

# **Assessing the relevance of academic competencies in college admission tests from a higher-order thinking perspective: a systematic review**

Juan F. Luesia<sup>1</sup>, Isabel Benítez<sup>2</sup>, Rosalba Company-Córdoba<sup>1</sup>, Irene Gómez-Gómez<sup>1</sup>, Milagrosa Sánchez-Martín<sup>1</sup>

<sup>1</sup>Department of Psychology, Universidad Loyola Andalucía, Avda. de las Universidades s/n, 47704 Dos Hermanas, Spain

<sup>2</sup>Department of Methodology for Behavioural Science, University of Granada, Campus Universitario de Cartuja, 18071 Granada, Spain

Corresponding Author:

Juan F. Luesia

e-mail: [jfluesia@uloyola.es](mailto:jfluesia@uloyola.es)

tel: +34 955 641 600 (Ext. 2607)

ORCID: 0000-0002-1017-6857

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## Abstract

The evaluation of students' competencies to face the challenges of university studies has mainly focused on the assessment of cognitive abilities through intelligence tests in the admission context. The results from previous studies demonstrate the predictive capacity of these abilities for subsequent university performance. However, current policies are aimed to identifying competencies from a broader approach, such as higher-order thinking skills (HOTS), that may influence college success in the admission testing context. A systematic review of the literature was carried out with the aim of extracting the most relevant competencies included in admission processes that predict academic success. A total of 2,681 original articles were identified. Of them, 42 met the inclusion criteria established according to the review carried out by two independent researchers. Following a peer-review procedure, the competencies assessed in incoming university students were coded and analyzed. Academic performance was explained by cognitive abilities, self-regulated learning (SRL) skills, and soft skills. Among the competencies assessed, the role of cognitive abilities such as numerical reasoning and verbal reasoning in academic success was highlighted. Within the SRL skills, the findings point to the relevance of critical thinking, effort regulation, time/study management, self-directed learning, leadership, and collaboration. Finally, soft skills such as conscientiousness, professionalism, internal locus of control, self-efficacy, and social responsibility, were also highlighted. The conclusions of the present study will help develop comprehensive competence assessments and educational resources focused on better preparing students before starting university studies, in line with the 21st century skills framework and 2030 Agenda policies.

Keywords: Systematic review; academic competence; academic success; higher-order thinking skills; validity evidence

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## 24 **1. Introduction**

### 25 1.1. Educational Assessment in the Context of College Admission Testing

26 The admission process is a relevant step in higher education, as it allows for the selection of students who  
27 will be part of a particular university. Although this process varies by country and type of university (public  
28 or private), there are two common elements to all admission evaluations: the assessment intent as a  
29 systematic process ensuring objectivity and the interest of every university in attracting successful students  
30 (Sawyer, 2013).

31 The use of admission tests by university entities is often marked by government policies. In European  
32 countries, as there is a mismatch between supply and demand, most admissions tests include a state  
33 selectivity test whose results imply the ordering of their candidates for the choice of the desired career. In  
34 these cases, the rigor of the process is the responsibility of the national admission systems, as well as  
35 ensuring equity and inclusiveness in the assessment (Haj et al., 2018). In addition, many countries, such as  
36 France, Germany, the Netherlands, and Spain, apply university admission criteria based on obtaining a  
37 secondary certificate or diploma. However, there are some exceptions, such as Sweden, which uses its own  
38 admissions test (Swedish Scholastic Aptitude Test, SweSAT) in addition to high school performance, and  
39 the UK, where each university may use additional criteria in addition to secondary grades (McGrath et al,  
40 2014).

41 On the other hand, in Iran, Pakistan, the Netherlands or North America, higher education entities use more  
42 flexible criteria, including specific tests according to the area of study (Iqbal et al., 2016; Niessen et al,  
43 2018; Renn & Reason, 2021; Staub, 2017). Specifically, in North America, most university admission  
44 assessments consist of the large-scale application of standardized tests (i.e., American College Testing  
45 ACT). Due to that fact, in the last decades there has been a trend of research focused on the promotion of

46 equal opportunities among ethnic or racial minorities in college access through the promotion of corporate  
47 social responsibility in educational institutions (Koljatic et al., 2021; Sireci & Randall, 2021).

48 There are also cases, such as Chile or Mexico, where both approaches are applied: While public universities  
49 use a criterion based on a selectivity test, private institutions have the power to have their own university  
50 entrance criteria (Lamadrid-Figueroa et al., 2012; Santelices et al., 2019).

51 The Organization for Economic Co-operation and Development (OECD) tries to establish a common  
52 framework for selecting students by proposing the utilization of three sources of information during  
53 admission processes (OECD, 2012): previous academic performance, such as Undergraduate Grade Point  
54 Average (UGPA), university entrance exams and additional factors (e.g., recommendation letters or work  
55 experience). Although previous studies have consistently pointed to prior performance as the best predictor  
56 of grade point average (GPA) (Chadi & de Pinto, 2018; Saunders-Scott et al., 2018), academic institutions  
57 habitually combine diverse sources of information to obtain wider information about students. The most  
58 frequent practice is to combine the administration of a specific entrance exam to assess academic  
59 performance and consult previous academic performance (Rowland & Rieken, 2018).

60 However, the university admission context is currently considered as a selection process but also as an  
61 opportunity to identify competencies that will be relevant in the students' path through university, as  
62 suggested in the 21st century skills framework (Greiff et al., 2015). In this context, competencies are  
63 defined as skills or abilities that can be promoted in the educational context (Sadler, 2013). Thus, skills or  
64 abilities (considered interchangeable) refer to a general concept, whereas competencies are attached to a  
65 particular purpose. These wider frameworks habitually include cross-cutting competencies such as critical  
66 thinking, problem solving, collaboration, or communication (European Union, 2019).

67 1.2. Assessment of Academic Competencies From a Higher-order Thinking Skills Approach

68 Beyond the debate about the phases and assessments developed during the admission process raises the  
69 discussion about which academic competencies are relevant. Two main approaches stand out in this regard:  
70 selecting individual competencies according to the specific needs of the university or assessing  
71 competencies to reach a comprehensive picture of the students' skills.

72 In the first approach, "intelligence" (measured through cognitive abilities and understood as a synonym of  
73 academic competence) occupies the main place in traditional admissions tests (Pretz & Kaufman, 2017).  
74 Cognitive abilities are commonly assessed by standardized tests, such as the Scholastic Assessment Test  
75 (SAT; College Board, 2017), the Medical College Admissions Test (MCAT; Association of American  
76 Medical Colleges, 2018) or the Graduate Record Examinations (GRE; Educational Testing Service, 2015).  
77 Nevertheless, this standard admission policy has been widely criticized because of restricted options in  
78 terms of evaluation instruments and alternative approaches promoting equal opportunities and a  
79 comprehensive perspective of student skills has grown (Hsieh, 2019; Stemler, 2012).

80 In the second approach, assessing academic competencies through a holistic approach involves considering  
81 different domain-general skills (Stemler, 2012). Among the options, a proposal focused on higher-order  
82 thinking skills (HOTS) is frequently adopted. HOTS define competencies in relation to Bloom's higher  
83 taxonomies, that is, competencies are related to processes used to acquire knowledge, skills, and abilities  
84 (Videregort et al., 2019). HOTS are considered essential for problem solving in higher education, as they  
85 allow students to promote their cognitive skills to move beyond superficial understanding and engage with  
86 complex and abstract concepts (Drigas & Karyotaki, 2014; Lu et al., 2021).

87 Within HOTS, the self-regulatory learning skills are referred to abilities to actively manage one's learning,  
88 monitor progress and make adjustments to achieve specific educational goals, including skills such as  
89 critical thinking, time/management, or metacognition (Zimmerman, 2008). As a result, in recent years,  
90 different educational programs have integrated SRL skills within university educational assessments  
91 (Fokkens-Bruinsma et al., 2021; Tsai, 2021).

92 Previous evidence has shown that SRL skills are associated with academic success. Specifically, critical  
93 thinking is the most widely studied HOTS, and its relationship with academic performance has been  
94 demonstrated to be significant (Anders et al., 2019; Akpur, 2020). Although critical thinking has not been  
95 traditionally relevant in educational assessment or admissions testing, it has been recently used as a measure  
96 of SRL skills, which has promoted the development of different instruments for its assessment. Some  
97 examples are California Critical Thinking Skills Test (Afshar & Movassagh, 2017), Cornell Critical  
98 Thinking Test (Dumitru, 2019), and Watson-Glaser Critical Thinking Appraisal (D'Alessio et al., 2019).  
99 In addition, the importance of time management in academic performance is noteworthy (Wolters & Brady,  
100 2021) which has been frequently assessed through the Learning and Study Strategies Inventory (LASSI;  
101 Theobald, 2021).

102 Finally, there is a more heterogeneous group of competencies, called soft skills or noncognitive abilities,  
103 that include personality traits, motivational factors, and psychosocial variables that have been studied as  
104 correlates of academic achievement (Richardson et al., 2012) and can be conceptualized as stable  
105 competencies in themselves. (Johnson et al., 2006). Although some soft skills have been shown to have  
106 relevance in the academic success of college students, they have not often been integrated into college  
107 admissions settings (Richardson et al., 2012). This is the case for conscientiousness, intrinsic motivation,  
108 or social engagement (Mishra, 2020). In this sense, instruments have been developed to integrate both soft  
109 skills and SRL skill, such as the case of the Multiple Mini-Interview (MMI; Cameron et al., 2017) (i.e.,  
110 critical thinking, communication, or motivation) and the Situational Judgment Test (SJT; Chan & Schmitt,  
111 2017) (i.e., collaboration or interpersonal skills).

112 Regardless of the approach used, institutions generally develop evaluation tools binding all the  
113 measurement instruments to assess the intended variables together. To evaluate their usefulness, studies are  
114 conducted to extract validity evidence to support the intended test score interpretations. Many of the  
115 validation studies use the first-year grade point average (FGPA) as a criterion to evaluate its capacity to

116 predict the academic performance (Stemler, 2012). However, GPA-based measures should not be  
117 considered equivalent to academic success since it is a narrow criterion that reflects domain-specific  
118 knowledge rather than general skills (Niessen & Meijer, 2017). Other measures, such as academic dropout  
119 (DO; Niessen et al., 2016) and absenteeism (Millea et al., 2018), can also contribute to explaining  
120 differences in admission test scores.

### 121 1.3. The Current Study

122 The diversity of approaches in admission processes has led to numerous literature reviews focused on  
123 identifying the best predictors of academic success. For instance, several meta-analyses have focused on  
124 the predictive validity of some standardized tests used as admission criteria, such as the study by  
125 Zimmerman et al. (2018), where the GRE score is identified as a valid predictor of academic achievement;  
126 or the study by Violato et al. (2020), which showed small and medium predictive validity of MCAT  
127 components in medical school performance. Other systematic reviews analyzed the utility of admission  
128 criteria focusing on specific programs such as nursing or health care (Al-Alawi et al., 2020; Benham &  
129 Hawley, 2015) and proposed different procedures for college selection (Meyer et al., 2019). Therefore,  
130 there is a lack of systematic reviews whose results were used to propose a wide picture of academic  
131 competencies that impact students' performance. Reaching solid evidence about the competencies  
132 influencing academic performance could help to propose a framework where the relative relevance of  
133 diverse competencies is displayed to help researchers and policy-makers promote comprehensive  
134 evaluations and support programs for students. That would also be helpful to universities and admissions  
135 officers because they could extend admissions tests to include relevant competencies useful for professional  
136 work, for instance, SRL and soft skills. As current trends emphasize (European Union, 2019), universities  
137 should train individuals to address future challenges by functioning in a complex and constantly changing  
138 environment.

139 In this context, this study attempts to overcome limitations and gaps not covered by previous systematic  
140 reviews. The present study aims to explore the utility of university admission criteria, with a focus on  
141 conclusions about academic competencies associated with academic success. We expect that the results  
142 will provide us with a set of key competencies related to university performance, which will support  
143 proposing comprehensive assessments in the context of university admission testing. To achieve that goal,  
144 a systematic review of the academic competencies assessed in university admission tests was carried out  
145 with the aim of extracting those having an impact on academic performance. Competencies' impact was  
146 conceptualized in terms of validity evidence based on the relations to a criterion (AERA et al., 2014),  
147 specifically in relation to academic success.

## 148 **2. Method**

149 A systematic review was conducted based on updated PRISMA guidelines for systematic reviews and meta-  
150 analyses (Page et al., 2021) and an updated reporting guidance of the original statement (Moher et al.,  
151 2009).

### 152 2.1. Literature Research

153 Keywords were determined to reach the goals of the study by grouping the terms into four search fields:  
154 university admission process, assessment, academic success, and university students. The same specific  
155 terms combined with Boolean operators were used for all the databases consulted, delimited by title and  
156 abstract, as Table 1 shows. The literature computer-based search was performed through the following  
157 electronic bibliographic databases: *Web of Science*, *Scopus*, *ERIC*, *PsycINFO*, and *PsycTEST*. References  
158 with the selected articles were also reviewed.

159 {Please insert Table 1 about here}

### 160 2.2. Eligibility Criteria

161 Inclusion and exclusion criteria were defined concerning population, competencies in the assessment,  
162 assessment period, institution developing the assessment, outcome, design, language, and publication type.

163 There were no restrictions related to the year of article publication. A detailed description is provided in  
164 Table 2.

165 {Please insert Table 2 about here}

166 As Table 2 indicates, within the *Population* criterion, only students who entered the college were  
167 selected; that is, they were described as candidates to enter the university or as first-year students and  
168 above. The criterion *Competencies in assessment* was used to assure that competencies were clearly  
169 described. Regarding the criterion *assessment period*, all assessments applied to incoming students were  
170 identified. *The assessment developer* criterion allowed the exclusion of studies that apply statewide  
171 admission tests or studies that analyze specific instruments or tests so that only articles analyzing  
172 admission criteria determined by their academic entities are included. Finally, only studies reporting  
173 validity evidence based on relations to academic success were included under the *Outcome* criterion, that  
174 is, studies including specific measures defined as academic performance, such as first-year GPA or  
175 overall GPA.

