Journal of
Higher Education Policy
And
Leadership Studies

JHEPALS (E-ISSN: 2717-1426)

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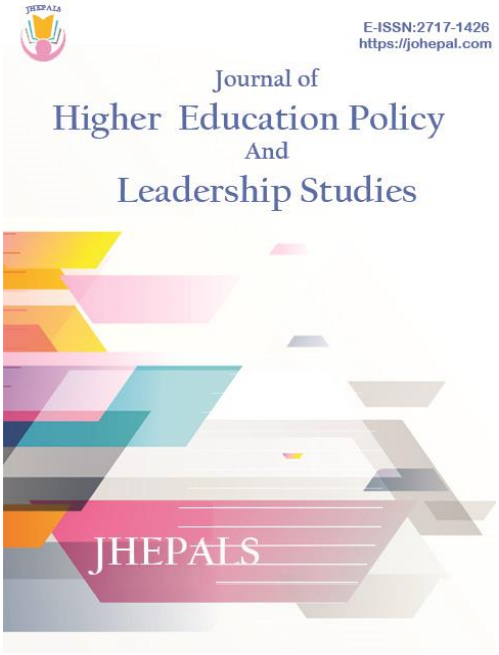
Psychoeducational Factors Associated with University Students' Success and Failure



Agustin Freiberg-Hoffmann [1]

CONICET- Research Institute, Faculty of Psychology, University of Buenos Aires, ARGENTINA
Email: agustinfreiberg@gmail.com
https://orcid.org/0000-0001-8737-1186

Agustin Romero-Medina [2]

Faculty of Psychology, University of Murcia, SPAIN
Email: agustinr@um.es
https://orcid.org/0000-0002-3496-3409

Ruben Ledesma [3]

CONICET-Faculty of Psychology, University of Mar del Plata, ARGENTINA
Email: rdledesma@gmail.com
https://orcid.org/0000-0002-8598-4680

Mercedes Fernández-Liporace [4]

CONICET- Research Institute, Faculty of Psychology, University of Buenos Aires, ARGENTINA
Email: mliporac@psi.uba.ar
https://orcid.org/0000-0001-7044-8386

Article Received **2022/05/23** | Article Accepted **2022/09/11** | Published Online **2022/09/30**

Cite article as:

Freiberg-Hoffmann, A., Romero-Medina, A., Ledesma, R., & Fernández-Liporace, M. (2022). Psychoeducational factors associated with university students' success and failure. *Journal of Higher Education Policy and Leadership Studies*, *3*(3), 90-106. DOI: https://dx.doi.org/10.52547/johepal.3.3.90

[DOI: 10.52547/johepal.3.3.90]

Psychoeducational Factors Associated with University Students' Success and Failure

Journal of Higher Education Policy And Leadership Studies (JHEPALS)

E-ISSN: 2717-1426
Volume: 3 Issue: 3
pp. 90-106
DOI:
10.52547/johepal.3.3.90

Agustin Freiberg-Hoffmann *
Agustin Romero-Medina
Ruben Ledesma
Mercedes Fernández-Liporace

Abstract

The study was aimed at analysing learning styles, learning strategies, and learning approaches altogether in order to identify psychological variables likely to explain academic achievement in college students. Data were gathered using the locally adapted versions of the Honey-Alonso Questionnaire of Learning Styles, the Learning and Study Strategies Inventory, and the Revised Two-Factor Study Process Questionnaire. Two independent samples of college students were analysed (527 for the exploratory factor analysis; 437 for the path analysis). First, exploratory factor analysis was conducted to identify which styles, strategies, and approaches loaded on which factor. Second, a path analysis was run to examine the influence of the factors on academic achievement. Results showed that all learning styles, strategies, and approaches were retained, loading on two factors that, afterward, explained academic achievement. Factor 1 joined all the learning strategies from LASSI, Accommodating and Assimilating styles as well as the Deep approach. This factor explained academic achievement positively. Factor 2 grouped Converging and Pragmatist styles, and the Surface approach, explaining academic performance negatively. These findings will be useful for teachers to plan teaching methods targeted at training students' cognitive, and metacognitive skills. Such enhancement would lead to better academic outcomes.

