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Learning styles and approaches to learning in excellent and average first-year university students

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Abstract We assessed the learning approaches and learning styles of a sample of 148 excellent students selected from 11 degrees from nine centers of the Polytechnic University of Valencia (Spain), and we compared the results with those of a sample of 133 average students from the same centers. We found that excellent students took deeper approach than average students and that they preferred reflective and theoretical learning styles. Average students adopted a more surface approach, and they preferred active and pragmatic learning styles. Greater academic achievement was related to the deep approach and to the reflective and theoretical learning styles. Poorer academic achievement was related to the surface approach and an active style. University professors may reinforce the deep approach by placing high aims for students which go well beyond reproducing knowledge but use other complementary methods other than expository teaching: problem solving, case studies, designing projects, raising questions, discussion and negotiation in the classroom, etc. To accomplish this, teachers must encourage students to be committed, and these methods help do that. It also helps to introduce more demanding evaluation procedures which do not merely involve repeating what has been learnt, but include training guidance that offers students feedback.

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Introduction

University students' learning becomes particularly important with the new European university framework as set out by the Bologna convergence process in a pedagogic model that centers on students learning, which intends to be active, constructive, and autonomous. In this context, research into university students learning processes is important, and this work is included in it.

The results we present herein were obtained from a 2-year research work which intended to analyze the way that students with better marks to study at university learn, which may explain their academic achievement with a view to specifying efficient working models. To this end, we studied the way that several groups of first-year university students with better marks to study at university learn by comparing their results with those of students who obtained an average mark to study various degrees at the Polytechnic University of Valencia (E. Spain) by following their progress during their first 2 years at university.

This work centers on the obtained results of students' learning styles and learning approaches. Although recently some authors prefer the term "learning pattern" (Vermunt and Vermetten 2004; Vermunt 2005) to refer to student learning forms, or some suggest that "learning conceptions" better fit the traditional notion of learning styles (Richardson 2011), learning styles, and approaches are still two relevant constructs that explain learning processes and remain absolutely valid in the literature. Proof of this is found in issue 3 of volume 21 of the *Learning Individual Differences Jou*rnal of 2011, about styles—cognitive and learning—with the articles of Mayer (2011) McCune and Entwistle (2011), and Richardson (2011), among others. Further proof is the fact that a European network exists, the European Learning Styles Information Network, which works actively in this field (Evans et al. 2010).

Our research has analyzed four constructs to study students' learning: learning strategies, learning approaches, learning styles, and attitudes to learning, which we have evaluated using four different instruments. This is because the four offer scientific rigor and are absolutely valid in the literature and because we understand that the information collected is much wealthier and varied than when using a single construct and a single instrument. We do not share Vermunt's "learning styles" concept, which is broader than the classic interpretation of learning styles (Vermunt and Vermetten 2004; Vermunt 2005), because he uses it "as a superordinate concept in which the cognitive and affective processing of subject matter, the metacognitive regulation of learning, conceptions of learning, and learning orientations, are united" (Vermunt and Vermetten 2004: 362). Vermunt's version of the "learning styles" concept better fits that understood as "learning patterns" or as "orientations to studying" (Entwistle and McCune 2004; Vermunt 1996). Indeed, Vermunt prefers the name learning patterns yet, strangely enough, the name of his evaluation instrument is not changed but remains to be the "Inventory of Learning Styles" (ILS). We are well aware that Vermunt's integration attempt in the learning context, where various overlapping constructs co-exist, is excellent, and we agree with the need for the integration of the various conceptualizations into the field of student learning in higher education (Vermunt and Vermetten 2004). Yet without questioning the ILS, we agree with Boyle et al. (2003) in that it is still necessary to conduct more research works and to check different instruments and their underlying learning models. While these studies are being carried out and a broader

consensus is reached, we are inclined toward "more classical" versions of learning styles and approaches, constructs whose results we have analyzed in this work.

Learning styles and learning approaches originate from the naturalistic perspective and refer to predispositions in the learning form. However, they are different constructs, as we shall see later on. We consider it is interesting to analyze their relations with excellence and their incidence on students' achievement in relation to the first data collection carried out during the first 2 years of this research work. We believe that this may prove to be a relevant contribution because, normally in the literature, these constructs have been considered separately, save a small number of works like that of Cuthbert (2005), which analyzes their trend and their possible interrelations.

