

UNIVERSITY STUDENT ENGAGEMENT INVENTORY (USEI)

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5 University Student Engagement Inventory (USEI): Psychometric properties

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25 University Student Engagement Inventory (USEI): Psychometric properties

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27 Abstract

28 Academic engagement describes students' investment in academic learning and achievement
29 and is an important indicator of students' adjustment to university life, particularly in the first
30 year. A tridimensional conceptualization of academic engagement has been accepted
31 (behavioral, emotional and cognitive dimensions). This paper tests the dimensionality,
32 internal consistency reliability and invariance of the University Student Engagement
33 Inventory (USEI) taking into consideration both gender and the scientific area of graduation.
34 A sample of 908 Portuguese first-year university students was considered. Good evidence of
35 reliability has been obtained with ordinal alpha and omega values. Confirmatory factor
36 analysis substantiates the theoretical dimensionality proposed (second-order latent factor),
37 internal consistency reliability evidence indicates good values and the results suggest
38 measurement invariance across gender and the area of graduation. The present study
39 enhances the role of the USEI regarding the lack of consensus on the dimensionality and
40 constructs delimitation of academic engagement.

41 **Keywords:** academic engagement, higher education, first-year students, assessment,
42 measurement invariance

43 Introduction

44 Research on engagement emerged from professional and occupational contexts. In
45 these contexts, engagement is defined as a positive psychological state that is characterized
46 by vigor, dedication and absorption associated with work-related well-being (Bakker et al.
47 2008; Hirschi 2012; Schaufeli and Bakker 2010). In recent years engagement has also been
48 studied in educational contexts, namely in higher education (Bresó et al. 2011; Christenson
49 and Reschly 2010; Kuh 2009; Vasalampi et al. 2009). These studies are often present in
50 international research concerning academic learning and achievement (Krause and Coates
51 2008; Schaufeli, Martinez, Marques Pinto, et al. 2002).

52 Students' academic engagement can be defined as the time, intention and energy
53 students devote to educationally sound activities. Academic engagement is related to the
54 policies and practices that institutions use to induce students to take part in those activities
55 (Hodson and Thomas 2003; Kuh 2005; Wierstra et al. 2003). Research has established that
56 engaged students invest more in their performance, participate more and tend to develop
57 mechanisms to help them persist and self-regulate their learning and achievement (Klem and
58 Connell 2004; National Research Council and Institute of Medicine 2004).

59 Academic engagement is associated with a positive way of experiencing academic
60 activities and contexts, since it is related to positive academic and social outcomes (Klem
61 and Connell 2004; Wonglorsaichon et al. 2014), to satisfaction and self-efficacy (Coetzee
62 and Oosthuizen 2012), and to a reduction of achievement problems, burnout and dropout
63 (Chapman et al. 2011; Christenson et al. 2012; Christenson and Reschly 2010; Eccles and
64 Wang 2012; Elmore and Huebner 2010; Finn and Zimmer 2012; Fredricks et al. 2004, 2011;
65 Gilardi and Guglielmetti 2011; Reschly and Christenson 2012a).

66 As engagement is a broad meta-construct it can be problematic because various
67 definitions exist both within and across the different types of engagement (Fredricks et al.
68 2016). Two dominant conceptualizations of academic engagement have emerged in the
69 literature (for a recent debate on academic engagement see Senior and Howard 2015).
70 Schaufeli, Martinez, Marques-Pinto, Salanova and Bakker (2002) adapted the Utrecht Work
71 Engagement Scale (UWES) from the business organizations' perspective to measure student
72 engagement in university settings. The adapted scale, the UWES – Student version (UWES-
73 S), uses the same three work engagement dimensions (vigor, absorption and dedication)
74 adapted to the university context by rephrasing some of the original UWES items. The other
75 predominant student academic engagement conceptualization by Fredricks et al. (2004)
76 defines academic engagement as a multidimensional construct, integrating behavioral,
77 emotional and cognitive dimensions, which is usually in line with the notion that the
78 behavioral component corresponds to vigor, the emotional one to dedication and the
79 cognitive one to absorption (Christensen 2017). However, criticisms have been raised
80 regarding Salanova et al.'s (2002) and Fredricks et al.'s (2004) student academic engagement
81 conceptualizations. The former was a simple adaptation of the workplace to the university
82 context; the latter was derived mainly for high school students (Marôco et al.
83 2016). Theorizing academic engagement as a multidimensional construct allows for the better
84 generalization and understanding of academic engagement as a combination of its several
85 factors. Also, analysis of the engagement first-order factors (behavioral, emotional and
86 cognitive) allows for pinpointing the different contribution to overall engagement and direct
87 interventions.

