ANALYSIS OF THE DOMINANT MODE OF THINKING OF UNIVERSITY STUDENTS IN DIFFERENT FIELDS OF STUDIES USING THE FOUR BRAIN MODEL OF HERMANN

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Abstract

In the university context teachers usually design different learning activities which may result in unequal results. Among many others, one of the factors that should be considered is personal thinking mode, which is related to the way each person reasons and learns. This study extends the results about the thinking style of students obtained in a previous one [1], with more students and more degrees. The thinking style has been identified with a simplified questionnaire based on the Hermann's four brain model in which four brain profiles are identified: A (logical), B (sequential), C (interpersonal) and D (imaginative). Students from Journalism, Industrial Design, Business Administration and Computational Math with Computer Engineer have participated in this study. The results show that in the degree of Journalism the main profile is B nearly followed by D. In the degree of Industrial Design Engineering the main profile is D. In the degree of Computational Math the main profile is A. Profile B, is the most common in Business Administration. This results are compared with previous ones and can help teachers to understand how their students think and, therefore, to develop learning activities in a more successful way.

Keywords: group formation, industrial design teaching, thinking brain style.

1 INTRODUCTION

There are several stereotypes about the personal and social skills of the university students depending on their field of study. This is frequently confirmed by teachers who teach the same subject or apply the same method in different degrees, since they usually notice different reactions, support and participation depending on the degree. For example, an activity such as a transgressive role playing is very motivating for some students but it can be rejected by other students. On the other hand, some students feel really comfortable when are demanded to develop a work or project in which logical thinking and algorithms or similar techniques have to be applied.

Besides, the personal characteristics are not the only factors that determine the students' election among a number of degrees, but also the options to get a social and economic promotion or family also influence [2]. Thus, even though the students that choose a degree may share several characteristics, it is very possible that we find also students with different thinking characteristics.

On the other hand, the European Space for Higher Education [3] has lead to changes in the teaching methodology in which participation methodology, non presential work, active learning and a competence oriented method have become more important [4].

So, getting a deeper knowledge about the characteristics that define the student thinking mode can be useful to develop a plan teaching activities that lead to a higher success. In this context a study was done in University Jaume I in which the thinking mode of students from technical and non-technical degrees was measured in order to compare them [1] The results showed that students from industrial design show higher percentages in profiles D, and B; whereas in businesses administration B is the strongest thinking mode and in industrial engineering A and B reach the highest positions. Consequently, a difference according to the degree chosen has been observed.

In the present study new data have been collected in order to include students from the Faculty of Human and Social Science and to increase the number of students from other degrees and consequently compare the results according to the branches of knowledge.

2 METHODOLOGY

2.1 Test for the four quadrant model of the brain

The Herrmann model of brain divides the brain in left and right hemispheric and in upper (frontal) and lower (limbic) areas, thus considering four areas and four brain profiles [5] [6] [8] (Fig.1). According to this model, there are four thinking modes:

Profile A (ANALITYCAL, upper and left): characterized by logical, analytical, fact-based and quantitative thinking. Problem solving, abstraction and math are some of the competences associated to this profile.

Profile B (SEQUENTIAL, lower, left): defined by organized, sequential, planned and detailed thinking. Usually present in very organized and structured people.

Profile D (IMAGINATIVE, upper, right): typified by holistic, intuitive, integrating, synthesizing thinking style. People with this profile stand out for their intuition, originality, art and creativity.

Profile C (INTERPERSONAL, lower, right): characterized by interpersonal, feeling-based, kinesthetic, and emotional thinking. Typical of talkative, extroverted and affective people, who easily work with different people.

