Educational and Learning Resources in a Greek Student Sample: QELC factor structure and methodological considerations

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Abstract:
This research, inspired by the Actiotope Model of Giftedness as a holistic approach to gifted students' potential, aims to address theoretical, methodological, and structural aspects of the Questionnaire of Educational and Learning Capital (QELC) in a Greek sample of children and young teenagers (10- to 14-year-olds). QELC (Ziegler & Baker, 2013) was administered in classrooms, assessing the students' educational and learning resources as two forms of capital, the educational one (5 subscales) and the learning capital (5 subscales) as self-reported by students. The total sample consisted of 740 students, from 16 Greek primary and secondary public schools in Athens, other cities and some non-urban areas of Greece. Cronbach's α indices for the Educational capital and Learning capital subscales were satisfactory ranging from .74 to .85. Confirmatory Factor Analysis, through 1st and 2nd order models, confirmed the theoretical structure of 10 distinct subscales and also supported to a satisfactory extent two higher-order factors. Statistically significant differences were observed for the educational didactic scale and the attentional learning scale by place of residence, and by the two age-bands of students (10- to 11- and 12- to 14-year-olds). The results are discussed on the basis of the QELC verified factor structure and its theoretical implications, along with its cross-cultural perspective.

Keywords:
educational and learning capital, Actiotope Model of Giftedness, first and second-order factor-structure, cross-cultural perspective, the "appropriate coefficients" question

Introduction

As early as the ′90s, it has been argued that excellence appears through the individual-environment interaction, rather than through individual traits (Csikszentmihalyi, 1988, 1996). Since then, 30 years have passed but in the twenty-first century, it is considered a necessity "to abandon g-centrism in identifying gifted individuals in the realm of successful intelligence, which is more closely related to practical, adaptive skills" (Tannenbaum, 2000, p. 50). From a social-psychological approach, giftedness was identified by Tannenbaum (1983, 1988) with great performance or high productivity, through the combination of five factors: superior general intelligence, exceptional special aptitudes, non-intellective facilitators, environmental influences – on social, physical and intellectual levels, and situational factors of chance or luck in life stages. All these five factors have to be combined at a high level in order to connect potential with high-level accomplishment; therefore, success depends upon a combination of all five facilitators, and failure can result from even a single deficit.

Exceptional actions are likely to be achieved within a highly stimulating environment within family, school and peer groups, which may facilitate exceptional use of excellent characteristics and also overcome effectively all deficits and obstacles (Mönks, Heller, & Passow, 2000; Mönks, Van Boxtel, Roelefs, & Sanders, 1986). However, as regards school environment and gifted student identification and educational provision, adequate motivation and support are intended to be implemented *after* the identification of the gifted student, an identification mostly based on traits of giftedness and psychometric processes (Gari, Kalantzi-Azizi, & Mylonas, 2000; Phillipson, Phillipson, & Eyre, 2011). However, from a systemic point of view, high learning achievements and effective fulfillment of the student's potential remain at risk. Psychosocial support and educational provisions often depend on students' specific traits and their assessment, along with the possible coordinated efforts of students towards a set of feasible goals and aims; therefore, the benefits are likely to be temporary and restricted by the assessed traits themselves and the relevant goals set (Ziegler & Phillipson, 2012).

For the Actiotope Model of Giftedness (AMG), the focus is on the interaction between a rich stimulating school community and the extreme inner potential of students, which can effectively create excellent achievement. Instead of analyzing students' traits, the unit of analysis of giftedness and any kind of excellence is the *actiotope*, which is a combination of variables within the individual and his/her interactions in the environment in which he/she acts – material, social, and informational (Ziegler, 2005). The term "actiotope" is derived from two Greek words, the verb *ἄγω* that means "to drive towards" and the word *τόπος* that means "place". A student, especially a gifted one, becomes an "ἄκτωρ"", that is, a person who moves towards a direction that bears a specific meaning. Thus, an actiotope focuses on an individual's acting and interacting with contextual ecological, biological, and social levels of a community system, containing all the specific individual qualities that are unique, viewed from the specific environmental context for each individual (Ziegler & Stoeger, 2008, 2017; Ziegler, Stoeger, Harder, Park, Portešová, & Porath, 2014). Therefore, the AMG is interested in a holistic approach to students' potential, founded on students' goal-directed actions and their specific meanings, as well as their interdependence with other school community members actions, along with general acceptance and support on a material, cultural and psychosocial basis. High abilities, extraordinary achievement and excellent development of skills are perceived by the AMG as the best adaptation to the environmental demands and the best response to the available inner resources.

Under the systemic principle that a system needs effective and adequate resources in order to evolve and function as a unit (Bateson, 1979; von Bertalanffy, 1968), external and internal resources seem to highly regulate the gradual fulfillment of an individual-system potential. Beyond the linear cause-and-effect approach to giftedness, excellence can be achieved as a result of a dynamic combination of excellent traits and facilitating parameters, but it can also become a cause of developing new skills, adopting new attitudes and values, and exploring alternative meanings of action. On the basis of the equifinality systemic principle, excellent outputs may be achieved from a great variety of starting points, and the opposite, different results are likely to appear despite the fact that the starting point is absolutely the same (Ziegler & Phillipson 2012). Therefore, whatever can nourish and motivate excellent development, either as a fruitful input of the inner system itself or derived by the environment, can actually improve high abilities, expert skills and eminent actions urging gradually towards more future effective system outputs (Bateson, 1979; Dowling, 1985; Molnar, 1986; Ziegler, 2005; Ziegler & Baker, 2013; Ziegler & Phillipson, 2012; Ziegler & Stoeger, 2017; Ziegler, Vialle, & Wimmer 2013).

