

Assessment of dispositional and contextual variables in educational settings: IEPA and AYES scales

José A. Cecchini Estrada, Julio A. González-Pienda, Antonio Méndez-Giménez, Javier Fernández-Río, Jorge L. Fernández-Losa and Carmen González González-Mesa
Universidad de Oviedo

Abstract

Background: Despite the fact that there are a few instruments designed to measure dispositional and contextual variables in educational contexts, the goal of this study is to elaborate and validate two questionnaires to measure learning interest, effort and progression as dispositional (IEPA) and contextual (AYEs) variables in secondary education students. **Method:** An initial version of both scales was developed. They were reviewed by a panel of experts and tested on two pilot studies. The final versions were administered to the described sample and their psychometric properties were tested. Factor analyses (exploratory and confirmatory) were conducted on three sets of data: Mathematics ($n = 290$), Spanish Language and Literature ($n = 283$), and Physical Education ($n = 289$). **Results:** Both final scales had three dimensions with four items in each dimension. All standardized loads and critical values of t were overwhelmingly positive, while alpha coefficients ranged from .85 to .91. Both scales showed adequate construct validity, convergent validity, discriminant validity and concurrent validity. **Conclusions:** Results showed that these new scales have adequate psychometric properties, allowing a valid and reliable assessment.

Keywords: Scale validation, learning, secondary education.

Resumen

Evaluación de variables disposicionales y contextuales en el ámbito educativo: escalas IEPA y AYES. Antecedentes: si bien existen en la literatura instrumentos diseñados para evaluar variables disposicionales y contextuales en ámbitos educativos, la finalidad de este estudio es elaborar y validar dos cuestionarios que permitan medir el interés, el esfuerzo y la progresión en el aprendizaje en el alumnado de Educación Secundaria como variables disposicionales (IEPA) y contextuales (AYES). **Método:** tras elaborar una primera versión, que fue sometida sucesivamente a un juicio de expertos y a dos estudios piloto previos, se comprobaron las medidas psicométricas de la versión definitiva. Se realizaron análisis factoriales (exploratorios y confirmatorios) en tres conjuntos de datos: Matemáticas ($n = 290$), Lengua Castellana y Literatura ($n = 283$) y Educación Física ($n = 289$). **Resultados:** las escalas definitivas están compuestas por tres dimensiones de cuatro ítems cada una. Todas las cargas estandarizadas y los valores críticos de t superaron ampliamente los niveles mínimos recomendados, el coeficiente alfa osciló entre .85 y .91. Ambos cuestionarios mostraron una adecuada validez de constructo, validez convergente, validez discriminante y validez concurrente. **Conclusiones:** estos resultados indican que las nuevas escalas poseen adecuadas propiedades psicométricas, lo que permite una evaluación válida y fiable.

Palabras clave: validación de escalas, aprendizaje, Educación Secundaria.

Leading researchers have tried to discover how to generate, promote and develop interest in learning within and outside of the educational contexts (Hofer, 2010; Renninger & Su, 2012). Krapp, Hidi and Renninger (1992) have identified three different conceptualizations of interest in learning: a dispositional trait, a contextual feature and a psychological state (situational).

Regarding assessment instruments, Hidi and Renninger (2011) indicated a few drawbacks on the usage of self-report questionnaires. Nevertheless, a great number of empirical studies have explored the concept of interest in learning with this type of

assessment tool (Frenzel, Dicke, Pekrun, & Goetz, 2009; Frenzel, Goetz, Pekrun, & Watt, 2010). A large number of self-informed assessment instruments have been used in different academic subjects (Linnenbrink-García et al., 2010; Renninger, Ewen, & Lasher, 2002). Forced-choice and open-ended questions, as well as Likert scales, have also been used. Similarly, the content and the structure of the items have also changed significantly from one assessment instrument to another. However, the item content must be in line with the conceptualization followed by the researchers (Hidi & Renninger, 2011), and it varies from simply asking about the participants' interest (i.e., "How interested are you in science?") to questions about complex components of interest in learning (i.e., "How likely is that you will solve the math problems that your teacher has assigned you?").