Background and state of the matter

Learning styles

Learning styles, as a theoretical construct whose origin is normally attributed to Kolb (1976), appeared in the 1970s as the preferred ways of learning that a subject employed (Entwistle and Peterson 2004), and as relatively general and constant predispositions to adopt the same strategy but in different situations and independently of the specific demands of a given task (Schmeck 1982a, b). They result from inheritance, experiences, and from demands of the environment (Kolb 1976), but they are firmly secured on the personality structure and prove more difficult to change than learning approaches as they are more adaptive. Among others, we point out the works of Pask (1976), who distinguishes the holistic and the serialistic styles, the works of Kolb (1976, 1984), which recognize four styles: accommodator, assimilator, converger, and diverger and those of Fleming and Mills (1992), which defend a three-style model (VARK/VAK): visual, auditory, and kinesthetic or tactile.

We opted for the proposal put forward by Honey and Mumford (1986), whose model is based on a review of Kolb's model, which distinguishes among the activist, reflector, theorist, and pragmatist styles and comes with a questionnaire to assess them (the Learning Styles Questionnaire (LSQ)) (1986). These researchers aimed to discover why it is that when two subjects share the same learning context, one learns while the other does not, or why one learns more than the other. They concluded that this was because there are four styles which respond to the four phases of a cyclic learning process: action, reflection, theory, and pragmatism. The preferred form to face learning in a specific context, where the priority is, for example, theoretical reflection, would explain why a given subject with a preferred way of facing learning is successful at learning or not. So it is that a preferentially activist and pragmatist subject will come across problems with learning demands of the reflective–theoretical type, and vice versa.

We opted for Honey and Mumford's proposal given its functionality and also because we have some studies that have adapted the instrument to the Spanish context, which have been developed by Alonso (Alonso et al. 1995) and which she called the CHAEA questionnaire (in English, The Honey-Alonso Questionnaire on Learning Styles). The instrument, which has been frequently employed in the business context, has also been often used in education (Cassidy 2004); indeed, we later provide examples of its use in several research works conducted with university students. It is true that the literature provides some critical references on its psychometric properties (Cassidy 2004; Coffield et al. 2004), but it is also certain that there are studies which have found good internal reliability–consistency and validity data (Alonso et al. 1995; Escurra 2011; Pickworth and Schoeman 2000), the first

using exploratory factor analyses—with Spanish students—while the last two resorted to confirmatory factor analyses—with Peruvian and South African students.

Based on the responses of the 80 questionnaire items, which we shall describe later on, students' learning style profile may be delimited more or less predominantly in all four styles: activist, reflector, theorist, and pragmatist.

Several works in the literature analyze the relation between learning styles and academic achievement in different countries. Some examples of these research works include those by Camarero et al. (2000), Goldfinch and Hughes (2007), Manzano and Hidalgo (2009), Esguerra Pérez and Guerrero Ospina (2010), and Ruiz et al. (2006), among others. The conducted works tend to find positive, yet poor, correlations between the reflective style—and at times between the theoretical style—and academic achievement, and negative correlations between the active style and performance.

All these works employed the Honey and Mumford questionnaire or the Spanish adapted versión, and they only did correlations.

Approaches to learning

Approaches to learning are understood to be learning processes which learners establish in order to deal with an academic task, and they originate from the learners' perceptions of the task and from their attributes (Entwistle and Peterson 2004). This concept offers elements that are both situational and personal (Biggs 1988, 1993): When a student is faced with a task, two basic questions are raised: What do I want to accomplish with this? What can I do to accomplish it? The former refers to challenges and motives, while the latter corresponds to the strategies and resources to achieve them (McCune and Entwistle 2011): Thus, learning approaches are based on motives and adopt certain strategies.

Learning approaches are of a predisposition or direction nature in terms of learning in a specific way, and this relates them to learning styles. Nevertheless, they are more flexible than learning styles and can adapt to the context and requirements (Biggs 1988) by summoning suitable strategies to meet the more specific or particular objectives intended. Basically, with learning approaches, each person is predisposed to use one approach or another, but the person–situation interaction implies that it may adapt its operation to the most relevant approach to perform the task properly.

Theoretical construct development derives from the research conducted by the Gothenburg Group (Marton, Saljö, Swenson, etc.) and by the Lancaster Group (Entwistle, Ramsden, etc.), to become known later as the Edinburgh group, which carried out qualitative–naturalistic analyses by means of observations and interviews, and which coined the expression "learning approach" by distinguishing between a deep approach and a surface approach (Marton and Säljö 1976a, b; Marton 1983). Entwistle and team devised the ASI (Approaches to Studying Inventory) Questionnaire, of which there have been several versions (Entwistle et al. 1979; Entwistle and Ramsden 1983). The use of this questionnaire with a large sample of British university students helped distinguish three approaches: the deep approach to learning, the surface approach, and the strategic approach. A later version was RASI (Revised Approaches to Studying Inventory) (Tait et al. 1998), and there is another more recent version: the LSQ (Learning and Studying Questionnaire) (Entwistle et al. 2002).