### 176 2.3. Selection of Studies

177 Using inclusion and exclusion criteria, three reviewers participated in the selection of the studies (JL, RCC,  
178 and IGG). All the articles were divided into two sets with the same volume of articles. Each set was  
179 examined by two independent reviewers (set 1: JL and RCC; set 2: JL and IGG). First, a title and abstract  
180 screening phase was developed to analyze the eligibility of the articles. Then, full-text articles were  
181 reviewed for final inclusion. In case of disagreement between the two reviewers in charge, the third  
182 independent reviewer reached a final decision (set 1: IGG; set 2: RCC). Interrater reliability was tested  
183 (McHugh, 2012). The level of agreement between the reviewers was almost perfect for set 1 ( $\kappa_1= 0.93$ ;  
184 95% CI, 0.76 to 1.09) and strong for set 2 ( $\kappa_2= 0.84$ ; 95% CI, 0.67 to 1.01).

### 185 2.4. Data Extraction

186 Once the articles were selected, the characteristics of the studies and the results provided were coded and  
187 analyzed. For this purpose, information was extracted in three different sections. First, the *Main*  
188 *Characteristics of the Studies* section included information about the country, academic institution, and  
189 sample characteristics (college/degree, sample size, and descriptive data). Second, in the *Admission Test*  
190 *Characteristics* section, data from the assessments in each article were pooled. Concretely, the following

191 properties were analyzed: instruments used to assess academic competencies (i.e., SAT), the measure of  
192 academic success (i.e., first-year GPA), and the type of competencies included in the model (C: cognitive  
193 abilities, SRL: self-regulated learning skills; S: soft skills). The following background variables were also  
194 collected: performance before university entry (P), domain-specific knowledge (K) evaluated by the score  
195 obtained in a test in a given area (i.e., English as a second language), and sociodemographic variables (S)  
196 (i.e., age).

197 Thereafter, the competencies assessed were identified and analyzed. First, HOTS were classified into two  
198 groups. The first group was composed of the self-regulated skills (SRL), considering those competencies  
199 that have an impact both at the individual level (i.e., critical thinking) (Richardson et al., 2012; Zimmerman,  
200 2008), and at the social level, in line with the socially shared regulation skills which are typical in academic  
201 environments (i.e., collaboration, organizational behavior or leadership) (Schunk & Mullen, 2013). The  
202 second group, cognitive abilities (C), was identified through the cognitive abilities model proposed by  
203 Ackerman and Heggestad (1997) (i.e., numerical reasoning, writing skills, or perceptual ability). Finally,  
204 the third group, soft skills (S), was identified through categorization into three major groups, in line with  
205 the review of Richardson et al. (2012): personality traits (PER), motivational and attitudinal factors (MOT),  
206 and psychosocial and contextual influences (SOC).

207 Finally, a deep evaluation of specific results for every competence assessed in each study was performed  
208 in the section *Relevance of academic competencies in admission criteria*. The goal of this section was to  
209 highlight the key competencies analyzed in all the studies in the systematic review. Validity evidence was  
210 interpreted through Cohen's effect size guidelines (1988). Then, the evidence found was summarized as  
211 positive (+) when academic competencies had a significant association with academic success or  
212 nonsignificant (NS) when there were no significant associations.

## 213 2.5. Risk of Bias Assessment

214 The risk of bias in individual studies was assessed using two instruments. On the one hand, an adaptation  
215 of the Newcastle–Ottawa Scale (NOS) for nonrandomized study guidelines (Wells et al., 2000) where Cook  
216 and Reed (2015) proposed a five-item checklist (NOS-E) to analyze five domains: representativeness of  
217 the intervention group (scores from 0 to 1), selection of the comparison group (0 to 1), comparability of  
218 comparison group (0 to 2), study retention (0 to 1, being 1 when more than 75% of the initial sample  
219 completed the study) and blinding of assessment (0 to 1, being 1 when the assessment contained no self-  
220 reporting measures). Scores range from 0 to 6 points.

221 On the other hand, the Medical Education Research Study Quality Instrument (MERSQI; Reed et al., 2007)  
222 analyzes six domains with 10 items: study design (one item with scores from 1 to 3), sampling (two items:  
223 number of institutions, with scores from 0.5 to 1.5; and response rate, with scores from 0.5 to 1.5, including  
224 “Not applicable” option), type of data (one item with scores from 1 to 3), validity evidence for evaluation  
225 scores (three items: content, internal structure, and relationship with other variables, with scores ranging  
226 from 0 to 1 for each of them), data analysis (two items: sophistication, with scores from 1 to 2; and  
227 appropriateness, with scores from 0 to 1), and outcome (one item with scores from 1 to 3). Total scores  
228 ranged from 5 to 18 points. Since the articles included in this review were nonintervention designs (see  
229 Table 2), two items were modified: study design (removal of score 3, randomized controlled trial) and  
230 outcome (removal of scores 2, behaviors, and 3, patient/health care outcome). As a result, the range of total  
231 MERSQI scores was from 5 to 15.5 in this study. Both instruments were used together, as recommended  
232 in the guidelines (Cook & Reed, 2015), in which they are considered complementary instruments: while  
233 NOS-E makes greater reference to the implications of the study and is more subjective, the MERSQI  
234 focuses on objective design aspects. Thus, the combined application of these instruments can be found in  
235 different systematic reviews focusing on higher education (Chung et al., 2016; Kuleshova et al., 2020).

### 236 3. Results

237 The results of the study are presented in different sections. First, the selection process is described. Second,  
238 the results obtained by analyzing the risk of bias of the studies are shown. Next, the main characteristics of  
239 the articles are summarized. Then, details about each admission are described. Finally, an in-depth analysis  
240 of the competencies is carried out, and a summary of key competencies is provided.

### 241 3.1. Study Selection

242 Figure 1 shows the flowchart illustrating the process for identifying the final articles included in the  
243 systematic review. A total of 3,948 articles were identified from five different databases, and 39 articles  
244 were identified from a manual review of references included in the retrieved articles and related  
245 systematic reviews. Once duplicates were removed, the 2,683 remaining articles were analyzed. Title and  
246 abstract screening were performed, followed by a more in-depth full-text analysis. Finally, 42 articles  
247 were included in the study: 38 through database searching and 4 through manual review.

248 {Please insert Figure 1 about here}

### 249 3.2. Risk of Bias of the Included Studies

250 The specific scores related to the risk of bias are shown in Appendix 1 (Table A.1 and Table A.2).  
251 Regarding NOS-E scores, most of the articles (a) were representative of the population studied (97.6%);  
252 and (b) contained a sample divided into two or more groups, drawn from the same community (66.7%);  
253 respect the comparability of comparison group (c), 38.1% of the articles included comparisons by  
254 controlling for one characteristic of the sample, 33.3% included no separate comparison group, and  
255 28.6% included comparisons by controlling for at least two characteristics of the sample; the majority of  
256 articles (d) retained at least 75% of the initial sample until the end of the study (52.4%); however, most of  
257 them (e) did not include blinded outcome assessments (57.1%). The average NOS-E score was 3.55 (*SD*  
258 = 1.37).

259 Regarding MERSQI scores, most of the articles (a) were considered cross-sectional or posttest studies  
260 (57.1%); and (b<sub>1</sub>) included analyzed results from a single institution (90.5%); with respect to the response  
261 rate, (b<sub>2</sub>) 66.67% of the articles had a ratio equal to or above 75%, excluding the nine articles in which  
262 this item was not applied (NA); the type of data (c) was considered objective (69.0%) in the majority of

263 the cases; regarding the validity evidence (d), all the articles (e<sub>1</sub>) provided relevant evidence of, at least,  
264 relationships with academic performance variables, although in most cases no relevant content or relevant  
265 internal structure was reported (64.3%); finally, all articles (e<sub>1</sub>) provided more than descriptive analyses;  
266 (e<sub>1</sub>) included analyses appropriate to the design and type of data proposed; and (f) results based on the  
267 analysis of academic competences are included. Considering those 33 articles in which all items were  
268 applied (range 5 to 15.5), the average MERSQI score was 11.48 (*SD* = 1.13). Regarding those 9 articles  
269 in which item b<sub>2</sub> could not be applied (range 5 to 14), the mean MERSQI score was 10.39 (*SD* = 0.70).  
270 According to the original guidelines, the scores of both scales should not be considered in absolute terms;  
271 however, the mean scores obtained on the NOS-E (3.55) and MERSQI (10.39 and 11.48) scales were  
272 considered acceptable, as they were within the ranges published by the authors' guidelines (Cook & Reed,  
273 2015).

### 274 3.3. Main Characteristics of the Studies

275 Table 3 shows the study characteristics: study descriptors, main elements of the assessment, and sample  
276 characteristics. The included studies were developed in universities in 16 different countries, although the  
277 majority of them were developed at universities in the United States (45.2%), Australia (7.1%), Netherlands  
278 (7.1%), Pakistan (7.1%) and South Korea (7.1%). Most of the assessments were applied in specific  
279 academic disciplines (83.3%), with health science disciplines predominant, specifically medical (42.9%)  
280 and dentistry (14.3%). The sample size was 663 students on average, considering the 42 studies included  
281 in the review. Study #10 had the largest sample (*n* = 8,843), while study #06 included the smallest sample  
282 (*n* = 94). The sex of the participants was reported in 29 articles: the sample was mainly composed of women,  
283 with an average percentage of 58.3 (men: 41.7%).

284 {Please insert Table 3 about here}

### 285 3.4. Admission Test Characteristics

286 Table 4 presents the information about the admission criteria described in the articles. Analysis of the  
287 properties showed that 38 of the 42 articles (90.5%) included GPA as a measure of academic success.  
288 Specifically, 27 of the 42 articles (64.3%) used first-year GPA, and 13 of the 42 articles (31.0%) used total

289 career GPA as a measure. Only articles #16 (dropout), #18 (LMCC), #28 (IPE) and #29 (Rank) employed  
290 non-GPA measures. A total of 23 assessments (54.8%) combined cognitive with other types of variables:  
291 12 (28.6%) with self-regulated learning and soft skills (C-SRL-S), 10 (23.8%) with soft skills (C-S), and  
292 one (2.4%) with self-regulated learning skills (C-SRL). In addition, 13 (31.0%) included exclusively  
293 cognitive assessments (C). The most studied competencies in each category were numerical reasoning and  
294 verbal reasoning (C), learning and study strategies, and critical thinking (SRL), Big Five and emotional  
295 intelligence (PER), motivation and learning goal orientation (SRL0T), critical thinking (SRL), and  
296 communication and ethics (SOC). In addition, 35 of the 42 studies contained background variables (83.3%)  
297 (excluding #12, #23, #25, #27, #28, #36 and #38). Among them, the most frequently included variable was  
298 previous performance (31 out of 42 studies, 73.8%), followed by specific knowledge (12 out of 42, 28.6%)  
299 and sociodemographic characteristics (12 out of 42, 28.6%).

300 {Please insert Table 4 about here}

### 301 3.5. Relevance of Academic Competencies in Admission Criteria

302 A deep analysis of the variables assessed in the admission tests is detailed in the following sections as well  
303 as in the five tables included in Appendix 2. The main findings related to the relevance of cognitive abilities,  
304 SRL skills, personality traits, motivational and attitudinal factors, and psychosocial and contextual  
305 influences are shown.

#### 306 3.5.1. Relevance of Cognitive Abilities

307 Table 5 shows the results regarding the relevance of the variables. Six competencies were identified with  
308 both significant and nonsignificant associations with academic performance. All the cognitive variables  
309 except reading comprehension (#15, #24 and #35, positive; #04, #14, #16, #23 and #31, nonsignificant)  
310 and perceptual abilities (#09 and #31, positive; #06, #07, #29, #34, #35 and #38, nonsignificant) seemed to  
311 be related to academic success. Specifically, seven studies showed positive and significant associations

312 between verbal reasoning and performance (#03, #05, #15, #18, #27, #32 and #33), whereas correlations  
313 were not significant in five studies (#04, #08, #16, #22 and #30). In addition, writing skill showed positive  
314 associations in four out of the five studies analyzed (#11, #23, #30, and #33, positive; #08 nonsignificant).  
315 The same occurred for logical reasoning (#07, #13 and #38, positive; #29 and #34 nonsignificant) and  
316 numerical reasoning (#02, #05, #15, #16, #23, #24, #27, #30, #31, #32, #33, #35 and #41, positive; #04,  
317 #14, #17 and #22, nonsignificant). For further details, please review Appendix 2 (Table B.1).

318 {Please insert Table 5 about here}

### 319 3.5.2. Relevance of SRL Skills

320 As Table 6 shows, seven of the twelve competencies exhibited significant associations with academic  
321 performance. Specifically, collaboration showed positive associations in the only study in which it was  
322 included (#13). The same occurred for effort regulation (#10) and self-directed learning (#14). However,  
323 contradictory results were found for the other competencies. Specifically, the evidence was more positive  
324 than nonsignificant for critical thinking (#13, #19, #20 and #35, positive; #17, nonsignificant), leadership  
325 (#26 and #27, positive; #32, nonsignificant) and time management (#25 and #36, positive; #20,  
326 nonsignificant). Regarding concentration, elaboration, and metacognition competencies, one article with  
327 positive (#36) and one with nonsignificant (#20) evidence were found for each of them. No evidence was  
328 found for coping ability (#34), decision-making (#29), organization (#20 and #36), self-knowledge (#34),  
329 and study behavior (#12). For further details, please review Appendix 2 (Table B.2).

330 {Please insert Table 6 about here}

### 331 3.5.3. Relevance of Soft Skills

#### 332 3.5.3.1. Personality and Traits

333 As shown in Table 7, nine of the eleven competencies included in the *PER* category obtained significant  
334 associations with academic performance. Concretely, evidence was relevant in conscientiousness (#03, #25

335 and #27), extraversion (#03 and #27), grit (#01), procrastination (#25) and professionalism (#19 and #37).  
336 Contradictory results were obtained for a greeableness (#03, positive; #27, nonsignificant), openness (#03  
337 positive; #27 nonsignificant), emotional intelligence (#03, #07 and #42, positive; #29, #34, #38 and #39,  
338 nonsignificant), and perseverance (#27 positive; #26 and #32 nonsignificant). In contrast, no evidence was  
339 found about neuroticism (#03 and #27) and resilience (#17). For further details, please review Appendix 2  
340 (Table B.3).