Keywords: Learning; Academic Achievement; College Students; Psychological Assessment

***Corresponding author's email:** agustinfreiberg@gmail.com

[DOI: 10.52547/johepal.3.3.90]

Introduction

Academic achievement in higher education is one of the major current concerns in the educational field. On the one hand, low performances and high dropout figures are commonplace. According to official reports, only 64% of freshmen remain in the system, whilst a scarce 27% achieve graduation in the expected time as stated by study programes (República Argentina, Ministerio de Educación, Cultura, Ciencia y Tecnología, 2019). On the other hand, 51% of students barely pass one course per year-term (Fernández, 2018).

Different factors influence the undergraduates' achievement —economical, academic, individual, etc. (García de Fanelli, 2014). Among the individual factors, psychological variables play a capital role. Specifically, learning styles, learning strategies, and learning approaches stand out as the ones with major influence. They are all cognitive and metacognitive operations participating in the learning process enabling, delaying, or obstructing it, according to how efficiently each student manages their combined use (Alonso et al., 1994; Biggs et al., 2001; Entwistle et al., 2013; Kolb, 1984; Pintrich et al., 1991; Weinstein & Mayer, 1986).

Learning styles describe the way students perceive and process information. They are composed of cognitive, affective, and physiological features which set the students' preferences regarding learning (Keefe, 1982). Such preferences make content easier to be learned for the ones who show styles according to each specific learning activity (Alonso et al., 1994).

Learning strategies are related to thoughts and behaviours involved in problem-solving (Weinstein et al., 1987). Strategies can be categorised as follows: cognitive, metacognitive, and resources-management. Cognitive strategies are the series of methods employed to process information, linking it up to prior knowledge. Metacognitive strategies let students planning and monitoring their own learning. The last category, identified as resource management, includes motivational and affective features as well as attitudes (Weinstein & Mayer, 1986). On the grounds of the previous description, it seems reasonable to expect that the use of efficient strategies leads to quality learning. Such strategies help students to feel at ease when dealing with different assignments (Kisac & Budak, 2014).

Learning approaches refer to motivations and strategies used to solve assignments or activities in class. Such approaches depend on how each student perceives a specific content and the problems to be solved. Therefore, the undergraduates' perception of their own cognitive skills regarding the type of task and learning environment is crucial (Biggs, 1988). Besides, motivated students using complex cognitive resources can achieve long-term learning. Conversely, the ones who show no interest only memorise unconnected facts which fade out soon (Biggs et al., 2001).

So far, learning styles, strategies and approaches have been scarcely analysed altogether (Cano-García & Justicia-Justicia, 1994). Most of these studies examined two of these variables at once (Jalgaonkar et al., 2018; Nosheen & Hussain, 2020; Soundariya et al., 2017). Many others took into account only styles (e.g. Alkooheji & Al-Hattami, 2018; Magulod Jr., 2019; Viloria et al., 2019; Yudha, 2019), only strategies (e.g. Azmimurad & Osman, 2019; Biwer et al., 2020; Deschênes et al., 2020), or only approaches (e.g. Alsayed et al., 2021; Soyer & Kirikkanat, 2019; Tho et al., 2020; Zamora Menéndez et al., 2020). Even when those developments considered the variables independently, all of them reported the key role they play when academic achievement matters (Table 1).

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Table 1
Styles, strategies, and approaches to learning in undergraduates. Previous findings.

Authors	Year	Constructs	Results
Cano-García & Justicia-Justicia	1994	Styles Strategies Approaches	Styles, approaches, and strategies were grouped into four factors: Traditional Study Methods, Deep Processing, Elaborative Processing, and General Learning Styles.
Jalgaonkar et al.	2018	Styles Approaches	Learning styles varied according to the attended major; all students used a Deep Approach. Styles and approaches were proven not linked to academic achievement.
Nosheen & Hussain	2020	Styles Strategies	Significant and positive correlations between different learning styles and strategies and academic achievement.
Soundariya et al.	2017	Styles Approaches	50% of students showed a variety of styles whereas the other 50% preferred a unique style. All of them employed a Deep Approach.
Yudha	2019	Styles	Learning styles were proven as influencing mathematical reasoning.
Alkooheji & Al-Hattami	2018	Styles	Students used multiple learning styles; their preferred styles depended on the type of academic task.
Magulod Jr.	2019	Styles.	Significant differences in styles by academic achievement, the father´s occupation, and high school programme studies were found.
Viloria et al.	2019	Styles	Significant differences in learning styles by major.
Azmimurad & Osman	2019	Strategies	Students used learning strategies in different measures according to their major.
Biwer et al.	2020	Strategies.	Learning strategies can be trained by specific intervention programmes.
Deschênes et al.	2020	Strategies	Digital media were proven to impact training cognitive and metacognitive strategies.
Alsayed et al.	2021	Approaches	Deep and Surface Approaches were used in equal measure. Both approaches were positively related to age.
Soyer & Kirikkanat	2019	Approaches	Academic self-efficacy and hope showed a positive effect on the Deep Approach. Avoiding goals was proven a robust predictor of the Surface Approach.
Tho et al.	2020	Approaches	Deep Approach was a mediator between positivity as a personality trait and life quality in college.
Zamora Menéndez et al.	2020	Approaches	The higher the use of the Deep Approach, the more academic perseverance.