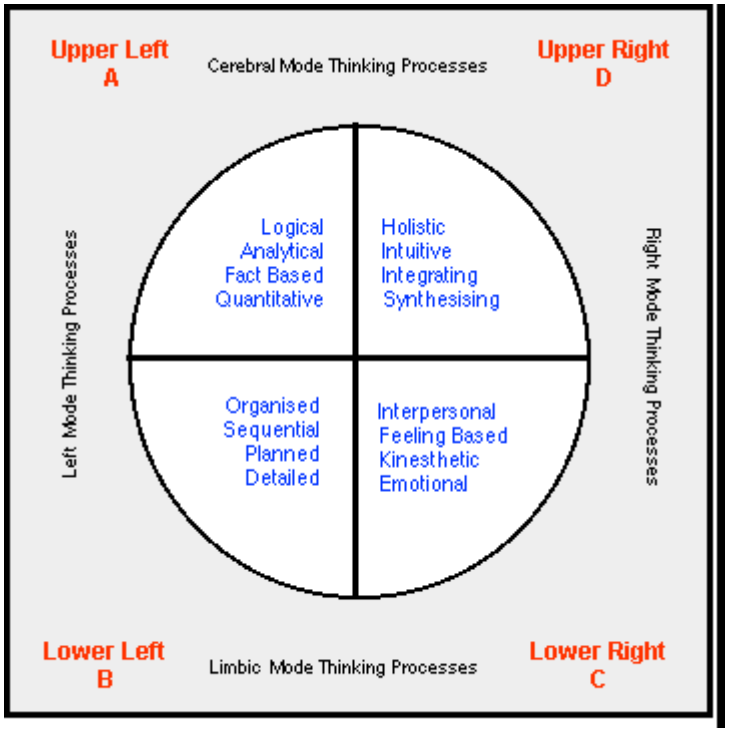

Figure 1. Hermann model of the brain [7]

The dominant mode is determined through a questionnaire with 120 items [5]. Sometimes there is more than one dominant profile and we find double or even triple or quadruple dominance.

2.2 Data collection

In order to classify the students in profiles a reduced version of the Herrmann 4 [6] [8] model brain test has been applied. This version, developed by Jiménez-Velez [9] is composed of 40 items that allow identifying the brain dominances in a quicker and easier way than in the original one (Table 1).

Table 1: Quadrant dominance test (Jiménez-Vélez)

Use the following numerical score from 1 to 5 (fill in the number in the chart).

What I do better	5
What I do well	4
What I do just fair	3
What I do less well	2
What I do worst	1

Note: As much sinerity as much objective is this test.

Test A:

1	I have specific skills in math and science	
2	I think the best way to solve a problem is being analytic	
3	I incline towards critics in every matter	
4	I have skills to solve complex problems using logic	
5	Before taking something as true, I check it and I search other sources	
6	I have the ability to understand and to handle numbers and statistics looking for a result	
7	I like solving problems knowing them and looking for exact measures	
8	I have the capacity to reason out a problem in a deductive manner starting from a theory	
9	In a problem, when I separate the ideas I am able to relate them totally	
10	I select among the alternatives using reasoning and intelligence, in opposition to instinct and emotion	
	Sum =	
	Multiply x 2 =	

Test B

1	Planning and organization are priorities in my activities	
2	It is important for mi to have a place for each thing and each thing in its place	
3	I use to listen to the others' opinions and to make clarifications	
4	I prefer specific instructions instead of overall instructions in which many details remain open open	
5	I put a lot of attention in small details or in a project parts	
6	I have the ability to control and dominate my emotions when I am doing a plan or project	
7	I think that working with a method step by step is the best way to solve my problem	
8	I have specific capacities in front of an audience or speaking in public	
9	I formulate methods or means to reach an aim, before going into action	
10	I have the ability to coordinate people or to organize the elements in order to reach coherent and harmonious relations	
	Sum =	
	Multiply x 2 =	

Test C

1	I prefer to work in group instead of working alone	
2	It is important to me to be accompanied by someone in many occasions	
3	I believe in human transcendence, in something superior or spiritual	
4	I am emotional in difficult situations	
5	Frequently I am move to solve social problems	
6	I usually give preference to emotions over rationality in my decisions	
7	I enjoy, observe and feel emotions with the nature beauty	
8	I have abilities to perceive, understand, and manipulate relative positions of objects in the space	
9	I frequently use all my sense to solve my problems (smell, sight, taste, touch, hearing)	
10	I have capacities to develop and keep good communications with different kind of people	
	Sum =	
	Multiply x 2 =	

