



RELATIONSHIP BETWEEN UNIVERSITY EDUCATION IN STRATEGIC MANAGEMENT AND CHESS IN A BOTH LEARNING PROCESS: AN APPROACH ACROSS LEARNING PATHS[♦]

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Abstract. *Purpose* – In this work, a reflexive experiential learning process is collected, which relates concepts the strategic management and learning the game of chess in a flipped classroom and blending learning process for the 2017/18 and 2018/19 courses.

Research methodology – The method followed has been the initial approach of the learning curves and the time series of the analysis of learning patterns in the game of chess. Also, for the study of the relationship between the game of chess and its analogy with strategic management, we used a questionnaire, and we apply cluster and network analysis.

Findings – The main results reveal the existence of different learning patterns (linear, quadratic, random walk), associated with the various skills of the students. Likewise, different learning groups have been identified concerning the times and learning levels by activities. The underlying idea is the motivation that the game of chess exerts on students to foster greater understanding.

Research limitations – The limitations are related to the size of the classroom and the different initial levels of chess knowledge, which have been a real challenge to carry out this work. Finally, the combination of activities, between chess and strategic management knowledge is complicated to handle, requiring large doses of planning. These limitations are perhaps challenging to solve, although possible help could be associated with more teachers being involved in the process.

Practical implications – The simultaneous learning of chess with the consequent increase of cognitive skills and Strategic Management concepts could intensify the motivation of the student and generate a virtuous circle that drives both areas.

Originality/Value – This new experience in Spain contributes to filling a perhaps significant gap in the literature. In parallel, the practice of chess in the classroom has corroborated a level of commitment and motivation of students in the knowledge of the concepts of strategic management. The results achieved could suggest the incorporation of chess practice as a motivating factor in management subjects.

Keywords: chess, strategic management, individual differences, learning path, university education.

JEL Classification: A22, M19, I23.

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Introduction

On 13 March 2012, the European Parliament promoted chess as a pedagogical tool in the education system. In Spain, this action is reflected in the Congress of Deputies in 2015. There is abundant literature that demonstrates, as Kazemi et al. (2012) mention, the influence of chess on the development of mathematical skills or problem-solving, the increase of intelligence or creativity Milat (1997). In this sense, Graber (2009) mentions the importance of deep and long-term thinking, which is associated with chess and business. This would reduce the short-sightedness of short-term profits, reduce investment in R&D and employee training costs, among other things. Cannice, (2013, p. 25) points out that many strategic and general concepts can be easily understood on a superficial level, but alternatively teaching methods can be used to include these concepts to students better. In this sense, as mentioned by Johnson and Proctor (2017), how skills and abilities are acquired and maintained, as well as the factors affecting qualified performance, are issues of high interest to both academia and the professional world. Although there are no conclusive results on which the best pedagogical methods for the acquisition of skills and abilities are, some authors, such as Farashahi and Tajeddin (2018), have recently demonstrated that students perceive the simulation method as the most effective compared to the case studies or lectures method.

In this work, a process of reflexive experiential learning is collected, which relates concepts in the context of strategic management and the teaching of the game of chess simultaneously. Therefore, as mentioned (Osgerby et al., 2018) in line with the constructivist hypothesis, students accumulate their knowledge through continuous active cognitive processes that adapt to changing circumstances. Within the consideration of the constructivist method, from which students acquire competences and construct knowledge as opposed to memoiristic learning, this work initially relies on the pedagogical model of the “flipped classroom” (hereinafter FL), which refers to an inverted classroom, made known by Lage et al. (2000).

Subsequently, as Artero Escartin and Domeneque Claver (2018) mention, it was Bergmann and Sams (2012), who consolidated the “inverted classroom” or “reverse classroom” methodology according to Talbert (2012). The objective of this is based on considering the student in the central core of the learning process, through the promotion of self-learning, interaction with the teacher, in the planning of activities, which includes the preparation of an appropriate environment, the use of multimedia media and an appropriate and accepted evaluation system. Some authors such as González-Fernández and Huerta (2019) indicate that this methodology relates concepts of lessons learned and blended learning whose contribution is related to the development of skills related to self-disciplined teams. Likewise, they consider that students develop text-mindedness, and the development of spatial and visual skills, being the process of learning by solving problems, factors that define them.

In general, the teaching-learning process is related to Information Technologies, and to the application of games in this process. As mentioned by Fernández-Mesa et al. (2016), gamification is related to the incorporation of elements of the game, in our case chess, to a non-ludic computer program with the aim of increasing their motivation (Dominguez et al., 2013).