As for learning styles, several studies found that they are associated with academic achievement, sometimes in a positive way and some others, negatively (e.g. İlçin et al., 2018; Khanal et al., 2019; Tan & Laswad, 2015). Regarding learning strategies, students possessing a wide repertoire of strategies available to be used according to the activity, get the better achievement (Yaghobkhani Ghiasvand, 2010; Jouhari et al., 2016). Significant correlations between specific strategies and academic performance were reported as well (Alkhateeb & Nasser, 2014; Bahamón et al., 2013; Nabizadeh et al., 2019). There is a sound consensus referring to findings from different studies on learning approaches. The Deep approach was positively associated with academic achievement, whereas the Surface approach was negatively linked (Çetin, 2016; Chen et al., 2014; Herrmann et al., 2017).

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On account of the ideas previously described, examining strategies, styles, and approaches one by one only offers partial information. Accordingly, analysing them all together would enable a better comprehension of how students learn, leading to identifying features likely to enhance or hamper academic achievement (Gargallo-López et al., 2006). That information would let the development of interventions and programmes aimed at fostering academic achievement in different stages of the educational pathway. For instance, elementary and high school could be conceived as stages to train and shape strategies, styles, and approaches in order to improve learning, therefore promoting better achievement in higher education. Furthermore, planning tailored training programmes to modify inadequate styles, strategies, and learning approaches in college when they are not useful to the requirements of each major arises as a beneficial alternative.

Following these ideas, the study is aimed at 1) identifying possible assemblages of the dimensions involved in learning styles, strategies, and approaches taken together —Study 1—, and 2) analysing the influence of the factors —identified in Study 1— on academic achievement —Study 2.

Research Methodology

Measures

Demographic and Academic Survey

Personal Variables: Gender/ Age.

Academic Variables: major, number of passed courses, and time elapsed from admission to the present. These two last measures were used to estimate an index of academic achievement. The criterion employed to choose this indicator corresponds to the official measure used by universities in Argentina. Students are required to pass at least two courses in a one-year term to remain in the system (República Argentina, Ministerio de Educación de la Nación, 1995). Measuring academic achievement using this index does not imply ignoring its partiality since it represents only one of the possible ways to estimate this complex issue. Indeed, a more accurate representation of academic performance should include, at least, dimensions such as satisfaction with the major, average time from admission to graduation, efficiency rate, and success rate (Martín et al., 2008). However, gathering a such number of measures was far beyond the scope of the study, and the decision of leaving them out was based on the idea of starting with a plain and manageable number of indicators. Given that, the measure used must be interpreted cautiously and carefully.

Honey-Alonso Questionnaire of Learning Styles —CHAEA according to the Spanish acronym— (Alonso et al., 1994).

The local version of the scale adapted to be used with college students from Buenos Aires (Freiberg-Hoffmann et al., 2020; Freiberg-Hoffmann & Fernández-Liporace, 2013) was employed. It obtained adequate content, face, and construct validity evidence —principal components analysis and confirmatory factor analysis—, as well as an acceptable internal consistency of the dimensions' scores. This inventory, which can be applied in a short session, is composed of 28 dichotomous items responded according to the agreement (+) or disagreement (-) with each statement. The test assesses four learning styles: three from

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Kolb´s model —Assimilating, Converging, and Accommodating—, and the one by Alonso et al. (1994) —Pragmatist style—, as a result of the analyses conducted on the local version. Concisely, accommodators prefer new challenges, avoid logical analysis, and act guided by intuition. Assimilators can handle a wide variety of content. They are not very sociable, feeling comfortable when analysing abstract concepts, as well as when looking for coherence. Converging students are less inclined to follow suggestions from others. They enjoy testing new models and developing laboratory trials. Pragmatists prefer testing hypotheses focusing on their positive features. They are impatient when thrilled by ideas, looking for practical solutions to problems. KR-20 coefficients were .65 for the Assimilating style, .63 for the Converging style, .62 for the Accommodating style, and .50 for the Pragmatist one.

