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Learning Styles and Access to Virtual Learning Environments in the Academic Performance

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Abstract: This study focuses on the issue regarding student-centred teaching and learning. Based on the acknowledgement of students' learning styles, we tried to identify indicators which might enable us to relate students' learning styles to academic performance results as well as to the frequency of use of a virtual learning environment (VLE) used by the institution which the sample subjects participating in this study belong to. The research questions guiding this study were as follows: Are there any relations between students' learning styles and the frequency of accesses to the institution's VLE? Are there any relations between students' learning styles and academic performance? Are there any relations between the frequency of accesses to the institution's VLE and students' academic performance results? In order to answer the above research questions, we defined the following aims: identifying the sample subjects' predominant style; assessing the influence of subjects' learning styles on their learning results; assessing the influence of subjects' learning styles on the frequency of access to the institution's VLE; assessing the influence of the frequency of access to the VLE on learning results. This study enabled the identification of learning styles and the search for indicators which may allow the establishment of a relation between the learning styles of a sample of 51 undergraduates from a Portuguese public higher education degree course and their learning results, as well as the frequency of their access to the virtual learning environment (VLE). The data concerning learning results and the frequency of access to the VLE resulted directly from consulting the institution's databases associated with the VLE, whereas the data regarding learning styles was obtained after conducting the Honey-Alonso CHAEA survey, also integrated in the institution's VLE. From the results obtained stands out the fact that the majority of the sample subjects have a predominant reflexive learning style. As well as this, there are a high percentage of undergraduates with higher learning preferences in more than one style. With regard to academic performance, the results show that both the final classifications mean and the mean of the course units in which the students obtained a passing mark were higher among the students with a predominant reflexive learning style. The highest mean of the number of accesses to the VLE was observed among the students with a predominant pragmatist learning style. The correlation between the variables associated with the learning styles and the mean of students' marks is low or very low in all situations. This study may reveal to be of great importance, as it enables the obtainment of indicators which facilitate the understanding of the relation between undergraduates' learning styles and the use of VLEs within a formal teaching and learning context.

Keywords: learning styles, virtual learning environments, academic performance

1. Introduction

In this paper, emphasis is laid on knowing students by identifying their learning styles, on the technological means supported by a virtual learning environment (VLE) and on the relations between students' learning styles, accesses to VLEs and results of academic performance.

As highlighted by Abidin, Rezaee, Abdullah, and Singh (2011), learning processes vary from person to person due to the presence of biological and psychological differences.

According to Valencia (2014), higher education institutions must focus on undergraduates' ways of learning and on their difficulties to adapt to the demands of higher education. The author admits that it is a challenge for teachers to acknowledge their students' ways of learning, previous knowledge, needs, paces, motivations, expectations and skills.

We assess the existence of relations between the sample subjects' learning styles, learning results and frequency of access to the virtual learning environment of the institution they belong to.

For the identification of the undergraduates' learning styles, we administered the Honey-Alonso learning styles identification questionnaire, Cuestionario Honey-Alonso de Estilos de Aprendizaje (CHAEA). For the identification of the students' frequency of accesses to the institution's VLE, we used access records stored in databases associated with that same VLE. The data collected on the frequency of accesses to the VLE and the

performance results concern the first semester of the 2014/2015 academic year, the semester under analysis. The performance results translated into students' marks were obtained from the institution's databases by consulting the final marks records of the sample subjects.

The sample is composed of undergraduates attending the 1st year of a Management degree course of a Portuguese higher education institution. Considering the given sample, we sought for indicators which may contribute to the achievement of the following goals: identify the sample subjects' predominant learning style; assess the influence that each subject's learning style may or not have on their learning results; assess the influence that each subject's learning style may or not have on the frequency of access to the institution's virtual learning environment.

The paper starts with the introduction, followed by the main topics, namely the theoretical framework, methodology, presentation and discussion of results, conclusions and references.

2. Theoretical framework

Both the themes of virtual learning environments (VLEs) and learning styles have deserved the attention of numerous researchers, educators and educational institutions. Relating the two and getting the best of each one of them may contribute to the improvement of the teaching and learning process and consequently, the improvement of academic performance. Gašević, Dawson, Rogers and Gasevic (2016) highlight that the association of data regarding students' activity in a VLE with their academic performance is moderated by the teaching conditions.