During the process of knowledge of chess, the students carry out a group research project, in the relationship of the subject of strategic management of the company. The students carry out a proactive process of learning by doing, with the tutoring of the teacher and specific masterclasses, for conceptual or methodological explanations. As a consequence with this process (understanding and/or application a particular concept or methods), and in line with (VanSchenkhoef et al., 2018) the experiential learning is an appropriate methodology, because of that combine experiences, perception, cognition and behaviour (Kolb, 1984).

On the one hand, it seeks to take advantage of the process of reflective learning in the classroom, as proposed by Hedberg (2009). Authors as Minocha et al. (2017) make an exciting development of an experiential process, where they try to argue that much of business school practice and pedagogy is still rooted in content rather than context, where priority is given to academic knowledge in favour of practice intelligence. In this work we are also interested in addressing and developing the concept of Practice Intelligence, as mentioned by Minocha et al. (2017) is defined as the capability of managers to analyses, make sense of, reflect upon and shape a response to complex problem contexts and includes the aspects as; problem-solving, the relevance of creativity, imagination in the approach of future scenarios.

On the other hand, and in line with Howard (2014), Cannice (2013), among others, implementing a process of experiential learning, where the practice of the game of chess, with strategic deductive and inductive approaches, the discovery of new knowledge and its linkage with those related to strategic management make up the development structure and the mechanisms of discussion and analysis. The contribution of this work focuses on the simultaneous learning process of chess and the concepts of the strategic management field in an experiential learning process, employing the methodologies mentioned in courses 2017/18 and 2018/19 in the only subject of the fourth year of the business administration career. Except for error, this is the first experience carried out in Spain in the university context. The simultaneous learning of chess with the consequent increase of cognitive skills and Strategic Management concepts could intensify the motivation of the student and generate a virtuous circle that drives both areas.

To determine the results achieved from the pedagogical innovation carried out, the concept of the learning curve is used. According to Howard (2014) the validity and generality of this law is debatable and subject to different considerations both in the field of psychology and economics. Learning, in this context, refers to the functional relationship between the time required to improve the performance of an activity and the repetition activity Wright's, (1936). As mentioned by Grosse et al. (2015) learning (or experience) curves assume that performance (output) improves as a task is repetitively performed, which is attributed to experience that is accumulated by the individual or group performing the task. These authors make an in-depth study of the works that use learning curves in the last three decades.

The work is organised as follows: the material and methods are set out in the following section. The third section deals with the leading results. Finally, the fourth section presents the main conclusions.

1. Material and methods

1.1. Participants

The learning process has been carried out with 121 students from the fourth year of the Business Administration and Management studies in the morning and afternoon shifts, in the subject of strategic management.

The learning process has been carried out in academic years 2017/18 and 2018/19, in the career of Business Administration in the subject of fourth-year strategic management, as mentioned. Table 1 shows the composition of students per year and the percentage of them who said whether they play chess.

Table 1. Characteristics of the sample (source: own elaboration)

Course	N° of students	Play chess
2017/18	64 (55% female, 45% male)	52.0%
2018/19	57 (53% female, 47% male)	47.4%

In order to know the level of chess knowledge of the students, different ways were used; 1) a small questionnaire was carried out, where among other things, the students were asked if they knew how to play chess 2) the students who answered yes were suggested to download the app Chess Live (<https://chess-live.uptodown.com/android>) and to be classified in one of the six existing levels.

The information or process data has been collected by direct measurement from questionnaires and exercises provided to students during the four months from late January to early May 2018 and 2019. The characteristics of the student sample tested are shown in Table 2.

Table 2. Characteristics of the student sample (source: own elaboration)

	2017/18	2018/19
Population	83	78
Sample size	64(79.5%)	57(70.3%)
Sampling error	5.90%	6.78%
Confidence interval 95%	$p = q = 0.5$	$p = q = 0.5$
Analysis unit	Student 4th strategic management	Student 4th strategic management
Geographical scope	University of Alcalá (Madrid-Spain)	University of Alcalá (Madrid-Spain)
Type of sampling	Convenience	Convenience
Measuring instrument	Anonymous survey	Anonymous survey
Date of realisation	may-2018	may-2019

The duration of the activities in the classroom is interrupted since they are two days a week (plus the student's activity outside the classroom) and continued during the term. The type of learning is a motor learning and cognitive learning. Motor learning, since learning is a chance, resulting from practise or a novel experience, in the capability for responding Adams (1971). Cognitive learning, since students learning both by himself and by the group.