Learning and Study Strategies Inventory —LASSI— (Weinstein et al., 1987).

The version employed was adapted to be used with college students from Buenos Aires and thus, previously analysed in a local sample (Freiberg-Hoffmann et al., 2017). It includes 33 items responded by a 5-option likert scale. Five types of strategies are assessed: Motivation —academic attitudes and goals—, Resources for Learning —strategies used by students to enable their own learning processing—, Ability to Rank Information —skills to distinguish main ideas to learn them in-depth—, Collaborative Learning —interpersonal communication aimed at improving the access to information as well as learning by means of a cooperative interaction—, and Information 2.0 Management Competence —strategies related to the search, analysis, selection, and communication of information. This version obtained adequate content and construct validity evidence, as well as an appropriate stability-reliability, and internal consistency of its dimensions —ordinal alphas: .93 Motivation, .85 Resources for Learning, .94 Ability to Rank Information, .97 Collaborative Learning, and .76 Information 2.0 Management Competence.

Revised Two Factor Study Process Questionnaire —R-SPQ-2F— (Biggs et al., 2001).

The version adapted for college students from Buenos Aires was used (Freiberg-Hoffmann & Fernández-Liporace, 2016). It measures two learning approaches —Deep and Surface—, using 20 items —10 per dimension— with a 5-option likert response. Its content and construct validity evidence as well as its stability-reliability indices and internal consistency coefficients were adequate —ordinal alphas: .76 Deep approach, .83 Surface approach. Deep approach students show high motivation, guided by curiosity and a remarkable involvement in learning tasks. These students analyse content in-depth, engaging themselves meaningfully and thoroughly in the activity. Conversely, Surface approach students only perform the minimum requirements to pass their courses, exhibiting low interest and investing a low effort. They use strategies aimed at learning information automatically, by repetition (Biggs, 1988).

Participants

Convenience sampling was used. Two independent samples were analysed. One was analysed in the exploratory factor study conducted to identify the dimensions of styles, strategies, and approaches taken together —Study 1. The other one was used to examine how well the extracted factors explained academic achievement —Study 2.

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- Study 1: The sample was composed of 527 college students from public universities in Buenos Aires (40.8% males; 59.2% females) attending different major courses (58.4% Psychology, 33.8% Industrial Engineering, 7.8% Medicine), with ages between 17 and 36 years old ($\overline{X}$ = 22.53; SD = 3.70).
- Study 2: The sample was composed of 437 college students from public universities from Buenos Aires (61.8% males; 38.2% females) attending different majors (39.6% Industrial Engineering, 24.3% Psychology, 14.9% Physics, 6.4% Electro-mechanic Engineering, 6.4% IT, 5% Chemical Engineering, 2.1% Electronic Engineering, 1.4% Law). Ages ranged from 17 to 36 years old ($\overline{X}$ = 21.34; SD = 3.41).

Procedures

The study was ethically endorsed by the University of Buenos Aires. Data were gathered while classes were taking place. Students were informed about the voluntary character of the participation, as well as about the possibility of stopping responses at any moment of the procedure. Informed consent was signed. It explained the goals of the study and guaranteed the confidentiality of the results as well as personal data anonymity. Participants received no retributions.

Data Analysis

First, a parallel analysis was conducted in order to decide the number of factors to be extracted in the exploratory factor analysis (Merino-Soto & Domínguez-Lara, 2015). Factor 10.5 was employed to do so. In order to compare empirical data, 500 randomised correlational matrices were generated. Results were interpreted from the 95th percentile of random eigenvalues and higher since it is a conservative criterion that enables the retention of fewer factors. It is also a good means to prevent Type I errors.