Resources for students may be derived either from the environment, *as exogenous resources,* or from the inner self, as a set of *endogenous resources* that may facilitate, support and strengthen learning achievement. Adequate exogenous resources may facilitate students' action repertoires effectively and urge their potential internal resources to high levels of fulfillment. The former type of resources refers to educational resources mostly derived by the school community members actions and educational processes, e.g. parents, instructors, peer group etc., on a psychosocial, financial and material level; the latter type refers to inner resources, localized in students themselves that regulate learning processes oriented towards what each student, as a unique entity in a specific environmental setting, has access to. These exogenous and endogenous resources interact dynamically and co-construct two different types of capital for students' lives within the school community: *the educational capital*, on economic, cultural, social, materialistic (infrastructural) and educational/didactic levels, and *the learning capital*, on biological/physiological grounds, on selecting optimal actions in order to satisfy demanding needs and desired goals, on performing goals and aims, on experience, and on attentional focus to what is crucial or the most important.

Therefore, ten distinct forms of capital are available to each student; on the educational level: economic, cultural, social, infrastructural and didactic capitals; and on the learning level: organismic, actional, telic, episodic and attentional capitals (Vladut, Vialle, & Ziegler, 2015; Ziegler & Baker, 2013; Ziegler, Balestrini, & Stoeger, 2018; Ziegler, Chandler, Vialle, & Stoeger, 2017; Ziegler & Phillipson, 2012). *Economic educational capital* refers to material valuables and every kind of valuable goods or procedures that may support learning and education (Ziegler & Baker, 2013). For example, the hard economic crisis in Greece has seriously restricted economic and scientific resources on all levels of the educational system; approximately 500,000 adults aged 40 or less, holding at least B.Sc. degrees (e.g. physicians, lawyers, engineers, dentists, academics, etc.) have migrated to other European countries, the United States, Australia and Asian countries (European Commission, 2017; Gari, 2019) in search of better working and living conditions; *Cultural educational capital* includes values, attitudes, ideologies, ideal symbols and ways of thinking that may facilitate or set obstacles to learning processes. In a study on 568 Greek teachers of both genders (50.4 % females), approximately half of whom worked at state schools in Athens in both primary (56.3 %) and secondary education (43.7 %), teachers' attitudes were found to be positive towards enriching educational processes for the gifted students, the social value of gifted students, and the idea of giftedness as a social capital (Gari, 2016); *Social capital* includes all educational institutions, scholars and other respectful individuals and organizations that contribute to the effectiveness of educational and learning procedures; *Infrastructural educational capital* refers to all goods and materials available (buildings, classrooms, libraries, alternative methods of study etc.) to facilitate educational and learning procedures or – if absent – the opposite, to hinder them; *the didactic educational capital* includes experts, teachers, trained instructors, programs and curricula, included in the implementation of educational processes (Ziegler & Baker, 2013). *Organismic learning capital* regards physical and mental health, along with physiological strengths vs. deficits; *Actional learning capital* includes all sets and patterns of individuals' actions, the "action repertoire of a person" (Ziegler & Baker, 2013, p. 30); *Telic learning capital,* a term that derives from the Greek word "τέλος", which means *moving towards an end or an ultimate point,* includes all goals and aims that an individual sets in order to create chances for meeting his/her needs; *Episodic learning capital,* derived from the Greek word "επεισοδιακός" which means "to be based on a set of prior experiences", in order to select the optimal actions for achieving goals and aims of important meaning, within the current situation; finally, *attentional learning capital* refers to the levels of attention effectiveness towards what is important or of crucial significance for each specific circumstance, on both quantitative and qualitative levels (Ziegler & Baker, 2013).

The empirical basis of the educational and learning capital forms was also extended through a recent study which separately examined three different samples – 365 primary school students in the United Arab Emirates, 90 German female STEM professionals, and 74 German long-distance runners. For the sample of primary school students, it was shown that, beyond IQ, QELC scores predict excellence in academic achievement. For the group of professionals, the adequate availability of exogenous and endogenous resources seemed to play an important role in higher skill development, excellence in performance and a more effective professional development. In addition, the process itself of increasing achievement level seemed to contribute to the gradual possession of more and more exogenous and endogenous resources and their better use, forming "a virtuous circularity" of outcomes (Ziegler, Debatin, & Stoeger, 2019).

Throughout the world the concepts of giftedness and excellence vary. For example, the Western vs. the East Asian conceptions of giftedness focus on individualistic vs. collectivistic social perceptions and the mind-body dualism of the Western Enlightenment vs. the Confucian holistic outlook, respectively. However, in Western research on giftedness a conceptual bias seems to be apparent, while the necessity of cross-cultural research on giftedness remains a demand, due to the small number of cross-cultural studies conducted, mostly on the topics of conceptions of giftedness, identification strategies and educational provision (Stoeger, Balestrini, & Ziegler, 2018). For the QELC model of ten forms of capital, a first set of cross-cultural comparisons was attempted in a study with students in China, Germany and Turkey (mean age ranging from 12.70 to 13.98 years), which effectively supported the QELC psychometrically, and with respect to its construct and concurrent validity (Vladut, Liu, Leana-Taşcilar, Vialle, & Ziegler, 2013). Later, QELC was successfully supported in Israel as well (Paz-Baruch, 2015) and in the United Arab Emirates (Ziegler, Debatin, et al., 2019).

As regards age and gender differences for the ten QELC subscales, a study with a large Turkish sample (1,620 students in groups of mean ages 10.5, 13.08 and 16.20 years) reached statistically significant sex differences only within the group of 13-year-olds, in favor of girls, for the economic, cultural, social, organismic and telic capitals. With respect to age, statistically significant differences appeared between the two other age groups (of 10-year-olds and 16-year-olds), with higher cultural capital scores for the younger students (Leana-Taşcilar, 2015).

The aims of the current study are two-fold, following a theoretical and also a methodological-statistical-metric perspective. The theoretical aims are the description of the QELC structure in a large Greek sample and its extension to exploring cross-cultural differences and similarities. The methodological and statistical aims are: i) the overall attempt to verify the theoretical QELC dimensions in this Greek sample via zero-order confirmatory factor analysis, ii) the implementation of specific statistical methods to test for modeling implications, iii) the application of a variation of an "exploratory SEM" attempt (Asparouhov & Muthén, 2009) to allow for comparisons across the first-order CFA outcomes and second-order confirmatory factor models, and iv) a cross-cultural comparison across correlation tables, in an initial attempt to compare the Greek QELC data with four other countries: China, Germany, Israel, and Turkey.