In addition, Biggs (1987a and 1993) and team consistently investigated this matter. Biggs defended the typology of the three approaches and developed the Study Process Questionnaire (SPQ) to assess them among university students (Biggs 1987b, 1988). Nonetheless, he lately postulated the existence of only two approaches: deep and surface (in the R-SPQ-2 of Biggs et al. 2001, the new version of the SPQ, which has good psychometric qualities of internal

reliability–consistency and validity) because sufficient data to ensure the existence of the strategic approach were lacking. Indeed, the confirmatory factor analyses done with the SPQ (Kember and Leung 1998; Kember et al. 1999) revealed that the best model was a two-factor one (surface and deep); this led the authors to devise the new version, in which the confirmatory factor analysis revealed that the two-factor solution was also good (Biggs et al. 2001). Later, other researchers, like Phan and Deo (2008) using the SPQ of 1987 with a sample of university students from the Fiji Islands, who also employed a confirmatory factor analysis, found that the two-factor model provided the best fit. Apart from the data provided by Kember and team to validate the R-SPQ-2, there are other works in which the confirmatory factor analysis shows that the theoretical two-factor model proposed, corresponding to the deep and surface approaches, for the new 2001 version, gave the best fit. Along these lines, we found the study of Gijbels et al. (2005) with a sample of Dutch students, which was published in this journal, and the studies of Hernández et al. (2004) and of Justicia et al. (2008), with samples of Spanish university students. The last cited work, also published in the *European Journal of Psychology of Education*, detected that the best solution was a two-factor one when using both an explanatory factor analysis and a confirmatory factor analysis with two different student samples. Moreover, Kyndt et al. (2011) and Bliuc et al. (2011b) provided excellent internal consistency data from the R-SPQ-2. Previously, Richardson (1994) had questioned the existence of the strategic factor. In addition, Cuthbert (2005) collected data from research works supporting the two constructs, surface and deep, but which questioned the strategic approach. Although Entwistle and his group continued to postulate the existence of the three approaches (Entwistle and McCune 2004), the results of Bigg's research works, and of the other aforementioned authors, led us to decide on his construct and on his evaluation instrument, the R-SPQ-2, which offers good psychometric properties, for the present research work.

Hence, our group, in agreement with what the Gothenburg Group defended and what the Lancaster Group initially postulated and with Biggs' more recent contribution, endorses the existence of the two approaches previously referred to, deep and surface.

The relevance of the subject matter derives from the impact that learning approaches have on academic achievement. There is information deriving from different research works in different countries: Valle et al. (1997), Valle et al. (2000), Biggs (1987b), Zeegers (2001), Muñoz and Gómez (2005), Gargallo et al. (2006), De La Fuente et al. (2008), Ruiz et al. (2008), and Bliuc et al. (2011a), among others.

All these research works, which have used the SPQ or the R-SPQ-2, reflect the influence of learning approaches on academic achievement, which was positive for the deep approach and negative for the surface approach.

The results obtained for influence on achievement appear to be clearer for approaches than for styles. Besides, the statistics employed were more varied than the styles because, other than correlations, inter-group differences analyses and multicausal analyses have been done.

Nevertheless, styles and approaches have not been dealt with in the context which our research refers to, that is, to analyze the excellent students' profile by studying the first university years.[1]

The excellent students theme has been poorly researched. There are some studies on how students work during their first year at university, which analyzed the predictor variables that

[1] We chose the first 2 years as both are fundamental for students' integration into the university. The first year is a critical course in which students find themselves in a new domain that they do not dominate: new organization, new teachers, new methods, new classmates, etc. Besides, the first university year has the worse failure rate in universities (Cabrera et al. 2006). The second university year is about adaptation: Students have some university experience, but problems may still appear, e.g., changes in a degree, etc.

adjust well (Pritchard et al. 2007); impact of the family structure (Deronck 2007); and social support and academic stress (Rayle and Chung 2007). We also found studies that analyzed the factors influencing academic achievement, such as that of Fore (1998), which studied native students, or that of Strayhorn (2006), which focused on students whose parents did not go to university, or the work of Goldfinch and Hughes (2007), which examined the incidence of learning styles on achievement, among other variables. There are also some research works on achievement while students study (De Miguel and Arias 1999; Meléndez 2007).

However, we were unable to confirm the existence of research data on excellent students' way of acting which analyze the different relevant variables involved in their learning to determine their way of acting as opposed to other student types.