88 Clarification is needed since some theoretical frameworks almost overlap with
89 previous literature (Fredricks 2015). In the academic engagement literature, there is a need

90 for clear definitions with differentiation between the dimensions within the adopted
91 framework (Fredricks et al. 2004). Raising the importance of having measures that take this
92 into consideration without crossing the content of different dimensions of different factors
93 increases the utility of analyzing the validity evidence of multidimensional psychometric
94 instruments. Marôco, Marôco, Campos and Fredricks (2016) reviewed the main criticisms of
95 both approaches and developed the University Student Engagement Inventory (USEI). This
96 inventory includes the behavioral, cognitive and emotional dimensions of academic
97 engagement, which is the definition and division of dimensions adopted by most research
98 (Fredricks 2015). The behavioral dimension is related to behaviors such as attending classes,
99 arriving on time, doing prescribed tasks/homework in scheduled time, participating in
100 activities in and out of the classroom, and respecting the social and institutional rules. The
101 cognitive dimension refers to all the students' thoughts, perceptions and strategies related
102 with the acquisition of knowledge or development of competencies to academic activities,
103 for example their study methods, learning approaches and academic self-regulation. The
104 emotional dimension refers to positive and negative feelings and emotions related to the
105 learning process, class activities, peers and teachers, for example a sense of belonging,
106 enthusiasm, and motivation (Antúnez et al. 2017; Carter et al. 2012; Marôco et al. 2016;
107 Sheppard 2011). Validity evidence based on response processes (i.e. face validity) of the
108 behavioral, cognitive and emotional as dimensions of academic engagement was evaluated
109 by a focus group of university students and psychologists in the original proposal of Mâroco
110 et al. (2016). In this study, we focus on the validity evidence based on the USEI's internal
111 structure.

112 Although there is a consensus about the relevance of this construct to the explanation
113 of academic behavior and learning, there is not a precise delimitation of the construct and its

114 dimensionality (Christenson et al. 2012; Fredricks and McColskey 2012; Kahu 2013;
115 Reschly and Christenson 2012; Wolf-Wendel et al. 2009). A debate is still ongoing
116 concerning the definition and internal structure of the academic engagement construct. This
117 conceptual haziness (Appleton et al. 2008) extends to the dimensionality of the construct's
118 instruments: Some authors assume it to be a unidimensional primary factor or a second-order
119 factor as it is a general motivational trait or state, while other authors defend its
120 multidimensionality, but without consensus regarding the number of dimensions (Fredricks
121 et al. 2004; Handelsman et al. 2005; Lin and Huang 2018; Reschly and Christenson 2012b).

122 In this paper, we focus on the USEI for the university context and evaluate one of the
123 sources of evidence proposed in the *Standards for Educational and Psychological Testing*
124 (American Educational Research Association et al. 2014) regarding the validity evidence
125 based on the internal structure. Specifically, we aim to find good validity evidence regarding
126 the dimensionality of the first-order three-factor model (H1) of a possible second-order latent
127 factor model (H2), measurement invariance for gender (H3) and for the scientific area of
128 college graduation (H4), and good evidence of reliability of the scores through internal
129 consistency using several estimates (H5). This type of validity indicators intends to
130 demonstrate the relevance of an instrument that simultaneously can be useful to investigation
131 and practice. Namely, shown evidence of a meta-construct (academic engagement) which is
132 useful for research, demonstrating the utility of its specific domains for interventions with
133 specific students' subgroups.

134

135 **Method**

136 Validity is a vital issue when it refers to the quality of psychometric scales, and it
137 refers to the extent to which the evidence supports the interpretation of scale scores (Crutzen

138 and Peters 2017). Validity concerns the understanding of scale scores in a specific study; it
139 isn't a characteristic of a scale in itself (American Educational Research Association et al.
140 2014). Consequently, evidence from other studies must be used to justify the choice of a
141 specific scale, although in a strict sense it doesn't guarantee the same validity evidence in a
142 new study (Crutzen and Peters 2017). Nevertheless, every study that uses psychometric
143 scales must pay attention to the validity evidence brought by each scale in each study.
144 Historically, different types of validity have been approached; the current *Standards for*
145 *Educational and Psychological Testing* evolved after the first version, more than 60 years
146 ago (American Psychological Association 1954). The current *Standards* approach validity as
147 a unitary concept, with five sources of validity recognized (Sireci and Padilla 2014): based
148 on internal structure, based on test content, based on the relation to other variables, based on
149 response processes and based on the consequences of testing. Although these are not
150 considered to present distinct types of validity, an inclusive evaluation of the instrument
151 includes these different sources of evidence in a coherent account (American Educational
152 Research Association et al. 2014).

153 Validity evidence based on the internal structure includes three basic aspects:
154 dimensionality, measurement invariance and reliability (Rios and Wells 2014). To assess
155 dimensionality, one can opt for several factor analytic methods; however, confirmatory factor
156 analysis (Brown 2015) is the most comprehensive approach for comparing observed and
157 hypothesized test structures, as it evaluates the relationships between items and the latent
158 variables (theoretical constructs) and which items should be measured (Bollen 1989).