341 {Please insert Table 7 about here}

#### 342 3.5.3.2. Motivational and Attitudinal Factors

343 Table 8 shows that within the *MOT* category, positive correlations were found in four of the five  
344 competencies included. Relevant evidence was obtained in the internal locus of control (#14) and self-  
345 efficacy (#14). However, two competencies had contradictory results, with predominantly nonsignificant  
346 results: learning goal orientation (#32, positive; #26 and #27, nonsignificant) and motivation (#10, #20,  
347 #26, #33 and #36, positive; #11, #12; #18, #21, #29, #34, #39 and #40, nonsignificant). Career orientation  
348 showed irrelevant results in the two studies (#27 and #32) in which it was included. For further details,  
349 please review Appendix 2 (Table B.4).

350 {Please insert Table 8 about here}

#### 351 3.5.3.3. Psychosocial and Contextual Influence

352 As detailed in Table 9, positive associations were found in six of the seven competencies identified in the  
353 *SOC* category, except social integration, which did not show significant associations in either of the four  
354 articles analyzed (#10, #17, #18, and #27). Mainly positive associations were found in social  
355 responsibility (#26, #32, positive; #27 nonsignificant) and ethics (#13, #27 and #32, positive; #05 and #26  
356 nonsignificant). Relating to ethics, three articles with positive results (#13, #27, and #32) and three with  
357 nonsignificant results (#05, #20, and #26) were found for each of them. Finally, associations were mostly

358 irrelevant in communication (#13, #19, #28, #34 and #37, positive; #14, #17, #18, #29, #33 and #39,  
359 nonsignificant) and institutional integration (#27 positive; #26 and #32 nonsignificant). For further  
360 details, please review Appendix 2 (Table B.5).

361 {Please insert Table 9 about here}

#### 362 3.5.4. Summary of Key Competencies

363 The results in the previous sections provide information on the predictive validity of academic  
364 competencies on academic success. As the goal of the present study is to obtain a comprehensive picture  
365 of all the competencies connected to a academic performance, Table 10 lists, classifies and defines the key  
366 competencies for predicting academic success, that is, competencies with evidence supporting their  
367 relationship with a academic achievement.

368 {Please insert Table 10 about here}

369 To facilitate the interpretation of the results, a glossary of terms is provided in Appendix 3 (Table C.3.)

### 370 **4. Discussion**

371 The present study aimed to summarize the available evidence regarding the competencies in university  
372 admission tests influencing students' academic performance. Despite the heterogeneity of the studies,  
373 evidence supports the inclusion of cognitive abilities, self-regulated skills, and soft skills as part of  
374 admission assessments. This finding is in favor of arguments proposing more comprehensive assessments  
375 where HOTS are considered (Stemler, 2012). In the present study, 18 key competencies in university  
376 academic performance were extracted. Most of them were self-regulated learning competencies (six),  
377 followed by personality traits (five), cognitive abilities (four), motivational and attitudinal factors (two) and  
378 psychosocial contextual influences (one).

379 These results are congruent with previous literature (Broadbent, 2017; Panadero, 2017). Although the  
380 admission tests are focused on cognitive variables (assessed by standardized tests such as ACT, SAT, or

381 MCAT), there is sufficient evidence to ensure that the inclusion of SRL and soft skills in these evaluations  
382 leads to a greater explained variance in performance (Fonteyne et al., 2017; Makransky et al., 2017). As  
383 evidence of this, several instruments have been identified in this review: the Learning and Study Strategies  
384 Inventory (Lobb et al., 2006; West & Sadoski, 2011), the Multiple Mini-Interviews (Husband & Dowell,  
385 2013; Lee et al., 2016; Rauf et al., 2018) or the Situational Judgment Test (Nye et al., 2018) and the Biodata  
386 Inventory (Oswald et al., 2004; Schmitt et al., 2009).

387 Regarding cognitive abilities, it was found that verbal reasoning and writing skills can be relevant in a  
388 competence model. Specifically, verbal reasoning and writing skills have been closely linked to the study  
389 of crystallized intelligence and academic performance. The results found in this study are congruent with  
390 those of other studies. The relationship appears to be significant in different studies using standardized tests  
391 (Jones et al., 2020; Viola et al., 2020). Similarly, numerical reasoning and logical reasoning have been  
392 identified as relevant cognitive abilities. These competencies have been linked to the study of fluid  
393 intelligence over the years, which in turn has been related to academic performance (Green et al., 2017;  
394 Schult et al., 2016).

395 According to the rest of the cognitive abilities, evidence based on relations to the academic success  
396 competencies of reading comprehension and perceptual abilities was not significant. However, due to the  
397 limited contexts where the studies were developed, as in dentistry programs (Ihm et al., 2013; Rich et al.,  
398 2011; Rowland & Rieken, 2018; Tsai, 2014), solid conclusions cannot be drawn about their predictive  
399 utility. There are also other cognitive abilities, such as working memory or visual attention, that are relevant  
400 in previous literature (Musso et al., 2020). However, although working memory seems to be relevant in  
401 academic performance, the effect produced in a university context seems to be much smaller because of the  
402 increasing significance of procrastination (Gareau et al., 2019). In the case of visual attention, the explained  
403 variance of academic performance could be attributed to learning and study strategies (Musso et al., 2020).

404 Therefore, the inclusion of these measures in university educational evaluations does not seem clear since  
405 they do not explain academic performance by themselves.

406 Regarding the results obtained for self-regulated learning skills, critical thinking and learning and study  
407 strategies are the most widely studied. The results found in critical thinking were mostly positive, in line  
408 with Fong et al. (2017), who found a moderate relationship between critical thinking (as an ability or  
409 disposition) and academic performance. However, these results should be considered with some caution  
410 when competence is assessed from subjective interviews (Kim et al., 2016). When critical thinking is  
411 assessed by using validated scales such as the CCTST (Tsai, 2014), the relevance to academic performance  
412 increases, as shown in a review of available instruments (Anders et al., 2019). The contradictory results  
413 found in learning and study strategies may be due to the difficulty of assessing this construct, as it is  
414 evaluated through different variables (i.e., time management or organization). Nevertheless, when  
415 considered as a unitary construct, it seems to have a significant but low effect size (Fong et al., 2021;  
416 Nabizadeh et al., 2019). Besides, as a self-report measure, they may have limitations in high-stakes testing,  
417 such as in the context of college admissions (Niessen & Meijer, 2017). In addition, collaboration and  
418 leadership competencies seem to be relevant in the prediction of teamwork-related aspects of academic  
419 performance and, thus, can be considered academic performance measures for educational practitioners  
420 (Anwar & Menekse, 2020; Schunk & Mullen, 2013).

421 In this sense, the inclusion of the above-mentioned higher-thinking skills is particularly important. SRL are  
422 considered the link between cognitive abilities and academic achievement (Ferao et al., 2022). Moreover,  
423 these skills are important not only in the individual domain but also in the academic social domain, such as  
424 collaboration and leadership, so that higher-thinking skills play a determining role as socially mediated  
425 cognitive abilities (Hacker, 2018; Larkin, 2009). In this line, future research should focus on nontraditional  
426 instruments to measure these constructs in the admission context, avoiding the main limitations of self-  
427 report measures (Niessen et al., 2016; Schmith, 2012).

428 This systematic review also identified a heterogeneous spectrum of soft skills. Regarding competencies  
429 related to personality and traits, the results are partially supported by the literature. Specifically,  
430 conscientiousness seems to have the clearest support according to different Big Five reviews, with low to  
431 medium effect sizes. However, the associations do not appear to be significant for extraversion,  
432 agreeableness, neuroticism, and openness to experience (Zell & Lesick, 2022). Some studies support the  
433 impact of grit, although it seems to be more associated with measures of academic performance in terms of  
434 dropping out and retention (Palisoc et al., 2017).

435 Concerning motivational and attitudinal factors, the results obtained in motivation, internal locus of control,  
436 and self-efficacy may support the moderating role of these three competencies in subsequent academic  
437 performance (Drago et al., 2018; Elliott, 2016). This relationship between these competencies and  
438 performance could explain the contradictory results in those studies that assessed motivation.

439 Finally, within psychosocial contextual influences, communication is studied by noncognitive instruments  
440 generally affected by subjective scoring by college officers (i.e., MMI). The dissimilar results may be due  
441 to the low reliability of this type of instrument (Husbands & Dowell, 2013). However, this competence  
442 might not be so much related to GPA but to academic retention (Zegre et al., 2022). On the other hand, the  
443 relevance of social responsibility in college appears to be innovative as a long-term, once students have  
444 completed their academic career (Garibay, 2018).

445 In short, the evidence provided supports the use of admission tools based on a broad spectrum of higher-  
446 order skills, including cognitive abilities and SRL skills, and soft skills to improve the prediction of college  
447 student outcomes and to provide more comprehensive and individualized career counseling. The results  
448 obtained provide strong evidence that the admission tests analyzed in this review are strengthened by the  
449 inclusion of competencies that complement the cognitive assessment of the students.

450 The study presents some limitations. Some of the competencies could not be assessed individually, as many  
451 of the tests used in the assessment tests yielded results in an aggregate form. Additionally, there was no

452 homogeneity in the types of instruments used for each competence assessed, so conclusions should be  
453 considered with caution. This occurs in some tests that include mixed cognitive abilities, such as the SAT,  
454 which assesses verbal reasoning, literacy skills, and numerical reasoning at the same time (Oswald et al,  
455 2004), or in the case of less known instruments such as the Q1000, which is composed of spatial, numerical  
456 and verbal domains (Niessen et al., 2018).

457 Despite these limitations, the evaluation of the different admission tests in this systematic review is a first  
458 step toward obtaining a comprehensive model of competencies to identify those skills involved in academic  
459 success, starting from a model of cognitive abilities but adding SRL and soft skills.

460 The results of the present study provide information about variables influencing academic performance,  
461 which would allow us to propose a comprehensive assessment to promote students' improvement during  
462 their university studies, as Zamanzadeh et al. (2020) indicated. University policies should focus their efforts  
463 on programs that explicitly improve students' higher-order thinking skills (Nguyễn & Nguyễn, 2017). An  
464 assessment tool that complies with these variables could be useful to address individualized evaluations in  
465 university students, which would help develop college policies focused on addressing students' educational  
466 needs (Meijer et al., 2020). In this way, the model could be used within a common competence evaluation  
467 with the objective, aligned with the 21st century skills framework (Dwyer et al., 2014) and with SDG4 of  
468 the 2030 Agenda (United Nations, 2015) to promote educational quality policies based on a comprehensive  
469 vision of the incoming student body.

470 Addressing the assessment of academic competencies based on the HOTS approach involves extending the  
471 evaluation beyond traditional competencies. That is a challenge but also a relevant source of information  
472 for better-supporting students' development during the university as well as for training abilities and skills  
473 for future professional life. Over the next few years, research on comprehensive assessments should be  
474 developed. The importance of reaching accurate measures of a broad spectrum of competencies will not

475 only help in making decisions in the context of university admissions but also in the assessment of  
476 competencies that represent training needs.

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\*: Articles included in the systematic review

## Tables

Table 1. Search terms gathered by field

Search field	Search terms
University admission process	("admission* process*") OR ("college* admission*") OR ("universit* admission*") OR ("student* admission*") OR ("college* select*") OR ("universit* select*") OR ("student* select*") OR ("competitive* select*") OR ("college* entrance*") OR ("universit* entrance*") OR ("student* entrance*") OR ("academic* perform* predict*") OR ("student* recruitment*") OR (prerequisite*) OR (enrollment*) OR ("college* criteri*") OR ("universit* criteri*")
Assessment	(test*) OR (measur*) OR (evaluat*) OR (assess*) OR (estimat*) OR (tool*) OR (questionnaire*) OR (scal*)
Competence	(competenc*) OR (skill*) OR (abilit*) OR (mediator*) OR (predictor*)
success	(GPA*) OR (grade*) OR (perform*) OR (achiev*) OR (success) OR (outcome*)
University students	(undergraduate*) OR (freshman*) OR (sophomore*) OR ("junior* student*") OR ("senior* student*") OR ("upper division* student*") OR ("universit* student*") OR ("college* student*") OR ("bound* student*") OR ("academic* student*") OR ("junior* applicant*") OR ("senior* applicant*") OR ("upper division* applicant*") OR ("universit* applicant*") OR ("college* applicant*") OR ("bound* applicant*") OR ("academic* applicant*") OR ("tertiary education") OR ("high* education")

Table 2. Inclusion and exclusion criteria

<b>Criteria</b>	<b>Inclusion criteria</b>	<b>Exclusion criteria</b>
Population	College students or incoming students.	Other population.
Competencies in assessment	Competence/ies is/are assessed.	There are no measures of competencies, or they are not included in the assessment.
Assessment moment	The assessment is applied to incoming students at the university.	Other different moments (e.g., baccalaureate or master's studies).
Institution	The university entity is the developer of the assessment.	Tests are developed by state governments or testing companies.
Outcome	Validity evidence on the relationship between competence/ies and university academic performance (i.e., first-year GPA).	Other types of outcomes.
Design	Nonintervention designs.	Intervention designs.
Language	English or Spanish.	Other languages.
Publication type	Peer-reviewed articles.	Other.