Objectives

Based on the data collected, the objectives of the present study are to know the differences between excellent and average students in learning styles/approaches, both groups' multivariate profile and its relation with academic achievement.

Method

Design

This research uses a comparative-type design (McMillan and Schumacher 2010) with two groups of subjects: excellent and average students, in terms of their former academic achievement.

Participants

The sample consisted in 281 students, 148 excellent students and 133 average students, studying at the Polytechnic University of Valencia (E. Spain).

The sample was formed by non-probabilistic sampling of the intentional type and by considering two criteria: degree and type of students. The intention was to obtain, on the one hand, students of different degrees which could explain the diversity in learning approaches over time by incorporating variations due to the characteristics of a specific degree. On the other hand, when selecting the student groups, two groups were chosen, excellent and average, for the purpose of obtaining two representative groups of exceptional performance and standard performance in the various degrees. This approach proved adequate for this objective because, although the definition of the more extreme groups could have led to us finding more significant differences, we were particularly interested in distinguishing between students with average performance and those with superior performance as this would allow us to more finely specify the excellent students profile as opposed to the more usual performance at this university.

Regarding the first criterion, we selected 11 groups of students from 11 degrees offered in nine centers. These degrees were: Technical Industrial Engineer, Technical Industrial Design Engineer, Computer Science Engineer, Technical Engineer in Public Works, Technical Architect, Architect, Telecommunications Engineer, Civil Engineer, Industrial Engineer, MA in Fine Arts, and MSc in Biotechnology.

As regards types of students, those who had obtained the highest marks in their PAU (University Access Exam) exam were selected, these being the students in the 90 percentile, or above, in each degree. Those who were found around the degree median were chosen as average students by taking a semi-interquartile deviation over and above this value as a range. Hence, the excellent students' PAU mark was 8.7 while that of average students was 7.3, and statistically significant differences were found between both groups ($t_{273,567}=14.823$; $p<.000$).

Using these two criteria, the minimum sample planned (which we wished to maintain during the 2 years the research work lasted) was ten excellent students and ten average students per group, which gave a total of 220 students. Since there were reasonable expectations that some students would drop out of the experiment over the 2-year research period, the initially selected sample was slightly larger, with around 300 students, in order to obtain replacements for those who dropped out. Of these 300 subjects, we obtained a response from 281, who were subjected to the instruments used during the first study year.

Measuring instruments

The data collection instruments employed were the Honey-Alonso Questionnaire on Learning Styles (in Spanish, CHAEA) of Alonso et al. (1995) and the Revised Two-Factor Study Process Questionnaire (R-SPQ-2) of Biggs et al. (2001).

CHAEA provided information about the four learning styles: activist, reflector, theorist, and pragmatic. It consists of 80 items, 20 per style. Students had to indicate if they agreed more with an item than they disagreed, or vice versa. The "I agree" scores obtained one point, and the "I disagree" scores were given 0 points, and students could obtain a score of between 0 and 20 points per style. The reliability of each style was as follows: activist, $\alpha=0.63$; reflector, $\alpha=0.59$; theorist, $\alpha=0.60$; pragmatist, $\alpha=0.51$.

The R-SPQ-2 F of Biggs et al. (2001) was developed with modified SPQ items (Biggs 1987a, b). It contains 20 items divided into two scales, one about the surface approach and the other about the surface approach, with ten items each. The two scales are subdivided into two factors which assess motives and strategies (the surface ones in one scale and the deep ones in another). The questionnaire employs a Likert-type evaluation scale with five categories ranging from "never or very rarely" (1 point) to "always or almost always" (5 points). The reliability of the four subscales was: surface motive, $\alpha=0.66$; surface strategy, $\alpha=0.67$; deep motive, $\alpha=0.61$; deep strategy, $\alpha=0.71$.

Procedure and statistical analyses

Participants were informed about the research work purpose and were encouraged to participate in it via personal communication. They completed the questionnaires by means of a Polytechnic University of Valencia E-learning platform (https://poliformat.upv.es/portal), and we collected their ratings.

The statistical analyses carried out to respond to the objectives were: descriptive, multivariate analysis of variance (MANOVA), discriminate analysis, and a categorical principal components (CATPCA) analysis. The SPSS 17.0. program was used for all the analyses done.

Results

Firstly, we present the descriptive results of the learning styles and approaches scores of both the excellent and average students. Secondly, we include the results of intergroup

differences. Thirdly and finally, we present the joint dimensional structure of the learning styles and the learning approaches by considering both groups and their academic achievement during the first year at the same time.