159 Measurement invariance assesses whether an instrument is fair for different
160 subgroups from a psychometric perspective (van de Schoot et al. 2012), such as occupations
161 (Sinval et al. 2018), countries (Reis et al. 2015), genders (Marsh et al. 2010) and other groups.

162 It can also be evaluated using different statistical approaches, with multigroup confirmatory
163 factor analysis being the most popular (Davidov et al. 2014). This approach consists of setting
164 increasingly constrained sets of structural equation models, and comparing the more
165 restricted models with the less restricted models (van de Schoot et al. 2015).

166 Since the validity of scores depends on their reliability (American Educational
167 Research Association et al. 2014), without reliability we can't have appropriate validity
168 evidence (Kaplan and Saccuzzo 2013). It can be evaluated with different techniques,
169 although the most usual is through internal consistency estimates, such as Cronbach's α ,
170 Revelle's β or McDonald's ω_h (Zinbarg et al. 2005). It provides evidence about the
171 consistency of the test scores across repeated administrations (American Educational
172 Research Association et al. 2014).

173

174 **Participants**

175 A sample of 908 Portuguese first-year university students (ages ranging from 17 to
176 58 years; $M = 19.41$; $SD = 4.79$; $Mdn = 18$) from a public university in the north of Portugal
177 was used to evaluate the psychometric properties of the USEI. These students commonly
178 took courses in three main areas: 40.18% were from technology or engineering courses;
179 29.52% from economics or law courses; and 30.30% from languages or humanities. Most
180 students were women (64.58%) and only 8.57% had a part-time or full-time occupation. With
181 respect to parents' level of education, 50.65% of mothers had a basic education level, 30.27%
182 a high school level and 19.08% a higher education level; meanwhile, 58.99% of fathers had
183 a basic education level, 24.64% had a secondary level and 16.38% a higher education level.

184

185 **Measures and procedures**

186 The USEI (Marôco et al. 2016) is a self-report Likert-type (1 = “never” to 5 =
187 “always”) scale with 15 items organized in three academic engagement dimensions:
188 behavioral (BE; e.g. *I usually participate actively in group assignments*), cognitive (CE; e.g.
189 *I like being at school*) and emotional (EE; e.g. *I try to integrate the acquired knowledge in*
190 *solving new problems*). This instrument presented good evidence of reliability and factorial,
191 convergent and discriminant validity evidence in a previous research study (Marôco et al.
192 2016). Exploratory and confirmatory factor analyses confirm systematically specific items
193 for each dimension. Reliability coefficients in terms of the consistency of items are above .63
194 (ordinal omega values) and above .69 (ordinal alpha values) for three dimensions.

195 A non-probabilistic convenience sample was considered, with the inclusion criterion
196 being students entering university. Data were collected in the classroom context with the
197 permission and collaboration of teachers. The aims of the study were presented, and
198 confidentiality was ensured. The participants provided informed consent stating their
199 voluntary agreement to participate in the study. Ten minutes were enough to fill in the
200 inventory and give some personal information for sample characterization.

201

202 **Data analysis**

203 All statistical analysis was performed with R (R Core Team 2018) and RStudio
204 (RStudio Team 2017). The descriptive statistics were obtained using the *skimr* package
205 (Rubia et al. 2017). Confirmatory factor analysis (CFA) was conducted to evaluate the
206 psychometric properties of the data gathered with the USEI, namely its internal structure
207 validity evidence. CFA was performed with the *lavaan* package (Rosseel 2012) using the

208 weighted least squares means and variances (WLSMV) estimation method, which is
209 indicated for nonlinear response scales. Internal consistency reliability estimates for ordinal
210 variables, average variance extracted (AVE) and heterotrait-monotrait (HTMT) were
211 calculated using the *semTools* package (semTools Contributors 2016), while Mardia's
212 Kurtosis (Mardia 1970) was assessed using the *psych* package (Revelle 2017).

213 The CFA was conducted to verify whether the proposed three-factor structure presented
214 an adequate fit for the study sample data. We used as goodness-of-fit indices the TLI (Tucker-
215 Lewis Index), χ^2/df (ratio of chi-square to degrees of freedom), the NFI (Normed Fit Index),
216 the CFI (Comparative Fit Index) and the RMSEA (Root Mean Square Error of
217 Approximation). The fit of the model was considered good for CFI, NFI and TLI values
218 above .95 and RMSEA values below .06 (Hu and Bentler 1999; Marôco 2014).

219 To analyze convergent validity evidence, the AVE was estimated as described in Fornell
220 and Larcker (1981). Values of $AVE \geq .5$ were considered acceptable indicators of convergent
221 validity evidence. To determine whether the items that are manifestations of a factor were
222 not strongly correlated with other factors, discriminant validity evidence was assessed.
223 Acceptable discriminant validity evidence was assumed when for two factors x and y , AVE_x
224 and $AVE_y \geq \rho^2_{xy}$ (squared correlation between the factors x and y), or when the HTMT
225 (Henseler et al. 2015) ratio of correlations is higher than .85 (Kline 2016).