The structure of self-reports differs in the number and the frequency of the items used. Ainley and Patrick (2006) argued that even a single item can be enough to identify an individual's

learning interest. However, to be able to understand the relationship between interest and other motivational variables, or the evolution of interest, a set of items provides more relevant information (McHale, Kim, Dotterer, Crouter, & Booth, 2009). Finally, Frenzel et al. (2009) supported the validation of instruments based on the age group due to the conceptual changes observed in their research on teenagers' interest in mathematics.

Regarding effort, several studies have linked this concept to interest (Renninger, 2003). Effort appears in the scientific literature connected to various theoretical frameworks (i.e., theories of motivation, attribution theory, the theory of goal setting, the expectancy theory, the theory of cognitive load), but none of these theories have conceptualized it, which has led to the emergence of different meanings. In the educational context, effort can be seen as a non-cognitive trait that reflects students' attitude or enthusiasm toward participation in school work and performance (Kuo-Hsun & Chin-Chun, 2010). Therefore, it seems important to measure students' effort as one of the factors contributing to achievement in education. However, it has been divided in mental or cognitive effort (Yeo & Neal, 2008) and physical exertion (Guan, Xiang, McBride, & Bruene, 2006).

The structure of self-reports varies depending on the type of effort (mental or physical), but also on the number of items used, the rating scales and their validity. Several studies have used a single-item instrument (Paas, Tuovinen, Tabbers, & Van Gerven, 2003; Yeo & Neal, 2008), and it has been applied, although slightly modified, in educational psychology (Paas et al., 2003; Van Gog & Paas, 2008); particularly, in studies based in the cognitive load theory (Sweller, Ayres, & Kalyuga, 2011). However, these single-item scales are also criticized (Van Gog, Kirschner, Kester, & Paas, 2012). Therefore, to understand the relationship between effort and other motivational variables, it seems more appropriate to use a set of items (Dweck, 1999; Wentzel, 1996; Xiang & Lee, 2002).

Regarding progression in learning, various strategies have been used to assess this concept. Some have focused on the product, whereas others have concentrated on the process of learning (Brown, Campione, Webber, & McGilly, 1992). The most widely used assessment instruments are based on specific tests (mathematics, language, etc.) or general tests (values, skills, attitudes, etc.). Among the former, some studies have considered students' final grades as the sole outcome variable, whereas others included test scores, scales or specific tests (De la Fuente, Pichardo, Justicia, & Berbén, 2008; Trautwein & Köller, 2003). Finally, some studies addressed learning in the classroom, while others included homework (Rosário et al., 2011).

Based on the aforementioned, the purpose of this study was to develop two scales which would allow a valid and reliable assessment of contextual and dispositional variables related to learning interest, effort and progression in secondary education students. These two instruments are in line with recent studies that have proposed new models focused on the study of self-regulated learning from an interactive and interdependent perspective of the teaching process (Alonso-Tapia, 2005; Alonso-Tapia & Pardo, 2006; De la Fuente & Justicia, 2007).

Although there are instruments designed to assess dispositional and contextual variables in educational settings, we have developed two scales to overcome some of the limitations detected, and to fulfil the goals described earlier in the construction process of these instruments. The specific limitations detected were: (a)

lack of instruments to measure interest, effort and progression as contextual and dispositional variables of learning; (b) different assessment instruments used in different academic subjects, which does not allow for comparison; (c) inconsistency in item content of some instruments and dimensions; (d) the mismatch, in many cases, of the age group; and (e) the restrictions derived from the number of items used. Therefore, our goals were: (a) to design two scales to measure both contextual and dispositional aspects of learning (De la Fuente & Justicia, 2007; Krapp et al., 1992), while globally analyzing students' interest, effort and progression in learning; (b) to build useful tools to measure specific contexts (Hidi & Renninger, 2006), maintaining a basic structure that could be used in different curricular subjects (Math, Spanish Language and Literature, and Physical Education), (c) to generate age-appropriate questionnaires, in our case, for adolescents (Frenzel et al., 2009); and finally, (d) to comprise a limited, but sufficient, number of items for the instrument to be effective and efficient.

Method

Participants

A total of 835 secondary education students (1st, 2nd, 3rd and 4th grade of Compulsory Secondary Education [CSE]), randomly selected from 8 different high schools in Asturias, agreed to participate. Data were extracted from three different curricular subjects: Math (MT, $n = 290$, mean age = 13.55 ± 1.14 years, age range = 12-16), Spanish Language and Literature (LC, $n = 283$, mean age = 13.53 ± 1.04 years, age range = 12-16), and Physical Education (EF, $n = 289$, mean age = 13.71 ± 1.12 years, age range = 12-16). Table 1 shows participants' distribution among the different course levels.