Method

Sample

Our sample consisted of 740 students, recruited from 16 Greek primary and secondary public schools in Athens and some other urban and non-urban areas of Greece. For the 50 QELC items, we first explored for possible missing values and 24 cases were detected in which only 80% or less of the items had been responded to (*n* of missing items ^{3} 10). Excluding these 14 cases from further analysis, all 726 remaining cases did not exceed six missing answers per case, all distributed randomly. These missing values were replaced by the corresponding variable mean, therefore for all 726 cases the full data set was available. To double-check this replacement for all 50 items, we compared the standard deviations before and after replacement; the largest change reached only −.005 and its mean change was approx. −.002. Thus, the changes in standard deviations were trivial and we retained the replaced missing values for further analysis (*n* = 726).

In terms of the students' gender, location of their school and place of residence, 361 (49.7 %) were males and 365 (50.3 %) were females; 275 students (37.88 %) reside in Athens, 206 (28.37 %) reside in sub-urban areas and 245 (33.75 %) reside in rural areas. Two age groups were formed, the first one consisted of students of the fourth and fifth grades of primary school (ages 10 and 11, mean age = 10.46) and the second group included students of the sixth grade of primary school and also the first and second grades of junior high school (ages 12, 13 and 14, mean age = 12.56).

Instrumentation

The Questionnaire of Educational and Learning Capital (QELC), comprising 50 questions regarding students' educational capital (5 subscales) and learning capital (5 subscales) (Ziegler & Baker, 2013), was administered to students in classrooms. Each subscale (5 items) measures one of the ten forms of capital. The ten subscales are the following (an example-item for each subscale is given): *learning capital* includes the *organismic* subscale ("Being physically fit also helps me to learn and study for school for long periods of time"), the *actional* subscale ("I know a lot of strategies for learning and studying"), the *telic* subscale ("I set a goal for myself to continuously improve my performance at school"), the *episodic* subscale ("I have a lot of experience on how I can do very well in school"), and the *attentional* subscale ("In my daily routine, nothing distracts me from learning and studying for school"). *Educational capital* consists of the *economic* subscale ("My family spends more money on my schooling than other families do"), the *cultural* subscale ("I know a lot of people who think that learning and studying are very important"), the *social* subscale ("Other people give me good advice on how I can further improve my academic performance"), the *infrastructural* subscale ("Because of my good learning and studying environment I can be among the best in school"), and the *didactic* subscale ("During classroom instruction I am taught how to learn & study more effectively").

The QELC subscales show satisfactory to high Cronbach's α levels in the literature, ranging from .60 to .83, except for the telic subscale where α was only .49 (Vladut, Liu et al., 2013). For the sample of this study, Cronbach's α reliability estimates were satisfactory (> .73); specifically, these estimates by subscale were as follows: for the learning capital subscales, organismic subscale *a* reached .74, for the actional subscale α = .76, for the telic subscale α = .74, for the episodic subscale α = .81, and for the attentional subscale α reached .79; for the educational economic subscale *a* reached .80, for the cultural subscale α = .76, for the social subscale α = .77, for the infrastructural subscale α = .75, and for the educational didactic subscale α reached .85.

Results

Descriptive statistics, outliers, and the "appropriate coefficients" question

Basic descriptive statistics were first calculated at the item level. Although the measurement level of these 50 items is ordinal, we should briefly comment on the basic properties of these items; most distributions were negatively skewed (the average skewness was approx. −.82). However, for most of the items only less than 3 univariate outliers existed, and these outlier cases were more than ten for only one item, with the overall median value being 2 outlier cases. Thus, no action was taken with respect to outliers and all 726 cases were retained.

The second step was to examine whether *Pearson's r* correlations might possibly be affected by the skewness levels in our data; for this, we computed both parametric correlations (*Pearson's r*) among all 50 QELC items and also non-parametric ones (*Kendall's Tau-b*). Comparing these matrices through *Fisher's z* transformation (Mylonas, Veligekas, Gari, & Kontaxopoulou, 2012), only 90 out of the 1,225 non-parametric correlations were significantly different at the .05 level, from the corresponding parametric ones (approx. 7%). Thus, we were fully justified in employing parametric correlations in further analyses as the "appropriate coefficients hypothesis" was not refuted.

The age-group question; a developmental approach

The third step was of developmental nature and referred to the sample different developmental age bands (groups "1" to "5", corresponding to 10 to 14 years of age, respectively). This age variability begged the question of whether the initial raw scores might be suffering from bias due to age variations. If so, we should adjust the raw scores by extracting this bias from the measure (Mylonas & Furnham, 2014). This procedure, if deemed necessary, would affect the raw scores of the initially biased items themselves but not the correlations which would remain the same in any case. First a partial correlation approach was conducted and through *Fisher's z* transformation no statistically significant difference emerged between the partial correlations and the zero-order ones, despite the numerous arithmetic differences observed. Suspecting that true differences might be masked due to the nature of the measures, we also employed an eta-correlation approach and we computed all η and η^2 indices reflecting the correlation of two age-bands (10 & 11 vs. 12 to 14 years) with each of the 50 items. We indeed detected ten items with large η and η^2 values; for these, the method described by Mylonas & Furnham (2014) was employed and initial raw scores were adjusted by removing the unwanted variance (these items were named as 'cor' ones and appear as such in Tables and Figures).

Confirmatory Factor Analysis; 1st order modeling

The main 1st order CFA outcomes are summarized in Table 1.

After justifying the use of the available data through the procedures described above, we employed factor-analytic techniques to test for the Ziegler theoretical structure (Ziegler, Vialle, & Wimmer, 2013). We expected 25 items to form five separate quintuple factors on learning capital and the other 25 items to form five other separate quintuple factors on educational capital. We tested this model for the overall sample (*n*=726), as developmental effects were not present any more and there was no need to run the analysis separately for each age group. We computed the outcomes through LiSRel and R statistical packages. The CFA outcomes, as computed for successive models, are summarized in Table 1 and Figure 1.