226 The reliability of the internal scores evidence was assessed through internal consistency
227 measures. The ordinal Cronbach's alpha coefficient (α) and composite reliability (CR) were
228 calculated. Since alpha has been shown to present evidence of a measure's internal
229 consistency only when the assumptions of the essentially tau-equivalent model are obtained
230 (Revelle and Zinbarg 2009), the ordinal coefficient omega (ω) for each factor (Raykov 2001;

231 Zumbo et al. 2007) and the hierarchical omega (ω_h) coefficient (Green and Yang 2009; Kelley
232 and Pornprasertmanit 2016; McDonald 1999) were also calculated. Higher alpha values are
233 desirable, although excessively high values of alpha aren't recommended, as this reveals
234 unnecessary repetition and overlap (Streiner 2003). Values of $CR \geq .7$ were considered to be
235 satisfactory indicators of internal consistency (Marôco 2014). Omega values show evidence
236 of how much of the overall variance of a factor in the data that is due to that specific factor,
237 ω , was calculated for each of the three factors. As regards the ω_h , a higher value will indicate
238 a stronger influence of the latent variable common to all of the factors, and that the observed
239 scale scores generalize to scores for the common latent variable (Zinbarg et al. 2007). The
240 second-order factor reliability was also calculated using the omega coefficient (Jorgensen et
241 al. 2018).

242 The measurement invariance of the second-order model was assessed with the *lavaan*
243 package (Rosseel 2012), and we established a set of comparisons within a group of seven
244 different models based on the recommendations for ordinal variables (Millsap and Yun-Tein
245 2004) and for second-order models (Chen et al. 2005). An initial configural model was set,
246 which served as a baseline (configural invariance) for further equivalence testing (Edwards
247 et al. 2017). Next, metric invariance of the first-order factor loadings was tested with the
248 items' loadings forced to be equal across groups; this assessed whether the subgroups
249 attribute the same meaning to the different instrument items. The next step consisted in
250 forcing the second-order factor loadings to be equal across groups; this checked whether the
251 subgroups give the same meaning to the factors that compose the second-order latent factor.
252 Afterwards, scalar invariance of the first-order factors was tested, where thresholds were
253 added to be equal across groups (Millsap and Yun-Tein 2004). If scalar invariance was

254 obtained, it meant that the means or the thresholds of the items are also equal across the
255 subgroups, enabling comparisons between the different subgroups. Next, scalar invariance
256 of the second-order latent factor was tested, where the intercepts of the first-order latent
257 variables were forced to be equal across groups. This checked whether the first-order latent
258 levels were equal across groups. Usually, this was enough for measurement invariance, since
259 the next levels are too restrictive (Marôco 2014). After, the disturbances of first-order factors
260 were established as being equal across groups, to verify if the explained variances for the
261 first-order latent factors were equal across groups. Finally, if residual variances were also
262 added to be equal across groups without statistically significant differences, full uniqueness
263 measurement invariance was obtained, which means that the explained variance for all items
264 didn't change in regard to the subgroup (van de Schoot et al. 2012). Invariance across the
265 different levels can be assessed using two different criteria: the $\Delta\text{CFI} < .01$ between
266 constrained and free models (Cheung and Rensvold 2002), and the $\Delta\chi^2$ test comparing the fit
267 of the constrained vs. free models is not statistically significant (Satorra and Bentler 2001).

268

269 **Results**

270 *Items' distributional properties*

271 Summary measures, skewness (*sk*), kurtosis (*ku*) and a histogram for each of the 15
272 items are presented (Table 1) and were used to judge distributional properties and
273 psychometric sensitivity. Absolute values of *ku* smaller than 7 and *sk* smaller than 3 were
274 considered an indication of not strong deviations from the normal distribution (Finney and
275 DiStefano 2013). Mardia's multivariate kurtosis for the 15 items of the USEI was 37.5; p
276 $< .001$. All possible answer values for each item are also present, and no outliers were deleted.

277 Also interesting is the reduced number of missing answers from the 15 items (11 omissions
278 from item 10 “*My classroom is an interesting place to be*”).

279 The items’ distributional coefficients are indicative of appropriate psychometric
280 sensitivity, as it would be expected that these items would follow an approximately normal
281 distribution in the population under study. Despite these univariate and multivariate
282 normality indicators, the WLSMV estimator was used to account for the ordinal level of
283 measurement of the items, which can be done without concerns about this estimate.

284

285

286 Insert Table 1

287

288

289 *Factorial validity evidence*

290 In light of the previous researches on the USEI structure confirming the existence of
291 three dimensions, a confirmatory factor analysis was performed. The hypothesized three-
292 factor model’s fit with the data was good (Figure 1; correlations between latent variables, and
293 factor loadings for each item are shown), since CFI, NFI and TLI values were greater
294 than .95, and RMSEA values were less than .06. It is also important that the factor loadings
295 of all items are greater than .50, except for item 6 (the only reversed coded item in the
296 instrument).

