=377).

Result. Overall the results were satisfactory and no difficulties or limitations that may hinder the future development of the system were observed. The computerization process of the ASAS was completed according to technology standards, quality control and safety as proposed by the ITC. The internal structure of all scales presented a theoretically interpretable structure similar to that reported in the original papers.

Discussion and Conclusion. New studies should be developed to provide further validity evidence. ASAS proved to be an adequate assessment system for predicting academic satisfaction and useful for the prevention of early drop out in first-year students.

Keywords: Academic Satisfaction; Computerized Assessment, Factor Analysis, Internal Consistency.

Received: 05/02/14 *Initial acceptance: 06/08/14* *Final acceptance: 08/02/14*

Sistema de Evaluación Informatizado de la Satisfacción Académica para Estudiantes Universitarios de Primer Año

Resumen

Introducción. Los test informatizados se han transformado en uno de los métodos de evaluación educativa de mayor uso y eficiencia. En el ámbito de la evaluación psicoeducativa, cabe destacar los esfuerzos para generar sistemas de evaluación informatizados que permitan identificar alumnos en riesgo de abandonar sus estudios. Atendiendo a la importancia de la satisfacción académica en la permanencia académica, el presente trabajo tuvo por objetivo desarrollar un Sistema de Evaluación Informatizado de la Satisfacción Académica (SESA).

Metodología. El SESA evalúa diferentes variables implicadas en el modelo social cognitivo de satisfacción académica, tales como autoeficacia académica, expectativas de resultados, progreso en metas académicas y satisfacción académica. Se describe el proceso de informatización del SESA atendiendo a las directrices propuestas por la Comisión Internacional de Test y resultados psicométricos sobre la estructura factorial y consistencia interna del mismo (N=377).

Resultados. En términos generales los resultados obtenidos fueron satisfactorios y no se observaron dificultades o limitaciones que pudieran obstaculizar el futuro desarrollo del sistema. En relación al proceso de informatización del SESA-U se cumplimentaron de manera adecuada los estándares de tecnología, calidad, control y seguridad propuestos por la ITC. La estructura interna de todas las escalas fue teóricamente interpretable y semejante a la reportada en los trabajos originales.

Discusión y Conclusiones. Restan por desarrollar nuevos estudios tendientes a aportar mayores evidencias de validez. El SESA-U constituye un sistema adecuado para detectar de manera temprana estudiantes de primer año en riesgo de abandonar sus estudios.

Palabras Clave: Satisfacción Académica; Evaluación Informatizada; Análisis Factorial; Consistencia Interna.

Recibido: 02/05/14 *Aceptación inicial: 08/06/14* *Aceptación final: 02/08/14*

Introduction

The beginning of university studies is a transition period characterized by taking on new roles and challenges; it can lead to future psychosocial dysfunctions if these are not properly addressed. In fact, students' adaptation to new academic standards will determine their performance and behavior (von Suchodoletz, Trommsdorff, Heikamp, Wieber & Gollwitzer, 2009). Bandura (2006) proposed that during this educational transition, academic and social demands increase, which can lead to a decrease in motivation, lack of personal control, and lack of trust, factors that increase risk for drop out or low academic performance (Beidel & Turner, 2007; Inglés, 2007).

University dropout is an important problem with a high social cost. Therefore, many investigations in recent years have sought to assess the risk for drop out and for low academic performance of university entrants, as well as to identify factors that contribute to psychological well-being and academic adjustment in this population (Lent, 2004; Medrano, Galleano, Galera, & Valle Fernandez, 2010; Vecchio, Gerbino, Pastorrelli, Del Bove & Caprara, 2007). The study of university entrants' academic satisfaction has become particularly relevant at this time. In fact, academic satisfaction proved to be a mediating variable in social and academic integration, influencing the student's adaptation and consequently determining permanence at the university (Fernandes Sisto et al., 2008).

Despite the construct's importance, there are no effective systems in our geography that assess variables associated with academic distress. Considering the large number of students beginning their studies each year, it would be useful to have a computerized screening (Muñiz & Hamblenton, 1999) that produces automated preparation of diagnostic reports and early detection of university entrants at risk. Therefore, the main aim of this work is to develop and validate a Computerized Assessment System for Academic Satisfaction (ASAS) for first-year university students.