The independence model was, as expected, not acceptable in terms of statistical fit. We then tested a unifactorial model with all 50-items being considered as manifesting one-single latent variable; this model was not accepted either, although some rather interesting properties were revealed, such as the nearly acceptable RMSEA, the acceptable SRMR, the elevated Tucker-Lewis Index (TLI) as compared to the null (independence) model, the large AIC and BIC reduction, and the large drop in the $\chi^2 \div df$ ratio along with the very large and statistically significant reduction in the χ^2 value itself. From these results, one might argue

Table 1 *First Order Confirmatory Factor Analysis: Summary of outcomes*

Model	$\chi^{2\,i}$	*df*	$\chi^2 \div df$	*RMSEA [$CI_{90\%}$]*	*SRMR*	*GFI*	*CFI*	*TLI*	$\Delta\chi^2$	Δdf	*AIC*	*BIC*
a	17,093.16	1,225	13.95	–	–	–	–	–	–		17,193.16	18,048.35
b	4,936.35	1,175	4.20	.080 [.078 - .082]	.060	.73	.76	a-b .76	a-b 12,229.81***	50	6,785.70	5,595.11
c	2,900.35	1,130	2.57	.050 [.048 - .052]	.042	.85	.89	b-c .50	b-c 1,963,00***	45	3,473.68	3,855.45
d	2,696.51	1,120	2.41	.047 [.045 - .050]	.041	.86	.90	c-d .10	c-d 203.84***	10	3,260.23	3,717.58
								b-d .55	b-d 2,166.84***	55		
e	4,742.30	1,130	4.20	.079 [.077 - .081]	.060	.74	.77	b-e ≈.00	b-e 121,05***	45	6,509.64	5,697.50

Key:* *a = Independence model, ***b*** = Unifactorial model, ***c*** = 10-factor model, ***d*** = modified 10-factor model, ***e*** = "random-structure" 10-factor model

i : All minimum fit function χ^2 criteria were significant at the .001 level

* significant at the .05 level, ** significant at the .01 level, *** significant at the .001 level.

Note A: 10 raw item-scores were corrected for developmental stage bias (see developmental approach under the 'age-group question' section) but correlations are the same and this correction has no effect on CFA outcomes.

Note B: *Error covariances* (model ***d***) strictly within factors: EcI5-EcI2, EcE2-EcE1, EcE5-EcE1, EcE2-EcE5, EcC2-EcC1, LcO4-LcO2, LcO3-LcO2, LcO3-LcO4, LcE2-LcE1, EcS5-EcS2

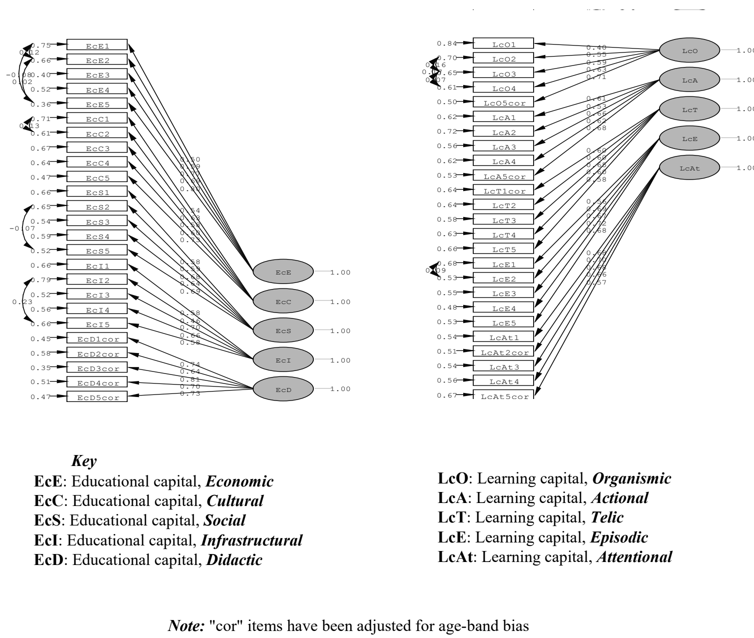


Figure 1 *Model "d ": CFA for 50 QELC Scores and 10 latent variables*

for a central, overarching theme present in the data, grouping all items under a single broader construct; we did not pursue this goal further in the current study, but future research may reveal interesting results.

The outcomes obviously suggested further modeling, so we then tested our main model (model "*c*"), that is the 10-factor theoretical structure for the five educational capital dimensions – economic, cultural, social infrastructural and didactic –and the five learning capital dimensions – organismic, actional, telic, episodic, and attentional ones (Ziegler, 2005; Ziegler, et al., 2013). Despite the notorious χ^2 statistical significance, the improvement with respect to the non-acceptable unifactorial model was evident in the AIC and BIC reduction, in the large TLI and in the statistically significant $\Delta\chi^2$ value. Although the fit for this model was good with CFI being nearly perfect, and RMSEA and SRMR reaching acceptable levels, the GFI reached only .85 and the $\chi^2 \div df$ value was still rather high, despite its large difference from the unifactorial model. As is obvious, some fine-tuning was necessary if we were to finally decide to retain this model, and these amendments should be carried out via the estimation of a few error covariances.We estimated 10 such error covariances, as were indicated during model "*c*" testing, allowing for error terms to correlate between specific items. We did so *strictly within factors*, thus not allowing for any cross-loadings involvement in our modeling. For the modified model "*d*", a much better fit was observed, with CFI, RMSEA, and SRMR at acceptable levels, with TLI showing a large improvement with respect to the unifactorial model and acceptable improvement from the non-modified ten-factor one, with the respective $\Delta\chi^2$ values being statistically significant as well and with AIC and BIC being further reduced. The GFI value and especially the $\chi^2 \div df$ value were not at perfect levels though, however, this model ("*d*") had shown the best statistical fit so far and clearly supported the existence of the theoretical ten-factor structure in our data and was accepted as the best model at this stage. The loadings for this solution are presented in Table 2.