Table 3. Main characteristics of the studies

<i>ID</i>	<i>Author/s and year</i>	<i>Country</i>	<i>Academic institution</i>	<i>Sample characteristics</i>				
				<i>College/ Degree</i>	<i>n</i>	<i>W (%)</i>	<i>M (%)</i>	<i>Mean age (SD)</i>
#01	Akos & Kretchmar, 2017	USA	University of North Carolina	General	209	72	28	ND
#02	Ali et al., 2017	Pakistan	Aga Khan University	Medicine	276	ND	ND	18-19
#03	Brannick et al., 2013	USA	South Florida	Medicine	209	56.0	42.1	23.5(2.8)
#04	Chisholm et al., 1995	USA	University of Georgia	Pharmacy	234	61.1	38.9	24.5(3.8)-25.3(4.0)
#05	Cortés-Flores & Palomar-Lever, 2008	Mexico	Private college (not specified)	Psychology	240	83.33	16.67	20.0(3.7)
#06	Curtis et al., 2007	USA	ND	Dentistry	94	ND	ND	ND
#07	Edwards et al., 2013	Australia	Three Universities (not specified)	Medicine	650	ND	ND	ND
#08	Evans & Wen, 2007	USA	Oklahoma State University	Pharmacy	434	34.6	65.4	30.3(5.3)
#09	Holmes et al., 2008	USA	University of Iowa	Dentistry	566	ND	ND	ND
#10	Hsieh, 2019	Taiwan	Database (not specified)	General	8843	ND	ND	ND
#11	Hughes et al., 2017	New Zealand	ND	Social Work	196	82.0	18.0	35.6
#12	Hulsman et al., 2007	Netherlands	University of Amsterdam	Medicine	418	68.4	31.6	21(2.8)
#13	Husband & Dowell, 2013	UK	University of Dundee	Medicine	268	59.0	41.0	20.8-21.6(2.4-2.2)
#14	Ihm et al., 2013	South Korea	Seoul National University School of Dentistry	Dentistry	353	39.6	60.4	27.2(2.6)
#15	Kegel-Flom, 1985	USA	University of Houston	Optometry	295	ND	ND	ND
#16	Kegel-Flom, 1986	USA	University of Houston	Optometry	290	ND	ND	23.1-25.9(3.7-5.3)
#17	Kim et al., 2016	South Korea	Seoul National University College of Medicine	Medicine	1162	35.7	64.3	21.7-24.9(1.6-2.5)
#18	Kulatunga-Moruzi & Norman, 2002	Canada	McMaster University	Medicine	97	ND	ND	ND
#19	Lee et al., 2016	South Korea	Kangwon National University	Medicine	249	43.4	56.6	25.6(3.1)
#20	Lobb et al., 2006	USA	University of Mississippi	Pharmacy	405	ND	ND	ND
#21	Luqman, 2013	Pakistan	Foundation University Medical College	Medicine	436	72.0	28.0	ND
#22	Lynch et al., 2009	UK	University of Aberdeen and University of Dundee medical schools	Medicine	341	63.0	37.0	18.0
#23	Mikitovics & Crehan, 2002	USA	ND	Education	1062	78.9	21.1	ND
#24	Niessen et al., 2016	Netherlands	ND	Psychology	851	31.0	69.0	20.0(2.1-2.3)
#25	Niessen et al., 2018	Netherlands	University of Groningen	General	104	71.0	29.0	19.0-20.0
#26	Nye et al., 2018	USA	Midwestern Area (not specified)	General	1449	57.2	42.8	ND
#27	Oswald et al., 2004	USA	Michigan State University	General	644	72.0	28.0	18.5(0.7)
#28	Rauf et al., 2018	Pakistan	Shifa Tameer-e-Millat University	Medicine	100	42.0	58.0	19.7(3.1)-20.3(1.1)

#29	Rich et al., 2011	New Zealand	University of Otago	Dentistry	411	55.0	45.0	ND
#30	Roush et al., 2014	USA	Kansas State University College	Veterinary	215	ND	ND	ND
#31	Rowland & Rieken, 2018	USA	Southern Illinois University	Dentistry	297	ND	ND	ND
#32	Schmitt et al., 2009	USA	10 Universities	General	2771	64.2	35.8	18-20
#33	Shahani et al., 1991	USA	Rice University	General	506	ND	ND	ND
#34	Simpson et al., 2014	Australia	University of New South Wales	Medicine	318	54.0	46.0	18.0-18.2
#35	Tsai, 2014	USA	Ten Universities (not specified)	Dentistry	415	ND	ND	ND
#36	West & Sadoski, 2011	USA	Texas A&M University	Medicine	106	34.0	66.0	ND
#37	Wiest et al., 2008	USA	Medical University of South Carolina.	Medicine	141	78.0	22.0	23.1(3.1)
#38	Wilkinson et al., 2011	Australia	University of Queensland	Medicine	339	50.1	49.9	ND
#39	Yusoff et al., 2011	Malaysia	Universiti Sains Malaysia	Medicine	196	65.3	34.7	ND
#40	Zhou et al., 2014	China	Southern Medical University	Medicine	1285	60.2	39.8	ND
#41	Zuñiga et al., 2009	Chile	Universidad Católica de Chile	Medicine	272	56.0	44.0	18.6(1.1)
#42	Zysberg et al., 2011	Israel	Northern Israel (not specified)	Nursing	102	72.5	27.5	25.3(4.3)

ND: No data; W: women; M: men; SD: Standard Deviation.

Table 4. Results of admission analysis

ID	Properties			Background variables			Competencies				
	Instruments	Academic success	Competence type				Cognitive (C)	Self-regulated learning (SRL)	Soft (S)		
				P	K	S			PER	MOT	SOC
#01	Grit-S; SAT	GPA (1)	C-S	✓*		✓	ND*		Grit*		
#02	AKU-MCAT	GPA (total)	C		✓*	✓*	NR*				
#03	MCAT; MSCEIT; NEO-PI-R, WLEIS	GPA (1-4)	C-S	✓*			VR*		Big five*; Emotional intelligence		
#04	PCAT	GPA (1)	C	✓*	✓		RC; VR; NR				
#05	DIT; EXANI-II	GPA (1)	C-S	✓*			VR*; NR*				Ethics
#06	DAT	GPA (1-4)	C	✓*			ND; PA				
#07	Interview; UMAT	GPA (1-4)	C-S	✓*			LR*; PA		Emotional intelligence*		
#08	MCAT	GPA (total)	C	✓*	✓*		VR; WS				
#09	DAT	GPA (total)	C	✓			PA				
#10	Adhoc instruments; GSAT	FS-GPA	SRL-S	✓	✓	✓		Effort regulation		Motivation	Social integration
#11	Interview; Writing task	GPA (1)	C-S		✓		WS			Motivation	
#12	SMMS; Study behavior (adhoc)	GPA (total)	SRL-S					Study behavior		Motivation	
#13	MCAT; MMI	GPA (1-2)	C-SRL-S			✓	LR*	Collaboration*; Critical thinking*			Communication*; Ethics*
#14	CSAS; DEET; GSE; IELCS; SDLRS	GPA (1-total)	C-SRL-S	✓*		✓*	RC; NR	Self-directed learning*		Locus of control*; Self-efficacy*	Communication
#15	OCAT	GPA (1-3)	C	✓	✓	✓	RC; VR; NR				
#16	OCAT	DO	C	✓	✓	✓	RC; VR; NR				
#17	Essay test; Interview; Written test	GPA (total)	C-SRL-S	✓	✓		NR	Critical thinking	Resilience		Communication; Social integration
#18	Interview; MCAT; Simulated tutorial	LMCC (Part I)	C-S	✓*			VR*			Motivation	Communication; Social integration
#19	MEET; MMI	GPA (1-2)	C-SRL-S	✓*			ND*	Critical thinking*	Professionalism*		Communication*
#20	DIT; LASSI; PCAT	GPA (1)	C-SRL-S	✓*	✓		ND*	Critical thinking; Learning and study strategies		Motivation	Ethics
#21	SMMS	GPA (1-5)	S	✓						Motivation	
#22	UKCAT	GPA (1)	C	✓			VR; NR				
#23	ACT; PPST	GPA (total)	C				RC; WS*; NR*				
#24	Adhoc instruments	DO; GPA (1)	C		✓*		RC; NR*				
#25	BFI; Q1000 Capaciteiten Hoog; Lay's Procrastination Scale; SMART	GPA (1)	C-SRL-S				ND	Learning and study strategies*	Conscientiousness*; Procrastination		

#26	ACT; SBEI; SJT	GPA (total); Major GPA	C-SRL-S	✓*	✓	ND*	Leadership	Perseverance	Learning goal orientation; Motivation*	Ethics; Institutional integration; Social responsibility
#27	ACT; Biodata Scale; SAT; SJT	Absenteeism; GPA (total)	C-SRL-S			VR*; NR*	Leadership	Big Five*; Perseverance	Career orientation; Learning goal orientation	Ethics; Institutional integration; Social responsibility*; Social integration Communication
#28	MMI	IPE	SRL-S							
#29	Interview; UMAT	Rank (2-5)	C-SRL-S	✓*	✓	LR; PA	Decision-making	Emotional intelligence	Motivation	Communication
#30	GRE	GPA (1-4)	C	✓		VR; WS; NR				
#31	DAT	GPA (1); Rank (1)	C	✓*		RC; NR; PA				
#32	ACT; Biodata Scale; SAT; SJT	Absenteeism; GPA (total)	C-SRL-S	✓*		VR*; NR*	Leadership	Perseverance	Career orientation; Learning goal orientation	Ethics; Institutional integration; Social responsibility Communication
#33	Essay; Interview; SAT	GPA (1)	C-S	✓		VR*; WS; NR*				
#34	Interview; UMAT	GPA (1-2, total)	C-SRL-S	✓*	✓*	LR; PA	Coping ability; Self-knowledge	Emotional intelligence	Motivation	Communication
#35	CCTST; DAT	GPA (1-4)	C-SRL	✓*		RC*; NR*; PA	Critical thinking*			
#36	LASSI; MCAT	FS-GPA	C-SRL-S			ND*	Learning and study strategies*		Motivation*	
#37	Interview; PCAT; SAT	GPA (total)	C-S	✓*	✓*	✓	ND*	Professionalism*		Communication*
#38	UMAT	GPA (1-4)	C-S				LR; PA	Emotional intelligence		
#39	Interview; MUnSYI	GPA (1-3)	C-S	✓			ND	Emotional intelligence	Motivation	Communication
#40	Adhoc instrument; NCEE	GPA (1)	S	✓*	✓				Motivation	
#41	PAM	GPA (1)	C	✓	✓		NR			
#42	AVEI	GPA (total)	S	✓				Emotional intelligence		

GPA (year/total): Graduate Point Average; FS-GPA: Last Semester GPA; DO: Dropout; IPE: Integrated Practical Examination; Rank: class placement (year); C: includes cognitive abilities; SRL: includes self-regulated learning skills; S: includes soft skills; P: includes previous performance; K: includes domain-specific knowledge testing; S: includes socioeconomic information; RC: reading comprehension; VR: verbal reasoning; WS: writing skill; LR: logical reasoning; NR: numerical reasoning; PA: perceptual ability; PER: personality and traits; MOT: motivational and attitudinal factors; SOC: psychosocial contextual influences; ND: no data; NS: nonsignificant evidence.  
Predictor variables of academic success in a regression model.

Table 5. Validity evidence based on relations to academic success: cognitive abilities

Competence	ID	Evidence	Description	
Reading comprehension	#04	NS	It was not included in two regression models (234 students).	
	#14	NS	Null or practically null effects in four regression models (353 students).	
	#15	+	Moderate positive correlations in first-year GPA in a sample of 295 students.	
	#16	NS	No evidence was found in a sample of 280 students.	
	#23	NS	This competence did not explain academic performance in a sample of 1,062 students.	
	#24	+	It was shown to be relevant for first-year academic achievement and academic dropout in a sample of 851 students.	
	#31	NS	No evidence was found in a sample of 297 students.	
	#35	+	It showed weak correlations with GPA and was relevant in the final model (415 students).	
Verbal reasoning	#03	+	Weak positive correlations in first and second-year GPA in a sample of 209 students.	
	#04	NS	It was not included in two regression models (234 students).	
	#05	+	The competence was relevant to the model in a sample of 240 students.	
	#08	NS	It was not included in a regression model of total GPA (417 students).	
	#15	+	Moderate positive correlations in first-year GPA in a sample of 295 students.	
	#16	NS	No evidence was found in a sample of 280 students.	
	#18	+	Weak positive correlations in a sample of 97 students.	
	#22	NS	No evidence was found in a sample of 341 students.	
	#27	++	It correlated weakly with GPA and was included in GPA and academic absenteeism models (644 students).	
	#30	NS	It did not correlate significantly with any GPA measure (years 1 to 4) in a sample of 215 students.	
	#32	++	It correlated moderately with GPA. It was included in GPA and academic absenteeism models (1,155 students).	
	#33	+	Weak positive correlations after the first year in a sample of 506 students.	
	Writing skill	#08	NS	It was not included in a regression model of total GPA (417 students).
		#11	+	It showed weak correlations with three academic achievement measures in a sample composed of 117 students.
#23		++	This competence explained academic performance in a sample of 1,062 students.	
#30		+	It correlated weakly with first and second-year GPAs and not with third and fourth-year GPAs (215 students).	
#33		+	Weak positive correlations after the first year in a sample of 506 students.	
Logical reasoning	#07	+	It correlated very weakly in two cohorts, weakly in three cohorts, and moderately in four cohorts (650 students).	
	#13	+	The results showed weak to moderate associations with GPA in six of the ten cohorts studied (452 students).	
	#29	NS	No evidence was found in a sample of 411 students.	
	#34	NS	It was not relevant in either model of academic performance (243 students).	
	#38	+	It showed very weak correlations with overall GPA (339 students).	

Numerical reasoning	#02	++	It was significant in a predictive model of performance in a sample of 276 students.
	#04	NS	It was not included in two regression models (234 students).
	#05	+	The competence was relevant to the model in a sample of 240 students.
	#14	NS	Null or practically null effects in eight regression models (353 students).
	#15	++	Weak positive correlations in first-year GPA and moderate correlations in second and third-year GPA in a sample of 295 students.
	#16	+	It was relevant in a sample of successful students compared to unsuccessful students. (n = 280).
	#17	NS	No evidence was found in a sample of 1,162 students.
	#22	NS	No evidence was found in a sample of 341 students.
	#23	++	This competence explained academic performance in a sample of 1,062 students.
	#24	+	It was shown to be relevant for first-year academic achievement and academic dropout in a sample of 851 students.
	#27	++	It correlated weakly with GPA and was included in GPA and academic absenteeism models (644 students).
	#30	+	It correlated weakly with first-year GPA. It did not correlate with second, third, and fourth-year GPA (215 students).
	#31	+	Weak evidence was found regarding their association with first-year GPA and rank in a sample of 297 students.
	#32	++	It correlated moderately with GPA and was included in GPA and academic absenteeism models (1,155 students).
	#33	+	Weak positive correlations after the first year in a sample of 506 students.
	#35	+	It showed weak correlations with GPA and was relevant in the final model (415 students).
	#41	++	It was significant in two predictive models of performance in a sample of 272 students.
Perceptual ability	#06	NS	It was not included in four regression models (94 students).
	#07	NS	It did not correlate in eight cohorts (650 students).
	#09	++	Moderate positive correlations with overall GPA in a sample of 453 students.
	#29	NS	No evidence was found in a sample of 411 students.
	#31	+	Weak evidence was found regarding their association with first-year GPA and rank in a sample of 297 students.
	#34	NS	It was not relevant in either model of academic performance (243 students).
	#35	NS	It showed very weak correlations with GPA, but it was not relevant in the final model (415 students).
	#38	NS	No associations were found with overall GPA (339 students).