 Electronic Journal of Research in Educational Psychology, *12*(2), 541-562. ISSN: 1696-2095. 2014, no. 33
http://dx.doi.org/10.14204/ejrep.33.13131

Explanatory Model of Academic Satisfaction

Despite Lent's efforts to formulate a unified satisfaction theory (Lent, 2004), definitions suggested in the empirical research are not entirely precise and in many cases depend on the instrument used to measure this construct. Nevertheless, general agreement is observed in considering perceived satisfaction as a cognitive component of psychological well-being that arises from people's comparison of their achievements and their aspirations (Diener, 1994). Such satisfaction judgments can be made considering one's life as a whole (life satisfaction) or specific domains such as work, family or career (Suldo, Riley & Shaffer, 2006).

Academic satisfaction can be seen as an antecedent or component of general life satisfaction (Lounsbury et al, 2004). According to Lent and Brown (2008), it involves the well-being and enjoyment that students perceive in their experiences within the academic role. It is also negatively related to delays in starting one's degree, academic failure, stress during educational transition and dysfunctional behaviors during the academic course (Lounsbury et al, 2003). Moreover, it is observed that academic satisfaction is positively related to academic adjustment (Lent, Taveira, Sheu & Single, 2009), social integration (Suldo, Riley & Shaffer, 2008), persistence in studies (Fernandes Sisto et al., 2008), academic success (Suldo et al, 2006) and general life satisfaction (Lounsbury et al, 2004).

In recent years many studies have tried to explain the relationships, causes and consequences of academic satisfaction. With this aim Lent et al (2007) had taken constructs derived from Social Cognitive Career Theory (SCCT) to propose a descriptive model of academic satisfaction comprising self-efficacy beliefs, outcome expectations, progress in goals, and academic and social support perceived by students.

Thus, the explanatory capacity of goals, self-efficacy beliefs, and social support as direct predictors of academic satisfaction was proven by path analysis (Figure 1). Thus, students who report high levels of academic satisfaction perceive that they are making good progress in their academic goals, have strong beliefs about their ability to get good performance on assigned tasks, have positive expectations about the consequences of being a university student and eventually gain adequate social support to achieve their educational goals (Lent et al, 2007).

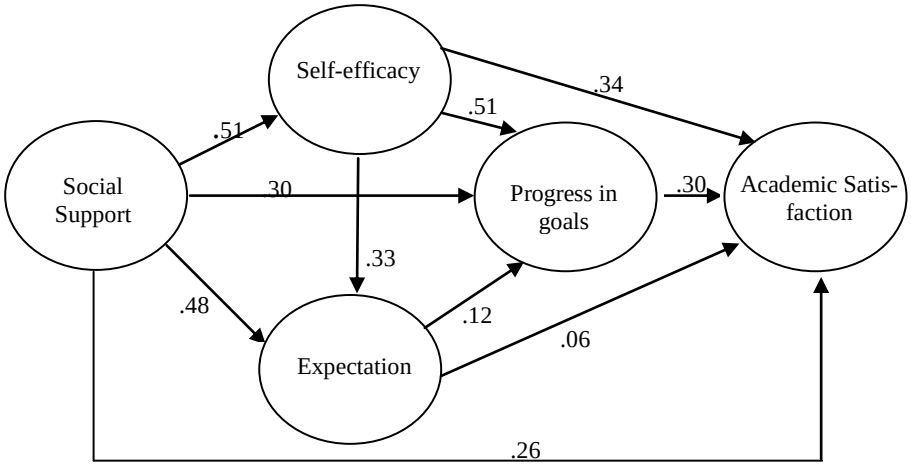

Figure 1. **Social Cognitive Model of Academic Satisfaction (Lent et al, 2007).**

The model also verifies that self-efficacy beliefs, outcome expectations and perceived academic social support indirectly influence academic satisfaction through perception of progress toward goals. In turn, academic social support is a source of self-efficacy and outcome expectations, which are also influenced by self-efficacy beliefs. The results show that the model has an excellent fit (CFI = .96, RMSEA = .06) and a significant explanatory value for academic satisfaction (R^2 = 68%). As observed in previous research, the only variable that did not show a significant influence on satisfaction was outcome expectations. However, the authors suggest that the instrument used may not adequately represent the students' expectations.

Computerized Assessment Systems

In the last 30 years, strong growth in the use of technology has been observed, with substantial breakthroughs in versatility and availability of computerized applications in several areas of psychology. The rapid evolution of computer technology has played a critical role in the development of instruments for psychological assessment (Zenisky & Sireci, 2002). This impact becomes especially evident in the expansion of computerized tests, which provide a wide range of innovations in the way items are presented, in estimating test scores and in reporting results (Leeson, 2006).