Instruments

The preliminary version of both questionnaires was developed based on the guidelines of previous research (Muñiz, 2005; Morales, Urosa, & White, 2003; Moreno, Martínez, & Muñiz, 2004, 2006; Muñiz, García-Cueto, & Lozano, 2005; Muñiz & Fonseca-Pedrero, 2008). After the review process, an initial set of items was grouped into several dimensions.

The first questionnaire, called IEPA (acronym in Spanish for Interest, Effort and Progression in Learning), aims to evaluate three dispositional variables of student learning (Table 2), and includes the following dimensions: Interest in Learning (i.e., "Learning is interesting and entertaining"), Effort to Learn (i.e., "In try hard to learn") and Learning Progression (i.e., "I see that I'm getting better").

The second questionnaire, called AYES (acronym in Spanish for Student Aid), aims to measure three contextual variables related to students' perceptions of the teaching process, and includes the following dimensions: (a) Raising Interest in Learning (i.e., "The tasks and lessons arouse the students' interest"), (b) Assistance in Learning (i.e., "The teacher knows how to help us and he/she does it"), and (c) Promotion of Effort Ethics (i.e., "Students' efforts and participation are rewarded"). Students must respond on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

In order to assess concurrent validity of both instruments, the Spanish version (Castillo, Balaguer, & Duda, 2001) of the MOS (Motivational Orientation Scale; Duda & Nicholls, 1992) was used.

It consists of 21 items, and it was developed to assess people’s ego orientation (8 items), task involvement (8 items), work avoidance

orientation (3 items) and orientation towards cooperation (2 items) in the academic context. Participants are asked to think about when they are most successful in school by means of the stem: “I feel most successful in school when” Participants must respond on a 5-point Likert scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

All subscales have shown adequate internal consistency in their Spanish versions (Cronbach’s alphas between .70 and .90). In this study, it is expected that motivational orientations will explain a significant amount of the variance of the subscales of both questionnaires, with Task Involvement and Cooperation Orientation explaining the highest percentage.

Procedure

Informed consent was obtained from parents and school principals. Students were told that the questionnaires would be kept anonymous and were given the option to refuse participation or withdraw at any time. All questionnaires were completed under the supervision of a researcher trained for this purpose. The completion of both questionnaires took about 15 minutes.

Data analyses

The initial version included a total of 18 items in each questionnaire: IEPA and AYES (6 items in each sub-scale). To ensure both content validity and the applicability of the instruments, the first versions underwent a triple process:

In order to carry a qualitative assessment of the items (content validity), the opinions of several experts were considered (Osterlind, 1989). Ten outstanding professors from different universities analyzed the adequacy of the items to the dimension assessed in each of the sub-scales using a five-point Likert scale (the final version was reduced to 15 items in each questionnaire, 5 for each sub-scale).

A sample of 1,250 secondary education students participated in a pilot study in order to eliminate the items that were confusing or had errors. One item from each subscale was eliminated, and the rest were used in the following study.

An exploratory factor analysis (EFA) was conducted in a sample of 450 participants (PE, *n* = 150, MT, *n* = 150 and LC, *n* = 150) in a second pilot study. Maximum likelihood with varimax rotation was used as the extraction method. Kaiser-Meyer-Olkin’s measure of sampling adequacy and Bartlett’s sphericity contrast were also calculated. In order to select the final number of factors, an Eigenvalue greater than one was applied, and only factor loadings greater than .40 were considered to assign items to factors.

In order to compare the models proposed in the AFE, a confirmatory factor analysis (CFA) was conducted on both theoretical models (AYES and IEPA). Each one produced three sub-scales or latent factors that, in turn, were determined by four variables or indicators reflecting the dimensions that are associated with measurement errors (Figure 1). This model was applied separately to each group (Byrne, 2008).