1.2. Materials

As Cannice (2013) mentions, it is difficult to decide when and how to carry out the simultaneous teaching of chess and SM. The strategic management subject is taught two days a week in 1.5 and 3-hour classes on Tuesdays and Wednesdays (morning and afternoon) respectively (not including tutorial classes). The time devoted to chess (average 18.75 hours/week in and out of the classroom and DE = 7.30) the classes were compatible with the activities of the subject. The students were free to choose the layout of the activities, which included tutoring by the teacher and quality control of the work. The material provided to the students consisted of movement and play comprehension exercises that are detailed in Table 3 and the Appendix. The students were provided with pieces and boards by groups (most frequently in the academic year 2017/18), and they also used chess software such as www.chess.com (most often in the academic year 2018/19). In the exercises to be developed, they were asked about the time of the activities (in 2017/18), degree of understanding and the group to which they belonged. Later, the questionnaires were collected with the keys that they chose. At the end of each class (or in the following week's class), the exercises were corrected. Table 3 shows the 51 activities carried out (column 1). Activity 0 corresponds to a previous introduction to chess; its history (including chess and cinema, chess and mathematics), the board and movements of pieces through a website created by the author of this work.

The activities were composed of sub-activities (2 or 3). These activities were delivered on paper, with which the board and practice pieces were made available to the student. Students recorded the time spent per activity, as well as the degree of understanding of the activity. The grouping of activities is based around eight levels of difficulty. The definition of the activities is structured from the basic knowledge of movements and pieces, the openings, the intermediate development, and the endings. The last column shows the resources used. Regarding the average degree of comprehension of the activities between 0 and 100%, it was 80.40%, distributed according to levels; #1 = 90.8%; #2 = 77.3%; #3 = 75.7%; #4 = 89.4%; #5 = 88.8%; #6 = 81.2%; #7 = 70.7%; #8 = 68.9.

1.3. Methodology

1.3.1. Methodology of the analysis of learning patterns in the game of chess (2017/18)

The method followed has been the initial approach of the learning curves, however, and given the heterogeneity of game levels observed since the beginning of the experiment and the different possible learning patterns, an automatic detection process is used (lower value of the Akaike information criterion) of the time series by activity with both Statgraphics and Gretl software, which in addition to including the usual learning curves (power, exponential, logarithmic or quadratic) allows detecting other models such as ARIMA.

Table 3. Description of activities in 2017/18 and resources used 2017/18 and 2018/19 (source: own elaboration)

Variable	Number of sub-activities	Learning levels	Mean (time in min.)	Standard deviation	Min	Max	Definition of the activity	Used resources
Activity_0							Presentation*	1) https://justodejorge.wixsite.com/justodejorge
Activity_1	2	1	0.56	2.56	0	20	Chess board_I	2) Boards and physical pieces provided
Activity_2	2	1	0.70	1.43	0	10	Chess board_II	
Activity_3	2	1	2.10	2.41	0	15	Box names (algebraic notation)	3) Exercises and games on paper
Activity_4	2	1	0.48	1.04	0	5	Movements of the pieces_1	
Activity_5	2	1	0.56	1.23	0	5	Movements of the pieces_2	
Activity_6	2	1	0.65	1.40	0	5	Movements of the pieces_3	
Activity_7	2	1	0.59	1.24	0	5	Movements of the pieces_4	
Activity_8	2	1	0.72	1.55	0	8	Movements of the pieces_5	
Activity_9	2	2	5.82	4.32	0.3	20	Tactical and strategic gameplay	1) Exercises and games on paper
Activity_10	1	2	5.61	4.84	0.1	20	Fast checkmate study_I	2) Projection of the results by transparencies
Activity_11	1	2	7.68	5.64	0.1	20	Fast checkmate study_II	3) www.jinchess.com/chessboard/composer
Activity_12	1	2	7.31	5.04	0.1	20	Concept of sacrifice and combinations	4) Chess_diagram_maker.html www.svg_experimenter.deds.nl/chessboard/
Activity_13	2	2	8.25	7.05	0.1	30	Strategy and vision of the game_I	5) Boards and physical pieces provided
Activity_14	3	2	3.43	2.37	0.1	15	Strategy and vision of the game_II	6) www.chessgame.com
Activity_15	3	2	4.05	2.86	0.2	12	Openings and development_I	
Activity_16	3	2	5.73	3.99	1.5	25	Openings and development_II	