Descriptives of the learning styles and learning approaches of excellent and average students

Both types of students presented the best score for the reflector learning style, followed by the theorist, the pragmatist, and the activist styles (Table 1 and Fig. 1).

When comparing the two students groups, excellent students obtained higher scores than average students for the reflector and theorist styles than for average students, who obtained higher scores for the activist and pragmatist styles.

Both student types presented higher scores in the deep approach than in the surface approach. The highest value obtained was for deep motive, followed by deep strategy, surface strategy, and surface motive (Table 2 and Fig. 2).

When comparing both students groups, higher scores were noted for excellent students in the deep strategy and the deep motive, while average students obtained higher scores for surface strategy and surface motive.

Differences between excellent and average students in learning styles and learning approaches

The analysis done of the intergroup differences was done by means of a MANOVA and by a discriminate analysis.

The MANOVA was done to discover if there were any differences between both groups. The model is made up of eight dependent variables, the four learning styles (activist, theorist, pragmatist, and reflector) and the surface and deep learning strategies and motives. The independent variable was the student group (excellent and average).

The M box test for the equality of the variances–covariances matrices was not significant (M Box=44.370; F=1.192; p=0.199), and the matrix was equal for both groups. Regarding the identity matrix, the Bartlett sphericity test was significant (χ^2=2163.053; gl=35; p=0.000), indicating that there are sufficient correlations among the dependent variables. Consequently, performing a MANOVA was appropriate.

The Wilks' Lambda was also significant (Table 3), thus significant differences were found between excellent and average students in learning styles and learning approaches jointly. The estimated effect size was relevant but moderate (10.6 %).

In order to obtain a better approach of each dependent variable's contribution to the multivariate profile in relation to the significant effect encountered in the MANOVA, a discriminate analysis was done. We decided on a complete model that included all the

Table 1 Learning styles in excellent and average students

Styles	Excellent		Average	
	Mean	Standard deviation	Mean	Standard deviation
Activist	11.87	3.116	12.52	2.938
Reflector	16.96	2.289	16.20	2.631
Theorist	14.39	2.421	14.06	2.910
Pragmatist	13.16	2.494	13.51	2.623

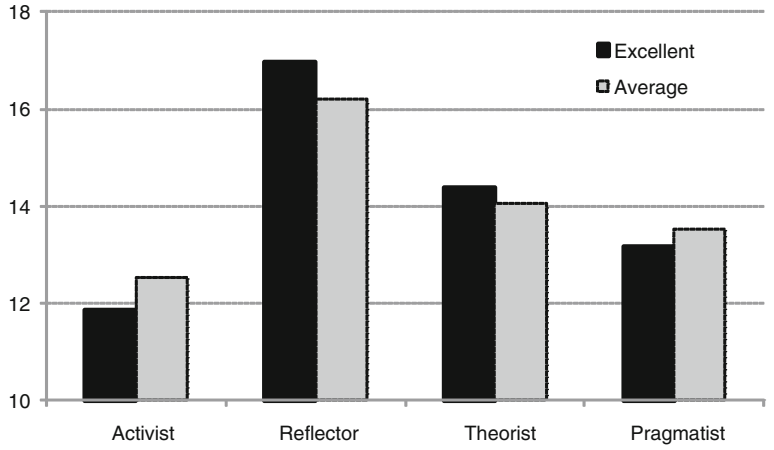

Fig. 1 Learning styles in excellent and average students. The score scale goes from 0 to 20 points for each style

variables considered, which is in line with the objective. The dependent variable was the students group (excellent and average), while the independent variables were the four learning styles and the deep and surface learning strategies and motives.

A single function was obtained by characterizing the students group into two values, which was significant (Table 4). The relation noted was of a mean intensity, as indicated by the canonical correlation value.

This discriminant function significantly separates both students groups. Hence, the results of the discriminant function obtained in the centroids of the groups (Table 5) evidence that the excellent students group is located on the negative pole of the function, whereas the average students group is on the positive pole.

We can see how the reflector style and the surface strategy/motive are relevant to separate both groups, and to therefore contribute to differences in profile (Tables 5 and 6). Excellent students are characterized by the higher reflector-style level and by the lower surface strategy/motive levels, while average students are characterized by the opposite. The remaining dimensions show no significant contribution to the discrimination profile, although the deep strategy and deep motive variables come close to the level of significance and also characterize excellent students.

Finally, this model enabled us to correctly identify the correspondence group for 63.8 % of the cases (62.3 % with crossed validation), which indicates the appropriateness of the proposed model. Both students groups present good classifications, although excellent students are better identified (65.2 %) than average ones (62.2 %) (Table 7).