The European Commission (2014) suggests that the data obtained from the records regarding students' actions in VLEs may show evidence of the way students involve in the course, the way they interact with other students and acquire concepts. It can also provide information on the learning process, allowing the identification of students at risk, thus contributing to the decrease of failure rates.

From a pedagogical perspective, the VLEs used in educational institutions enhance developments and provide new experiences. However, they are mainly targeted towards the production and distribution of contents. The majority of the applications integrated in VLEs were designed focusing on content rather than the learning process (Salinas, 2012). According to this author, these environments replicate traditional teaching by distributing online contents, sending messages and notices, and communicating through discussion forums and chats.

The use of VLEs allows the diversification of teaching and learning strategies since according to Soflano, Connolly and Hainey (2015), the use of one single teaching strategy for all students may have a negative impact on the learning results, namely for students whose way of learning differs from that of most students. When the focus of learning is laid on the student, it is essential to know their predominant learning styles. As highlighted by Zacharis (2011), numerous educators admit that understanding the differences in their students' learning styles is an important aspect for the effectiveness of teaching and learning. Learning styles account for individual differences among people when immersed in a learning process (Moreno & Defude, 2010). One of the most used definitions of learning style is presented by Keefe (1979), who states that learning style can be defined as the composite of characteristic cognitive, affective, and physiological factors that serve as relatively stable indicators of how a learner perceives, interacts with, and responds to the learning environment. As a result of different initial experiences and educational levels, students considerably vary in the way they approach learning and consequently, in the way they must be taught (Zacharis, 2011).

As far as ways of learning are concerned, some students learn better interactively and some individually, others focus on facts and data while others are interested in theories and concepts, some prefer visual information while others respond better to written and spoken explanations (Mupinga, Nora, & Yaw, 2006). Some may understand better through images while other prefer texts, some deal well with theories while others deal better with experimentation and examples (Truong, 2016). As highlighted by Zacharis (2011), various learning styles models are being used to assess the way students learn to learn. Among such models, we highlight those of Kolb (1984), Honey and Mumford (1992), Pask (1976), and Felder and Silverman (1988). In this study, we chose the model of Honey and Mumford (1992).

According to El-Bishouty, Chang, Graf, Kinshuk, and Chen (2014), learning styles affect the way each person learns, acts within a learning group, participates in learning activities, relates to others and solves problems.

Within the context of higher education, the acknowledgement of undergraduates' learning styles may help to build environments which provide good conditions for an effective learning (Cornejo & Martín, 2013).

When teachers acknowledge their students' learning styles they can, as educational agents, change, adapt and create educational practices enhancing pedagogical actions which are more coherent according to their students' needs, interests and capacities. Valencia (2014) states that the acknowledgement of students' learning styles contributes to the creation of educational and pedagogical responses which enable teachers to follow and help students to achieve new and pertinent ways of learning in higher education.

3. Methodology

The data used in this paper was obtained during the first semester of the 2014/2015 academic year (September 2014 to February 2015), from a sample of 51 undergraduates, 17 of which are male and 34 are female. The age mean is 21, the median is 20 years old and the mode is 19 years old. They are all in the first year of a Management degree course in a Portuguese public higher education institution. The population is of 166 subjects and the sample corresponds to approximately 31% of the population. It is a non-probabilistic convenience sample and was selected within a course where one of the researchers was teaching.

With respect to the aims, this study is exploratory with predominantly descriptive features. It is exploratory because it may be considered a preliminary study aiming to a deep knowledge of the variables under study within the context they are inserted in, and because it enables the obtainment of indicators which may represent starting points for broader studies. It can be considered descriptive because there is no intention of assessing the influence of manipulating independent variables over dependent variables. Hence, the focus of this study lies on the description of findings related to the sample and the variables under study, without any researchers' experimental action.

The nature of the study is quantitative because the variables assume quantitative values and it is possible to study statistical relations between them. Quantitative research enables the testing of the relation between variables and such variables can be measured with instruments which provide numerical data which can be analysed through statistical procedures (Creswell, 2014).

With regard to the data collection procedures, this study can be considered a desk review. The data collection procedures relate to computing procedures of consultation and extraction of information from the databases associated with the VLE adopted by the higher education institution that the students belong to.