Continue Table 3

Variable	Number of sub-activities	Learning levels	Mean (time in min.)	Standard deviation	Min	Max	Definition of the activity	Used resources
Activity_17	3	2	7.36	5.15	0.3	25	Openings and development_III	
Activity_18	3	2	5.95	4.09	0.3	20	Intermediate game movements_I	
Activity_19	3	2	7.21	5.16	0.2	25	Intermediate game movements_II	
Activity_20	3	3	7.72	4.90	1.3	20	Intermediate game movements_III	
Activity_21	3	3	10.39	8.11	2	45	Intermediate game movements_IV	
Activity_22	3	3	6.12	4.52	1	20	Intermediate game movements_V	
Activity_23	3	3	6.11	5.22	1	25	Intermediate game movements_VI	
Activity_24	3	3	5.81	4.50	1.2	25	Intermediate game movements_VII	
Activity_25	3	3	4.91	2,74	0.5	13	Intermediate game movements_VIII	
Activity_26	3	4	3.64	2.5	0.5	10	Final game moves_I	
Activity_27	3	4	3.79	2.5	1	10	Final game moves_II	
Activity_28	3	4	4.39	3.4	0.3	15	Final game moves_III	
Activity_29	3	4	3.48	2.5	0.4	10	Final game moves_IV	
Activity_30	3	4	4.39	2.5	1	10	Final game moves_V	
Activity_31	3	5	3.59	2.2	1	10	Final game moves_VI	
Activity_32	3	5	3.96	2.5	1	10	Final game moves_VII	
Activity_33	3	5	3.99	3	1	15	Final game moves_VIII	
Activity_34	3	5	4.36	2.4	5	10	Final game moves_IX	

End of Table 3

Variable	Number of sub-activities	Learning levels	Mean (time in min.)	Standard deviation	Min	Max	Definition of the activity	Used resources
Activity_35	3	5	4.67	3.1	1	15	Final game moves_X	
Activity_36	3	6	6.02	5.7	1	27	Checkmate in 1 move	
Activity_37	3	6	4.29	3.1	1	20	Checkmate in 1 move	
Activity_38	3	6	4.23	2.5	0.3	10	Checkmate in 1 move	
Activity_39	3	6	4.25	4.7	0.4	20	Checkmate in 1 move	
Activity_40	3	6	9.24	5.4	2	20	Checkmate in 1 move	
Activity_41	3	6	12.64	6.8	2	25	Checkmate in 1 move	
Activity_42	2	7	11.8	11	2	60	Checkmate in 2 move	
Activity_43	2	7	16.45	16	1	60	Checkmate in 2 move	
Activity_44	2	7	18.09	18	3	60	Checkmate in 2 move	
Activity_45	2	7	19.71	17	3	60	Checkmate in 2 move	
Activity_46	2	7	18.28	17	4	60	Checkmate in 2 move	
Activity_47	2	7	18.81	17	2	60	Checkmate in 2 move	
Activity_48	2	8	18.89	19	3	60	Checkmate in 2 move	
Activity_49	2	8	21.28	20	1.5	60	Checkmate in 3 move	
Activity_50	2	8	24.73	21	5	60	Checkmate in 3 move	
Activity_51	2	8	19.13	18	1.5	60	Checkmate in 3 move	

In addition, the methodological proposal of (Box & Jenkins, 1973) has been considered. The analyses and results that will be presented in the following section have been carried out fundamentally on an individual basis per student and per group according to three levels; i) 25th percentile, middle and 75th percentile level.

1.3.2. Methodology of the analysis of the relationship between the game of chess and its analogy with strategic management (2017/18 and 2018/19).

With the aim of capturing the relationship between the game of chess and the strategic management, a questionnaire was carried out in 2017/18 with two groups of questions, the first group of twenty questions (see Table 5) that pose analogies with the strategic management and the second group of three additional issues related to the feasibility of interrelating the game of chess with the strategic management, with business management in a broad sense and with continuity of the teaching of chess in future courses. Each question in the first group could contain two or more proposals and the possibility of the student, including a different one. A five-position Likert scale was used to show the student's degree of agreement. In the academic year 2018/19, the analogies were to be interpreted by the students and therefore, only the left column of Table 5 (chess side analogy) was provided, and they had to complete it with their interpretation of the concepts explained in the subject (SM side analogy). To distinguish the relationship, a network analysis was applied. Besides, three additional questions were included, relating to their level of satisfaction with the experience with the association between chess and SM. In order to obtain the information from the surveys, a descriptive analysis of means and a cluster analysis was carried out, which will be described in the following section.