Table 2 Learning styles in excellent and average students

Dimensions	Excellent		Averages	
	Mean	Standard deviation	Mean	Standard deviation
Surface strategy	2.17	0.66	2.54	0.65
Surface motive	1.98	0.60	2.34	0.63
Deep strategy	3.05	0.67	2.91	0.66
Deep motive	3.38	0.61	3.23	0.68

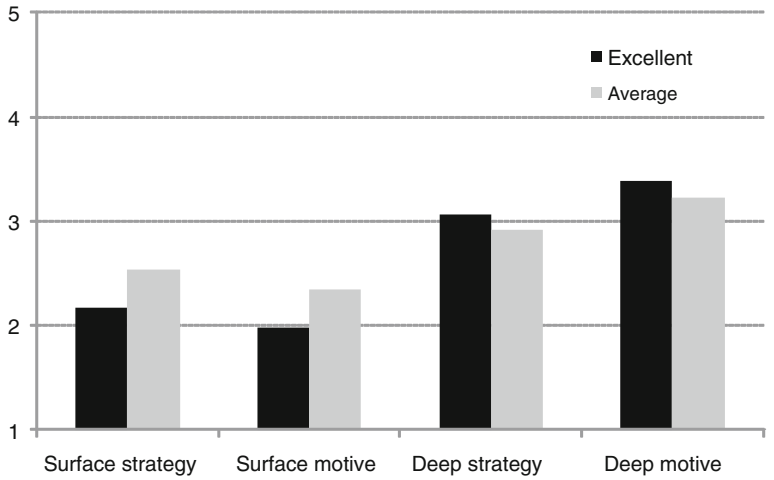

Fig. 2 Approaches to learning in excellent and average students. The score scale goes from one to five points in each factor

The dimensional structure of styles, approaches, and academic achievement of both excellent and average students

This section aims to offer an approach for the combined learning styles and approaches' dimensional structure by including in the dimensions domain excellent and average students' representative positions, as well as the achievement accomplished in the June call of the first university year. Groupings are represented by centroids. Achievement was evaluated by obtaining the mean grade of each student on the course and by calculating the weight of the grades gained in the subject matters as a percentage in terms of each student's number of credits. For the statistical process, the grade obtained for the first university year was characterized as a university would do it: Failed, 0–4.9; Passed, 5–6.9; Good, 7–8.9; Excellent, 9–10. The aim here is to obtain an overview of dimensional structuring and its relations with not only the students groups but also with their academic achievement. To this end, we did a CATPCA given the metrics of the variables involved.

We opted for a two-dimensional solution which explained almost 53.1 % of variance (Table 8), with 34.3 % of variance explained by the first dimension and 18.8 % explained by the second dimension. Therefore, the first dimension is more relevant and contributes more to explaining variance, while the second one helps explain variance to a lesser extent. The coefficients of reliability (Cronbach's α) indicate the model's appropriateness.

The separation between students groups is basically done by means of learning approaches, while learning styles play a highly marginal role in this separation (Fig. 3). The approaches and centroids of both students groups and achievement are located on one axis from the lower left quadrant to the upper right quadrant. Styles are found almost orthogonally and are, therefore, independent of this axis. The activist style is somewhat of

Table 3 Multivariate contrast of the MANOVA

	Value	*F*	Sig.	Partial eta-squared
Wilks' Lambda	0.894	3.726	0.000	0.106

Table 4 Self-values and contrast of the discriminant functions of the learning styles/approaches

Function	Self-value	% of variance	Canonical correlation	Wilks' Lambda	Chi-squared	gl	Sig.
1	0.119	100	0.326	0.894	28.502	8	0.000

an exception as it tends to come close to the surface approach area, although it is distinguished in terms of the second dimension.

As regards students groups, excellent students present a deep learning approach in motives and strategies, and the theorist, reflector, and pragmatist learning styles. Average students are characterized by a surface learning approach, in motives and strategies, and by the activist learning style.

Thus, we can see that the findings obtained in the former approaches are completed when considering the dimensions structure as a reference. So it seems to be a better definition of the basic contrast that distinguishes excellent students from average students. The contribution of the learning styles differences is reduced to a marginal value, with approaches taking a clearly central value. On the other hand, the tendency displayed in achievement during the first university year also adapts well to this opposition dimension because excellent students obtained better grades, ranging between Good (7–8.9) and Excellent (9–10), whereas average students obtained Passed (5–6.9) and Failed (0–4.9). We can observe that starting university studies is a complex adaptation process for the whole sample. Thus, excellent students were found to be somewhere between the Good and Excellent grades when their average grade, when selected to study at university based on their PAU mark, was clearly excellent. Average students' academic achievement lowered to an intermediate position, somewhere between just passing and failing subject matters, and their average PAU mark came close to Good.