Computerized tests became the most recommended method in structured situations of psychological measurement, ensuring greater accuracy in scoring and providing immediate

feedback to those examined through graphic presentations or printed reports (Burke & Normand, 1987). Computerized assessment systems have a significant presence in the workplace (Woicik, Stewart, Pihl & Conrod, 2009), health care (Thornton III & Gibbons, 2009), and clinical and neuropsychological areas (Butcher, Perry & Hahn, 2004). However, the use of computer systems has been particularly influential in education (Marks & Burden, 2005).

Current work in computerized educational assessment includes efforts to build evaluation systems for early, efficient identification of students at risk for drop out. In this line of work there are many studies from different researchers such as Reid (1996), for early detection of dyslexia cases; Lindsay (2004), for early recognition of students with learning difficulties and studies; Crombie, Knight and Reid (2004) created computerized screening system to assess basic literacy skills, and so on. Thus, a considerable number of projects have been developed for screening special needs that require more careful monitoring of a student's educational progress. It is this type of computerized assessment that we suggest would be particularly useful with university entrants.

Considering the importance of academic satisfaction in predicting social adjustment, academic performance, permanence in one's degree and psychological well-being, (Lent et al, 2007), it would be helpful to have an assessment system to predict academic satisfaction in university entrants. Moreover, considering the large number of students who begin their studies each year, this evaluation system should be computerized as it would generate diagnostic reports automatically, automate the scoring process and profiling, ensure accuracy and objectivity of the measurements, eliminate mistakes in scoring and processes, allowing rapid administration of large groups of people (Butcher, Perry & Atlis, 2000; Muñiz & Hamblenton, 1999).

Method

Participants

Participants were 377 university entrants of public and private universities from Córdoba, Argentina. In order to work with a representative sample, degrees from different disciplines were included.

The sample was mostly composed of women (65.8%) and students younger than 23 years old (mean = 21.92, standard deviation = 5.95). Note that the sample size meets requirements for univariate and planned multivariate statistical methods (Tabachnick & Fidell, 2001).

Measures

Social Academic Support Scale (Lent et al., 2007). This instrument has nine items to assess to what extent the social context of students helps them in achieving their academic goals (e.g. "My friends encourage me to continue with my studies"). Participants must indicate their level of agreement with each statement on a five-point scale (from “strongly disagree” to “strongly agree”). Psychometric studies reported by Lent et al. (2007) indicate satisfactory internal consistency (α = .84) and a one-dimensional structure.

Social Academic Self-Efficacy Scale (Medrano & Olaz, 2008). This local self-report instrument has been studied with the Cordoba university population. It assesses students’ beliefs about their interpersonal skills. The Social Academic Self-Efficacy Scale is composed of seven items (e.g. "ask the teach a question out loud and in front of your peers") and has acceptable internal consistency (α = .84). Moreover, previous studies have demonstrated its predictive ability in relation to academic performance in university entrants (r = .21, p<0 .00; Medrano & Olaz, 2008).

Learning Self-Efficacy Scale (SELF-A; Zimmerman & Kitsantas, 2005*).* This scale is a self-report instrument with ten items that assess students’ perceived ability to engage in learning processes such as planning, organization and recall (e.g. "When you are struggling to remember details of a concept, can you find ways to relate the information in order to remember it?”). The SELF (Zimmerman & Kitsantas, 2005) presented a value α = .96, and showed predictive ability for academic performance (r = .68, p<0.00).

Academic Achievement Self-Efficacy Scale (Medrano, 2009). This scale measures students’ beliefs about their ability to pass and get good grades. It has six items measuring beliefs that students have about their ability to pass a subject and get a final average over 4, 5, 6, 7, 8 and 9, using a scale of 10 positions (from 1 "I can’t do it", to 10 "I'm sure I can do it "). Studies performed (Medrano, 2009) indicate that the inventory has a one-dimensional struc-

ture and optimal internal consistency (α = .94). In turn, test-criterion relationship studies showed prediction of academic performance (r =.42, p<0.01).

Outcome Expectations Scale (Lent et al., 2007). Ten items measure students' expectations or perceived consequences of attaining their university degree (e.g. "when I graduate I will get a well-paid job"). Participants must indicate their level of agreement using a ten-point Likert scale from 0 (strongly disagree) to 9 (strongly agree). The original psychometric studies indicate that this instrument has a one-dimensional structure and high internal consistency (α = .91) (Lent et al, 2007).