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+: Weak evidence; ++: Strong evidence; NS: Non-significant evidence.

Table 6. Validity evidence based on relations to academic success: self-regulated learning skills

Competence	ID	Evidence	Description
Collaboration <sup>1</sup>	#13	+	The results showed weak to moderate associations with GPA in six of the ten cohorts studied (452 students).
Coping ability <sup>1</sup>	#34	NS	It was not relevant in either model of academic performance (243 students).
Critical thinking	#13	+	The results showed weak to moderate associations with GPA in six of the ten cohorts studied (452 students).
	#17	NS	No evidence was found in a sample of 1,162 students.
	#19	+	No significant to weak positive correlations in students with second-year GPA in a sample of 249 students.
	#20	+	It showed weak correlations with first-year GPA in a sample of 405 students, but it was not included in the regression model.
	#35	+	It showed moderate correlations with GPA, but it was not relevant in the final model (415 students).
Decision-making <sup>1</sup>	#29	NS	No evidence was found in a sample of 411 students.
Effort regulation	#10	++	This competence was relevant in a model composed of 8,849 students in Taiwan.
Leadership <sup>1</sup>	#26	+	It did not predict GPA in a sample of 1,449 students.
	#27	+	It correlated very weakly with GPA and was included in a GPA model (644 students).
	#32	NS	It did correlate very weakly with GPA (1,155 students).
Learning and Study Strategies:	#20	NS	It was not included in a regression model of first-year GPA (405 students).
Concentration	#36	+	It showed weak correlations, but it was not included in the final model (106 students).
Learning and Study Strategies:	#20	NS	It was not included in a regression model of first-year GPA (405 students).
Elaboration	#36	+	It showed very weak correlations with first semester GPA (106 students).
Learning and Study Strategies:	#20	NS	It was not included in a regression model of first-year GPA (405 students).
Metacognition	#36	++	It showed moderate correlations and was included in the final model (106 students).
Learning and Study Strategies:	#20	NS	It was not included in a regression model of first-year GPA (405 students).
Organization	#36	NS	It did not correlate with academic performance, so it was not included in the final model (106 students).
Learning and Study Strategies:	#20	NS	It was not included in a regression model of first-year GPA (405 students).
Time/study management	#25	++	Moderate correlations were found in a sample of 104 students.
	#36	++	It showed moderate correlations and was included in the final model (106 students).
Self-directed learning <sup>1</sup>	#14	+	It was shown to be a strong predictor in two of four regression models (4 samples of 353 students).
Self-knowledge <sup>1</sup>	#34	NS	It was not relevant in either model of academic performance (243 students).
Study behavior <sup>1</sup>	#12	NS	No evidence was found in a sample of 418 students.

1: Emerging competence not identified in Richardson et al. (2012). The definition is provided in Appendix 3 (Table C.1); +: Weak evidence; ++: Strong evidence; NS: Non-significant evidence;

Table 7. Validity evidence based on relations to academic success: soft skills. Personality and traits

Competence	ID	Evidence	Description
Big Five: Agreeableness	#03	NS	No evidence was found in a sample of 209 students.
	#27	+	It correlated very weakly with GPA, but it was not included in any model (644 students).
Big Five: Conscientiousness	#03	+	Very weak positive correlations only in the first two GPA years of a sample of 209 students.
	#25	++	A moderate correlation was found in a sample of 104 students.
	#27	++	It correlated weakly with GPA and was included in GPA and academic absenteeism models (644 students).
Big Five: Extraversion	#03	+	Weak negative correlations only in the first two GPA years of a sample of 209 students.
	#27	+	It was included in GPA and academic absenteeism models (644 students).
Big Five: Neuroticism	#03	NS	No evidence was found in a sample of 209 students.
	#27	NS	It did not correlate with GPA and was not included in any model (644 students).
Big Five: Openness	#03	+	Weak negative correlations only in the first two GPA years of a sample of 209 students.
	#27	NS	It did not correlate with GPA and was not included in any model (644 students).
Emotional Intelligence	#03	+	Weak positive correlations in a sample of 209 students.
	#07	+	It correlated very weakly in two cohorts, weakly in one cohort, and moderately in two cohorts (650 students).
	#29	NS	No evidence was found in a sample of 411 students.
	#34	NS	It was not relevant in either model of academic performance (243 students).
	#38	NS	No associations were found with overall GPA (339 students).
	#39	NS	Scores were similar for both passing and failing students in all three academic years (196 students).
	#42	+	Weak positive correlations were found in a sample of 102 students.
Grit <sup>1</sup>	#01	++	Grit was significant in two predictive models of first-year GPA in a sample of 209 students.
Perseverance <sup>1</sup>	#26	NS	It did not predict GPA in a sample of 1,449 students.
	#27	+	It correlated very weakly with GPA (644 students).
	#32	NS	It did not correlate with GPA and was not included in any model (1,155 students).
Procrastination <sup>1</sup>	#25	+	A weak negative correlation was found in a sample of 104 students.
Professionalism <sup>1</sup>	#19	+	No significant moderate positive correlations in students with second-year GPA in a sample of 249 students.
	#37	+	This competence was part of the regression model although its predictive power was weak (141 students).
Resilience <sup>1</sup>	#17	NS	No evidence was found in a sample of 1,162 students.

1: Emerging competence not identified in Richardson et al. (2012). The definition is provided in Appendix 3 (Table C.1); +: Weak evidence; ++: Strong evidence; NS: Non-significant evidence.

Table 8. Evidence-based on relations to academic success: soft skills. Motivational and attitudinal factors

<b>Competence</b>	<b>ID</b>	<b>Evidence</b>	<b>Description</b>
Career orientation	#27	NS	It did not correlate with GPA and was not included in any model (644 students).
	#32	NS	It did not correlate with GPA and was not included in any model (1,155 students).
Internal locus of control	#14	++	Internal locus of control was shown to be a strong predictor in three regression models (353 students).
Learning goal orientation	#26	NS	The competence did not predict GPA in a sample of 1,449 students.
	#27	NS	It did not correlate with GPA and was not included in any model (644 students).
	#32	+	It correlated very weakly with GPA and was included in an academic absenteeism model (1,155 students).
Motivation	#10	+	It was shown to be a mediator in a large sample of 8,849 students in Taiwan.
	#11	NS	It did not correlate with any of the three academic achievement measures in a sample composed of 117 students.
	#12	NS	No evidence was found in a sample of 418 students.
	#18	NS	No evidence was found in a sample of 97 students.
	#20	+	It showed weak correlations with first-year GPA in a sample of 405 students, but it was not included in the regression model.
	#21	NS	No evidence was found in a sample of 436 students.
	#26	++	It was a significant predictor of GPA in a sample of 1,449 students.
	#29	NS	No evidence was found in a sample of 411 students.
	#33	+	Very weak positive correlations after the first year in a sample of 506 students.
	#34	NS	It was not relevant in either model of academic performance (243 students).
#36	+	It showed weak correlations with first semester GPA (106 students).	
#39	NS	Scores were similar for both passing and failing students in the first and third academic years (196 students).	
#40	NS	It was not included as a predictor of first-year GPA in a sample of 1,285 students.	
Self-efficacy	#14	++	It was shown to be a strong predictor in three of four regression models (4 samples of 353 students).

1: Emerging competence not identified in Richardson et al. (2012). The definition is provided in Appendix 3 (Table C.1); +: Weak evidence; ++: Strong evidence; NS: Non-significant evidence.

Table 9. Validity evidence based on relations to academic success: soft skills. Psychosocial contextual influences

Competence	ID	Evidence	Description
Communication <sup>1</sup>	#13	+	The results showed weak to moderate associations with GPA in six of the ten cohorts studied (452 students).
	#14	NS	Null or negative effects were found in 4 regression models. (4 samples of 353 students).
	#17	NS	No evidence was found in a sample of 1,162 students.
	#18	NS	No evidence was found in a sample of 97 students.
	#19	+	No significant to moderate positive correlations in students with second-year GPA in a sample of 249 students.
	#28	++	Moderate positive correlations in a sample of 100 students.
	#29	NS	No evidence was found in a sample of 411 students.
	#33	NS	Very weak positive correlations after the first year in a sample of 506 students.
	#34	+	It was relevant as a predictor of overall GPA (243 students).
	#37	+	This competence was part of the regression model although its predictive power was weak (141 students).
	#39	NS	Scores were similar for both passing and failing students in the first and third academic years (196 students).
Ethics <sup>1</sup>	#05	NS	The competence was not relevant in the final regression model in a sample of 240 students.
	#13	+	The results showed weak to moderate associations with GPA in six of the ten cohorts studied (452 students).
	#20	NS	It was not included in a regression model of first-year GPA (405 students).
	#26	NS	It did not predict GPA in a sample of 1,449 students.
	#27	+	It correlated very weakly with GPA and was included in an academic absenteeism model (644 students).
	#32	+	It correlated very weakly with GPA and was included in an academic absenteeism model (1,155 students).
Institutional integration	#26	NS	Institutional integration did not predict GPA in a sample of 1,449 students.
	#27	++	It correlated weakly with GPA and was included in a GPA model (644 students).
	#32	NS	It did not correlate with GPA and was not included in any model (1,155 students).
Social responsibility <sup>1</sup>	#26	+	It correlated very weakly with GPA in a sample of 1,449 students.
	#27	NS	It correlated very weakly with GPA (644 students).
	#32	+	It did correlate very weakly with GPA (1,155 students).
Social integration	#10	NS	It was shown to be relevant in a model composed of 8,849 students in Taiwan.
	#17	NS	No evidence was found in a sample of 1,162 students.
	#18	NS	No evidence was found in a sample of 97 students.
	#27	NS	It did not correlate with GPA and was not included in any model (644 students).

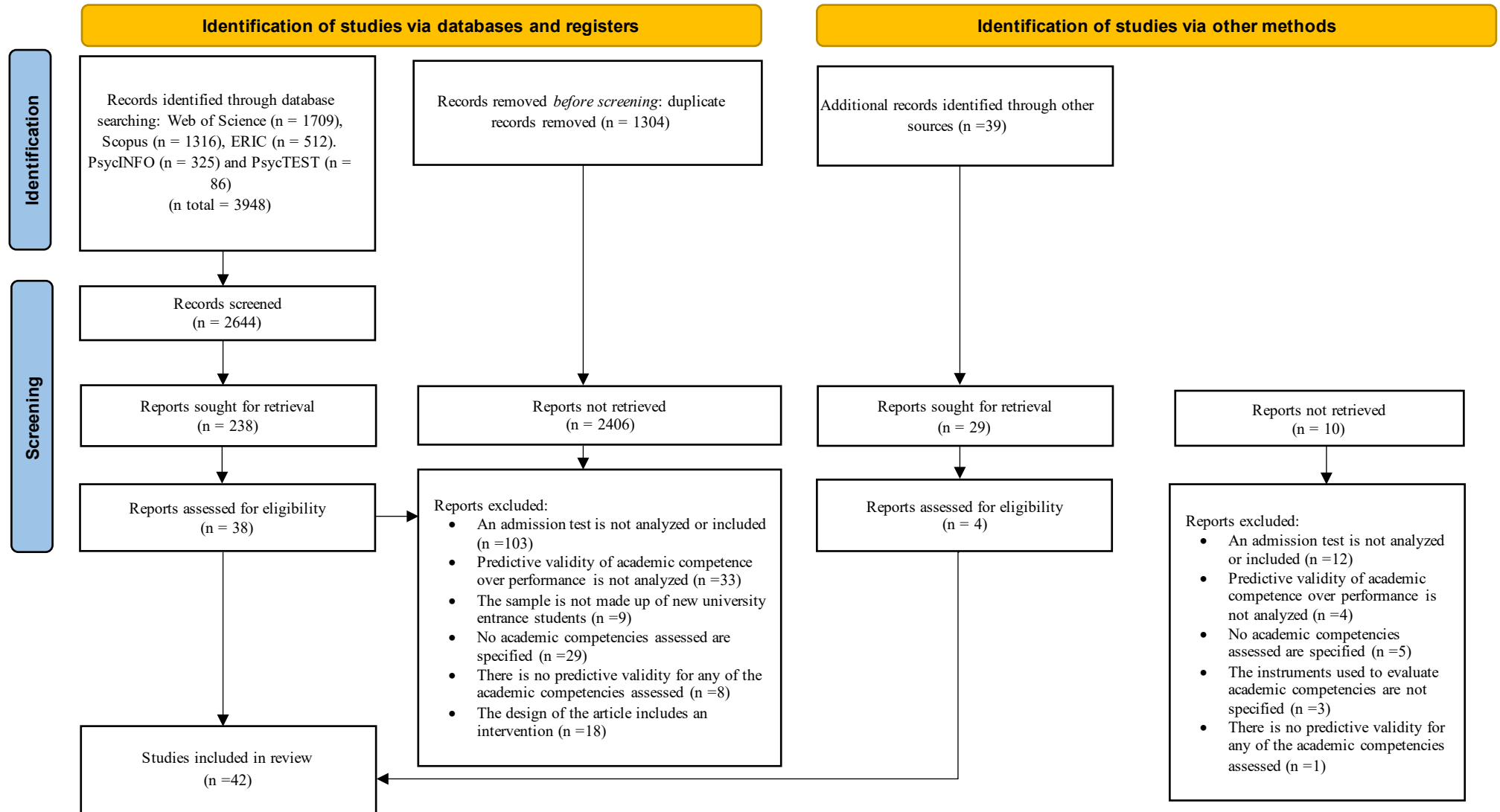
1: Emerging competence not identified in Richardson et al. (2012). The definition is provided in Appendix 3 (Table C.1); +: Weak evidence; ++: Strong evidence; NS: Non-significant evidence.