Test D

1	I have a strong interest or talent in painting, drawing, sketching, music, poetry, sculpture, etc.	
2	I have the ability to reason out in an advanced and creative way, being able to acquire, modify and retain knowledge	
3	I generate new ideas and innovations in my work	
4	I have the capacity to understand and to make use of visual and verbal images to represent similarities and differences	
5	I have the ability to perceive and understand a global problem without the need to analyze all the elements in detail	
6	Usually my best ideas emerge when I am not doing anything in particular	
7	I prefer to be well-known and remembered as a person who imagines and fantasizes	
8	I can frequently anticipate the problems solutions	
9	I have the capacity to use or understand objects, symbols and complex signals.	
10	I use play and sense of humor in many of my activities	
	Sum =	
	Multiply x 2 =	

Fill in this table the final result of the 4 previous tests.

	A quadrant	**B quadrant**	**C quadrant**	**D quadrant**
Final Score				

To obtain new data, the test has been applied to new students from the degree of industrial design and from businesses administration. Indeed students from the degree of journalism and from computational math and computing engineering have been also analyzed. The number and field of study of the students who have participated is summarized in the next table:

Table 2. Students who have participated in the study during the academic year 2013/14

Degree	**Subject**	**Teaching method**	**Number of students in the course or group**	**Number of students who have answered**
Industrial design	Conceptual design	Lectures; individual practice and group practice Main object: to develop a conceptual design for a new object	91	78
Journalism	Communication for equality	Innovative project	68	51
Business Administration	Selling techniques	Lectures and developing Works	99	86
Computational Math with Computer Engineer	Business initiative	Lectures and group reflections at the end of the lectures A business plan in group	54	51

3 RESULTS

The number of students who have answered the questionnaire is 266, 51 of which belong to the Journalism degree, 78 to Industrial Design degree, 86 to Businesses and Administration degree and 51 to Computational Math and Computers Engineering. These last were studying a subject in which students from both Computational Math and Computer Engineering were together in the same class. Table 1 shows the number of students per dominant quadrant. There is also a few number of students that have two dominant quadrants, this is for instance when a student has the same punctuation for A and for C, it is said that he/she is profile A/C, etc., so, these cases are also identified in Table 1.

Table 3. Dominant profile for students in the degrees analyzed

Degree	A	B	C	D	A/B	A/C	A/D	B/C	B/D	C/D	A/C/D	Total
Journalism		19	10	16		1	1	1	1		2	**51**
		37,25%	**19,61%**	**31,37%**		**1,96%**	**1,96%**	**1,96%**	**1,96%**		**3,92%**	**100%**
Industrial Design Engineering	13	19	6	33	3		2	2				**78**
	16,67%	**24,36%**	**7,69%**	**42,31%**	**3,85%**		**2,56%**	**2,56%**				**100%**
Business Administration	18	36	18	8	1	1	2	1		1		**86**
	20,93%	**41,86%**	**20,93%**	**9,30%**	**1,16%**	**1,16%**	**2,33%**	**1,16%**		**1,16%**		**100%**
Computational Math and Computers Engineering	32	5	2	8	2	1				1		**51**
	62,75%	**9,80%**	**3,92%**	**15,69%**	**3,92%**	**1,96%**	**0,00%**	**0,00%**		**1,96%**		**100%**
Total number per profile	**63**	**79**	**36**	**65**	**6**	**3**	**5**	**4**	**1**	**2**	**2**	**266**

As it can be seen, the dominant brain profile differs according to the field of studies.