The following exploratory factorial procedure was conducted using SPSS 21. A principal components analysis was calculated, forcing the extraction to two factors, as suggested by the parallel analysis previously performed. An Oblimin rotation was employed on the grounds of the hypothesis considering these factors as related.

Study 2 was conducted using the EQS 6.2 software. A path analysis was calculated. This procedure took the two factors obtained in the exploratory factor study, analysing their effect on academic achievement. The model was estimated by means of the maximum likelihood method, using indices such as GFI —Goodness of Fit Statistic—, AGFI —Adjusted Goodness of Fit Statistic—, and RMSEA —Root Mean Square Error of Approximation. Additionally, the parameters' effect size was estimated using the determination coefficient R2 according to Cohen´s cut-off points (Cohen, 1988; Civelek, 2018).

Results

Study 1: Exploratory Factor Study

The parallel analysis, performed to determine the number of factors to be retained, involved the use of a random eigenvalues matrix. When comparing this matrix to the observed eigenvalues, the suitability of the extraction of two factors was verified (Table 2).

Table 2
Parallel analysis

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Variable	Real-data eigenvalues	Mean of random eigenvalues	95th percentile of random eigenvalues
1	2.69	1.23	1.29
2	1.65	1.17	1.21

The principal components analysis took CHAEA, LASSI, and R-SPQ-2F subscales scores as input variables altogether. The extraction was forced to two factors, obtaining an adequate fit and a proper balance between the number of indicators and the number of participants (KMO= .706; Bartlett´s Sphericity Test: X^2= 737.241; df = 55; p < .01). In addition, subscales loaded on a unique factor, with values higher than .40 (Enders & Baraldi, 2018).

The structure explained 37.61% of the total variance —22.38% by Factor 1, and 14.22% by Factor 2. Every input subscale was retained (Table 3). A negative inter-factor correlation was found (Φ = -.071).

Table 3 shows how Factor 1 joined all the dimensions of learning strategies, two styles —Assimilating and Accommodating— and the Deep learning approach. Factor 2 grouped two dimensions of styles —Converging and Pragmatist— as well as the Surface approach. Following theoretical descriptions of the learning styles, strategies, and approaches, Factor 1 seems to be related to features mainly associated with good academic achievement whereas Factor 2 appears to be linked to low performance.

Table 3
Factor structure of CHAEA, LASSI, R-SPQ-2F

	Components	
Subscales	Factor 1	Factor 2
CL (1)	**.418**	.293
M (1)	**.593**	-.248
ARI (1)	**.418**	-.042
RL (1)	**.578**	.231
IMC (1)	**.475**	-.179
Assimilating (2)	**.581**	.009
Accommodating (2)	**.490**	-.030
Deep (3)	**.696**	-.379
Converging (2)	.063	**.751**
Pragmatist (2)	-.080	**.506**
Surface (3)	-.334	**.737**

Note. CL = Collaborative Learning; M = Motivation; ARI = Abilities to Rank Information; RL = Resources for Learning; IMC = Information 2.0 Management Competence. The numbers in brackets indicate the scale where each dimension belongs to: (1) LASSI; (2) CHAEA; (3) R-SPQ-2F.

Study 2: Path Analysis

In order to confirm the relation of the subscales with the latent variables —Factors 1 and 2—, and to verify whether each latent variable was able to explain lower or higher achievements, a path analysis was run on a new sample of students. Therefore, this study 2 was developed based on the following model: a) the input variables linked to higher achievements that were used in the previous factor analysis conducted in Study 1 (i.e., all

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the dimensions of learning strategies, Assimilating and Accommodating learning styles, and the Deep learning approach) were tested in terms of their joint convergence with the latent variable labeled as Factor 1; b) the input variables linked to academic failure —gathered in Factor 2 (i.e., Converging and Pragmatist learning styles, and the Surface approach)— were analysed in terms of their convergence with Factor 2; c) both latent variables —Factors 1 and 2—were related to academic achievement. The resulting model was estimated using the maximum likelihood method (Figure 1).