Still, some other questions remained; one of them was whether such improvement in statistical fit might be attributable to the large number of factors (10), especially considering the fact that we tested a unifactorial model and we then moved directly to the theoretical one which directs to numerous (ten) factors to be modeled. To account for such a possible method effect we also tested for a "random-structure" model, also with ten factors (model "*e*"). We randomly assigned items to the ten latent variables, modeling five random items for each factor (Table 1), so that each factor would enter the model as manifested from random combinations of learning and educational capital items (e.g., the telic dimension in the model was expected to be manifested from two organismic, one episodic, one didactic and one telic item). As expected, χ^2 was higher than the successful "*d*" model and the $\chi^2 \div df$ ratio returned to the unifactorial model levels. RMSEA was not acceptable anymore and CFI and GFI were very far from being acceptable.

Table 2 *Loadings; Solution = Model "d "*

Educational capital items	**Economic**	**Cultural**	**Social**	**Infrastructural**	**Didactic**
	(EcE)	(EcC)	(EcS)	(EcI)	(EcD)
1	.50	.54	.58	.58	.74
2	.59	.63	.59	.46	.64
3	.77	.58	.68	.70	.81
4	.69	.60	.64	.66	.70
5	.80	.73	.69	.58	.73
Learning capital items	**Organismic**	**Actional**	**Telic**	**Episodic**	**Attentional**
	(LcO)	(LcA)	(LcT)	(LcE)	(LcAt)
1	.40	.61	.60	.56	.68
2	.55	.53	.60	.69	.70
3	.59	.66	.65	.67	.68
4	.63	.62	.60	.72	.66
5	.70	.68	.58	.68	.57

A closer look though revealed that this "random-structure" model closely resembled our unifactorial modeling outcomes, in terms of goodness of fit indices and in terms of AIC, BIC, and χ^2 values. This seemed to underline the need to account for one or more overarching factors, a need which appeared but only in a subtle way during the unifactorial modeling. This, along with theoretical considerations, called for 2nd order factoring, as was carried out in the next stage.

Before following this quest though, we computed the aggregate scores for each of the ten dimensions to form new measures to be used in further analyses ("averaged aggregates"). These new measures reflected the five educational capital and the five learning capital factors; their basic descriptive statistics are presented in Table 3.

Table 3 *Descriptive Statistics for the Ten Aggregate Scores (Educational Capital and Learning Capital Factors)*

Educational Capital	***Economic***	***Cultural***	***Social***	***Infrastructural***	***Didactic***
	(EcE)	***(EcC)***	***(EcS)***	***(EcI)***	***(EcD)***
Mean	3.99	4.80	4.64	4.31	4.46
Median	4.00	5.00	4.80	4.40	4.70
Standard Deviation	1.20	.93	.94	.98	1.11
Standard error of Mean	.04	.03	.03	.04	.04
Skewness	−.49	−1.00	−0.85	−.46	−.80
Kurtosis	−.20	.96	.90	−.09	.17
Range	6.00	5.00	5.00	5.00	4.90
Min.	.00	1.00	1.00	1.00	1.07
Max.	6.00	6.00	6.00	6.00	5.97
Kolmogorov-Smirnov z *	.077	.124	.104	.081	.112
Shapiro-Wilk W *	.972	.926	.948	.977	.940

Learning Capital	***Organismic***	***Actional***	***Telic***	***Episodic***	***Attentional***
	(LcO)	***(LcA)***	***(LcT)***	***(LcE)***	***(LcAt)***
Mean	4.14	4.62	4.53	4.50	4.31
Median	4.20	4.80	4.60	4.60	4.40
Standard Deviation	1.00	.91	.97	.95	1.01
Standard error of Mean	.04	.03	.04	.04	.04
Skewness	−.41	−.97	−.84	−.80	−.58
Kurtosis	−.08	1.28	.79	.88	.09
Range	5.19	4.99	5.39	5.00	4.97
Min.	1.00	1.01	1.00	1.00	1.02
Max.	6.00	6.00	6.00	6.00	5.99
Kolmogorov-Smirnov z *	.073	.110	.105	.092	.077
Shapiro-Wilk W *	.982	.941	.951	.956	.969

* all statistically significant at the .001 level

Taking a closer look at the loadings for each of the items on its respective factor, these are not "1.00", obviously; one might wonder whether the computed aggregates truly reflect the dimensions as the weight for each participating item has been overlooked. Of course, we accept that their loading to other, theoretically unrelated factors is 0.00, and this was fixed in our modeling after all, but the relative importance of each item manifesting each factor is not the same. To explore for such a possible method effect, we computed the factor scores for this outcome (model "*d*") and we then correlated these scores with the aggregates (simple averaged sums). The results are presented in Table 4. One would expect only the diagonal elements to exceed .90 and under perfect similarity .95 (for averaged aggregates and factor scores to share at least 90% of their variance). However, this was not the case, and in three cases the correlation levels dropped even below .90. This irregularity was further highlighted by the fact that other, error correlations around .90 existed, between non-related factors, showing some possible levels of collinearity in the data, especially among the learning capital factors. This outcome underlined the need for 2^{nd} order factor modeling, as is presented next.

Confirmatory Factor Analysis; 2nd order modeling

The first action was to note down as reference models the independence (null) model and the modified ten-factor model outcomes, as these were computed in the previous stage (1^{st} order factoring). Models "*1*" and "*2*" are the same as the 1^{st} order CFA "*a*" and "*b*", so their difference remains the same of course, but for model "*3*" (all models tested are summarized in Table 5) we introduced two second order factors to be tested, namely educational capital and learning capital, each comprising its respective five factors. We tested this solution further through an amended 2^{nd} order factor model (model "*4*") also assuming orthogonality of all factors (model "*5*").