Academic Goals Progress Scale (Lent et al., 2007). This six-item instrument assesses students' perceived progress toward their academic goals. Students have to indicate on a five-point scale how they have met each academic goal according to different items (e.g. "study effectively for exams"). The rate of progress varies from "have not progressed at all" (value 1) to "have made excellent progress" (value 5). Psychometric studies by Lent et al. (2007) indicated a one-dimensional structure and adequate internal consistency (α = .81)

Academic Satisfaction Scale (Lent et al., 2007). This scale consists of seven items that examine the well-being and enjoyment that students perceive from their conduct related to their role as students (e.g. "I enjoy my classes most of the time"). Examinees use a ten-point scale to indicate their level of agreement with each statement. The original psychometric studies suggest that the scale has a one-dimensional factor structure and high internal consistency (α = .94).

Procedure and Statistical Analysis

Development of the ASAS was carried out into three stages. First, the scales that would integrate the assessment system were translated and translation quality was evaluated by a panel of experts (Coffman, 2008). In order to analyze the judge's opinion of the translated items quality, the Aiken V coefficient was calculated. To estimate the V coefficient and its confidence intervals, the Soto and Segovia (2009) program was followed, thereby estimating the probability that V occurs in the population (probabilistic extensions offered by the program are 90%, 95% and 99%). Taking into consideration the recommendations of Soto and Segovia (2009), the criterion of the intervals obtained was established as equal to or greater

than .70, and a confidence level of 90%, as is suggested when the number of judges is low (Penfield & Giacobbi, 2004).

The second phase involved the computerization of the scales that would be part of the ASAS. ITC technology standards, quality, control and safety were fulfilled (2005). Finally, to evaluate the psychometric properties of the computerized versions of each ASAS subscale, an initial exploratory data analysis was conducted in order to assess the assumptions required by the planned statistical techniques. Following that, internal structure studies were performed using exploratory factor analysis (EFA). Internal consistency was examined using Cronbach's alpha (α) statistic.

Results

Study N. 1: Translation of ASAS scales

Thescales that existed only in English (Outcome Expectations Scale, Academic Goals Progress Scale and Academic Satisfaction Scale) were translated to Spanish. Subsequently, a group of judges evaluated the translation quality.

As literal translation of the items can affect the operation and thereby introduce a bias in the measurement of constructs, the translations were made using the conceptual, semantic and functional equivalency of the reactants, rather than literal equivalence (Herdman, FoxRushby & Badia, 1997; Mimura & Griffiths, 2008). It is noteworthy that some of the translations did not use the same words as the original items, in order to ensure correspondence with the measured construct, keep the same meaning, whether connotative or denotative, so that actions involved in the reactants have similar goals and difficulties in both cultures.

As the literature suggests, a revision of translations was performed by a panel of experts (Coffman, 2008). This type of study provides valuable information on potential applicability to the population, translation adequacy and equivalence of translated items. Three bilingual experts were asked to review the quality of translations. They were provided with a protocol that had both the original items in English and their translations. Judges were requested to indicate the quality of translation using a scale of response ranging from "1" (low quality)

to "5" (high quality), considering the criteria of conceptual, semantic and functional equivalence of each reagent. As well, judges were invited to make suggestions for improving the translated items. In order to analyze the judge's opinion of the translation quality, the Aiken V coefficient was calculated.

Of the 37 reactives translated, 12 received values below .70 in the lower range. These reagents were modified according to judges' suggestions, which focused mainly on using language that was more familiar to the target population (e.g. "have respect from other people" was changed to "be respected by others,"). Other modifications were made to improve syntactic aspects or to optimize the semantic equivalence of the items. After making the revisions suggested by the judges, the questionnaire computerization process began.

Study N. 2: Computerization of the ASAS

To carry out the computerization process of the scales, International Test Commission guidelines (International Test Commission, ITC, 2005) regarding the use of computerized testing were followed. Specifically considered: 1) a minimum of technical aspects required for examinees to respond to the system, 2) ensuring that the system works properly and programming is error free throughout the evaluation process, 3) verify the examinees authenticity and their previous practice, and finally, 4) protect both test materials and the assessed data.

ASAS was designed to be an evaluation system that can be easily incorporated into the technology most commonly used by students and university entrants (it can be used from any operating system and the hardware requirements are minimal).

In order to reduce the chance of system failures during assessment and to provide appropriate assistance if the examinee so requires, the ASAS was equipped with help messages that guide examinees in appropriate system use. Either error or success messages appear, depending on the user's appropriate or inappropriate use.