297 Figure 1 – Confirmatory factor analysis of the University Students Engagement Inventory
298 (15 items) with first-year Portuguese university students ($\chi^2(87) = 286.665$, $p < .001$, $n =$
299 871 , $CFI = .987$, $TLI = .985$, $NFI = .982$, $RMSEA = .051$, $P(RMSEA \leq .05) = .356$, IC90
300 $].045; .058[$. R – Reversed.

301

302

303 Insert Figure 1 here

304

305

306

307 *Convergent validity evidence*

308 The average variance extracted (AVE) was acceptable for EE (.54), nearly acceptable
309 for CE (.49) and low for BE (.31). The convergent validity evidence was acceptable for the
310 CE and EE factors and unsatisfactory for the BE factor.

311

312 *Discriminant validity evidence*

313 Comparing data from these three dimensions, the AVE for EE ($AVE_{EE} = .54$) was greater
314 than $r^2_{BE,EE} (.36)$, but the $AVE_{BE} = .31$ was lower, the $AVE_{CE} = .49$ and $AVE_{EE} = .54$ were both
315 greater than $r^2_{EE,CE} = .24$, and the $AVE_{BE} = .31$ and $AVE_{CE} = .49$ were both less than $r^2_{BE,CE}$
316 $= .52$. The discriminant validity evidence was good for CE and EE, insufficient for BE and
317 EE, and poor for BE and CE. With regard to the HTMT criterion, the $HTMT_{BE,EE} = .60$,
318 $HTMT_{BE,CE} = .73$ and $HTMT_{EE,CE} = .51$, with all being below the recommended threshold.
319 Together, these findings detect strong correlations/overlap among the three latent constructs.
320 This points to a possible higher-order latent factor.

321

322 *Second-order construct*

323 We tested the possible existence of a higher-order latent variable, the meta-construct
324 *academic engagement*, which was hypothesized by the original authors (Marôco et al. 2016),
325 and suggested also by our lack of discriminant validity evidence findings. In regard to the
326 USEI with a second-order latent factor, overall the goodness-of-fit indices were good (Figure
327 2; gamma between the second-order latent factor and the first-order latent factors, and factor
328 loadings for each item are shown). The structural weights for the *academic engagement*

329 second-order factor model were medium/high: behavioral engagement ($\gamma = 0.93$; $p < .001$);
 330 emotional engagement ($\gamma = 0.64$; $p < .001$); and cognitive engagement ($\gamma = 0.77$; $p < .001$).

331 Figure 2 – Confirmatory factor analysis of the University Students Engagement Inventory
 332 (second-order model – 15 items) with first-year Portuguese university students ($\chi^2(87) =$
 333 286.665 , $p < .001$, $n = 871$, $CFI = .987$, $TLI = .985$, $NFI = .982$, $RMSEA = .051$, $P(RMSEA$
 334 $\leq .05) = .356$, IC90 [.045; .058]. R – Reversed.
 335

336 -----
 337 Insert Figure 2 here
 338
 339 -----
 340

341 *Reliability: Internal consistency evidence*

342 In terms of the hypothesized reliability evidence, the results suggest good evidence of
 343 internal consistency reliability (Table 2). The alpha values were higher than the omega values
 344 for all factors and for the total scale. The hierarchical omega for the total scale was good (ω_h
 345 $= .85$), which suggests a well-defined latent variable, thereby evidencing that this latent
 346 variable is more likely to be stable across studies, which also suggests that the general factor
 347 *academic engagement* is the dominant source of systematic variance (Rodriguez et al. 2016).

348 -----
 349 Insert Table 2
 350 -----

351 The internal consistency reliability of the second-order latent variable was good. The
 352 proportion of observed variance explained by the second-order factor after controlling for the
 353 uniqueness of the first-order factor ($\omega_{\text{partial L1}}$) was .87, the proportion of the second-order
 354 factor explaining the variance of the first-order factor level (ω_{L2}) was .87 and the proportion
 355 of the second-order factor explaining the total score (ω_{L1}) was .72.

356

357 *Measurement invariance by gender and scientific area of graduation*

358 Finally, to detect whether the same second-order latent model holds in different
359 scientific areas of graduation and genders, a group of nested models with indications of
360 equivalence is needed. The hypothesized full-scale invariance was supported for gender
361 (Table 3) using the Cheung and Rensvold (2002) Δ CFI criterion, while the $\Delta\chi^2$ criterion
362 supported only the second-order metric invariance. In regard to the hypothesized structural
363 invariance among different areas of study, full-scale invariance was supported by the Δ CFI
364 criterion, nevertheless the Δ CFI value for the first comparison was marginal at .010, although
365 the $\Delta\chi^2$ supported it, after we continued with the comparisons; the $\Delta\chi^2$ criterion allowed only
366 the first-order metric invariance (see Table 4). In both cases, the Δ CFI criterion was
367 preferable, since the $\Delta\chi^2$ is too restrictive (Marôco 2014).