Table 4 *Correlations between Averaged Aggregates and Anderson-Rubin Factor Scores (fs)*

		fs_1	***fs_2***	***fs_3***	***fs_4***	***fs_5***	***fs_6***	***fs_7***	***fs_8***	***fs_9***	***fs_10***
EcE	1. Economic	***.975***	.501	.556	.505	.292	.464	.375	.414	.446	.380
EcC	2. Cultural	.491	***.951***	.813	.639	.512	.527	.640	.642	.620	.573
EcS	3. Social	.560	.843	***.930***	.802	.671	.637	.748	.743	.718	.676
EcI	4. Infrastructural	.499	.649	.786	*.897*	.769	.784	.785	.793	.758	.778
EcD	5. Didactic	.306	.549	.694	.816	***.969***	.687	.809	.821	.711	.808
LcO	6. Organismic	.443	.539	.621	.767	.626	***.933***	.751	.708	-.700	.746
LcA	7. Actional	.390	.690	.777	.834	.804	.820	*.882*	.910	.895	.865
LcT	8. Telic	.426	.681	.760	.830	.806	.762	.898	*.876*	.860	.888
LcE	9. Episodic	.457	.663	.736	.791	.698	.754	.881	.859	***.944***	.833
LcAt	10. Attentional	.388	.605	.691	.814	.789	.806	.852	.885	.832	***.932***

Table 5 *Comparing 1st and 2nd Order Factor Outcomes*

Model	$\chi^{2\ i}$	*df*	$\chi^2 \div df$	*RMSEA [CI$_{90\%}$]*	*SRMR*	*GFI*	*CFI*	*TLI*	$\Delta\chi^2$	Δdf	*AIC* ^{j1}	*BIC* ^{j2}
1	17,093.16	1,225	13.95	–	–	–	–	–	–		17,193.16	18,048.35
2	2,696.51	1,120	2.41	.047 [.045 - .050]	.041	.86	.90	$^{1-2}$ .89	$^{1-2}$ 14,396.65***	105	3,260.23	3,717.58
3	3,295.37	1,172	2.81	.050 [.048 - .052]	.064	.83	.87	$^{1-3}$ .86	$^{1-3}$ 13,797.79 ***	53	3,501.37	3,973.89
4	3,200.37	1,159	2.76	.049 [.047 - .051]	.048	.84	.87	$^{1-4}$ .86	$^{1-4}$ 13,892.79 ***	66	3,432.37	3,964.53
5	4,144.96	1,173	3.53	.059 [.057 - .061]	.219	.82	.82	–	–	–	12,304.96	31,022.16

Key: 1 = Independence model, ***2*** = modified 10-factor model (1st order CFA model "*d*") , ***3*** = second order factor model (two second order factors), ***4*** = amended 3rd model, see note A below, ***5*** = orthogonal factors model, see Note B below

^{i} : All minimum fit function χ^2 criteria were significant at the .001 level

^{j1} : Computed as $\chi^2 + \{ [k(k + 1)] - 2df \}$

^{j2} : Computed as $\chi^2 + \{ \ln(N) \{ [k(k + 1) \div 2] - df \} \}$

* significant at the .05 level, ** significant at the .01 level, *** significant at the .001 level.

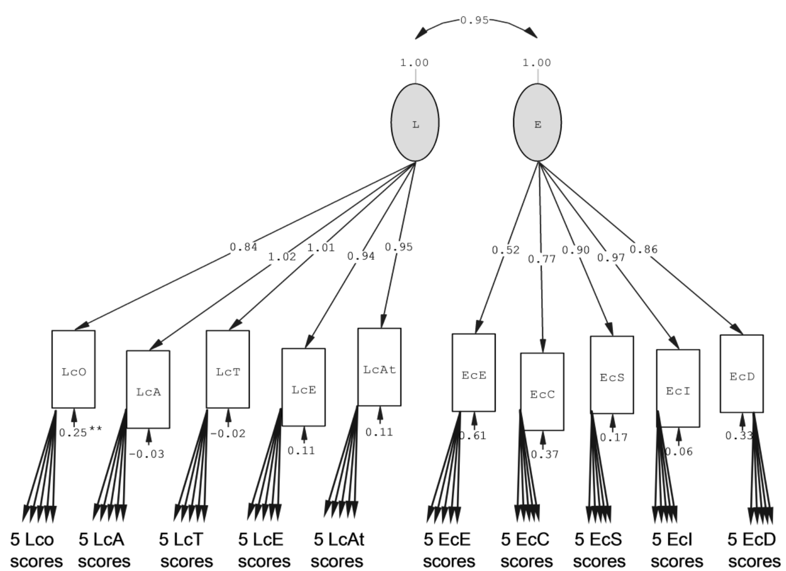
Note A: The *4th* model is the *3rd* model amended for negative parameter estimates

Note B: This orthogonal model assumes zero correlation between latent variables (1st and 2nd order ones)

The 3rd model is obviously not as good as the 2nd one which is the 1st order modified ten-factor model. Although the RMSEA and the SRMR indices remain at acceptable levels, the GFI and CFI values have dropped and the $\chi^2 \div df$ ratio is enlarged. The gain (TLI) from the independence model is less, as compared to model "*2*" and the χ^2 itself is larger. Finally, AIC and BIC values are also larger. Thus, a direct 2nd order factor structure does not seem to fit the data well. We also detected negative parameter estimates during the computations, a multicollinearity side-effect. To remedy this, and in an attempt to enhance the solution, we attempted to amend this model by relaxing the initial parameters for the 2nd order factors and for the reference factors in the first-order solution. The outcome was slightly better (model "*4*"), but still the $\chi^2 \div df$ ratio was larger than the one in model "*2*" and χ^2 itself was larger as well; however, the GFI, CFI, RMSEA and SRMR indices remained at acceptable levels, with a tendency to match the indices in model "*2*" (1st order model "*d*"). Finally, a 5th model was tested with orthogonal latent variables. The RMSEA index remained at acceptable levels, but the GFI and the CFI values were much lower than acceptable levels; the $\chi^2 \div df$ ratio was enlarged along with the χ^2 value itself. The most problematic indices in this solution were the SRMR (.219), along with the large AIC an BIC values; thus this orthogonal model did not fit the data whatsoever, an indication that there is some inter-connection both among the 1st order factors and between the 2nd order ones, with the same indication present in the 1st order solutions as depicted in the correlational analysis of factor scores and averaged aggregates showing some extent of a dynamic "osmosis-like" connection between educational and learning capitals. Finally, for the amended 2nd order factor solution and for reasons of comparability with the 1st order factoring solution, we present (Table 6) the loadings which were computed for model "*4*" in this stage of analysis. Finally, model "*4*" loadings of the 1st order factors on the 2nd order ones can be found in Figure 2 which graphically shows this model's outcomes.