Table 10. Summary of key competencies according to the results of the review

<i>COG</i>	Verbal reasoning	Ability to analyze and evaluate written material and synthesize information obtained from it, analyze relationships among parts of sentences, and recognize relationships among words and concepts.
	Writing skill	Ability related to express through the written word. It includes elements of writing skills including spelling, grammar, sentence organization, vocabulary, ideas, and content.
	Logical reasoning	Competence in which a level of logical analysis is required to arrive at the correct solution.
	Numerical reasoning	It refers to basic mathematical skills, understanding of elementary mathematical concepts, and quantitative reasoning ability.
<i>SRL</i>	Collaboration	Ability to work collaboratively with a group of people to achieve a common goal.
	Critical thinking	Capacity to critically analyze learning.
	Effort regulation	Persistence and effort when faced with challenging academic situations.
	Leadership	Ability to move others to want to strive for shared aspirations. This implies the ability to encourage, motivate and/or influence others.
	Time/study management	Capacity to self-regulate study time and activities.
	Self-directed learning	Learning strategy that allows learners to take charge of their learning process.
<i>PER</i>	Conscientiousness	Personal tendency to be self-disciplined and achievement-oriented.
	Extraversion	Personal tendency to be an assertive, positive, and sociable student.
	Grit	Personal tendency to be passionate and persevering in the achievement of long-term goals.
	Procrastination	Personal tendency to delay working on tasks and goals.
	Professionalism	Personal tendency to have an articulated and externally imposed perception of what is within the parameters of the collective powers and responsibilities of a profession or the performance of an academic task.
<i>MOT</i>	Internal locus of control	The source of a student's motivation, attribution, and self-worth is either intrinsically or extrinsically determined.
	Self-efficacy	Students' general perceptions of academic capability.
<i>SOC</i>	Social responsibility	Being responsible to society and the community and demonstrating good citizenship.

COG: cognitive abilities; SRL: self-regulated learning skills; SOFT: soft skills; PER: Personality and traits; MOT: Motivational and attitudinal factors; SOC: Psychosocial contextual influences.

Figure 1. PRISMA flow diagram



## Appendix 1

Table A.1. Risk of bias scores obtained on the NOS-E scale

		NOS-E: Item scores					
		Representativeness of intervention group (a)	Selection of comparison group (b)	Comparability of comparison group (c)	Study retention (d)	Blinding of assessment (e)	Total Score
#01	Akos & Kretchmar, 2017	1	1	1	1	1	5
#02	Ali et al., 2017	1	1	2	0	0	4
#03	Brannick et al., 2013	1	0	0	1	0	2
#04	Chisholm et al., 1995	1	1	1	0	1	4
#05	Cortés-Flores & Palomar-Lever, 2008	1	1	1	1	1	5
#06	Curtis et al., 2007	1	1	1	0	1	4
#07	Edwards et al., 2013	1	1	2	1	0	5
#08	Evans & Wen, 2007	1	0	0	1	1	3
#09	Holmes et al., 2008	1	1	2	1	1	6
#10	Hsieh, 2019	1	1	2	0	0	4
#11	Hughes et al., 2017	1	1	1	0	0	3
#12	Hulsman et al., 2007	1	1	1	1	0	4
#13	Husband & Dowell, 2013	1	1	1	1	0	4
#14	Ihm et al., 2013	1	1	2	1	0	5
#15	Kegel-Flom, 1985	1	1	1	1	1	5
#16	Kegel-Flom, 1986	1	1	2	1	1	6
#17	Kim et al., 2016	1	0	0	1	0	2
#18	Kulatunga-Moruzi & Norman, 2002	1	0	0	0	0	1
#19	Lee et al., 2016	1	1	1	1	0	4
#20	Lobb et al., 2006	1	1	1	0	0	3
#21	Luqman, 2013	1	0	0	1	0	2

#22	Lynch et al., 2009	1	0	0	0	1	2
#23	Mikitovics & Crehan, 2002	1	1	1	0	1	4
#24	Niessen et al., 2016	1	0	0	1	1	3
#25	Niessen et al., 2018	1	1	1	0	0	3
#26	Nye et al., 2018	1	1	2	1	0	5
#27	Oswald et al., 2004	1	1	1	0	0	3
#28	Rauf et al., 2018	1	0	0	0	0	1
#29	Rich et al., 2011	1	1	2	1	0	5
#30	Roush et al., 2014	1	0	0	0	1	2
#31	Rowland & Rieken, 2018	1	1	1	0	1	4
#32	Schmitt et al., 2009	1	1	2	0	0	4
#33	Shahani et al., 1991	1	1	2	0	0	4
#34	Simpson et al., 2014	1	1	2	1	0	5
#35	Tsai, 2014	1	0	0	1	1	3
#36	West & Sadoski, 2011	1	0	0	1	0	2
#37	Wiest et al., 2008	1	0	0	0	0	1
#38	Wilkinson et al., 2011	0	1	1	0	1	3
#39	Yusoff et al., 2011	1	1	1	0	0	3
#40	Zhou et al., 2014	1	1	2	1	1	6
#41	Zuñiga et al., 2009	1	0	0	1	1	3
#42	Zysberg et al., 2011	1	0	0	0	1	2

Representativeness of intervention group (a): 0 = not representative, 1 = very or somewhat representative of the average learner in community. Selection of comparison group (b): 0 = no separate comparison group or drawn from a different community, 1 = drawn from the same community. Comparability of comparison group (c): 0 = no separate comparison group; 1 = controlled for 1 subject characteristic, 2 = controlled for 2 or more subject characteristics. Study retention (d): 0 = poor retention could introduce bias; 1 = retention unlikely to introduce bias. Blinding of assessment (e): 0 = outcome assessment not blinded; 1 = outcome assessment blinded.

Table A.2. Risk of bias scores obtained on the MERSQI scale

		MERSQI: Item scores								
		Sampling (b)			Data analysis (e)					
	Study design (a)	Institutions (b <sub>1</sub> )	Response rate (b <sub>2</sub> )	Type of data (c)	Validity (d)	Sophistication (e <sub>1</sub> )	Appropriateness (e <sub>2</sub> )	Outcome (f)	Total Score	
#01	Akos & Kretchmar, 2017	1	0.5	1.5	3	2	2	1	1.5	12.5
#02	Ali et al., 2017	1	0.5	0.5	1	2	2	1	1.5	9.5
#03	Brannick et al., 2013	1	0.5	1.5	1	2	2	1	1.5	10.5
#04	Chisholm et al., 1995	1	0.5	0.5	3	1	2	1	1.5	10.5
#05	Cortés-Flores & Palomar-Lever, 2008	1	0.5	1.5	3	1	2	1	1.5	11.5
#06	Curtis et al., 2007	1	0.5	0.5	3	1	2	1	1.5	10.5
#07	Edwards et al., 2013	2	1.5	1.5	3	1	2	1	1.5	13.5
#08	Evans & Wen, 2007	1	0.5	1.5	3	1	2	1	1.5	11.5
#09	Holmes et al., 2008	2	0.5	1.5	3	1	2	1	1.5	12.5
#10	Hsieh, 2019	1	1.5	NA	1	2	2	1	1.5	10*
#11	Hughes et al., 2017	2	0.5	1	3	1	2	1	1.5	12
#12	Hulsman et al., 2007	2	0.5	1.5	1	1	2	1	1.5	10.5
#13	Husband & Dowell, 2013	2	0.5	1.5	3	2	2	1	1.5	13.5
#14	Ihm et al., 2013	2	0.5	1.5	1	2	2	1	1.5	11.5
#15	Kegel-Flom, 1985	2	0.5	1.5	3	1	2	1	1.5	12.5
#16	Kegel-Flom, 1986	2	0.5	1.5	3	1	2	1	1.5	12.5
#17	Kim et al., 2016	1	0.5	1.5	3	1	2	1	1.5	11.5
#18	Kulatunga-Moruzi & Norman, 2002	1	0.5	NA	3	2	2	1	1.5	11*
#19	Lee et al., 2016	2	0.5	1.5	3	1	2	1	1.5	12.5
#20	Lobb et al., 2006	2	0.5	NA	1	1	2	1	1.5	9*
#21	Luqman, 2013	1	0.5	1.5	1	1	2	1	1.5	9.5
#22	Lynch et al., 2009	1	1	NA	3	1	2	1	1.5	10.5*
#23	Mikitovics & Crehan, 2002	1	0.5	NA	3	1	2	1	1.5	10*

#24 Niessen et al., 2016	1	0.5	1.5	3	2	2	1	1.5	12.5
#25 Niessen et al., 2018	2	0.5	0.5	1	2	2	1	1.5	10.5
#26 Nye et al., 2018	1	0.5	1.5	1	2	2	1	1.5	10.5
#27 Oswald et al., 2004	2	0.5	NA	1	3	2	1	1.5	11*
#28 Rauf et al., 2018	1	0.5	0.5	3	1	2	1	1.5	10.5
#29 Rich et al., 2011	2	0.5	1.5	3	1	2	1	1.5	12.5
#30 Roush et al., 2014	1	0.5	0.5	3	1	2	1	1.5	10.5
#31 Rowland & Rieken, 2018	2	0.5	NA	3	1	2	1	1.5	11*
#32 Schmitt et al., 2009	2	1.5	0.5	1	2	2	1	1.5	11.5
#33 Shahani et al., 1991	1	0.5	1	3	1	2	1	1.5	11
#34 Simpson et al., 2014	2	0.5	1.5	3	1	2	1	1.5	12.5
#35 Tsai, 2014	1	0.5	1.5	3	2	2	1	1.5	12.5
#36 West & Sadoski, 2011	1	0.5	1.5	1	1	2	1	1.5	9.5
#37 Wiest et al., 2008	1	0.5	NA	3	1	2	1	1.5	10*
#38 Wilkinson et al., 2011	1	0.5	0.5	3	1	2	1	1.5	10.5
#39 Yusoff et al., 2011	2	0.5	NA	3	1	2	1	1.5	11*
#40 Zhou et al., 2014	2	0.5	1.5	1	2	2	1	1.5	11.5
#41 Zuñiga et al., 2009	1	0.5	1.5	3	1	2	1	1.5	11.5
#42 Zysberg et al., 2011	1	0.5	2	3	2	2	1	1.5	13

Study design (a): 1 = single-group cross-sectional or single-group posttest only; 2 = 2-group nonrandomized or cohort studies. Sampling-institutions (b<sub>1</sub>): 0.5 = 1 institution; 1 = 2 institutions; 1.5 = 3 or more institutions. Sampling-response rate (b<sub>2</sub>): 0.5 = rate below 50% or not reported; 1 = rate between 50%–74%; 1.5 = rate equal to or above 75%; NA = Not applicable. Type of data (c): 1 = assessment by study participant; 3 = objective or observer ratings. Validity evidence for evaluation instrument scores (d) (summative scores): 1 = content; 1 = internal structure; 1 = relationships to other variables. Data analysis-Sophistication (e<sub>1</sub>): 2 = beyond descriptive analysis. Data analysis-Appropriate (e<sub>2</sub>): 1 = Data analysis appropriate for study design and type of data. Outcome (f): 1.5 = knowledge, skills.

## Appendix 2

Table B.1. Detailed information about evidence based on relations to a cademic success: cognitive abilities

Competence	ID	Main results	
Reading comprehension	#04	Reading comprehension was not included in a regression model of first-year academic achievement in the first sample of 119 students ( $p = .37$ ) and the second sample of 115 students ( $p = .13$ ).	
	#14	The effect of reading comprehension on academic performance was practically null in 6 models ( $b = .01; p < .05$ ) and null in 2 models ( $b = .00; p > .05$ ).	
	#15	The study-reading of the OCAT tool correlated moderately with first-year GPA ( $r = .33, p < .01$ ). No significant associations were found with second and third-year GPA.	
	#16	The study-reading of the OCAT tool was similar in successful students ( $M = 53.7; SD = 29.5$ ) relative to unsuccessful ( $M = 41.4; SD = 29.9$ ) ( $p > .05$ ).	
	#23	The reading part of PPST was not included in the final regression model ( $\beta = .04; p > .05$ ).	
	#24	The reading comprehension component of the skills test showed weak positive correlations with first-year academic performance ( $r = .25; p < .01$ ) and very weak negative correlations with dropout ( $r = -.13; p < .01$ ).	
	#31	Reading comprehension scores on the DAT test showed very weak correlations ( $r = .11; p < .05$ ). However, no differences were found between underachievers and remaining students ( $p > .05$ ). The competence is not included in the final model ( $p > .05$ ).	
	#35	Reading comprehension sub-scores of DAT showed weak correlations with the first two years' GPA ( $r = .25-.29; p < .05$ ). In addition, DAT scores explained 18% and 17% of the variance in GPA ( $p < .05$ ), respectively.	
	Verbal reasoning	#03	Verbal reasoning MCAT scores (including two knowledge tests) showed weak correlations for academic years 1-2 ( $r = .23; p < .01$ ) and 3 ( $r = .30; p < .01$ ); but not for year 4.
		#04	Verbal reasoning was not included in a regression model of first-year academic achievement in the first sample of 119 students ( $p = .56$ ) and the second sample of 115 students ( $p = .27$ ).
#05		The Verbal Reasoning Component of the EXANI admissions test is included in the final regression model (aggregated scores). The effect size is greater than the minimum required ( $R^2 = .05; p < .01$ ).	
#08		Verbal reasoning was not included in the total GPA regression model ( $\beta = .05; p > .01$ ).	