Apart from the data regarding the students' gender, degree course and course year, the main data analysed in this study concerns students' learning styles, their number of accesses to the VLE and their academic performance, translated into the final marks obtained in the course units they are enrolled in.

For collecting the data, some ethical principles were born in mind, namely the data confidentiality and the anonymity of the undergraduates involved. As highlighted by Lam, Lo, Lee, and McNaught (2012), the extraction of records from a virtual environment provides relevant information regarding the availability and access to contents and it avoids students and teachers' waste of time with surveys or other data collection techniques to obtain that same information. The use of VLEs which automatically keep records of the students' activities may provide an alternative to the research methodologies using surveys (Black, Dawson & Priem, 2008).

The data regarding the identification of learning styles was obtained through the CHAEA questionnaire, integrated in the VLE. The data regarding the number of accesses to the VLE was automatically recorded in databases and later obtained from those same databases.

4. Presentation and discussion of results

4.1 Sample subjects' learning styles

In the identification of learning styles, we considered the approach developed by Honey and Mumford (1992), which accounts for four learning styles: activist, reflector, theorist and pragmatist. The identification of the subjects' learning styles was based on the online conduction of the CHAEA questionnaire available in the institution's VLE.

The CHAEA questionnaire is composed of 80 dichotomous items, with 20 items corresponding to each learning style. The answer to each item admits a score of one or zero points, according to the respective higher or lower level of agreement of the subject with the given statement. The score of each subject in each learning style is obtained according to their answers to the CHAEA questionnaire and to the profile defined by Alonso, Galego and Honey (1999) within the context of their learning styles theory.

After obtaining students' scores in each learning style, the data was grouped into five different groups denominated as: activist, reflector, theorist, pragmatist and mixed.

The predominant learning style of each subject was identified according to the style in which they had the highest score. The subject was included in the mixed group when they had two or more scores that were similar and higher than the remaining ones.

Table 1 presents the distribution of the sample subjects among the referred groups of learning styles.

Table 1: Subjects' distribution per predominant learning style (n=51)

Learning style	**Students**	
	n	%
Activist	5	9.8
Reflector	29	56.9
Theorist	3	5.9
Pragmatist	6	11.8
Mixed	8	15.7

The majority of students showed a higher preference for the reflector learning style. The predominant theorist learning style accounted for the smallest number of students.

Bearing in mind that each student revealed features associated with the four learning styles, we determined the mean, mode, median, minimum and maximum score for the set of scores regarding each style. The distribution of the statistics associated with these scores is presented in Table 2.

Table 2: Distribution of scores statistics per learning style (n=51)

Learning style	**Scores per learning style**				
	Mean	Median	Mode	Minimum	Maximum
Activist	11.8	12	12	6	18
Reflector	15.9	16	14	2	20
Theorist	13.9	14	15	6	19
Pragmatist	13.5	13	12	6	19

By observing Table 2 we see that the mean of scores varies from learning style to learning style and that the highest (15.9) concerns the reflector style and the lowest (11.8) concerns the activist style. The means of the theorist and the pragmatist style are 13.9 and 13.5, respectively. In a study conducted by Ojeda and Herrera (2013) involving 170 undergraduates of an Engineering degree course, the results showed that the highest average scores were found in the reflector style.

The aims of this study are to find indicators which enable a better understanding of students' way of learning considering their learning styles and to define strategies supported by VLEs which enable the improvement of their academic performance. Therefore, hereafter follows the analysis of the undergraduates' academic performance according to their learning styles.

4.2 Learning styles, academic performance and access to the virtual learning environment

After identifying the undergraduates' learning style, some questions arise such as: Does each subject's learning style influence their academic performance? The answer to this question involves various analysis and perspectives as both the individual style and academic performance involve multiple dimensions. However, some dimensions are more easily observable and allow the obtainment of indicators which may help to understand the relations between the subjects' learning styles and their academic performance. Hence, from research conducted on a sample of 317 students, Abidin, Rezaee, Abdullah and Singh (2011) concluded that learning styles have an impact on students' global academic performance, highlighting the importance of acknowledging students' learning styles in order to provide teachers with this knowledge and therefore enable them to provide a more effective learning.

Academic performance is an indicator of learnings which depicts each student in terms of their capacities and abilities as a result of their participation in an educational situation (Valencia, 2014). Another question that also arises is to know whether each subject's learning style influences their frequency of access to the institution's virtual learning environment.