Considering that limited experience with computer use can affect the performance of examinees on computerized instruments (Olea & Hontangas, 1999), a training module was introduced in the ASAS, providing pictures and videos to describe the instructions step by step.

Finally, security measures were implemented to protect the collected data and prevent illegal access to the system. Thus, users must register and create a personal password, preventing others from accessing their private information. In addition, the administrators of ASAS can decide to enable the questionnaires for a predetermined time to prevent any questionnaire from being available on the Internet indefinitely.

Study N. 3: Analysis of Internal Structure and Internal Consistency

An exploratory analysis of initial data was conducted in order to understand the behavior of the variables, evaluate the quality of the data and verify compliance with assumptions required by the statistical procedures (Tukey, 1977). As suggested by Arias Martinez (1999), univariate and multivariate outliers that may affect the analysis were detected. 30 univariate outliers and 14 multivariate outliers were identified. A factor analysis with and without outliers was performed, following by the Pearson correlation coefficient from rotated matrix saturation in order to examine convergence of factor solutions (Rivas Moya, 1999). The results suggested high congruence or similarity between the factor solutions (values greater than .90), therefore we chose to retain the outliers.

All items showed close to normal distribution considering the criteria proposed by George and Mallery (2010) of skewness and kurtosis values within ± 2. Furthermore, Mardia rates below the critical value of 70 were observed when assessing multivariate normality as suggested by Rodríguez Ayán and Ruiz (2008). According to this, we concluded that the non-normality is not a critical element with respect to the results of the factorial analysis.

To evaluate the feasibility of the AFE, the Kaiser-Meyer-Olkin sampling adequacy index and Bartlett's sphericity test were considered; both methods suggested the existence of an acceptable intercorrelation for the AFE considering the criteria suggested by George and Mallery (2010). The Maximum Likelihood extraction method was performed because it best reproduces the population values when the data has normal, multivariate distribution and the statistical significance of the extracted factors can be calculated (Martinez Arias, 1999).

Different criteria were considered in order to determine the number of factors to be extracted, such as the proportion of variance explained, the interpretation of the scree plot and

 Electronic Journal of Research in Educational Psychology, *12*(2), 541-562. ISSN: 1696-2095. 2014, no. 33
http://dx.doi.org/10.14204/ejrep.33.13131

the results obtained by using parallel factor analysis software (Watkins, 2008). To interpret the extracted factors, an oblique promax rotation was performed (kappa = 4), as factors showed moderate correlation with each other (*r* values greater than .30). The rotated factor structure of all scales comprising the ASAS is shown in Table 1.

Table 1. **Factor Structure (configuration matrix)**

Academic Support	
Item 1	.67
Item 4	.74
Item 2	.72
Item 6	.79
Item 9	.69
Social Academic Support	
Item 7	.83
Item 8	.79
Item 5	.67
Item 3	.52
Extrinsic Outcome Expectations	
Item 1	.80
Item 2	.98
Item 3	.44
Intrinsic Outcome Expectations	
Item 4	.78
Item 5	.45
Item 7	.60
Item 9	.74
Social Academic Self-Efficacy	
Item 1	.88
Item 2	.84
Item 3	.78
Item 4	.90
Item 5	.79
Item 6	.80
Learning Self-Efficacy	
Item 1	.71
Item 2	.77
Item 3	.71
Item 4	.39
Item 5	.49
Item 6	.61

Item 7	.80		
Item 8	.78		
Item 9	.52		
Item 10	.52		
Academic Achievement Self-Efficacy			
Item 1		.78	
Item 2		.89	
Item 3		.94	
Item 4		.86	
Item 5		.73	
Item 6		.57	
Progress toward Academic Goals			
Item 1			.66
Item 2			.76
Item 3			.79
Item 4			.65
Item 5			.77
Item 6			.83
Item7			.68
Academic Satisfaction			
Item1			.57
Item 2			.73
Item 3			.76
Item 4			.56
Item 5			.61
Item 6			.76
Item 7			.74

Cronbach's α was calculated in order to assess the internal consistency of the ASAS scales and confidence intervals using the same program on the Vista version 7.9.2.5. As Ledesma (2004) notes, in order to estimate confidence intervals, the α coefficient (as the reliability of a test) is not an absolute invariant property through samples, as any statistical estimate is affected by sampling error. Considering this, the α value for each factor and their respective intervals for a confidence level of 95% were calculated (Table 2).