Multivariate normality was also examined, and kurtosis coefficients indicated that the samples had a non-normal distribution (Mardia, 1974). Therefore, we used bootstrapping techniques with 1000 resampling bootstraps. The confidence intervals of regression weights, and the standardized regression weights showed that the

Table 1
Sample Distribution by Grade-Level and Gender

	Gender		
	Males N (%)	Females N (%)	
Grade-level	1 st	106 (55.50)	85 (44.50)
	2 nd	112 (56)	88 (44)
	3 rd	134 (53.82)	115 (46.18)
	4 th	114 (59.07)	79 (40.93)
Total	466 (55.94)	367 (44.06)	

Table 2
IEPA and AYES Scales

Learning Interest, Effort and Progression (IEPA)
En las clases de... Matemáticas, Lengua Castellana y Literatura, Educación Física... [In the... Math, Spanish Language and Literature, Physical Education,... class...]
1. El aprendizaje es divertido [Learning is fun] (INT1) 2. Noto que mejora mi nivel [I feel that my skills are improving] (PRO1) 3. Persisto en el intento de mejorar [I keep trying to improve] (ESF1) 4. Lo paso bien aprendiendo [I have fun learning] (INT2) 5. Observo que mejoran mis habilidades en esta asignatura [I think that my skills in this subject are improving] (PRO2) 6. Me esfuerzo por aprender [I try hard to learn] (ESF2) 7. Me divierto aprendiendo habilidades y/o competencias [I have fun learning skills and competences] (INT3) 8. Veo que estoy mejorando [I see that I’m getting better] (PRO3) 9. Me exijo todo lo que puedo [I push myself as much as I can] (ESF3) 10. El aprendizaje es interesante y entretenido [Learning is interesting and entertaining] (INT4) 11. Siento que avanzo [I feel that I improve] (PRO4) 12. Intento superarme [I try to do better] (ESF4)
Student Aid (AYES)
En las clases de... Matemáticas, Lengua Castellana y Literatura, Educación Física... [In the... Math, Spanish Language and Literature, Physical Education,... class...]
1. Las propuestas son divertidas [Tasks are fun] (DI1) 2. El profesor nos ayuda cuando tenemos problemas para aprender [The teacher helps us when we have difficulties] (AA1) 3. Se recompensa el esfuerzo y la participación de los estudiantes [Students’ efforts and participation are rewarded] (CE1) 4. Las prácticas son agradables [Tasks are enjoyable] (DI2) 5. El profesor nos guía adecuadamente en el aprendizaje [The teacher guides our learning] (AA2) 6. Se tiene en cuenta el esfuerzo y la constancia del alumnado [Students’ efforts and perseverance are valued] (CE2) 7. Las tareas y lecciones despiertan el interés de los alumnos [The tasks and lessons arouse the student’s interest] (DI3) 8. El profesor sabe cómo ayudarnos y lo hace [The teacher knows how to help us and he/she does it] (AA3) 9. Se valora la participación y el esfuerzo de los estudiantes [Students’ efforts and participation are valued] (CE3) 10. La oferta de actividades es interesante y sugestiva [Tasks are interesting and appealing] (DI4) 11. El profesor nos enseña a aprender [The teacher teaches us how to learn] (AA4) 12. Se reconoce el esfuerzo del alumnado [Students’ efforts are acknowledged] (CE4)

estimated values were significantly different from zero in all scales (Byrne, 1998, Table 1). Consequently, the maximum likelihood (ML) method was used.

As recommended, several indices were used to evaluate the model fit (Hu & Bentler, 1999): Chi-square statistic (χ^2), root mean square residual (SRMR), comparative fit index (CFI), adjusted goodness of fit index (AGFI), root mean square error of approximation (RMSEA) and its 90% confidence interval. For well-specified models, SRMR values should be less than .08, RMSEA less than .06, CFI values should not be lower than .95, and AGFI values not lower than .90 (Hu & Bentler, 1999).

