Learning and Individual Differences 56 (2017) 34–48

Contents lists available at ScienceDirect

Learning and Individual Differences

journal homepage: www.elsevier.com/locate/lindif

Program-specific prediction of academic achievement on the basis of cognitive and non-cognitive factors

Lot Fonteyne*, Wouter Duyck, Filip De Fruyt

Ghent University, Faculty of Psychology and Educational Sciences, Henri Dunantlaan 2, 9000 Ghent, Belgium

ARTICLE INFO

Keywords:
Educational program choice
Differential predictive validity
Program specific prediction
Higher education academic achievement
Non-cognitive assessment

ABSTRACT

Choosing a suitable study program is one of the factors that facilitates academic achievement and thus prevents drop-out in the first year of tertiary education. This requires adequate information on both the individual abilities and the environment during the study choice process. The SIMON (Study Skills and Interest MONitor) project of Ghent University, Belgium, provides this information to prospective students through an online tool that informs them a) on the match between their interests and study programs and b) about their personal chances of success in specific study programs. The current study intends to validate the prediction of program-specific chances of success by examining a) the (incremental) predictive validity of cognitive and non-cognitive variables of conscientiousness, motivation, self-efficacy, metacognition and test anxiety and b) the differential predictive power of variables within and across study programs. In addition, a path model with structural relations between variables was tested. The sample consisted of 2391 new incoming students.

Results supported the incremental validity of non-cognitive factors. Achievement could be predicted by cognitive and background factors and by conscientiousness, self-efficacy and test anxiety. Moreover, the predictive power of variables varied across study programs, which suggests that research findings about the prediction of academic achievement might benefit from taking into account the specific program context.

Practical implications for research and (educational program choice) counselling of students are discussed.

1. Introduction

1.1. Study context: flanders and the SIMON project

Drop-out rates in higher education are high. The Organization for Economic Co-operation and Development reported that 32% of incoming tertiary students do not graduate from a program at this level (OECD, 2008). Vocational choice, and more specifically choice of program of study or major, is certainly an important topic in this matter. According to person-environment fit theories, choosing an educational program that fits the individual is one of the factors that facilitates academic success and can thus prevent drop-out in the first year of tertiary education. For example, the Minnesota Theory of Work Adjustment posits that a person's achievement and satisfaction is predicted from the correspondence between the abilities of the person and the ability requirements of the environment (Dawis, 2005). In order to make an optimal study choice, adolescents should identify their values and abilities, as well as the educational possibilities that correspond with these values and abilities (Swanson & Schneider, 2013). This requires adequate information on both the individual and the environment during the study choice process. When potential students are able to assess their personal abilities and their fit with educational programs, this may increase student retention (McGrath et al., 2014). Moreover, providing an instrument that assesses these factors may increase social equality in higher education as it are often socially vulnerable groups that lack the information to make a realistic educational program choice or to enroll in tertiary education (Müller, 2014; OECD, 2003).

Although universally relevant, such an assessment tool is especially valuable in the current study context, Flanders, which is the northern region of Belgium. Flanders has a public education system where access to higher education is almost unconstrained. The majority of higher education systems across the world use some form of examination (e.g., the Scholastic Aptitude Test in the US) or rely on a minimal secondary education academic performance in the admission process. In Flanders, however, admission restrictions virtually don't exist. Any student with a secondary education qualification can enter almost any higher education institution and field of study. With the exception of medicine, dentistry and performing arts programs, there are no selection exams, there are no entrance quota and secondary education Grade Point

* Corresponding author.
E-mail addresses: Lot.Fonteyne@UGent.be (L. Fonteyne), Wouter.Duyck@UGent.be (W. Duyck), Filip.DeFruyt@UGent.be (F. De Fruyt).

http://dx.doi.org/10.1016/j.lindif.2017.05.003
Received 12 September 2016; Received in revised form 22 April 2017; Accepted 1 May 2017

Average (GPA) is never considered for admission. On top of that, tuition fees are extremely low (below $1000 per year). This system is assumed to foster social mobility and to improve participation of economically disadvantaged groups in higher education, but the open entrance implies de facto that the first year of university is typically a "selection year". Less than 40% of university students pass all courses during the first year of studying (even after repeated examination attempts). This is alarming, especially because first year performance is one of the best predictors of academic retention (de Koning, Loyens, Rikers, Smeets, & van der Molen, 2012; Murtaugh, Burns, & Schuster, 1999).

In addition to open access, students must enroll in a specific study program and select a major already at the start of higher education. Therefore, in the current paper the term 'study program' refers to both the choice of program of study and of the specific major. Switching programs usually requires students to restart as a freshman. Taken together, the study options are numerous and (financial and motivational) consequences of selecting an inappropriate program are high. This context makes the study orientation process even more important and the provision of adequate information on the match between a prospective student and a specific study program even more crucial.

In response to these challenges, Ghent University started the SIMON-project (Study skills and Interest MONitor), developing a freely available online assessment tool by which students can assess their interests (SIMON-I, Fonteyne, Wille, Duyck, & De Fruyt, 2016) and competencies (SIMON-C). As admission is free by law, SIMON is not an admission tool, but it is designed to provide prospective students (*before* enrollment) with relevant information on the match between their interests/competencies and study programs and on program-specific chances of success in tertiary education. The assumption is that adequate and personalized information will help students to make better higher education study choices. As stated by McGrath et al. (2014), this can be achieved by introducing non-selective entry tests and strengthening pre-university orientation, which is exactly the objective of the SIMON-project.