2. Results

2.1. Results of learning patterns in the game of chess

Table 3 showed some characteristics of the activities carried out, including time by activity (see also Appendix). Figure 1 shows the evolution of the meantime, 25th and 75th percentile. As can be seen, the time spent on activities 40 to 51 is increasing, the most sophisticated levels (6 to 8). Growth between activities 9 to 13 and 18 to 21 is also marked).

A higher level of detail of the time used is shown in Figure 2, where three groups can be seen. The group #1 with the least time is made up of 15% of the sample (10 students), groups #2 and #3; 59% (38 students) and 26% (16 students) respectively. For simplicity, only the times of some students have been shown in the figure; the rest oscillate between the maximum and minimum values of each group. In the case of group #3, the times are even higher than the 60 minutes that the Y-axis picks up.

In more detail, the violin graphs of the times of some activities in Figure 3 clearly show the existence of different groups when analysing the exterior part of the charts (Kernel distributions). For example, the two or three modes in levels 5, 6 and 8.

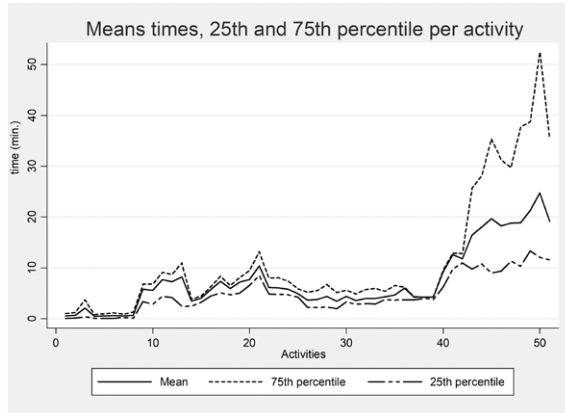


Figure 1. Times per activity (2017/18) (source: own elaboration)

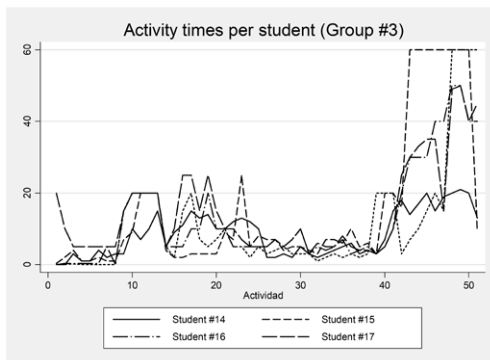
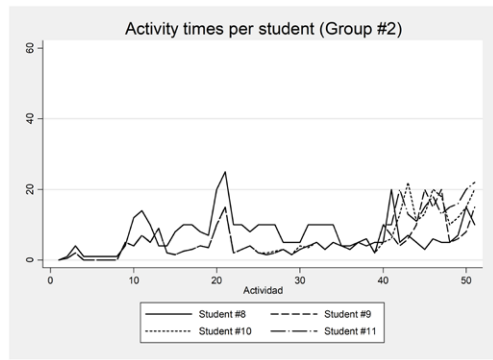
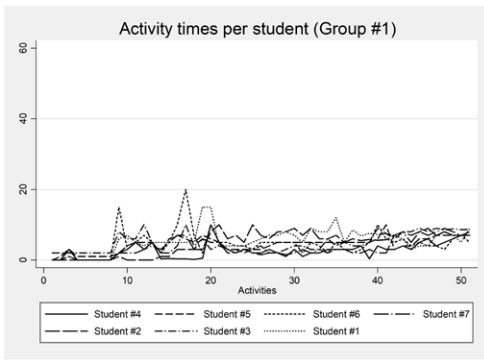


Figure 2. Times by activity according to groups (2017/18) (source: own elaboration)

Table 4 shows the results of the estimations of the learning trajectories for the whole group in their average values, 25th and 75th percentile, and in an individualised way for nine students as an example, according to their belonging to the previously established time groups.

The classification of the models estimated in Table 4, and shown in Figure 4, represent in a similar way to the absent ones; exponential smoothing, ARIMA, random walk and linear or quadratic models.