Table 6 *Loadings; Solution = Model "4 "*

Educational Capital items	***Economic***	***Cultural***	***Social***	***Infrastructural***	***Didactic***
1	.49	.59	.58	.60	.74
2	.62	.66	.58	.48	.64
3	.77	.57	.69	.70	.81
4	.69	.59	.64	.67	.70
5	.78	.72	.67	.60	.73
Learning Capital items	***Organismic***	***Actional***	***Telic***	***Episodic***	***Attentional***
1	.42	.61	.60	.58	.69
2	.63	.54	.61	.69	.70
3	.63	.66	.65	.68	.68
4	.69	.61	.60	.73	.66
5	.70.	.68	.59	.68	.56



** Error variances presented here correspond to 2nd order factoring model "3" and are indicative; after amending for the negative variances in LcA and LcT, all error variances equal 1.00

Figure 2 *Model "4": 2nd Order CFA for 2 Higher-Order Factors, 10 First Order Ones, and 50 QELC scores*

A cross-cultural approach; correlation similarity across four countries

For the last step of our analysis, we employed four zero-order correlation tables for the 50 QELC-items as published for China, Germany, Israel and Turkey (Paz-Baruch, 2015; Vladut, Liu et al., 2013). Having computed the same correlation table for Greece, we compared all five correlation tables through *Fisher's z* transformation in order to explore for possible differences in the patterns of item inter-correlations. The existence of such differences, if present, might indicate important "guidelines" for future cross-cultural modeling (i.e., through multi-group confirmatory factor analysis and/or multivariate covariance structure analysis). The outcomes are summarized in Table 7. The numbers below the diagonal refer to the absolute number of significantly different pairs of correlations ($p < .05$) between countries and the entries above the diagonal are the respective percentages.

We should first note that for the 10 pairs of inter-correlation matrices (correlating the averaged aggregate QELC scores) almost all of them were different to a larger or a smaller extent (statistically significant differences exceeding 15 % of the correlation pairs); the only exception was observed between the Israeli and German matrices which seem at least quite similar. The Chinese correlational pattern (cp) differs from those of all the other four countries (31 % to 49 % of correlation pairs are different), and especially from the German and the Turkish ones. Israeli cp is marginally different from the Greek one (16 %) but clearly different from the Turkish one (22 %). Greek cp is quite different from both the German and the Turkish one (29 %), while the Turkish cp is quite different from the German one (22 %), as well.

Age and place differences

A series of one-way ANOVAs were conducted, in order to explore the relations of some demographic and other variables of interest with the 10 QELC capitals. Specifically, we related these scores with gender, two age groups (9- & 10-year-olds vs. 12- to 14-year-olds), and students' permanent place of residence and school location (capital vs. provinces). Comparing across places, the educational didactic capital mean was higher for Athens (M = 4.81) compared with M = 4.15 for provincial places ($F_{1, 724}$ = 70.63, $p < .001$ [$p = .000$], η^2 = .09), but the learning telic capital mean score was higher for students of provincial areas (M= 4.73), as compared with Athens (M = 4.35), $F_{1, 724}$ = 28.03, $p < .001$ [$p = .000$], η^2 = .04.

Comparing across age bands, the didactic capital mean was higher (M = 4.79) for the

Table 7 *Correlation Comparisons (Through Fisher's z, 45 Coefficients) Across Five Countries*

	China	***Germany***	***Greece***	***Israel***	***Turkey***
China	0	49 %	33 %	31 %	44 %
Germany	22	0	29 %	13 %	22 %
Greece	15	13	0	16 %	29 %
Israel	14	6	7	0	22 %
Turkey	20	10	13	10	0

younger age group, in comparison with the older age group (M = 4.25) ($F_{1, 724}$=43.93, p < .001 [p = .000], η^2 =.06). The same held true for the attentional capital; mean score was higher (M= 4.58) for the younger ages, than the older (M = 4.13) ($F_{1, 724}$=36.63, p < .001 [p = .000], [], η^2 =.05). No differences were found in terms of gender.

Discussion

In line with previous research results for the QELC reliability and the relevant theoretical assumptions, we verified the ten factor CFA model for a Greek sample, including five distinct factors for educational capital and five factors for learning capital (Ziegler & Baker, 2013; Ziegler, Balestrini, et al., 2018; Ziegler, Debatin, et al., 2019; Ziegler & Stoeger 2017). All ten forms of learning capital – organismic, actional, telic, episodic, and attentional, along with the educational economic, cultural, social, infrastructural and didactic capitals, seem to co-exist, as distinct internal and external types of resources. The interdependent co-existence of these capitals seem to form a dynamic potential for the school life span of all students; their effective combination seems a necessary and also a sufficient prerequisite in order to fulfill any high potential demand, regardless of the specific starting point for each student. Within a functional and flexible motivating environment, an interaction of these ten capitals can nurture an excellent system of outputs (Ziegler & Phillipson, 2012) not only for gifted students but for the great majority of students. Nevertheless, educational and learning capitals, as core issues within the Actiotope Model of Giftedness, seem to re-orient the study of giftedness towards a systemic understanding of excellence. It may also re-define the "key starting point" to support *all students* at school, towards an amelioration of their potential into the highest possible abilities and skills.

Our results seem to corroborate the existing evidence that the QELC is indeed a reliable and metrically valid tool for cultural use and possibly cross-cultural comparisons, under -emic and -etic perspectives (Hui & Triandis, 1985), enriching our cross-cultural view of the giftedness concept and the identification of gifted students. We should not fail to comment on some levels of (multi) collinearity present in our data though. This was observed mainly within the learning capital subscales, especially while we correlated the averaged aggregate scores with the factor scores directly computed from the factor structure's factor coefficients and through the osmosis indications during 2nd order CFA modeling. Although this collinearity does not seem to pose a threat to the scale's validity, we need to reflect on this osmosis that possibly works under the surface and inter-relates several learning capital subscales. The phenomenon does not appear within the educational capital subscales, possibly due to stronger independence powers reflecting a more clear-cut distinction of the constructs in the students' minds; this distinction may not be so clear with respect to learning capital constructs though, possibly reflecting the many vague, unlimited or undifferentiated aspects pervading the Greek educational system, which can result in further undifferentiated conceptions of it by the students (Ziegler, Debatin, et al., 2019; Ziegler & Phillipson 2012; Ziegler & Stoeger, 2017).