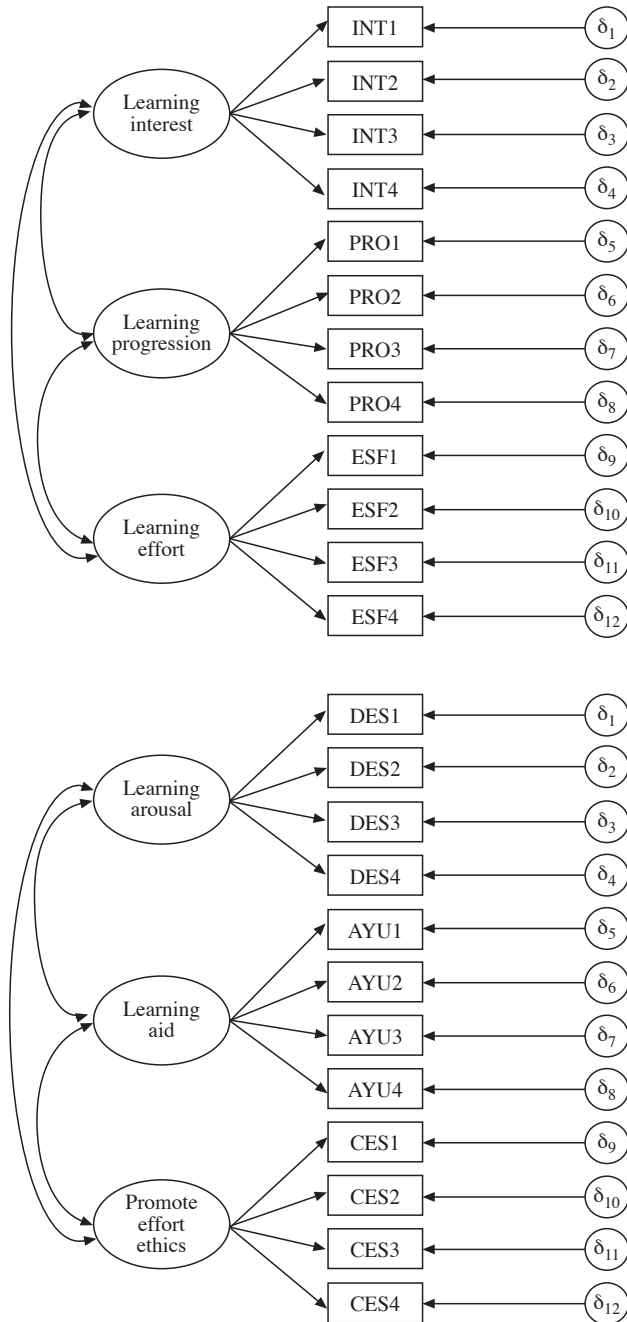


Figure 1. AYES and IEPA theoretical model to be tested through CFA with each sample

Convergent validity was determined through the statistical significance of the factor loadings of the indicators for each latent construct. Cronbach's alpha was calculated to assess reliability of the scores. The minimum value for this coefficient to be considered appropriate is .70 (Nunnally, 1978).

In order to test discriminant validity, the square root of the average variance extracted (AVE) was compared with the correlations between constructs (Fornell & Larcker, 1981). This procedure was performed to ensure that the assessed constructs were more closely related to their own observable measures than to other constructs.

To examine whether the model parameters (both questionnaires) remained invariant across the three samples (different curricular subjects), a multigroup analysis (three groups) was conducted. The CFA involved three successive steps: equal factor loadings, equal covariance and equal variances (Byrne, 1998, 2008). Gender invariance was also examined.

Concurrent validity was assessed using six independent regression analyses. In each one, the sub-scales of the AYES IEPA questionnaires were the criterion variables, while the scores of the MOS were the predictor variables. According to previous research, motivational orientations should explain a significant amount of the variance of the six sub-scales (Castillo et al., 2001; Cecchini, González, López-Prado, & Brustad, 2005; Cecchini, González, Méndez-Giménez, & Fernández-Río, 2011).

All analyses were performed using the SPSS 18.0 and Amos 18.0.

Results

Pilot study exploratory factor analysis

Bartlett's sphericity test (1950) indicated that the items were dependent ($p < .001$), and the Kaiser-Meyer-Olkin index of sample adequacy was higher than the recommended .50 value ($KMO = .92$ for the IEPA and $KMO = .94$ for the AYES). The range of eigenvalues of the factors varied from 8.92 to 1.25 for IEPA, and from 11.97 to 1.52 for AYES, explaining 66.5% and 68.12%, respectively, of the variance.

Confirmatory factor analysis

In both questionnaires, CFI values ranged between .98 and .99, AGFI between .95 and .96, SRMR between .03 and .05 and RMSEA between .016 and .060. These results exceeded the most demanding conditions in each and every one of the samples (Table 3).