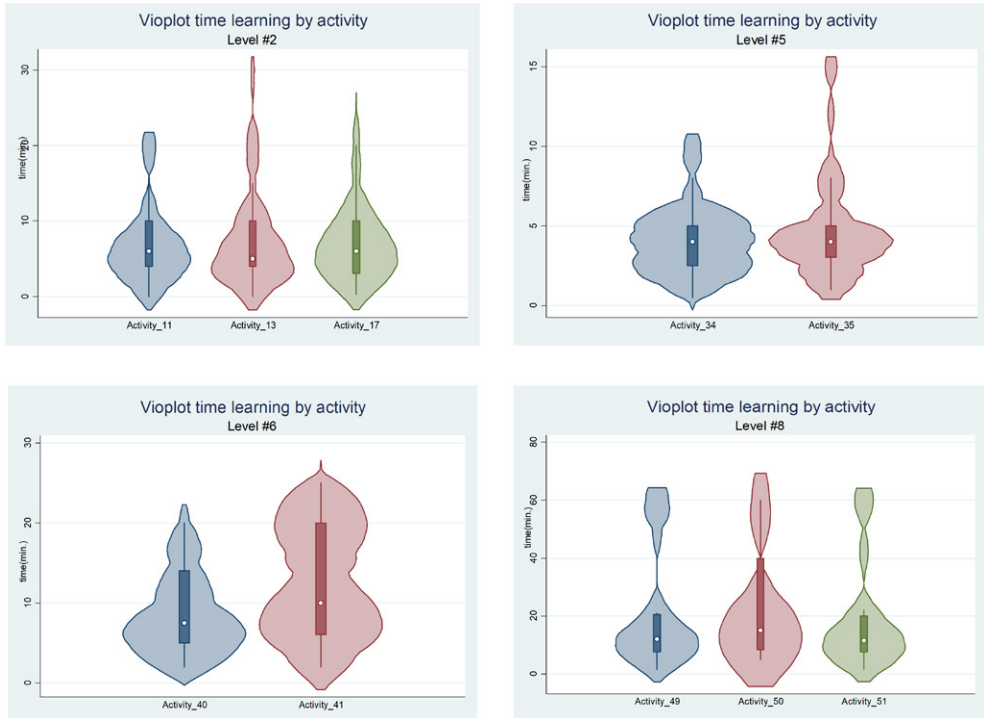


Figure 3. Violin graphs of the times of the selected activities and levels. (2017/18) (source: own elaboration)

Table 4. Group and individual learning trajectories (2017/18) (source: own elaboration)

	Función	Components	RSME	AIC
Classroom				
Mean	random walk		2.09	1.47
25th	random walk		1.32	0.55
75th	ARIMA (1,1,2)	AR (1) -0.88(-5.40)** MA(-0.82)** -MA(2) -5.43(-4.16)**	4.11	1.48

End of Table 4

	Función	Components	RSME	AIC
Students				
<i>Group #1</i>				
Student #1	Cuadratic function	$-0.803 + 0.504 t - 0.007 t^2$	2.64	2.01
Student #2	simple exponential smoothing	$\alpha = 0.562$	1.48	0.82
Student #3	simple exponential smoothing	$\alpha = 0.434$	1.96	1.38
Student #4	Lineal function	$0.534275 + 0.0829955 t$	1.86	1.32
Student #5	simple exponential smoothing	$\alpha = 0.51$	1.48	0.82
Student #6	simple exponential smoothing	$\alpha = 0.24$	3.59	2.59
Student #7	simple exponential smoothing	$\alpha = 0.65$	1.41	0.73
<i>Group #2</i>				
Student #8	ARIMA (1,1,1)	AR (1) 0.44(3.31)** MA(1) 1.00(102.1)**	6.41	3.79
Student #9	simple exponential smoothing	$\alpha = 0.37$	3.99	2.81
Student #10	ARIMA (1,0,2)	AR (1) 1.05(57.6)**MA(1) 0.42(3.15)**MA(2) 0.40(3.05)**	3.66	2.71
Student #11	simple exponential smoothing	$\alpha = 0.58$	3.46	2.52
Student #12	ARIMA (1,1,2)	AR (1) $-0.65(-3.26)**$ MA(1) $-0.31(-98.01)**$ 1.81)MA(2) 0.61(5.66)**	4.81	3.26
Student #13	simple exponential smoothing	$\alpha = 0.59$	4.26	3.67
<i>Group #3</i>				
Student #14	random walk		3.45	3.45
Student #15	random walk		8.4	4.25
Student #17	simple exponential smoothing	$\alpha = 0.69$	7.66	4.11
Student #16	ARIMA (2,1,2)	AR (1) 0.008(0.07) AR(2) $-0.66(-5.91)**$ MA(1) $-0.02(-27.9)$ MA(2) $-1.05(-27.9)**$	4.83	3.3

Note: ** p < 0.01; *p < 0.05 RSME = Root Mean Squared Error; AIC = Akaike Information criterium.