- In Journalism the majority profile is B (sequential), with a 37% of students, followed by profile D (imaginative) with a 31%. So, profiles B and D cover a 68% of the total journalism students analyzed. It is also remarkable that there no students with a dominance in profile A (analytic), and those with a good punctuation in A share this profile with profiles C and D, and thus are students with A/C or A/D profiles. Journalism seems to be one of the degrees with a higher number of double profiles. From all the degrees analyzed, this is the one with the lowest number of students is the most common profile, this is, in this degree there is a higher combination of profiles.
- In Industrial Design and Product Development students are mainly of profile D (imaginative), with a 42%, followed by profile B (sequential) with a 24%. The fact that imaginative profile is the most common it can be expected from the fact that in this degree creativity is one of the most important competences and there are many academic activities in which and holistic, intuitive and synthesizing vision is demanded.
- On the other hand, students from Businesses and Administration are mainly of type B (sequential), with a percentage of 42%. Profiles A (sequential) and C (interpersonal) are also present in this field of studies with a percentage of 21% each one. Here, the results are also in line with the competences of organization, planning, concern about details, etc., that are demanded for these studies.
- In Computational Math and Computers Engineering the most important profile is A (analytic), with a 63% of the students. Far from the amount of students in profile A, the next profile is D (imaginative) with a 16% of students. This result also agrees with the expected profile in these studies, where students feel comfortable with activities that require analytical reasoning. Anyway, it is remarkable the low number of students with dominance in the right lateral of the brain.
- If we sum the total number of students, profile C (interpersonal) is the less common with almost half of students than in any of the other three profiles.

Figure 2 shows the students' profiles distribution for each degree, in order to compare them in a visual way. Considering the simple dominances (and not the double or triple ones), profile B is the most common, with almost a 30% of the total students, nearly followed by profiles D and A with around a 24%. Profile C is the weakest one with a 13% and around a 7% of the students have double or triple dominance.

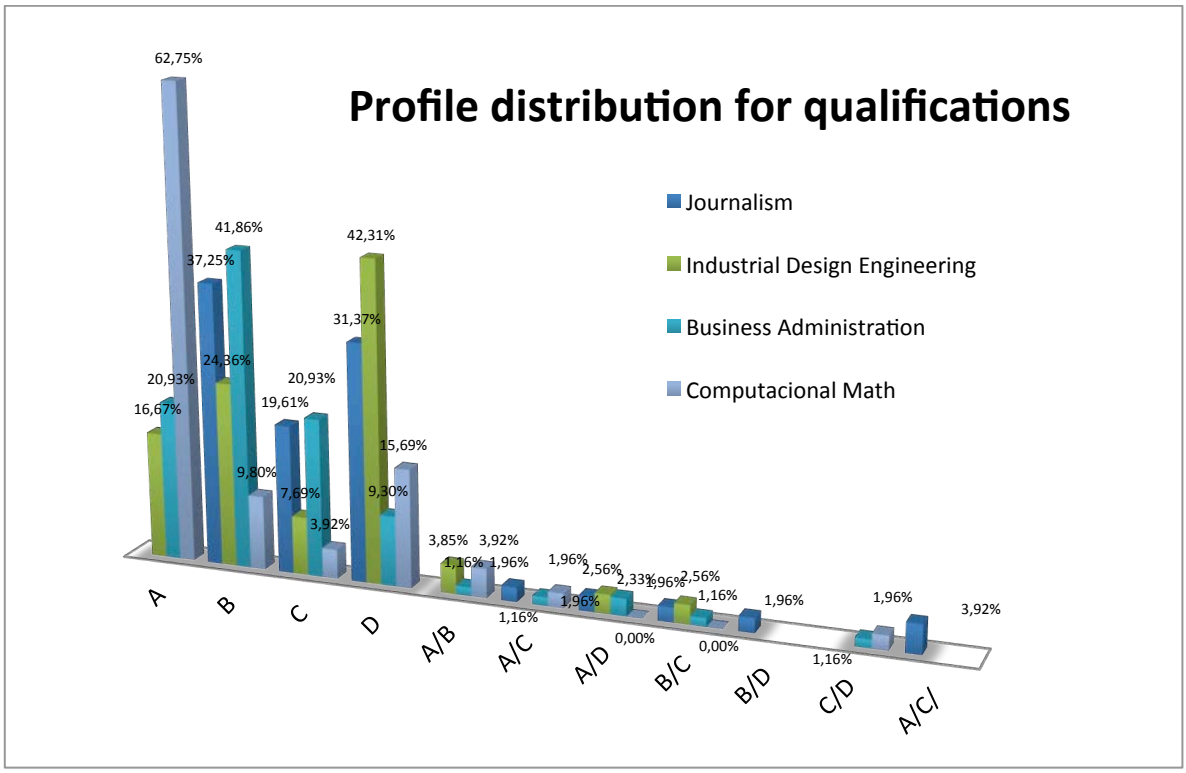

Figure_2: Profile distribution for qualifications

When comparing these results with those obtained in the previous study [1] (Table 4), we can observe, for the Industrial Design students, that asses that profile D (imaginative) is again the most common followed by profile B. In this case the differences between profile D and B are lower than in the data collected for this communication. Assuming that a huge amount of data, collected during several years would be needed to be able to state the percentage of students for each profile, the main conclusion here is that both studies confirm that profile D followed by B is the most common among the Industrial Design students. The percentages of students belonging to profiles A and D is not consistent between the two studies, thus concluding that every year the students profile is changeable and more data would be needed.