368 -----

369 Insert Table 3

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371

372 -----

373 Insert Table 4

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375

376 **Discussion**377 **Hypotheses findings**

378 This study obtained findings that allow our H1 to be confirmed, since the data
379 gathered with the USEI presented good psychometric properties in terms of validity evidence
380 based on the internal structure, something that was observed in other studies with this
381 instrument, which obtained acceptable/good overall goodness of fit (Costa et al. 2014) and

382 good overall goodness of fit (Marôco et al. 2016). The confirmatory factor analysis presented
383 good evidence about factorial validity, since goodness-of-fit indices values ranged from very
384 good to good, and only item 6 had a lambda of less than .50. Analyzing its content, item 6 is
385 the only one reverse coded, which suggests that it should be presented in the same direction
386 as the other items in the future. Marôco, Marôco and Campos (2014) report this kind of
387 improvement in the items' correlations in student burnout (an opposite construct to academic
388 engagement). The USEI's convergent validity evidence is acceptable and the AVE values
389 were good for the EE dimension, marginally acceptable for CE and less than acceptable for
390 BE. These values show that the items of each dimension were good manifestations of the
391 factors they load onto. The discriminant validity evidence of the instrument was acceptable
392 for two of the three factors. The lack of discriminant validity evidence for BE may be due to
393 our sample being composed only of freshmen; in the original USEI study (Marôco et al.
394 2016) with students from other academic years, this lack of discriminant validity evidence
395 was not observed.

396 Our H2 was confirmed, something that has been tested by the original authors, with
397 whom our results were aligned in terms of structural weights, with behavioral engagement
398 having the highest gamma, followed by cognitive engagement and finally emotional
399 engagement (Marôco et al. 2016).

400 With regard to H3 and H4, our results brought evidence that allows comparisons to
401 be established between male and female genders using the USEI, and between first-year
402 students from technology or engineering courses, from economics or law courses, and from
403 languages or humanities. This finding was a novelty of our study, and is useful since previous
404 studies only assessed engineering students (Costa et al. 2014; Costa and Marôco 2017) or –
405 even with a sample from different courses – didn't test measurement invariance for the

406 scientific area of graduation (Marôco et al. 2016). Another novelty of this study was the test
407 of the second-order measurement invariance, since the only study that has tested
408 measurement invariance using this instrument (Marôco et al. 2016) did so only to compare
409 the structure between two independent samples without comparing specific scientific areas
410 of graduation, and regarding the first-order model. This finding will enable future
411 comparisons among these different groups to verify possible differences and their impact on
412 academic adjustment and achievement.

413 With regard to the evidence obtained about reliability, it was good for CR, ordinal α ,
414 ordinal ω and ω_h , suggesting adequate reliability of the data measured with the USEI. Our
415 results confirm our H5, and – nevertheless – are aligned with what was found in other studies,
416 where BE obtained lower reliability estimates than EE and CE (Costa et al. 2014; Marôco et
417 al. 2016).

418 Academic engagement is a relevant construct for describing student adaptation and
419 achievement in higher education. Engaged students tend to invest more in their performance
420 and develop strategies to persist in and to self-regulate their learning (Christenson and
421 Reschly 2010; Dilekmen 2007; Fredricks et al. 2011; Klem and Connell 2004). Consequently,
422 better academic success is expected (Lee 2014). In the literature, some consensus exists
423 defining academic engagement as a multidimensional construct, integrating behavioral,
424 emotional and cognitive dimensions (Fredricks et al. 2004). Our data from the USEI confirm
425 these three dimensions for describing students' academic engagement. Albithe the second-
426 order construct (academic engagement) presents higher path loadings in the behavioral
427 dimension ($\gamma = .93$) than emotional and cognitive engagement, respectively $\gamma = .64$ and γ
428 $= .77$. The differences are pertinent and are in line with the expected, since our sample was
429 constituted by freshmen. The literature suggests that the first-years students have less

430 maturity and autonomy to cope with the challenges of higher education (Bernardo et al. 2017;
431 Pascarella and Terenzini 2005). The first-year college students have their academic
432 engagement more expressed on behavioral terms, which can be seen on the academic routines
433 and tasks (e.g. attend to classes, group assignments).

434 Based on the foregoing discussion, we conclude that the USEI presents good validity
435 evidence about its internal structure, presenting promising results for future studies related to
436 other sources of validity and different university students' samples. This instrument can
437 become an interesting tool for education and psychology researchers for analyzing the
438 relationship between the different types of academic engagement and other personal and
439 academic variables important for students' adjustment and academic achievement.