Convergent validity and reliability of the measures

Table 4 shows that all standardized loadings (λ_1) and all the critical values of t exceeded the minimum recommended levels of .50 and 1.96 ($p < .05$) (Hair, Black, Babin, Anderson, & Tatham, 2006), ranging between .69 and .92. All Cronbach's alpha values were greater than .85.

Discriminant validity

Table 5 shows correlations between the four constructs, and on the diagonal, the AVE square root. These results showed

discriminant validity among constructs, although all of the constructs are closely related.

Multigroup confirmatory factor analysis

Depending on the curricular subject (Table 6), AYES showed no significant differences in χ^2 . Therefore, the model remained invariant. The IEPA showed significant differences in χ^2 when

the variances were limited. However, no significant changes were observed in the other variables. As χ^2 is sensitive to sample size, the criterion established by Cheung and Rensvold (2002) regarding ΔCFI was also employed. According to these authors, ΔCFI values less than or equal to -.01 indicate that the null hypothesis of invariance cannot be rejected.

Regarding gender, results showed that the factor structure of both questionnaires also remained invariant.

Table 3
CFA fit indices in the three samples

Questionnaires	Factors	Bollen-Stine bootstrap	χ^2	df	CFI	AGFI	SRMR	RMSEA (90% CI)
IEPA	Math	.110	76.97*	51	.99	.96	.04	.046 [.023, .067]
	Spanish Language and Literature	.288	75.30*	51	.98	.96	.04	.047 [.021, .069]
	Physical Education	.121	85.76*	51	.98	.95	.04	.056 [.034, .076]
AYES	Math	.739	54.15*	51	.99	.96	.03	.016 [.011, .046]
	Spanish Language and Literature	.099	95.24**	51	.98	.95	.05	.060 [.041, .080]
	Physical Education	.383	82.93*	51	.98	.95	.04	.054 [.031, .074]

* $p < .05$; ** $p < .001$

Table 4
Standardized loads (λ_1), Non-standardized loads (λ_2), Standardized Errors (S.E.), Critical Values of t and Cronbach Alphas in both Questionnaires for each Sample

IEPA	Items	Math					Spanish language and Literature					Physical Education					
		λ_1	λ_2	S.E.	t	α	λ_1	λ_2	S.E.	T	α	λ_1	λ_2	S.E.	t	α	
Learning interest	INT1	.81	1.00	-	-	.89	.85	1.00	-	-	.88	.69	1.00	-	-	.86	
	INT2	.88	1.03	.068	15.133***		.84	1.00	.068	14.670***		.80	1.04	.100	10.445***		
	INT3	.74	.91	.075	12.078***		.71	.86	.076	11.232***		.80	1.03	.101	10.210***		
	INT4	.85	1.06	.072	14.708***		.81	1.00	.074	13.538***		.81	1.09	.104	10.551***		
Learning progression	PRO1	.85	1.00	-	-	.93	.85	1.00	-	-	.91	.78	1.00	-	-	.91	
	PRO2	.83	.99	.061	16.242***		.85	.99	.064	15.512***		.69	1.08	.080	13.598***		
	PRO3	.92	1.07	.056	19.054***		.86	1.05	.068	15.452***		.86	1.11	.080	13.934***		
	PRO4	.91	1.12	.060	18.511***		.84	.97	.065	15.012***		.91	1.18	.078	15.108***		
Learning effort	ESF1	.74	1.00	-	-	.87	.74	1.00	-	-	.85	.74	1.00	-	-	.81	
	ESF2	.81	1.15	.096	11.966***		.85	1.07	.091	11.761***		.71	.99	.102	9.719***		
	ESF3	.79	1.22	.105	11.626***		.74	1.07	.106	10.140***		.72	.96	.102	9.594***		
	ESF4	.83	1.15	.096	11.926***		.71	.95	.096	9.829***		.73	1.16	.121	9.432***		
AYES			Math					Spanish Language and Literature					Physical Education				
	Learning arousal	DES1	.81	1.00	-	-	.86	.82	1.00	-	-	.87	.86	1.00	-	-	.86
		DES2	.84	1.04	.076	13.770***		.77	.92	.077	11.958***		.73	.78	.066	11.843***	
		DES3	.72	.89	.078	11.467***		.79	.95	.076	12.423***		.78	.87	.065	13.272***	
		DES4	.78	1.01	.080	12.667***		.80	.94	.075	12.440***		.69	.80	.069	11.558***	
	Learning aid	AYU1	.82	1.00	-	-	.91	.82	1.00	-	-	.90	.79	1.00	-	-	.87
		AYU2	.88	.95	.059	16.013***		.83	.93	.066	13.964***		.82	1.02	.079	12.968***	
		AYU3	.86	.99	.064	15.583***		.85	.98	.067	14.542***		.83	1.07	.081	13.204***	
		AYU4	.84	.91	.062	14.818***		.83	.98	.071	13.767***		.73	.88	.079	11.095***	
	Promote effort ethics	CES1	.76	1.00	-	-	.91	.77	1.00	-	-	.91	.75	1.00	-	-	.90
		CES2	.86	1.09	.079	13.872***		.84	1.00	.077	12.977***		.85	1.01	.077	13.149***	
		CES3	.90	1.13	.062	14.828***		.91	1.08	.075	14.359***		.89	1.11	.080	13.897***	
		CES4	.85	1.05	.076	13.893***		.88	1.12	.082	13.690***		.86	1.03	.077	13.385***	