- #15 The verbal component of the OCAT tool correlated weakly with first-year GPA ( $r = .17, p < .01$ ). No significant associations were found with second and third-year GPA.
- #16 The verbal component of the OCAT tool was similar in successful students ( $M = 49.7; SD = 29.8$ ) relative to unsuccessful ( $M = 46.3; SD = 28.7$ ) ( $p > .05$ ).
- #18 The verbal portion of the MCAT correlated moderately with the Medical Council of Canada's Licensing Exam Part I ( $r = .32; p < .05$ ).
- #22 The verbal component of the UKCAT did not correlate significantly with first academic year performance.
- #27 The SAT, which includes a verbal reasoning component, showed a weak correlation with grade scores of .33 ( $p < .05$ ). Aggregate scores were included in the final model ( $\beta = .34; p < .05$ ).
- #30 The Verbal part of the GRE did not correlate significantly with any GPA measure from years 1 to 4 ( $p > .05$ ).
- #32 The SAT, which includes a verbal reasoning component, showed a moderate correlation with grade scores of .53 ( $p < .05$ ). Aggregate scores were included in the final model ( $\beta = .35; p < .05$ ).
- #33 The verbal portion of the SAT showed weak correlations after the first academic year ( $r = .29; p < .01$ ). In addition, it was included in the GPA regression model.
- Writing skill #08 Writing skill was not included in the total GPA regression model ( $\beta = .10; p > .01$ ).
- #11 Writing tasks showed weak to moderate correlations in Semester 1 (.29;  $p < .005$ ); Semester 2 (.27;  $p < .005$ ); and first-year GPA (.23;  $p < .01$ ).
- #23 The writing skill portion of the PPST was included in the final regression model ( $\beta = .16; p < .01$ ).
- #30 The Analytical Writing part of the GRE correlated weakly with first-year GPA ( $r = .17; p < .05$ ) and second-year GPA ( $r = .16; p < .05$ ). However, it did not correlate significantly with third and fourth-year GPA ( $p > .05$ ).
- #33 Writing skills (essay) showed weak correlations after the first academic year ( $r = .21, p < .05$ ). However, it was not included in the GPA regression model.
- Logical reasoning #07 Competence showed significant correlations in 6 of the 9 study cohorts ( $p < .05$ ): very weak (.16 and .18), weak (.26), and moderate (.40, .47, and .48).
- #13 Logical reasoning was studied through an MMI interview (in aggregate form). The results showed that the score obtained was associated with six different cohorts of students ( $r = .19$  to  $.35; p < .05$ ). No associations were found in the other 4 cohorts.
- #29 The score on Section 1 of the UMAT did not correlate with rank in the second year ( $r = .09; p > .05$ ) or the fifth year ( $r = -.16; p > .05$ ).

Numerical  
reasoning

- #34 The score on Section 1 of the UMAT was not included in any of the two regression models (first two years' GPA and overall GPA) ( $p > .05$ ).
- #38 Logical reasoning, assessed by the UMAT (Section 1), showed very weak associations with the first academic year in a sample of medical students ( $r = .14$ ;  $p < .01$ ).
- #02 It was shown that the mathematical component of the AKU-AT is useful in the proposed academic performance prediction model ( $r = .88$ ;  $p < .01$ ).
- #04 Numerical reasoning was not included in a regression model of first-year academic achievement in the first sample of 119 students ( $p = .97$ ) and the second sample of 115 students ( $p = .63$ ).
- #05 The Mathematical Reasoning Component of the EXANI admissions test is included in the final regression model (aggregated scores). The effect size is greater than the minimum required ( $R^2 = .05$ ;  $p < .01$ ).
- #14 The effect of numerical reasoning on academic performance was practically null in 7 models ( $b = .00-.01$ ;  $p < .05$ ) and null in 1 model ( $b = .00$ ;  $p > .05$ ).
- #15 The quantitative component of the OCAT tool correlated moderately with first-year GPA ( $r = .41$ ,  $p < .01$ ) and weakly with second ( $r = .24$ ,  $p < .01$ ) and third-year GPA ( $r = .27$ ,  $p < .01$ ).
- #16 The quantitative component of the OCAT tool was higher in successful students ( $M = 50.4$ ;  $SD = 26.1$ ) relative to unsuccessful ( $M = 27.8$ ;  $SD = 18.6$ ) ( $p < .01$ ).
- #17 Numerical reasoning did not explain subsequent academic performance after performing logistic regression ( $p > .05$ ).
- #22 The numerical component of the UKCAT did not correlate significantly with first academic year performance.
- #23 The mathematical part of ACT was included in the final regression model ( $\beta = .16$ ;  $p < .01$ ).
- #24 The math component of the skills test showed weak positive correlations with first-year academic performance ( $r = .29$ ;  $p < .01$ ) and weak negative correlations with dropout ( $r = -.15$ ;  $p < .01$ ).
- #27 The SAT, which includes a numerical reasoning component, showed a weak correlation with grade scores of .33 ( $p < .05$ ). Aggregate scores were included in the final model ( $\beta = .34$ ;  $p < .05$ ).
- #30 The Quantitative part of the GRE correlated weakly with first-year GPA ( $r = .17$ ;  $p < .05$ ). However, it did not correlate significantly with second, third, and fourth-year GPA ( $p > .05$ ).
- #31 Quantitative reasoning scores of the DAT test showed very weak correlations ( $r = .18$ ;  $p < .01$ ) and significant differences between underachievers and remaining students ( $p < .05$ ). However, it is not included in the final model ( $p > .05$ ).

- Perceptual ability
- #32 The SAT, which includes a numerical reasoning component, showed a moderate correlation on grade scores of .53 ( $p < .05$ ). Aggregate scores were included in the final model ( $\beta = .35$ ;  $p < .05$ ).
  - #33 The mathematical portion of the SAT showed weak correlations after the first academic year ( $r = .27$ ;  $p < .01$ ). In addition, it was included in the GPA regression model.
  - #35 Quantitative reasoning sub-scores of DAT showed weak correlations with the first two years' GPA ( $r = .27-.28$ ;  $p < .05$ ). In addition, DAT scores explained 18% and 17% of the variance in GPA ( $p < .05$ ), respectively.
  - #41 The mathematical component (PAM) was included as a predictor of medical performance in two different models: fixed effects ( $p < .001$ ) and random effects ( $p < .001$ ).
  - #06 Perceptual ability was not included in a regression model of first-year GPA with normally tracking students ( $p > .05$ ) and underachieving students ( $p > .05$ ). It was also not included in a regression model of fourth-year GPA with normally tracking students ( $p > .05$ ) and underachieving students ( $p > .05$ ).
  - #07 Competence showed very weak correlations ( $r = .18$ ) in only 1 of the 9 study cohorts ( $p < .05$ ).
  - #09 The perceptual ability sub-score of DAT showed moderate correlations with overall GPA ( $r = .37$ ;  $p < .05$ ).
  - #29 The score on Section 3 of the UMAT did not correlate with rank in the second year ( $r = -.02$ ;  $p > .05$ ) or the fifth year ( $r = .16$ ;  $p > .05$ ).
  - #31 Perceptual ability scores of the DAT test showed very weak correlations ( $r = .17$ ;  $p < .01$ ) and significant differences between underachievers and remaining students ( $p < .05$ ). However, it is not included in the final model ( $p > .05$ ).
  - #34 The score in Section 3 of the UMAT was not included in any of the two regression models (first two years' GPA and overall GPA) ( $p > .05$ ).
  - #35 Perceptual ability sub-scores of DAT showed very weak correlations with the first two years' GPA ( $r = .11-.17$ ;  $p < .05$ ). Its predictive power was marginal in the second academic year.
  - #38 Perceptual ability, assessed by the UMAT (Section 3), did not show associations with the first academic year in a sample of medical students ( $r = .09$ ;  $p > .05$ ).
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Table B.2. Detailed information about evidence based on relations to academic success: self-regulated learning skills

Competence	ID	Main results
Collaboration	#13	Teamwork was studied through an MMI interview (in aggregate). The results showed that the score obtained was associated with six different cohorts of students ( $r = .19$ to $.35$ ; $p < .05$ ). No associations were found in the other 4 cohorts.
Coping ability	#34	Contrary to expectations, coping with uncertainty (interview 6) had a negative predictive value for academic performance during the first 4 years ( $p < .01$ ).
Critical thinking	#13	Critical thinking was studied through an MMI interview (in aggregate). The results showed that the score obtained was associated with six different cohorts of students ( $r = .19$ to $.35$ ; $p < .05$ ). No associations were found in the other 4 cohorts.
	#17	Critical thinking did not explain subsequent academic performance after performing logistic regression ( $p > .05$ ).
	#19	Station 1 of the MMI, critical thinking; showed a weak correlation with the practical part of the second academic year of medical students ( $r = .29$ ; $p < .01$ ). It was relevant to the second academic year in two models ( $B = .22$ -.27; $p < .05$ ).
	#20	The correlation of critical thinking (WGCTA score) with the first-year GPA was weak ( $r = .25$ ; $p < .001$ ). It was not included in the regression model ( $p = .15$ ).
	#35	Critical thinking (CCTST) showed moderate correlations with the first two years' GPA ( $r = .40$ ; $p < .05$ ). It contributed 5% to the explained variance of yield in the first and second years ( $p < .05$ ).
Decision-making	#29	The decision-making score (interview) did not correlate with rank in the second year ( $r = -.14$ ; $p > .05$ ) or the fifth year ( $r = .07$ ; $p > .05$ ).
Effort regulation	#10	Quality of effort was shown to be relevant in the proposed academic performance model ( $B = .13$ ; $p < .01$ ).
Leadership	#26	The correlation of leadership with Major GPA was very weak ( $r = .10$ ; $p < .05$ ) and was not included in any regression model ( $p > .05$ ).
	#27	Leadership showed very weak correlations on GPA ( $r = .14$ ; $p < .05$ ). Also, it was included in a GPA model ( $\beta = .11$ ; $p < .05$ ).
	#32	Leadership showed almost null correlations on GPA ( $r = .09$ ; $p < .05$ ). It was not included in a GPA model.
Learning and Study	#20	The correlation of concentration (LASSI) with the first-year GPA was very weak ( $r = .12$ ; $p < .05$ ). It was not included in the regression model ( $p = .32$ ).

Strategies: Concentration	#36	The correlation of concentration with first semester GPA was weak ( $r = .23; p < .01$ ). However, it was not included in the regression model ( $p > .05$ ).
Learning and Study	#20	The correlation of elaboration (LASSI) with the first-year GPA was not significant. It was not included in the regression model ( $p = .32$ ).
Strategies: Elaboration	#36	The correlation of elaboration with first semester GPA was very weak ( $r = .12; p < .05$ ). It was not included in the regression model ( $p > .05$ ).
Learning and Study	#20	The correlation of metacognition (LASSI) with the first-year GPA was not significant. It was not included in the regression model ( $p = .32$ ).
Strategies: Metacognition	#36	The correlation of metacognition with first semester GPA was moderate ( $r = .36; p < .01$ ). In addition, it was included in the regression model ( $\beta = .29; p < .05$ ).
Learning and Study	#20	The correlation of organization (LASSI) with the first-year GPA was not significant. It was not included in the regression model ( $p = .32$ ).
Strategies: Organization	#36	The correlation of organization with first semester GPA was not significant ( $r = .08; p > .05$ ). It was not included in the regression model ( $p > .05$ ).
Learning and Study	#20	The correlation of time/study management (LASSI) with the first-year GPA was not significant. It was not included in the regression model ( $p = .32$ ).
Strategies: Time/study management	#25	Time/study management was shown to have a moderate positive correlation with first-year academic performance in a sample of psychology students ( $r = .38-.48; p < .05$ ).
	#36	The correlation of time/study management with the first semester GPA was moderate ( $r = .36; p < .01$ ). In addition, it was included in the regression model ( $\beta = .33; p < .05$ ).
Self-directed learning	#14	The effect of self-directed learning on academic performance was significant in 2 models ( $b = .11-.14; p < .01$ ) and not significant in 2 models ( $b = .01-.06; p > .05$ ).
Self- knowledge	#34	Self-knowledge (interview 4) was not included in any of the two regression models (first two years' GPA and overall GPA) ( $p > .05$ ).
Study behavior	#12	Study behavior did not explain overall GPA in any of the two models used ( $p > .05$ ).

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Table B.3. Detailed information about evidence based on relation to academic success: soft skills.  
Personality and traits

Competence	ID	Main results
Big Five: Agreeableness	#03	No significant associations with subsequent academic performance were found for any of the 4 years analyzed.
	#27	Agreeableness showed very weak correlations with GPA ( $r = .10$ ; $p < .05$ ). However, it was not included in any academic performance model (GPA or absenteeism).
Big Five: Conscientiousness	#03	Conscientiousness scores showed very weak correlations for academic years 1-2 ( $r = .18$ , $p < .05$ ). No associations for years 3 and 4 were found.
	#25	This competence was shown to have a moderate positive correlation with first-year academic performance in a sample of Psychology students ( $r = .44$ ; $p < .05$ ).
	#27	Conscientiousness showed weak correlations with GPA ( $r = .21$ ; $p < .05$ ). Also, it was included in the GPA model ( $\beta = .15$ ; $p < .05$ ) and an academic absenteeism model ( $\beta = -.14$ ; $p < .05$ ).
Big Five: Extraversion	#03	Extraversion scores showed weak correlations for academic years 1-2 ( $r = -.15$ , $p < .05$ ). No associations for years 3 and 4 were found.
	#27	Extraversion showed no significant correlations on GPA ( $r = -.03$ ; $p > .05$ ). However, it was included in the GPA model ( $\beta = -.13$ ; $p < .05$ ) and an academic absenteeism model ( $\beta = .10$ ; $p < .05$ ).
Big Five: Neuroticism	#03	No significant associations were found with subsequent academic performance in any of the 4 years analyzed.
	#27	Neuroticism showed no significant correlations with GPA ( $r = .07$ ; $p > .05$ ). Also, it was not included in any academic performance model (GPA or absenteeism).
Big Five: Openness	#03	Openness scores showed weak negative correlations for academic years 1-2 ( $r = -.24$ ; $p < .01$ ). No associations for years 3 and 4 were found.
	#27	Openness showed no significant correlations with GPA ( $r = .03$ ; $p > .05$ ). Also, it was not included in any academic performance model (GPA or absenteeism).
Emotional Intelligence	#03	Emotional intelligence scores showed weak correlations for academic years 3 ( $r = .17$ ; $p < .05$ ) and 4 ( $r = .16$ ; $p < .05$ ). No associations for years 1 and 2 were found.
	#07	This competence showed significant correlations in 5 of the 9 study cohorts ( $p < .05$ ): very weak (.17 and .18), weak (.29), and moderate (.43, .47).