440 Although domain-specific subject areas aren't included in the instrument, they may
441 contribute to understanding the extent to which engagement is content-specific, and to what
442 extent it represents a general engagement tendency (Fredricks et al. 2004). Since this was a
443 study carried out with a sample of university students from different courses, it wasn't
444 desirable to have a different version for each course, and it wasn't practical either because of
445 time and resource constraints. If one wants to understand and study a specific academic
446 engagement dimension, this kind of more inclusive instrument might be insufficient,
447 although if the goal of the study is to obtain a single measure for each of the three types of
448 academic engagement, this instrument may be a good choice, since it addresses each
449 construct with few items, and the last word is given to the researcher.

450

451 **Theoretical Implications**

452 This study presents some theoretical findings that can enable a better understanding
453 of academic engagement as a multidimensional construct. USEI revealed a three-factor

454 structure that appears to be indicative of a higher-order construct, academic engagement. This
455 makes USEI unique regarding the potential of its conceptualization of academic engagement
456 as a meta-construct (Fredricks and McColskey 2012b), which is important to define well in
457 terms of its subdimensions (Fredricks et al. 2016). The results emphasize that this conception
458 of academic engagement works well in different scientific areas of college graduation
459 courses. There are some other subject specific instruments (Kong et al. 2003; Wigfield et al.
460 2008), but USEI has the particularity of being a general measure of academic engagement
461 for university students.

462 This is the first report addressing the USEI validity for students majoring different
463 study areas. The behavioral and emotional components of academic engagement in this
464 instrument didn't present the desired discriminant validity evidence, appearing to be
465 somehow related to their content. Our validity evidence supports a consistent alignment with
466 the academic engagement construct definition, showing good psychometric properties for the
467 study sample. As a convergence or product of motivation and active learning behaviors,
468 academic engagement works as a relevant variable with a strong impact in predicting the
469 student's permanence and success in completing his or her course in higher education
470 (Alrashidi et al. 2016; Barkley 2010; Kuh 2001).

471

472 **Practical Implications**

473 As for practical implications, USEI can be considered a tool with good psychometric
474 properties that can measure the perceptions of academic engagement behaviors, emotions
475 and internal cognitions in first-year university students. It is an instrument that was
476 specifically designed for university students and it is available for free. This can be done
477 across groups of different scientific areas of graduation and genders, without losing the

478 desirable measurement invariance that enables direct comparisons of scores between those
479 groups. This is something that hasn't been done before across gender or the scientific area of
480 graduation. These findings together can bring confidence to the measures obtained using the
481 USEI, knowing the academic engagement predictive relation with other variables. For
482 example, Costa and Marôco (2017) found that the emotional subdimension of academic
483 engagement had a statistically significant relation with students' dropout thoughts.
484 Consequently, this is an important implication, since USEI can be useful to assess
485 interventions for specific dimensions of students' engagement. USEI is particularly useful
486 for measuring cognitive engagement and emotional engagement, that are not directly
487 observed (Fredricks and McColskey 2012b). With USEI these subdimensions don't need to
488 be inferred from behavioral indicators or teacher rating scales, avoiding potential inferences
489 through those other methods (Appleton et al. 2006).

490 Self-report instruments have several advantages over other methods, they are
491 practical and relatively low cost tools for group or large-scale assessments (Mandernach
492 2015). This allows to obtain data over several waves and establish different types of
493 comparisons (e.g. universities, courses). The large-scale assessment of academic engagement
494 enables teachers, policymakers and administrative boards to assess students' learning status
495 and their academic life experiences (Coates 2005), making it possible to obtain relevant
496 instructional feedback to the institution's decision-makers and to the students themselves
497 regarding the measured constructs (Banta et al. 2009; Kember and Leung 2009). In this sense,
498 due to its psychological, contextual nature and complexity, academic engagement assessment
499 should take a multidimensional approach considering the behavioral, emotional and
500 cognitive aspects (Alrashidi et al. 2016; Mandernach 2015). This multidimensional approach
501 allows for differential analysis. For example, on the levels and types of investment in relation

502 to the scientific areas and to differentiated subgroups of students according to their socio-
503 cultural origin or their vocational career projects. With the Bologna Declaration (1999),
504 governments in European countries advocated for higher education to value and be based on
505 the active participation of students in their skills development and learning. This perspective
506 benefits from brief and multidimensional instruments that ensure a large-scale assessment of
507 the students' levels of academic engagement as related to their behavioral, cognitive and
508 emotional aspects.

509

510 **Conclusions**

511 All the research hypotheses were confirmed, pointing to the validity evidence of the
512 obtained findings, something that goes in line with other previous studies (Costa et al. 2014;
513 Costa and Marôco 2017; Marôco et al. 2016). There seems to be evidence that the USEI is
514 an appropriate psychometric instrument for the academic engagement framework adopted,
515 which is multidimensional and comprised of observable behaviors, emotions and internal
516 cognitions. Thus, it can help to capitalize on the potential of academic engagement as a
517 multidimensional construct (Fredricks 2015), with a higher-order dimension, academic
518 engagement. Our findings bring clarity regarding the psychometric properties of this
519 promising instrument, which can successfully measure the three different kinds of academic
520 engagement from the most adopted theoretical framework. This is the first instrument that
521 enables Portuguese university students to do so. Due to its reduced number of items this
522 instrument can be adequate to research proposes in large scale related with academic
523 engagement, and to practical purposes at the intervention levels can allow to identify
524 dimensions where teachers and university staff can design interventions based on the
525 specificities of each scientific areas or students' subgroups.