Discussion

Based on our data, excellent students are inclined to adopt a deep learning approach (deep strategy/motive) and the reflector and theorist styles, whereas average students tend to take a surface approach (surface strategy and motives) and the activist style. This does not necessarily mean that the relation between the deep approach and the reflector and theorist styles, and between the surface approach and the activist style is that encountered in any students sample; indeed, larger study samples would be necessary to state this. Our sample size is small and was selected with a view to distinguishing between excellent and average students. Any further considerations would require subsequent works.

In any case, when the achievement in our sample is good, it is related with the deep learning approach and with the reflector and theorist styles, and with the surface learning approach and the activist style when it is low.

Table 5 Functions in the groups' centroids

	Function
Group of students	1
Excellent	−0.315
Average	0.374

Table 6 The results of the discriminant analysis of learning styles and approaches to learning

Equality tests of the groups' means				Standardized coefficients of the canonical discriminant functions	Structure matrix
	Wilks' Lambda	*F*	Sig.	Function 1	Function 1
Activist style	0.993	1.943	0.165	0.019	0.252
Reflector style	0.977	6.120	0.014	−0.327	−0.447
Theorist style	0.995	1.242	0.266	0.137	−0.201
Pragmatist style	0.996	1.125	0.290	0.100	0.192
Surface strategy	0.924	21.362	0.000	0.410	0.835
Surface motive	0.913	24.609	0.000	0.559	0.896
Deep strategy	0.987	3.312	0.070	0.071	−0.329
Deep motive	0.986	3.634	0.058	−0.110	−0.344

Thus, the deep learning approach is related with students' excellence given its impact on achievement. Our data confirm data reported in former studies (Kember et al. 1995; De la Fuente et al. 2008; Gargallo et al. 2006; Ruiz et al. 2008; Valle et al. 2000; Bliuc et al. 2011a).

Verifying whether the deep approach is convenient is clearly challenging for university teachers, who must encourage it among their students so they can learn more and learn better, and because it is more likely to help them improve their studies.

We also have data from several research works which prove that teacher's teaching and learning methodology significantly influences the way students work (Biggs and Tang 2007; Entwistle 2009; Entwistle et al. 2003; Gargallo 2006, 2008; Hounsell and Hounsell 2007; McCune and Entwistle 2011). Regarding approaches, when teachers endorse approaches learning-centered and use coherent learning and assessment methodologies, students are inclined to take the deep approach; the opposite occurs when teachers endorse approaches teaching-centered which involve presenting an expository methodology with no alternatives and an assessment method in the final examination, as opposed to other teaching procedures. Conversely to what Cuthbert stated (2005), in former research works (Author 2006, 2008), we found data quite clearly indicating that teachers may reinforce the deep approach by placing high aims for students which go well beyond reproducing knowledge, but use other complementary methods other than expository teaching: problem solving, case studies, designing projects, raising questions, discussion and negotiation in the classroom, etc.

Table 7 Percentage of the students' classification after the discriminant analysis

		Correspondence group predicted	
		Excellent	Average
Original			
Students group	Excellent	65.2	34.8
	Average	37.8	62.2
Percentage of perfectly classified cases, 63.8 %			
Crossed validation			
Students group	Excellent	65.2	34.8
	Average	41.2	58.8
Percentage of perfectly classified cases, 62.3 %			

Table 8 The model summarized

Dimension	Variance explained Total (self-values)	Percentage	Coefficient of reliability Cronbach's alpha
1	2.745	34.3 %	0.727
2	1.499	18.8 %	0.381
Total	4.245	53.1 %	0.874

(Biggs 2005). To accomplish this, teachers must encourage students to be committed, and these methods help do that. It also helps to introduce more demanding evaluation procedures