	#29	The score on Section 2 of the UMAT did not correlate with rank in the second year ( $r = -.08, p > .05$ ) and showed negative weak correlations in the fifth year ( $r = -.25, p < .05$ )
	#34	The score in Section 2 of the UMAT was not included in any of the two regression models (first two years' GPA and overall GPA) ( $p > .05$ ).
	#38	Section 2 of the UMAT (Understanding people) did not show associations with the first academic year in a sample of medical students ( $r = .06; p > .05$ ).
	#39	Emotional quotient scores (MUnSYI) were similar for both passing students and failing students in all three academic years ( $p > .05$ ).
	#42	Emotional intelligence showed weak positive correlations with cumulative academic achievement, in a sample of 102 students ( $r = .26; p < .01$ ).
Grit	#01	Self-reported Grit-S was included as a predictor of first-year GPA ( $\beta = .13; p < .05$ ). Also, informant Grit-S was included as a predictor of first-year GPA ( $\beta = .25; p < .001$ ).
Perseverance	#26	The correlation of grit with Major GPA was not significant ( $r = .05; p > .05$ ) and was not included in any regression model ( $p > .05$ ).
	#27	Perseverance showed very weak correlations on GPA ( $r = .16; p < .05$ ). However, it was not included in any academic performance model (GPA or absenteeism).
	#32	Perseverance showed no significant correlations with GPA ( $r = .06; p > .05$ ). Also, it was not included in any academic performance model (GPA or absenteeism).
Procrastination	#25	This competence was shown to have a weak negative correlation with first-year academic performance in a sample of Psychology students ( $r = -.32; p < .05$ ).
Professionalism	#19	Station 3 of the MMI, Professionalism, and communication, showed a moderate correlation with the practical part of the second academic year of medical students ( $r = .45; p < .01$ ). It was relevant to the second academic year in one model ( $B = .44; p < .001$ ).
	#37	Potential for professionalism scores (interview) was part of the explanatory model of total GPA, ( $b = .03; p < .05$ ). However, the predictive power was lower compared to undergraduate GPA and PCAT scores.
Resilience	#17	Resilience did not explain subsequent academic performance after performing logistic regression ( $p > .05$ ).

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Table B.4. Detailed information about evidence based on relations to academic success: soft skills. Motivational and attitudinal factors

Competence	ID	Main results
Career orientation	#27	Career orientation showed no significant correlations with GPA ( $r = -.02; p > .05$ ). Also, it was not included in any academic performance model (GPA or absenteeism).
	#32	Career orientation showed negative weak correlations on GPA ( $r = -.16; p < .05$ ). Also, it was not included in any academic performance model (GPA or absenteeism).
Internal locus of control	#14	The effect of internal locus of control on academic performance was significant in 3 models ( $b = .35-.57; p < .05$ ) and not significant in 1 model ( $b = .02; p > .05$ ).
Learning goal orientation	#26	The correlation of continuous learning with Major GPA was not significant ( $r = -.01; p < .05$ ) and was not included in any regression model ( $p > .05$ ).
	#27	Learning goal orientation showed no significant correlations on GPA ( $r = .06; p > .05$ ). Also, it was not included in any academic performance model (GPA or absenteeism).
	#32	Learning goal orientation showed very weak correlations on GPA ( $r = .13; p < .05$ ). Also, it was included in a GPA model ( $\beta = .06; p < .05$ ).
Motivation	#10	Motivation was shown to be a variable that mediates academic performance through the quality of effort ( $b = .25; p < .01$ ).
	#11	Motivation (interview) did not correlate with any of the 4 measures of academic performance ( $r = .03-.17; p > .05$ ).
	#12	Motivation did not explain overall GPA in any of the two models used ( $p > .05$ ).
	#18	Motivation (assessed through the personal interview) did not correlate with the Medical Council of Canada's Licensing Exam Part I ( $r = .01; p > .05$ ).
	#20	The correlation of motivation with the first-year' GPA was weak ( $r = .20; p < .05$ ). It was not included in the regression model ( $p = .32$ ).
	#21	Motivation did not correlate with performance in any of the 5 academic years ( $p > .05$ ).
	#26	The correlation with Major GPA was moderate ( $r = .31; p < .05$ ) and was included in the regression model ( $p < .05$ ).
	#29	Motivation score (interview) did not positively correlate with rank in the second year ( $r = -.14, p > .05$ ) or the fifth year ( $r = .07, p > .05$ ).

	#33	Motivation (interview) showed very weak correlations after the first academic year ( $r = .10, p < .05$ ). However, it was not included in the GPA regression model.
	#34	Motivation (interview 1) was not included in any of the two regression models (first two years' GPA and overall GPA) ( $p > .05$ ).
	#36	The correlation of motivation with the first semester GPA was weak ( $r = .24, p < .01$ ). However, it was not included in the regression model ( $p > .05$ ).
	#39	Interview scores were significantly better for passing students than failing students during the second academic year ( $p < .05$ ), but they were similar during the first and third years ( $p > .05$ ).
	#40	None of the five factors from the motivational attitude questionnaire were included in the first-year GPA regression model: self-concept ( $p = .82$ ), faculty interaction ( $p = .64$ ), average authority ( $p = .25$ ), social goals ( $p = .26$ ), financial goals ( $p = .56$ ).
Self-efficacy	#14	The effect of self-efficacy on academic performance was significant in 3 models ( $b = .59-1.31; p < .01$ ) and not significant in 1 model ( $b = .16; p > .05$ ).

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Table B.5. Detailed information about evidence based on relations to academic success: soft skills. Psychosocial contextual influences

Competence	ID	Main results
Communication	#13	Communication skills were studied through an MMI interview (in aggregate). The results showed that the score obtained was associated with six different cohorts of students ( $r = .19$ to $.35$ ; $p < .05$ ). No associations were found in the other 4 cohorts.
	#14	Interpersonal communication was not significant in the 4 models ( $b = -.15$ -. $.00$ ; $p > .05$ ).
	#17	Communication skills did not explain subsequent academic performance after performing logistic regression ( $p > .05$ ).
	#18	Communication skills (assessed through simulated tutorial scores) did not correlate with the Medical Council of Canada's Licensing Exam Part I ( $r = .00$ , $p > .05$ ).
	#19	Station 3 of the MMI, composed of professionalism and communication; showed a moderate correlation with the practical part of the second academic year of the medical students ( $r = .45$ ; $p < .01$ ). It was relevant to the second academic year in one model ( $B = .44$ ; $p < .001$ ).
	#28	The MMI assessment, showed a positive moderate correlation of ( $r = .52$ ; $p < .01$ ).
	#29	Communication skills score (interview) did not correlate with rank in the second year ( $r = -.14$ ; $p > .05$ ) or fifth year ( $r = .07$ ; $p > .05$ ).
	#33	Oral communication (interview) showed very weak correlations after the first academic year ( $r = .10$ ; $p < .05$ ). However, it was not included in the GPA regression model.
	#34	Communication (interview 2) was included in an overall GPA regression model ( $\beta = .21$ ; $p < .01$ ). However, it was not included as a predictor of the first two years' GPA regression model ( $p > .05$ ).
	#37	Communication scores (interview) were part of the explanatory model of total GPA, ( $b = .03$ ; $p < .05$ ). However, the predictive power was lower compared to undergraduate GPA and PCAT scores.
	#39	Communication scores (interview) were significantly better for passing students than failing students during the second academic year ( $p < .05$ ), but they were similar during the first and third years ( $p > .05$ ).
Ethics	#05	The effect size of ethics was practically null for the proposed regression model ( $R^2 = .01$ ; $p < .05$ ).
	#13	Morality, ethics, honesty, and integrity were studied through an MMI interview (in aggregate). The results showed that the score obtained was associated with six different cohorts of students ( $r = .19$ to $.35$ , $p < .05$ ). No associations were found in the other 4 cohorts.

	#20	The correlation of moral reasoning (DIT percentile score) with the first-year GPA was not significant. It was not included in the regression model ( $p = .75$ ).
	#26	The correlation of ethics with Major GPA was very weak ( $r = .07; p < .05$ ) and was not included in any regression model ( $p > .05$ ).
	#27	Ethics showed very weak correlations on GPA ( $r = .14; p < .05$ ). Also, it was included in an academic absenteeism model ( $\beta = -.19; p < .05$ ). These results included multicultural appreciation scores (tolerance and respect for others).
	#32	Ethics showed very weak correlations on GPA ( $r = .16; p < .05$ ). Also, it was included in an academic absenteeism model ( $\beta = -.20; p < .05$ ). These results included multicultural appreciation scores (tolerance and respect for others).
Institutional integration	#26	The correlation of institutional integration with Major GPA was not significant ( $r = .02; p < .05$ ) and was not included in any regression model ( $p > .05$ ).
	#27	Institutional integration showed weak correlations on GPA ( $r = .21; p < .05$ ). Also, it was included in a GPA model ( $\beta = .11; p < .05$ ).
	#32	Institutional integration showed no significant correlations on GPA ( $r = .05; p > .05$ ). Also, it was not included in any academic performance model (GPA or absenteeism).
Social responsibility	#26	The correlation of social responsibility with Major GPA was very weak ( $r = .11; p < .05$ ). However, it was not included in any regression model ( $p > .05$ ).
	#27	Citizenship showed almost null correlations on GPA ( $r = .08; p < .05$ ). It was not included in any academic performance model (GPA or absenteeism).
	#32	Citizenship showed very weak correlations with GPA ( $r = .14; p < .05$ ). However, it was not included in any academic performance model (GPA or absenteeism).
Social integration	#10	Interactions with agents of socialization did not predict college success (with peers: $b = .00; p > .05$ ; with faculty members: $b = .00; p > .05$ ).
	#17	Social integration did not explain subsequent academic performance after performing logistic regression ( $p > .05$ ).
	#18	Social integration (assessed through the personal interview) did not correlate with the Medical Council of Canada's Licensing Exam Part I ( $r = .01; p > .05$ ).
	#27	Social integration showed no significant correlations with GPA ( $r = .04; p > .05$ ). Also, it was not included in any academic performance model (GPA or absenteeism).

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### Appendix 3

Table C.1. Glossary of terms

<b>Term</b>	<b>Description</b>
Academic competencies	Skills or abilities that can be promoted in the educational context (Sadler, 2013).
Big Five	The Big Five personality traits are a widely accepted framework for understanding and measuring personality. The five traits are openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism.
Coping ability	Coping-ability is a self-regulated learning (SRL) skill that involves the ability to identify and manage emotions, thoughts, and behaviors in response to challenging tasks and situations.
Cognitive abilities	Set of mental processes used to acquire, store, and use knowledge and skills. These processes include memory, executive functioning, problem-solving, and decision-making. These competencies comprise a major factor: general ability or intelligence (Ackerman & Heggestad, 1997).
Collaboration	Collaboration as a social level of Self-Regulated Learning (SRL) is the process of working together to accomplish a shared goal or objective. This includes engaging in meaningful communication, exchanging ideas and resources, and making decisions together. It also involves developing an understanding of one another's perspectives, learning, and problem-solving skills, and actively supporting each other in the pursuit of shared goals.
Communication	A process by which information, ideas, and messages are exchanged among individuals and groups within the academic community
Domain-specific knowledge	It refers to the assessment of a content area mastery, measured by the score obtained in a test in a given area (i.e., English as a second language). This concept is contrasted with the concept of domain-general skills (Stemler, 2012; Niessen & Meijer, 2017) or academic competence, considered the unit of analysis of this study.
Ethics	Moral principles and values govern the behavior of individuals and institutions in the academic setting.
Grit	Grit in higher education can be defined as the combination of passion and perseverance for long-term goals. It is a psychological trait that involves having a strong interest in a particular field of study or career, and the ability to maintain effort and commitment to achieving one's goals despite obstacles and setbacks.
Higher-order thinking skills	Higher-order thinking skills (HOTS), which involve Bloom's higher taxonomies, including processes of creation, evaluation, and analysis (Vidergor et al., 2019). HOTS require the use of cognitive abilities such as memory, attention, and reasoning, as well as self-regulatory skills such as metacognition, motivation, and self-control (Vidergor, et al., 2019).
Leadership	Leadership as a social SRL refers to the ability to effectively guide, direct and influence the actions of a group or organization toward a common goal.
Learning and study strategies	Students' awareness about, and use of, learning and study strategies related to skill, will, and self-regulation components of strategic

	learning (Musso et al., 2020). This set of skills usually comprises competencies such as concentration, elaboration, metacognition, organization and time/study management, which are assessed through different scales of the Learning and Study Strategies Inventory (LASSI; Theobald, 2021). They are part of the self-regulated learning skills group (Richardson et al., 2012).
Perseverance	Perseverance is a trait that involves the ability to persevere through difficulties, delay gratification, and persist in the pursuit of a goal despite obstacles and failures.
Procrastination	Procrastination refers to the tendency to delay or postpone tasks or activities, often despite knowing that it might have negative consequences.
Professionalism	Personal tendency to have an articulated and externally imposed perception of what is within the parameters of the collective powers and responsibilities of a profession or the performance of an academic task.
Resilience	It is the ability to cope with and recover from challenges, difficulties, and setbacks while maintaining a positive outlook and the ability to function effectively
Self-directed learning	Learning strategy that allows learners to take charge of their learning process.
Self-knowledge	Self-knowledge involves being aware of one's strengths and weaknesses and one's beliefs, as well as understanding how one's actions and decisions affect one's goals.
Self-regulated learning skills	These skills are characterized by actively managing one's learning, monitoring progress, and making adjustments to achieve specific educational goals, including skills such as critical thinking, time/management, or metacognition (Zimmerman, 2008). This conception entails skills at the individual level (i.e., self-knowledge) (Richardson et al., 2012) and the social level (i.e., collaboration) (Schunk & Mullen, 2013).
Social responsibility	Being responsible to society and the community and demonstrating good citizenship.
Soft skills	Set of skills integrated by personality traits, motivational and attitudinal factors (MOT), and psychosocial and contextual influences (SOC). This group has also been called non-cognitive skills, or non-cognitive competencies
Study behavior	Ability to set realistic and specific goals, identify the resources and materials needed to achieve them, develop and follow a plan for studying and practicing, monitor progress, and make adjustments as needed.