*** $p < .001$

Concurrent validity

Finally, motivational orientations explained a significant amount of the variance of the 6 subscales, with the Task Involvement and Cooperation Orientation being those accounting for the highest percentages (Table 7).

Discussion

The purpose of this study was to develop two scales which would allow valid and reliable assessment of contextual and dispositional variables related to learning interest, effort and progression in secondary education students.

To achieve this goal, the first objective was to design both scales at the same time. With this goal in mind, two initial questionnaires were designed by selecting a set of items congruent with the dimensions of the different subscales (Heidi & Renninger, 2011; Cecchini, Fernández-Losa, & Cecchini, in press). Items were

refined by a group of experts and underwent a pilot study. Factor analyses confirmed three subscales in each scale (four items each). All standardized loadings greatly exceeded the minimum recommended levels of .50 (Hair et al., 2006). Cronbach's alpha ranged between .85 and .91. Therefore, the discriminant power of both scales can be considered high. The square root of the AVE exceeds the correlation constructs in all cases (Fornell & Larcker, 1981). These results confirm that these new scales can be considered valid tools to measure both dispositional and contextual aspects of learning (De la Fuente & Justicia, 2007; Krapp et al., 1992).

The second goal was to build useful tools to measure specific educational contexts (Hidi & Renninger, 2006), maintaining a general structure suitable for different curricular subjects. All values obtained were acceptable to measure the same variables in the different subjects: MT, LC and PE. The multigroup AFC exceeded the most demanding conditions. The initial hypothesis that the factor structure of both questionnaires would be invariant regarding subject and gender was also accepted (Rensvold & Cheung, 2002).

Table 5
Square root of the variance (diagonals) and correlations among constructs

Questionnaires	Factors	Math			Spanish Language and Literature			Physical Education		
		1	2	3	1	2	3	1	2	3
IEPA	1. Learning interest	.81			.80			.78		
	2. Learning progression	.51	.88		.62	.85		.70	.95	
	3. Learning effort	.54	.53	.79	.53	.64	.76	.72	.64	.73
AYES	1. Learning arousal	.77			.79			.77		
	2. Learning aid	.65	.85		.67	.83		.74	.77	
	3. Promote effort ethic	.55	.72	.84	.66	.76	.85	.71	.81	.84