With regard to students' academic performance, we will consider the final marks obtained in the course units they are enrolled in. In order to relate the subjects of each predominant learning style to their final marks, we highlight that the mean of the 51 sample subjects' final marks in the course units was 12 out of twenty, the mean of the course units they passed was 3.2 and the mean of the number of accesses to the institution's VLE was of 145.5 accesses.

Table 3 presents the distribution of statistics regarding the final mark among the categories associated with learning styles.

Table 3: Distribution of statistics of final marks per learning style (n=51)

Learning style	**Academic performance (0-20 marking scale)**			
	Mean	Median	Minimum	Maximum
Activist	12.0	12.0	10.7	13.0
Reflector	12.1	11.8	10.0	18.4
Theorist	10.6	10.6	10.0	11.3
Pragmatist	11.5	11.5	10.5	12.7
Mixed	11.9	11.5	10.0	14.6

The data presented in Table 3 reveals that the statistics associated with the various learning styles are analogous and that the highest mean of marks was observed in the subjects of the reflector style and the lowest mean in the theorist style. Bearing in mind that the mean of marks does not express the number of course units that each student passed, Table 4 presents the distribution of statistics related to the number of course units that students passed.

Table 4: Distribution of statistics regarding the course units students passed per learning style (n=51)

Learning style	**Couse units students passed**			
	Mean	Maximum	Minimum	Median
Activist	3.0	4.0	2.0	3.0
Reflector	3.6	5.0	0.0	4.0
Theorist	1.7	4.0	0.0	1.0
Pragmatist	2.0	4.0	0.0	2.5
Mixed	3.0	5.0	0.0	3.5

What stands out is that the predominantly reflector students are the ones with the highest mean of passed course units while the predominantly theorist students are the ones who present the lowest mean. Except for the activist learning style, all the others reveal that there are students who did not pass any of the course units. It was also found that regarding the course units that students passed, the predominantly reflector students were the ones who passed the biggest number of course units, namely five, which corresponds to the total of course units they were enrolled in. Bearing in mind that virtual learning environments represent current resources of widespread use within educational institutions, especially in higher education institutions, this study also addressed the concern to assess the frequency of access to the VLE according to the undergraduates' learning styles.

Since the data of this research work accounts for one academic semester, we analysed the frequency of access to the VLE during that period of time. In Table 5, we present the distribution of the statistics regarding the frequency of access to the VLE among the sample subjects.

Table 5: Distribution of the frequencies of access to the VLE among the learning styles (n=51)

Learning style	**Frequency of access to the VLE**			
	Mean	Median	Minimum	Maximum
Activist	104.4	96.0	54.0	175.0
Reflector	156.8	132.0	12.0	329.0
Theorist	111.0	115.0	84.0	134.0
Pragmatist	170.3	164.5	64.0	255.0
Mixed	124.6	120.5	94.0	166.0

Considering that the number of subjects differs from learning style to learning style, it is not possible to use statistical tests which are robust enough to ensure whether these differences are significant. As it is not possible to generalise the results, we present some indicators supported by the data displayed in Table 5. Thus, we found that the students with a pragmatist style are the ones who reveal the highest frequency mean of access to the VLE while the students with an activist style reveal the lowest mean. The same is revealed as far as the median is concerned. Also, we found that the reflector style subjects present the largest amplitude regarding the number of accesses, with a minimum of 12 and a maximum of 329 accesses. Bearing in mind that each subject has a score per learning style, it is possible to consider four groups of scores, one for each learning style, as well as the respective means of the sample students' final marks. Therefore, we used Pearson's correlation to assess the level of association between each of the variables (activist, reflector, theorist and pragmatist) and the variable mean of subjects' marks in the course units they passed.

In Table 6, we present Pearson's coefficients of correlation between the variables mentioned, obtained through the statistical program SPSS (Statistical Package for the Social Sciences).

Table 6: Level of association between learning styles and the means of marks obtained by students in the course units (Pearson's coefficient of correlation)

		activist	**reflector**	**theorist**	**pragmatist**
activist	correlation	1	-.168	.078	.342*
	sig. (2-tailed)		.237	.586	.014
reflector	correlation	-.168	1	.629**	.176
	sig. (2-tailed)	.237		.000	.217
theorist	correlation	.078	.629**	1	.424**
	sig. (2-tailed)	.586	.000		.002
pragmatist	correlation	.342*	.176	.424**	1
	sig. (2-tailed)	,014	,217	,002	
**. Correlation is significant at the 0.01 level (2-tailed).					
*. Correlation is significant at the 0.05 level (2-tailed).					