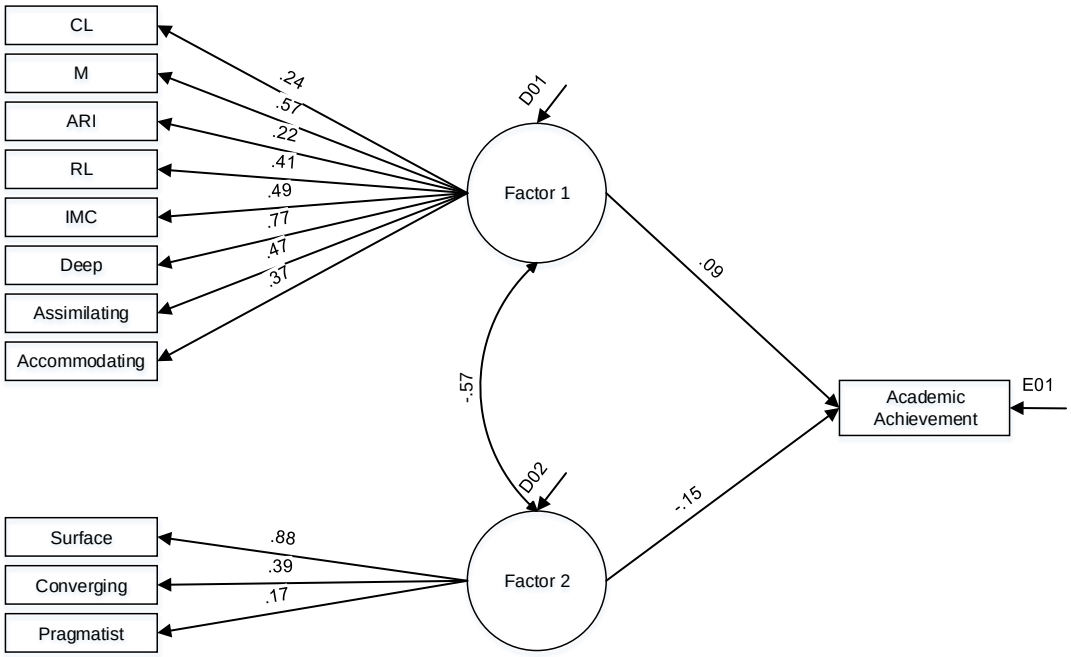

Figure 1. Causal model of academic achievement resulting from the principal components analysis.

GFI (.937) and AGFI (.906) indices achieved values over .90, cut-off point which differentiates a good fit from an average one (Kline, 2005). RMSEA index (.073) reached an adequate value as well, since it was between 0 and .08, according to recommendations by Civelek (2018).

Regarding the analysis of the estimated parameters, all of them were statistically significant ($p<.05$), except for the Collaborative Learning Strategy, and the Surface approach. Low effect sizes were found for the Collaborative Learning Strategy-Factor 1, Abilities to Rank Information-Factor 1, Pragmatist-Factor 2, Factor 1-Academic Achievement, and Factor 2-Academic Achievement parameters. Such estimations obtained medium to low values (Table 4).

Table 4
Effect size of the estimated parameters

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Parameters	β	R^2
CL-Factor 1	.24	.05
M-Factor 1	.57	.32
ARI-Factor 1	.22	.04
RL-Factor 1	.41	.16
IMC-Factor 1	.49	.24
Assimilating-Factor 1	.47	.22
Accommodating-Factor 1	.37	.13
Deep-Factor 1	.77	.59
Surface-Factor 2	.88	.77
Converging-Factor 2	.39	.15
Pragmatist- Factor 2	.17	.02
Factor 1-Academic Achievement	.09	.00
Factor 2-Academic Achievement	-.15	.02

Note. CL = Collaborative Learning; M = Motivation; ARI = Abilities to Rank Information; RL = Resources for Learning; IMC = Information 2.0 Management Competence. R^2 Cohen´s cut-off points small= .02, medium= .13, large= .26 (Cohen, 1988).

Among the total of the estimated parameters, only the Deep approach dimension reached an optimal value (>.70), whereas the rest was lower than .70, inferior limit recommended to establish a good fit (Kline, 2005). Besides, positive correlations between every dimension and the latent variables —Factors 1 and 2— were verified, as well as between Factor 1 and Academic Achievement. Conversely, the association between the latent variables was proven negative —Factors 1 and 2. The same happened with the association between Factor 2 and Academic Achievement.

Discussion

The study was aimed at examining college students' psychological variables related to high and low academic achievement, such as learning styles, learning strategies, and learning approaches. The Study 1 —exploratory factor study— analysed such psychological variables altogether, obtaining two factors. Such a finding was confirmed by Study 2 —path analysis, which also tested whether the factors were related to academic achievement. In order to bring clarity, the discussion was split into two sections referred to each Study.