526 Future studies should address longitudinal research designs, such as longitudinal
527 measurement invariance and measurement invariance for public/private universities, with
528 students from different graduation years, something that isn't often implemented as it should
529 be, since it is a condition for making proper comparisons between different groups (Davidov
530 et al. 2014). Future studies should also look at transcultural validity of the USEI in different
531 languages, other than the European/Brazilian Portuguese for which the USEI was initially
532 developed.

533 Also, other kinds of validity evidence should be addressed, such as evidence of
534 validity based on relationships with measures of other variables like student achievement,
535 drop-out, burnout and well-being (McCoach et al. 2013). Our sample only included first-year
536 students from a Portuguese public university, and it is desirable that other and more diverse
537 scientific areas of graduation should be included, such as students from private universities
538 and different grades, and also students with another status (such as a student worker).

539

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541 **Compliance with Ethical Standards**

542 **Conflict of Interest** On behalf of all authors, the corresponding author states that there
543 is no conflict of interest.

544 **Ethical Approval** All procedures performed in studies involving human participants
545 were in accordance with the ethical standards of the Institutional Ethics Research
546 Committee and with the 1964 Helsinki declaration and its later amendments or
547 comparable ethical standards.

548 **Informed Consent** Informed consent was obtained from all individual participants
549 included in the study.

550

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878 Table 1. Distributional properties of USEI's items

item	missing	<i>N</i>	<i>M</i>	<i>SD</i>	min	max	histogram
eng1	0	908	3.96	0.62	1	5	
eng2	2	908	4.62	0.57	1	5	
eng3	2	908	4.20	0.79	1	5	
eng4	1	908	3.35	0.91	1	5	
eng5	7	908	4.36	0.76	1	5	
eng6 ^R	5	908	3.88	1.01	1	5	
eng7	1	908	3.81	0.75	1	5	
eng8	3	908	4.14	0.74	1	5	
eng9	4	908	3.91	0.79	1	5	
eng10	11	908	3.69	0.77	1	5	
eng11	2	908	3.84	0.90	1	5	
eng12	1	908	3.57	0.92	1	5	
eng13	2	908	4.07	0.84	1	5	
eng14	1	908	3.93	0.71	1	5	
eng15	2	908	4.07	0.71	1	5	

Note. R – reversed.

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Table 2. Internal consistency of USEI dimensions for the Total Sample

USEI's dimensions	α_{ordinal}	ω_{ordinal}	<i>CR</i>
BE	.69	.63	.70
EE	.83	.78	.85
CE	.80	.75	.82
Total	.87	.85	-

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Table 3. USEI's models comparisons for gender

Model invariance	χ^2	df	χ^2/df	CFI scaled	$\Delta\chi^2$	ΔCFI scaled
Configural (factor structure)	336.29	174	1.93	.968	-	-
First-order loadings invariance	353.66	186	1.90	.969	6.94 ^{ns}	.001
Second-order loadings invariance	353.88	188	1.88	.970	0.12 ^{ns}	.001
Thresholds of measured variables	460.47	230	2.00	.964	57.61 ^{***}	.006
Intercepts of first-order factors invariance	499.33	233	2.14	.963	5.44 [*]	.001
Disturbances of first-order factors invariance	502.59	235	2.14	.963	1.40 ^{ns}	.000
Residual variances of observed variables invariance	578.33	250	2.31	.959	37.90 ^{***}	.004

Notes. ^{ns} $p > .05$; ^{*} $p < .05$; ^{***} $p < .001$

Table 4. USEI's models comparisons for scientific area of graduation

Model invariance	χ^2	df	χ^2/df	<i>CFI</i> scaled	$\Delta\chi^2$	ΔCFI scaled
Configural (factor structure)	539.91	262	2.06	.959	-	-
First-order loadings invariance	497.07	285	1.74	.969	13.14 ^{ns}	.010
Second-order loadings invariance	579.04	290	2.00	.962	25.70 ^{***}	.007
Thresholds of measured variables	684.93	373	1.84	.963	28.70 ^{ns}	.001
Intercepts of first-order factors invariance	736.91	379	1.94	.962	5.67 ^{ns}	.001
Disturbances of first-order factors invariance	747.34	384	1.95	.963	2.17 ^{ns}	.001
Residual variances of observed variables invariance	841.20	414	2.03	.961	28.32 ^{**}	.002

Notes. ^{ns} $p > .05$; ^{**} $p < .01$; ^{***} $p < .001$