Table 6
Factorial invariance regarding curricular subject and gender

Curricular subjects											
Questionnaire	Model	χ^2	df	$\Delta\chi^2$	Δdf	AGFI	CFI	SRMR	RMSEA (90% CI)	AIC	
IEPA	M _{shape}	238.02	153	–	–	.96	.98	.04	.029	[.022, .036]	400.02
	M _{load}	251.10	171	13/08/13	18	.96	.98	.04	.027	[.019, .033]	377.06
	M _{covariance}	253.63	177	15.61	24	.96	.98	.05	.26	[.018, .032]	367.59
	M _{variance}	284.27	183	4625*	30	.96	.98	.06	.029	[.022, .035]	397.40
AYES	M _{shape}	232.30	153	–	–	.96	.98	.04	.028	[.020, .035]	394.34
	M _{load}	250.72	171	18.14	18	.96	.98	.04	.026	[.019, .033]	376.71
	M _{covariance}	254.17	177	21.87	24	.96	.98	.05	.026	[.018, .032]	368.70
	M _{variance}	267.11	183	34.81	30	.96	.98	.06	.026	[.019, .033]	369.13
Gender											
Questionnaire	Model	χ^2	df	$\Delta\chi^2$	Δdf	TLI	CFI	SRMR	RMSEA (90% CI)	AIC	
IEPA	M _{shape}	216.47	102	–	–	.95	.98	.04	.038	[.031, .045]	324.47
	M _{load}	222.91	111	01/06/44	9	.95	.98	.04	.036	[.029, .043]	312.91
	M _{covariance}	223.09	114	01/06/62	12	.95	.98	.04	.035	[.028, .043]	307.04
	M _{variance}	227.05	117	01/10/58	15	.95	.98	.05	.035	[.028, .042]	305.05
AYES	M _{shape}	218.15	102	–	–	.95	.98	.05	.040	[.033, .048]	326.15
	M _{load}	225.51	111	01/07/36	9	.95	.98	.05	.038	[.031, .045]	315.51
	M _{covariance}	229.16	114	11/01/13	12	.95	.98	.05	.038	[.031, .045]	313.15
	M _{variance}	229.38	117	01/11/23	15	.95	.98	.06	.037	[.030, .044]	307.38

The third goal was to determine whether both scales were age-appropriate (Frenzel et al., 2009); in this case, for teenage students. As in previous works, the 5-point Likert scale responses showed scale suitability to the respondents' age and also for further statistical validation (Castillo et al., 2001).

The final goal was to obtain a suitable number of items for every scale. The final version of all subscales had a small but adequate number of items. Therefore, all instruments can be considered suitable and effective (McHale et al., 2009; Renninger et al., 2008; Van Gogh et al., 2012). This last feature has overcome some limitations of previous works which used long questionnaires on interest (Ainley & Patrick, 2006) or effort (Sweller et al., 2011; Van Gog & Paas, 2008).

Motivational orientations explained a significant amount of variance of the 6 sub-scales, which is consistent with previous works (Cecchini et al., 2005; Cecchini et al., 2011). Task involvement was associated with the belief that to be successful at school, you have to work, collaborate and cooperate with peers. Moreover, task-

oriented students find academic activities and school more fun, more interesting and less boring (Castillo et al., 2001).

This study has also some limitations. Important variables that could act as extraneous variables and compromise the validity of the results were not assessed. For example, students' prior performance, skills to manage the contents of each subjects, efficacy, etc... Therefore, further research should be conducted to address these issues. It would also be interesting to use any of the approaches specifically designed to analyze the relationships between students and the environmental context. For example, to use the hierarchical structure of the data and incorporate it into a structural equation model or perform a structural model multilevel regression analysis.

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Table 7
Bivariate correlations and regression analyses of both questionnaires with the motivational orientation scale

	IEPA						AYES					
	MATH						SPANISH LANGUAGE AND LITERATURE					
	Interest for learning		Learning progression		Learning effort		Interest arousal in learning		Learning aid		Promote effort ethics	
	r	β	r	β	r	B	r	β	r	β	r	β
Ego	.11	-.05	.16	.01	.06	-.08	.08	-.10	-.06	-.19*	.01	-.05
Task	.51***	.50***	.48***	.37***	.58***	.53***	.41***	.43***	.31***	.39***	.27***	.29***
Avoidance	-.06	.01	-.01	-.01	-.14**	-.07	.03	.09	-.07	.04	-.11	-.06
Cooperation	.22***	.03	.36***	.21***	.34***	.14**	.21**	.05	.11	-.01	.05	-.05
R2		.25***		.25***		.35**		.18***		.13***		.08**
PHYSICAL EDUCATION												
Ego	.11	-.03	.17**	-.01	.04	-.17**	-.02	-.15*	-.13	-.25**	-.06	-.18*
Task	.47***	.48***	.53***	.48***	.54***	.54***	.41***	.47***	.33***	.34***	.32***	.34***
Avoidance	-.15**	-.14**	.09	-.09	-.11	-.07	-.11	-.06	-.15**	-.07	-.08	-.01
Cooperation	.15**	-.06	.29***	.08	.28***	.05	.17**	.01	.27***	.16*	.22***	.10
R2		.23***		.28***		.29***		.21***		.20***		.14***

* p<.05; ** p<.01; *** p<.001

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