Study 1

Learning styles, learning strategies, and learning approaches converged into two factors. All learning strategies, the Deep learning approach, and the Accommodating and Assimilating learning styles loaded on Factor 1. In view of that, students exhibiting a predominance of Factor 1 use a wide variety of learning strategies, choosing one or another according to the requirements of each assignment or academic activity. They employ strategies since they feel thrilled by the learning process —Motivation Strategy—, and they are eager to learn content in-depth, using different resources to achieve a better result —Resources for Learning Strategy. Consequently, they know how to identify main ideas —Abilities to Rank Information Strategy—, to get information and to share it with their classmates —

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Collaborative Learning Strategy—, as well as to use CTI —Information 2.0 Management Competencies.

Factor 1 also involved the Deep approach, which implies curiosity, interest, and the will of achieving good performance. As for learning styles, two of them loaded on Factor 1: Accomodating and Assimilating styles. The former is related to the use of trial and error for problem-solving. The latter is linked to reading, reflecting, and using previous knowledge or skills to understand new concepts. Factor 2 grouped the Surface approach, and the Converging and Pragmatist learning styles. Students who showed a prevalence of Factor 2 lack interest and seem apathetic. Hence, they do not employ learning strategies at all. They prefer memorising and responding only to the minimum requirements to pass. Besides, they feel at ease learning by means of practical experiences —Converging style—, looking at the likely applications of knowledge to daily-life situations, and seeking the company of peers —Pragmatist style.

It is important to notice that low inter-factor correlations were found, implying adequate model parsimony. That suggests that the information offered by each factor is unique and independent of the other factor (Lloret-Segura et al., 2014).

Study 2

Study 2 confirmed the structure found in Study 1, also verifying the positive and negative influence of the factors on academic achievement.

Results such as Factor 1 explaining good academic achievement and Factor 2, a low performance seems reasonable. Previous studies reported dimensions loading on Factor 1 as positively correlated with academic achievement whereas dimensions loading on Factor 2 were negatively associated with that performance (e.g. Akbari Chermahini et al., 2013; Alvarado-Peña et al, 2017; Çetin, 2016; Chen et al., 2014; Yaghobkhani Ghiasvand, 2010; Jouhari et al., 2016; Öhrstedt & Lindfors, 2018; Tan & Laswad, 2015).

Even though the values of some of the parameters were low —especially Factors 1 and 2 regarding their linkage with academic achievement—, they seem acceptable. Two features are responsible for such values' decrease. On the one hand, it is worth mentioning that different numbers of items and alternatives to respond —dichotomous or ordinal— result in different variabilities of minimum and maximum scores. For instance, some scales get a maximum score of 5, such as Accommodating and Pragmatist styles whereas others reach higher maximum scores, such as Deep and Surface approaches, with 50 points. Additionally, values corresponding to the index which measures academic achievement fluctuate from 0 to 5 points. On the other hand, sample heterogeneity is also a feature likely to influence the magnitude of associations between variables (Goodwin & Leech, 2006). Further studies should analyse larger samples split by major.

Conclusions

Results from both studies lead to the hypothesis stating that students who reach academic success use various learning strategies fluently, showing a Deep learning approach at the same time. They also prefer Accommodating and Assimilating learning styles. Conversely, the ones who lack strategic learning and exhibit a Surface approach, usually get poor academic performance. Consequently, identifying and training cognitive and metacognitive

[DOI: 10.52547/johepal.3.3.90]

learning processes is essential for improving learning quality, and teachers should play a key role in planning and conducting such interventions. Learning strategies seem the easiest and most direct way to start with in order to help students to be more efficient, and therefore more interested and motivated. This would lead them to broaden the use of strategies in the future, creating a virtuous circle. Modifying teaching styles in order to make them suitable for specific students' learning styles, as well as changing teaching-learning environments to influence learning approaches are also major challenges that must be carefully planned. For instance, presenting activities that require the use of learning strategies —e.g., collaborative learning, employing CIT, and information search, among others—, presenting information using different formats —verbal, graphic—, and fostering commitment and understanding by means of significant tasks preventing students from failing courses, are changes which appear as sensible and easy to achieve.