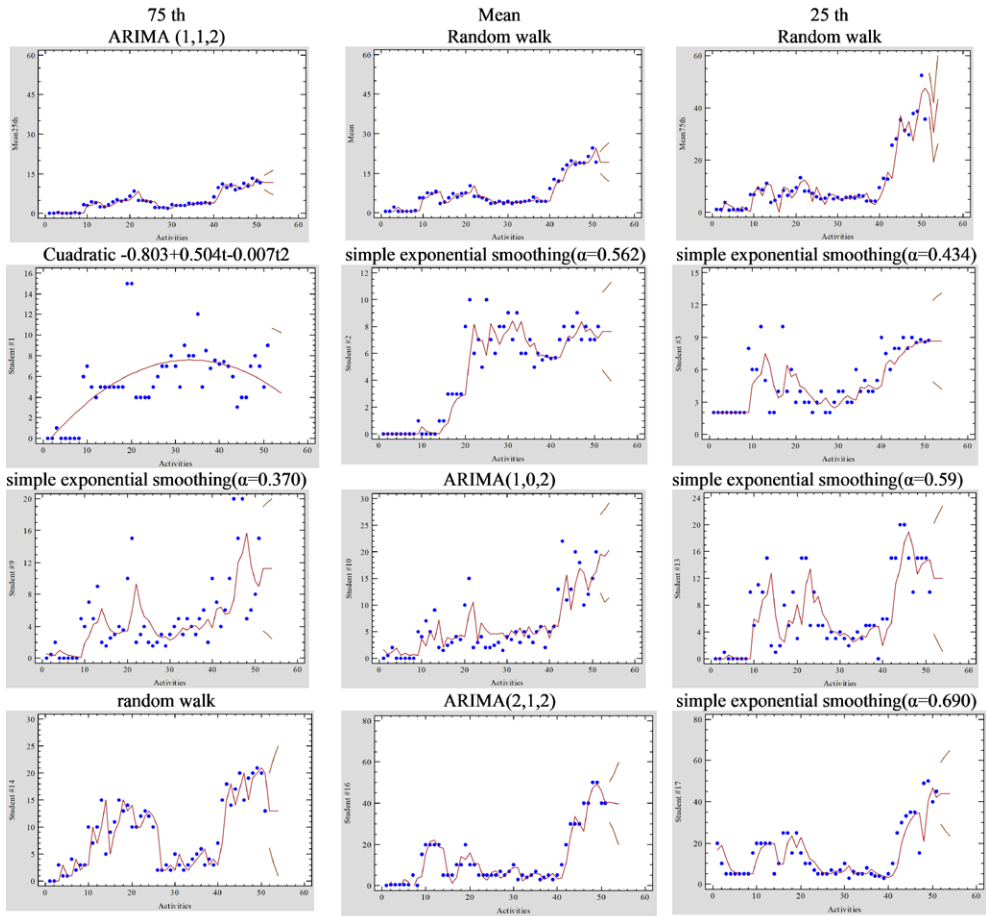


Figure 4. Learning paths (2017/18) (source: own elaboration)

2.2. Results of the relationship between the game of chess and its analogy with the SM

Course 2017/18

To determine the relationship between the game of chess and the analogy with the business world, through the strategic management, and under the methodology set out in section 2.3, Table 5, the results are shown. The fourth column shows the average values and the mode of the grade according to the proposed analogy. In the fifth column, the analogy is sorted according to the values in the fourth column. In general, high values of the degree of the agreement are observed, the global average is 3.97(SD = 0.41), being the maximum average and mode value of 4.62(5), corresponding to item 9.1 relating to the movements of the queen and the bishop in their diagonals and the analogy with the optimisation of resources. The minimum value is in item 6.3, with 3.02(3) mean and mode respectively, related to the tactical process of destruction of the opponent's defense and control of squares and diagonals and its analogy with the reduction of the field of activity (product-market). Therefore, a wide range of analogies between chess and strategic management are internalised by the students. These associations were previously discussed with the students throughout the classes.