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Table 2. **Internal Consistency (confidence level of 95%)**

Escale	Coefficient (α)	Lower Range	Upper Range
Academic Support	.77	.73	.80
Social Academic Support	.68	.62	.73
Extrinsic Outcome Expectations	.78	.74	.82
Intrinsic Outcome Expectations	.72	.67	.77
Social Academic Self-Efficacy	.91	.87	.93
Learning Self-Efficacy	.85	.82	.87
Academic Achievement Self-Efficacy	.90	.88	.91
Progress toward Academic Goals	.89	.87	.91
Academic Satisfaction	.85	.82	.89

Discussion

The main purpose of this work was to develop a computerized system for assessing academic satisfaction. This system will allow early identification of university freshmen who may be at risk of having low levels of academic satisfaction. Furthermore, it makes possible rapid administration to a large group of individuals in a more automatic, economical and efficient fashion than using traditional administration methods of pen and paper (Butcher, Perry & Atlis, 2000; Muñiz & Hamblenton, 1999).

The ASAS is composed of different scales that assess diverse variables involved in social cognitive model of academic satisfaction developed by Lent (et al, 2007). Thus, the ASAS would measure university entrants' perceived academic social support, academic self-efficacy beliefs, outcome expectations, progress toward academic goals and finally academic satisfaction.

Overall the results were satisfactory and no difficulties or limitations that may hinder the future development of the system were observed. Regarding translation studies and equivalences, most of the coefficients obtained from the Aiken V analysis of judges were higher than .70, which denotes a high agreement that the translation was semantically and functionally adequate and that there was conceptual equivalency. The items that fell below the critical value were modified according to observations made by the judges.

Regarding the ASAS computerization process, it was completed according to technology, quality control and safety standards proposed by the ITC (2005). Psychometric studies of computerized versions of the scales that make up the ASAS were satisfactory overall. The internal structure of all scales presented a theoretically interpretable structure similar to that reported in the original papers. Just as the scales of Social Support and Academic Outcome Expectations showed variations in relation to the original study (Lent, et al., 2007), exploratory factor analysis suggests the existence of two underlying factors rather than a single-factor structure. However, the new factors identified have an important conceptual value and gives greater precision in measurement of the above constructs. In addition, the academic social support scale assessed two related dimensions of this variable, the students' perception of support coming from their teachers or tutors, and the perceived "academic support" and "social academic support" from family, parents or peers. While both dimensions assess perceived support for achieving academic goals, the first refers to academic authority figures and the second to close affective figures, not necessarily connected to the student's academic setting.

As for the outcome expectations scale, two clearly distinguishable theoretical dimensions were identified. A first factor evaluates "extrinsic outcome expectations", meaning external reinforcing consequences that students anticipate (such as money or respect from other people). The second factor evaluates the "intrinsic outcome expectations", which refers to consequences related to enjoyment and interest in the task (e.g. "have a job that gives me satisfaction"). As Lieury and Fenouillet (2006) indicate, extrinsic motivation would be governed by external reinforcements such as money and social approval, while the intrinsic goal would represent higher interest in the activity itself. It should be noted, finally, that recent studies (Imberti & Medrano, 2011) indicate that only the intrinsic expectations correlate significantly with academic satisfaction (r = .53, p 0.00). This partially explains why the background studies report that performance expectations are not a good predictor of academic satisfaction (Lent et al., 2007); since they do not separate these two dimensions, the measurements are seen contaminated and cannot satisfactorily evaluate the relation between outcome expectations and academic satisfaction.

New studies remain to be developed to provide further validity evidence. More specifically, it will be necessary to develop a future appraisal of the social cognitive model of aca-

demic satisfaction (Figure 1), which would provide evidence of external validity for the ASAS.

Once the fit and predictive value of the social cognitive model of academic satisfaction was verified, a final ASAS module is to be designed that will produce automated reports for users. Thus, as soon as the entrants provide their answers, the ASAS will produce a "diagnostic report" automatically. Such reports significantly reduce the time that professionals spend to correct and analyze responses, ensuring a considerable reduction in mistakes that are typical of this process (Olea & Hontangas, 1999). Furthermore, having a system to develop automated reports enables immediate feedback from the user's results.

Realization of such studies would meet the psychometric requirements of international standards for valid, reliable use of the ASAS. We would then have an adequate computer system for predicting academic satisfaction and useful for early detection of entrants at risk of dropping out or having inadequate psychosocial adjustment. Also, having a model of academic satisfaction validated forthe local population would facilitate the development of research and design intervention programs to improve students' quality of life, restore their welfare and strengthen potential factors that promote positive functioning of university entrants.

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