In the Business Administration studies again the most frequent profile is B (sequential), arising a 47%, a little bit higher than in our data (42%) of the total students. The next profile is A, with the same percentage than in the new data (20%) followed by D (17,5%) and finally C (15%). Here, the position of profiles D and C changes in comparison to our data which can be due to the personal differences between the students from year to year. As a conclusion, it seems to be true that profile B is the most typical in this degree.

Table 4. Dominant profile for students in Universitat Jaume I collected by [1]

Degree	A	B	C	D	Total
Industrial Design	10	31	20	**34**	95
	10,5%	32,6%	21,1%	35,8%	
Business Administration	8	**19**	6	7	40
	20,0%	47,5%	15,0%	17,5%	

4 DISCUSSION AND CONCLUSIONS

This results can help teachers to understand how their students think and, therefore, to develop learning activities in a more successful way.

In engineering degrees, profile A is the most common, except for the case of Industrial Design Engineering, where D is the most popular one. This is not surprising since industrial design integrates many disciplines in its study program such as art, aesthetics, history, together with math, physics,

marketing, etc. This can explain why certain academic activities that cause rejection between engineering students are usually accepted by industrial design students.

In business administration profile B is the most common, followed by profiles A and C. It can be deduced that these students will have a positive answer to both rational and analytical individual activities and to team activities in which to apply interpersonal skills.

The teachers involved in this study have also discussed together about the reactions of the students to different group activities. This way, in Computational Math the students were asked to define a business plan which caused negative reactions and lack of creativity at the beginning. However, although for many students it was really difficult to do it, finally, all of them reached the aim. In journalism, the students had the possibility to choose between two tasks: one more adventurous, in which they should dress up and play risky roles and a more conventional one, consisting in doing a blog. Finally there were students who had no problem to play non-conventional roles, but it is remarkable that the alternative was chosen by many other students.

The obtained data can be compared to those from similar studies in different universities around the world, as those summarised in Table 5. The first conclusion is that profile B is the most dominant or in a high position in many studies, which agrees with our results. This study also matches with those in which engineers have been analysed and profile A is the dominant. The study published in [10] identifies profile D as the lowest one for engineering students, while in [11] and [12] C has the lowest position as it has happens in the degree of Computational Math and Computers Engineering.

Table 5. Similar studies

Authors	University	Degrees	Results
[13]	Chile	Arts, Economics and Education (226)	B>C>A>D It does not differ between degrees
[14]	Chile (Valparaíso)	Civil Industrial Engineering (61)	Predominancia A 64% (seguida de D de lejos 16%)
[15]	Colombia	Bacteriology (30)	A=B (50%)>C>D
[10]	Univ. Pretori Sudáfrica	Civil Engineering Science	A>C>B=D B>A>C>D
[11]	USA Univ Toledo	Engineering	A el que predomina y C el que menos
[12]	South Africa	Civil engineering	A>B>D>C

The results make evidence that the thinking style of students differ from one field of study to other. Then, if students have a more logical thinking style, will solve easily analytic tasks, but not necessarily will enjoy in doing open-ended tasks and group tasks. On the other hand, if the students present high scores in profiles D and C, they will be intrinsically motivated to creative and intuitive tasks, although they might suffer in solving problems which require analytic capacity.

These results are similar to the previous obtained in [1], making the conclusions stronger. Again, we suggest a reflexion about how the previous levels in the educational system may influence in a low development of profiles C and D, so, in future studies it would be interesting to analyse the dominances in different ages in order to detect in which moment the educational system focusses in the left hemisferia.

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