The findings presented above appear to be important not only for researchers but also for the higher education milieu. As for the former, non-precedent results were reported: either in general terms learning styles, learning strategies, and learning approaches were analysed independently or were examined taking only two of those variables at once. It is worth mentioning that this is the first study linking the three of them altogether. Indeed, these results should be investigated more in-depth in further studies which will be useful for upcoming comparisons. Regarding the higher educational milieu, describing the successful students´ features is paramount as higher academic achievement is usually related to more perseverance and determination in learning and therefore, to a lower likelihood of academic dropout. Moreover, assessing freshmen's academic features enables the early detection of students potentially at risk of failure and dropout. Such an early identification would lead tutors and teachers to tailor intervention programmes aimed at training students to improve their strategies, approaches, and styles, consequently increasing their chances to obtain a good academic performance. Decreasing academic failure would mean a direct impact not only on less academic failure, fewer delays in graduation, and fewer dropouts but also on a decrease in economical losses and personal frustration.

Among the limitations of the study, the impossibility of splitting the sample by major deserves special mention. It was due to the small number of participants attending each major. So, the former conclusions are only pertinent for college students, regardless of their individual differences and differences among majors. Further studies should address the matter.

The indicator used to estimate academic achievement is also an issue that should be reviewed. Even though the index analysed in the study is adequate, it is a restricted measure as well. Decisions regarding which indicators are to be included compared to others are always controversial in science. However, different facets of the same phenomenon should be taken into consideration. Hence, the study must be replicated using different available indices, such as Grade Point Average —GPA.

This study was intended to describe the effect of learning styles, strategies, and approaches on academic achievement in college students. Thus, two groups of dimensions were found, explaining academic performance either positively or negatively. Beyond the results and the practical implications discussed here, these psychological variables are not the only ones to be analysed. Self-efficacy, academic engagement, and perfectionism,

[DOI: 10.52547/johepal.3.3.90]

among others, also influence learning and then researchers' attention should be also drawn to them to get the whole picture.

Declaration of Conflicting Interests

The authors have no competing interests to be cited here.

Funding

This work was supported by the University of Buenos Aires funding (UBACyT #20020170100064BA), funding from National Scientific and Technical Research Council (PIP #11220200100352CO) and funding from National Agency for Scientific and Technological Promotion (PICT-2020-SERIEA-00087).

Human Participants

The authors declare they have worked with human participants. The study was endorsed by the Ethics Committee of the University of Buenos Aires. Ethical recommendations of the National Scientific and Technical Research Council (CONICET) for studies in Social and Human Sciences were also followed.

[DOI: 10.52547/johepal.3.3.90]

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[DOI: 10.52547/johepal.3.3.90]

Dr. Agustín Freiberg-Hoffmann works as a Senior Research at the National Council of Scientific and Technical Research in Argentina (CONICET). He is an Assistant Professor at the University of Buenos Aires, specialising in Psychometrics, also in charge of Ph.D. and Magister courses on Research Methodology and Academic Writing. His interests in his major field —Psychometrics and Psychological Assessment— are aimed at analysing different educational environments as well as self-regulated learning in undergraduates.

Prof. Agustín Romero-Medina works as a Full Professor at the Department of Basic Psychology and Methodology at the University of Murcia, Spain, in charge of the Basic Psychology Research Group. He is also a Senior Editor of the Annals of Psychology Journal, integrating academic committees of other several scientific journals. He has published 45 peer-reviewed papers, several books, and monographs, as well as 77 presentations at diverse conferences. His research interests are referred to as Psychology of Learning, particularly to learning processes in human learning, self-regulation, and learning approaches as related to Higher Education and High School outcomes.

Prof. Ruben D. Ledesma works as a Principal Researcher at the National Scientific and Technical Research Council (CONICET, Argentina) and as a Professor of Social Research Methods at the National University of Mar del Plata, Argentina. His research interests include Psychometrics and Applied Social Psychology.

Prof. Mercedes Fernández-Liporace is Senior Researcher at National Council for Scientifc and Technical Research CONICET, Argentina and Full Professor of Psychometrics in the University of Buenos Aires. She also teaches Academic Writing and Research Methods to postgraduate students. Her research work focuses on college students' performance and its associations with psychological variables as well as personality traits, and psychopathology, with an added aim on psychometric instruments adaptation, design, and validation.

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