Cultural and cross-cultural studies on giftedness, which are still scarce (Stoeger, Balestrini, et al., 2018), can be empowered via further cross-cultural QELC studies. The current study's initial cross-cultural results reflect the relations among the ten Greek educational and learning capitals as compared to the correlational patterns among the ten capital relations in China, Israel, Germany, and Turkey (Leana-Taşcilar, 2015; Paz-Baruck, 2015; Vladut, Liu, et al., 2013). The greatest similarities appeared between students in Israel and Germany, but the greatest differences appeared between students in China and students in all the other four countries. For the remaining students (Israel, Greece, and Turkey), all correlational patterns of relations differed amongst them and all other countries, either to a larger extent, e.g., the Greek patterns with the German and Turkish patterns or to a smaller extent e.g. the Turkish patterns with the Israeli and German ones, or the Israeli patterns with the Greek ones. In general, in this comparison of four different cultural settings, it is important to note that only one "cultural pattern" of correlations was common across Germany and Israel. Obviously, these findings cannot be fully interpreted at this stage of analysis, but they may offer some important hints for further research. In this future attempt, and ideally under a large – or at least larger – number of participating cultures, we might attempt a multivariate exploration of the similarities and differences across these correlational patterns relating educational and learning capitals through methods such as the "hit-matrix" and MDS-T methods (Georgas & Mylonas, 2006; Mylonas, 2009; Papazoglou & Mylonas, 2017), as described and applied in other studies on family values. Through these methods we might be able to better understand the common grounds and cross-cultural differences and/or even form homogeneous clusters of cultures sharing strong similarities in the way students capitalize on education and learning potential.

Finally, and further extending the above, cultural variety of educational and learning capitals across groups *within* a country e.g., among social groups of cultural and linguistic diversity, may be an obvious research necessity, as has been supported in a methodological study (Mylonas, 2009). In the current study, an initial effort to depict cross-cultural differences between groups within the Greek social setting was conducted through our comparisons between the Athenian subsample and the provincial areas one. Such an attempt may possibly indicate some of the variables to be considered as intra-country sub-groupings, possibly allowing or even demanding a "cross-cultural" analytic lens in future research. Specifically, the differences found for the educational didactic capital favored students in Athens, but for the learning telic capital, the differences found favored students in provincial towns; this finding apart from being an interesting point in our current discussion, also seems to be an interesting "hint" for further research and interpretation, under the within country "cross-cultural" rationale, as "place of residence" can culturally differentiate across groups of students (Gari, Mrvoljak, & Nikolopoulou, 2019 *April*). An initial interpretation may associate the higher didactic capital for students in Athens, (a capital city with a population of 3,762,000), with the higher information access opportunities these students enjoy, along with more alternative educational material, teaching methods and teaching "experts". On the other hand, the higher telic capital for students in smaller cities/towns and provincial places, as compared with students in the biggest city of the country, may depict their higher need to set life goals of specific meaning, and to pursue them in order to satisfy their present and future needs; otherwise, they may remain restricted within the limited provincial chances; these limited chances for "educational goods and commodities" may greatly urge them to self-regulate learning and to set for themselves alternative goals towards more effective learning and life chances (Ziegler, Stoeger, & Grassinger, 2011).

Limitations and future research

A first warning should stem from our attempt to reduce age-band inflicted bias, as this was triggered by the developmental method-factor, possibly active in any QELC data. The adjustment itself may be a discussion point, as one might wonder if we should continue adjusting the scores for other sources of bias as well; however, this might either lead us to unwantedly reduce the variance to levels less than adequate for statistical analysis, or in contrast would simply reflect some haphazard selection of exogenous factors to neutralize, which in the end would have devastating effects on the observed factorial structure, an effect we obviously wanted to avoid. Thus, one has to carefully select the biasing factors to control for, but apart from that, we should also note the actual property in our data, which forced us to adjust the scores, and this is no other than the developmental aspect itself. In this study and through the adjustments we performed, we avoided modeling our data separately for different age-groups, but this may not always be feasible or even desirable. The developmental factor should always be considered in future research so as to be properly treated as a part of the model or as a possible confound.

Some sample irregularities were related to the above concerns. One of them was the fact that age differences amongst participants existed – an advantageous disadvantage really. Another concern regards place of residence; although for the purposes of the current study the respective distribution can be considered satisfactory, if one wanted to draw safer conclusions about the necessity of including place of residence, either as a method factor or as a correlate in any multivariate modeling, one would have to better represent urban, sub-urban, and rural populations in Greece, also by testing for the possible departures from such a population distribution through the appropriate χ^2 tests. Of course, for the current non-normative study, the above do not constitute a serious threat, but in future research, they definitely should not be neglected. In addition, age-bands are not a perfect way to explore for possible correlations between educational-learning capital items and age; it would be much better to have the students' birth dates available so that their precise age (in days) might be computed and used as a correlate; this would definitely add to our power while removing the unwanted variance in the QELC data possibly caused by age variations. It would also be an idea for future studies either to keep the age constant in the sample, or the opposite, to study larger age spans, to either diminish any possible biasing effects or to study them in greater depth, respectively.

In future research, further comparative studies may also be conducted, inspired by prior eco-cultural and eco-social modeling; these models showed extensive functionality in depicting cultural similarities and differences across countries, or across cultural groups within a country (Georgas & Berry, 2005; Georgas, van de Vijver, & Berry, 2004); utilizing a set of a priori selected specific eco-social indices that are associated with five educational and five learning capitals dimensions, we might end up with a circumplex of differentiated clusters of countries/cultures of obvious theoretical and applied value.

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