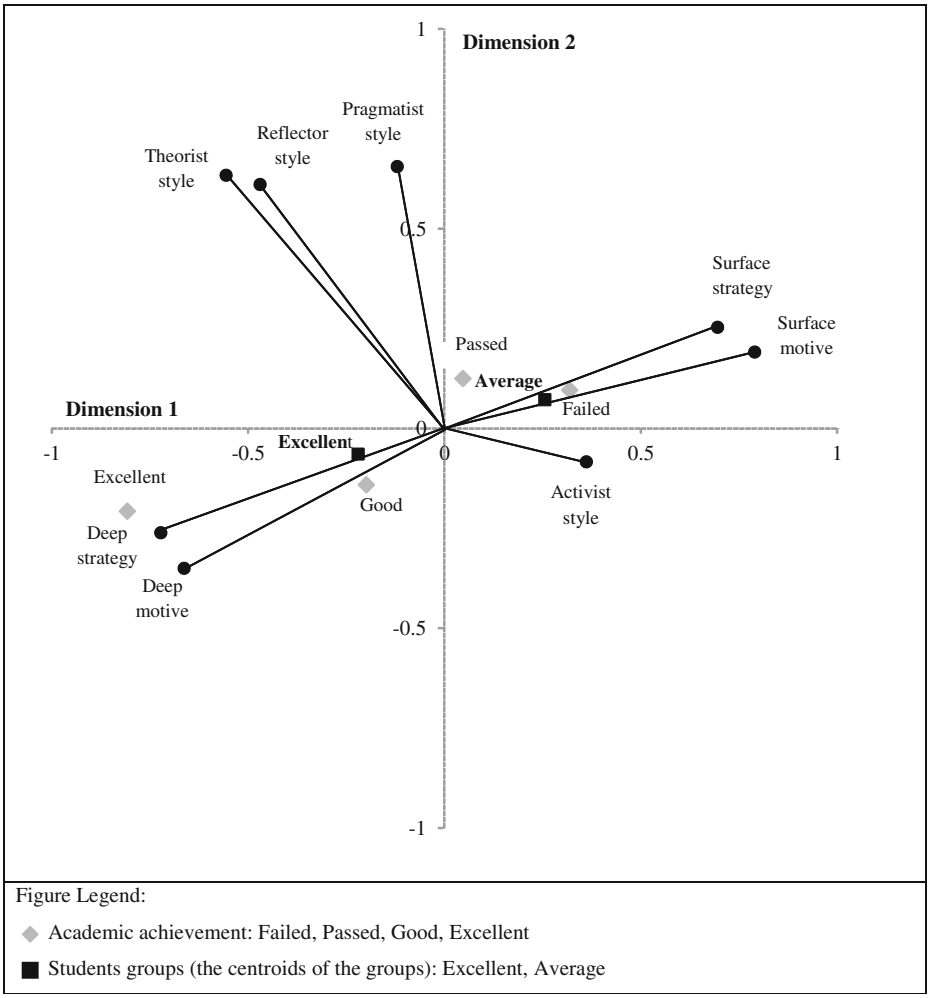

Fig. 3 Structure of the learning styles and learning approaches in excellent and average students. Figure legend: *gray diamond*: academic achievement: Failed, Passed, Good, Excellent. *Filled square:* students' groups (the centroids of the groups): Excellent, Average

which do not merely involve repeating what has been learnt but include training guidance that offers students feedback, etc. (McCune and Entwistle 2011).

On the other hand, although the relation between learning styles and achievement is much more moderate—our data corroborate those reported by Camarero et al. 2000; Goldfinch and Hughes 2007; Manzano and Hidalgo 2009; Esguerra et al., 2010—teachers can also do something about this. Should, in line with Kolb's experiential learning model (1984), a complete, ideal learning cycle include a more inductive procedure than a deductive one, students' discovery and construction of knowledge with help from teachers and their peers, starting with experimentation and action (bringing students into contact with reality and analyzing real problems), followed by reflection (the reflector approach, understanding what has been observed, relating it to what is already known, etc.), continuing with theoretical preparation (theoretically constructing the discipline by observing, reflecting on and integrating the concepts worked on in the learning cycle that are part of conceptual networks) and finishing with the pragmatic application (applying what we have learnt to real life and to practical problems), then we can include in teaching plans and actions the development of the disciplinary units or topics which are worked on in this approach, an approach that is more daring, yet more appealing to students, than traditional ones.

The traditional way that teachers proceeded with was quite different: They commenced with theories and ready-formed concepts, or explaining them, occasionally using a few examples, but very rarely finishing by experimenting and applying what has been learnt to real life or possibly to professional undertaking. The sequence we propose proceeds practically inversely: It begins with experience, and, based on reality, it goes on to construct the scientific knowledge of the discipline in successive steps, which involve reflective effort from experimenting with and analyzing this reality upon which work is done and observations are made. Next, students, mediated by teachers and their peers, discover how to elucidate and integrate concepts and go back to reality by practically applying what has been constructed. The dynamics involved are more like those employed by experimental scientists to construct knowledge.

This way of proceeding is more daring than the traditional form and proves more demanding for students and teachers alike. However, it is more appealing and motivating and can cooperate in encouraging the excellence of students. We always learn better what we have discovered for and constructed by ourselves with the help of others than being presented with something that has already been prepared which restricts our actions to merely memorizing it.

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