The focus in the current study is on the evaluation of competencies with regards to specific study programs (SIMON-C). As such, its purpose is to identify whether prospective students have low chances of success in specific study programs, based on historic data of students with comparable abilities. In contrast with high-stake admission tests, SIMON-C's discriminatory power lies at the lower end of the ability range: its aim is to identify a small group of students that has a very low probability of passing. This is also in accordance with the open access policy: only potential students who almost certainly lack the very basic abilities to succeed (should) get a clear warning, yet, students who may be vulnerable but who might still be able to pass get the benefit of doubt and are not be discouraged. In short, SIMON-C targets to predict tertiary academic achievement (and especially failure) relying on the student's skills and abilities. Assessment of skills and abilities in SIMON-C was based on the vast amount of studies pertaining to the prediction of academic success and retention.

1.2. What factors predict academic achievement?

1.2.1. Cognitive factors

The use of cognitive ability to predict academic success has a long standing tradition. In fact, the first broad test of cognitive ability (the Binet-Simon scale in 1905) was specifically designed to predict achievement in an educational context. Since then, cognitive ability, or g (a construct related to fluid intelligence) has been consistently found to predict academic achievement (Ackerman & Heggestad, 1997; Busato, Prins, Elshout, & Hamaker, 2000; Farsides & Woodfield, 2003; Kuncel, Hezlett, & Ones, 2004). As the importance of cognitive ability for academic achievement has been well documented, a detailed overview is beyond the scope of this study. It suffices to say that many authors argue that cognitive ability is (one of) the strongest predictor(s) of academic performance (Kuncel & Hezlett, 2010; Petrides, Chamorro-Premuzic, Frederickson, & Furnham, 2005), with correlations with GPA ranging from 0.30 to 0.70 (Roth et al., 2015). As a result, it is mainly cognitive ability that is tested for admission decisions in countries with restricted access to higher education. Most of these tests assess a combination of verbal and quantitative skills (Sedlacek, 2011).

In many predictive studies of academic achievement, previous academic achievement (often high-school GPA) is also taken into account. However, high-school GPA has the great disadvantage that it is not comparable across high schools (and even teachers). Moreover, studies indicate that grades have become a less useful indicator of student success, mainly because of "grade inflation" (Sedlacek, 2011). Therefore, in the current study we included hours of mathematics instruction in secondary education as a background factor, as previous data and research have shown that this is a relevant predictor in the current study context (Fonteyne et al., 2015). Note that Flanders does not have a common, standardized exam (like the SAT) at the end of secondary education.

1.2.2. Non-cognitive factors

Although cognitive factors are highly relevant in the prediction of academic achievement, correlations between ability measures and academic performance are lower at more advanced levels of education (Boekaerts, 1995), which is generally explained by range restriction effects (e.g., Furnham & Chamorro-Premuzic, 2004; Richardson, Abraham, & Bond, 2012; Sternberg, Grigorenko, & Bundy, 2001). Also, some students fail in spite of high cognitive ability and some students compensate a lack of cognitive or test-taking ability by showing greater motivation or effective study strategies (Komarraju, Ramsey, & Rinella, 2013). Therefore, assessment of other factors is also valuable.

Allen, Robbins, and Sawyer (2009, p.2) define non-cognitive factors as "nontraditional predictors that represent behavioral, attitudinal, and personality constructs, primarily derived from psychological theories". 'Non-cognitive' refers to a variety of constructs. As a result, several classifications have been proposed. De Raad and Schouwenburg (1996) noted that Messick (1979) provided an encompassing list of potential non-cognitive factors, which included background factors, attitudes, interests, temperament, coping strategies, cognitive styles, and values. Lipnevich and Roberts (2012) proposed a taxonomy of four categories: attitudes and beliefs (self-efficacy), social and emotional qualities, learning processes and personality. Sedlacek (2010) mentioned, apart from others, positive self-concept, realistic self-appraisal and also the ability to handle racism. This shows that the classification of these constructs is not straightforward which prompts a selection of relevant predictors depending on the context.

Apart from cognitive factors, personality has been proposed as one of the main determinants of academic achievement arguing that cognitive factors would measure maximal performance (what can the student do?) whereas personality would account for typical performance (what will the student do?) (Chamorro-Premuzic, Furnham, & Ackerman, 2006). Indeed, many studies have shown that (Big Five) personality factors add incremental predictive validity for academic achievement over and above cognitive factors (see e.g., Poropat, 2009). Especially *Conscientiousness* has been raised as an important predictor for academic success (Conard, 2005; Noftle & Robins, 2007; Poropat, 2009; Trapmann, Hell, Hirn, & Schuler, 2007). Therefore, conscientiousness was included in the current study.

As for other non-cognitive constructs, we chose to include only factors for which predictive validity for academic achievement has been demonstrated over and above cognitive factors. This allowed to limit testing time and was in accordance with our aim to advise prospective students based on a scientifically valid tool. We turned to meta-analyses to identify such non-cognitive constructs as these summarize the results of multiple studies and therefore generate more robust estimates of reliable effect sizes. We came across two large meta-analyses that fit our purposes. They are both well cited and examined the effect of non-