We considered the coefficient of correlation (δ) and used the classification of correlation proposed by Morais (2000): very low if $\delta \in$]-0.2; 0.2[; low if $\delta \in$ ( ]-0.4; -0.2] $\cup$ [0.2; 0.4[ ); moderate if $\delta \in$ ([-0.7; -0.4] $\cup$ [0.4; 0.7]); high if $\delta \in$ ( ]-0.9; 0.7[$\cup$]0.7; 0.9[ ); and very high if $\delta \in$ ([-1; -0.9] $\cup$ [0.9; 1]).

Therefore, the conclusion is that the correlation between the variables associated with each learning style and the mean of marks is significant as far as the activist style is concerned, with a level of significance lower than 0.05, thus a low and negative correlation. Also to be highlighted is the observation of other significant correlations: moderate and positive between the variables theorist and reflector; low and negative between the variables pragmatist and activist; moderate and positive between the variables pragmatist and theorist.

In the light of this, no evidence was found that may suggest that each student's learning styles may influence their learning results.

The acknowledgement of the data presented is not alone sufficient to draw conclusions about the influence that the frequency of access to the VLE may have on the teaching and learning process. However, the indicators of frequency associated with other indicators, namely the tools that students mostly use or the tasks they develop may help researchers, educators and institutions to develop teaching and learning strategies increasingly more adequate to their students' learning styles and consequently, open perspectives to the obtainment of better learning results.

With regard to the tools mostly used and the activities developed by students in the VLE, we highlight a study conducted by Alves, Miranda and Morais (2015), in which the authors studied the accesses to the VLE of a higher education institution by a sample of approximately 7000 students per year, during five years. They concluded that the tools of the VLE mostly used were Resources, Messages and Assignments, and that the activities developed most frequently were consulting information, sending messages and submitting assignments.

We admit that after acknowledging students' predominant learning styles, the frequency of access to the VLE and the actions they develop in the VLE, it is easier to adequate the teaching and learning strategies to their favourite ways of learning and it is easier to provide students with conditions that may enable a better performance.

As highlighted by Gallego and Alonso (2016), people learn in different ways not only because they have diverse skills, motivations and knowledge, but also because they have differing favourite learning styles. The authors consider that teachers should focus on their students' learning and that therefore, methodologies which take learning styles into account represent a good perspective to the improvement of education.

5. Conclusions

The study was conducted in the 2014/2015 academic year with a sample of 51 undergraduates of a Management degree course in a Portuguese public higher education institution. The aim was to identify the sample subjects' predominant learning styles using Honey-Alonso's classification into activist, reflector, theorist and pragmatist. We also sought indicators enabling the assessment of eventual relations between each subject's predominant learning style and the variables learning results and frequency of access to the VLE of the subjects' higher education institution.

By using a zero to twenty points scale for each learning style, as assumed in Honey-Alonso's theory, the score means in learning styles varied from 11.8 (activist) to 15.9 (reflector), with 13.5 (pragmatist) and 13.9 (theorist).

Considering each subject's predominant learning style as the one in which they obtained the highest score, we found that the majority of subjects (57%) have a predominant reflector style.

With regard to learning results, although it is not possible to assess the existence of significant differences among the several groups of learning styles due to the characteristics of the sample, we found that the group presenting the highest mean of final marks and the highest mean of number of course units passed is the group with a predominant reflector style.

Regarding the frequency of access to the VLE, the highest mean of number of accesses was found in the students with a predominant pragmatist style (170.3) and the lowest in the activist style (104.4), with (111.0) in the theorist style and (156.8) in the reflector style. With respect to the relation between the set of scores obtained by the subjects in each learning style and the learning results, we found that the correlation between the variables regarding each learning style and the mean of students' marks is low or very low in all situations and no evidence was found to conclude that learning styles significantly influence undergraduates' learning results. Considering the exploratory features of the study and the small size of the sample, the results of this study cannot be generalised. However, they can represent starting points to further developments of the issue regarding the use of VLEs according to students' learning styles in order to improve their academic results.

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