Table 5. Strategies of the chess game and its analogy with the strategic management (2017/18) (source: own elaboration)

Item	Questions	Analogies with SM	Mean (Mode)	Order N°
1	The analogy of the chess board and its pieces, and how to tactically deploy resources is related to the SM in terms of	1.1 Resources and capabilities of the firm	4.20(4)	18
		1.2 Understanding the environment	3.88(4)	30
2	The moves made by the pieces in chess are related to the strategic management, in terms of	2.1 How managers deploy their resources	4.08(5)	3
		2.2 How CEO's manage HR, technology	3.72(4)	35
3	In chess they move white pieces first, then black. If both players had a perfect game. White's pieces advantage in moving first gives it the victory.	3.1 The leader firm in innovation is the most competitive	4.05(4)	22
		3.2 Concept of creative destruction	3. 23(3)	48
4	In the first moves you try to dominate the center of the board, if you play with the white pieces. If you dominate the center, you control the board.	4.1 Leader firm dominate the sector	4.46(5)	9
		4.2 Following companies could dominate the sector	3.35(3)	47
5	The double attack involves the simultaneous execution of two or more simultaneous attacks that the opponent cannot counteract at the same time, usually due to weaknesses, this is related in SM to	5.1 Product and market development (diversification)	3.77(4)	33
		5.2 Product and process innovation	3.74(4)	34
		5.3 Vertical integration processes and investment in R&D	3.71(4)	37
6	The destruction of the defense is a tactical process, it is achieved when a rival piece is directly eliminated, which controls important lines or squares, this is related in SM with	6.1 Organisational restructuring	3.85(4)	32
		6.2 The reorientation of the activity	3.57(4)	41
		6.3 The reduction of the field of activity	3.02(3)	50
7	The diving is another of the tactical processes in chess. This is the immobilisation of an attacked piece that would leave, if moved, another piece of greater value unprotected. If this piece is the king, the dive is absolute and the total immobilisation, this is related in SM to	7.1 Launching of fictitious or simulated signals in strategies of fusion, internationalisation, etc. that seek wear and tear	3.72(4)	36
		7.2 Presence of causal ambiguity	3.42(3)	46

Continue Table 5

Item	Questions	Analogies with SM	Mean (Mode)	Order N°
8	Deviation is a tactical process that consists of forcing a rival piece to leave its current position, giving our pieces access to decisive squares or lines, this is related in SM to.	8.1 Market counter-segmentation	3.45(4)	45
		8.2 Exclusive access to suppliers with new technology	3.97(5)	24
		8.3 Product/process differentiation	4.03(5)	23
9	When you move the Queen or your Bishops, you consider doing it in wide range diagonals, to take full advantage of the capabilities of this resource, this is related in strategic management to.	9.1 Optimization of resources	4.62(5)	1
		9.2 Limited rationality	3.12(3)	49
10	Sometimes, incorrect movements of the own pieces block the king's movements, making it easier for the opponent to checkmate.	10.1 Power and influence of stakeholders towards management	3.58(3)	40
		10.2 Conflict of interest and balance for survival	4.28(4)	11
11	Attack on discovery, it is that when a piece moves and discovers the action of another that is behind it, it can create a threat between the two. Sometimes, it can be a double check, this is related in SM to	11.1 Integration of the supplier in the value chain	3.46(3)	43
		11.2 Strategic alliances with other companies by national or international markets	4.17(5)	19
12	In processes of opening and development of games, the disposition and movement of pawns is fundamental, their capacities increase, if it is done properly, this is related in SM to	12.1 Coordination of activities can provide competitive advantages (complementarity of resources)	4.23(4)	16
		12.2 Leadership / efficient management turn weak points into strong points (weak resources into strong ones)	4.25(5)	13
13	When a crown pawn (reaches the other side of the board) becomes another piece much more powerful, this is related in SM to	13.1 An effective HR leader develops HR skills	3.97(4)	25
		13.2 Efficient leadership / management turn weaknesses into strengths and strategies	4.57(5)	3
14	By castling in chess, the king is protected, but the king can be a key player in the attack.	14.1 The protection of a valuable resource prevents appropriateness	3.68(3)	38
		14.2 Protecting a valuable resource prevents substitutability, imitability and transferability	3.89(5)	29
		14.3 The protection of a valuable resource, leads to causal ambiguity	3.62(3)	39

End of Table 5

Item	Questions	Analogies with SM	Mean (Mode)	Order N°
15	When you perform a movement and development of a piece, do you think about the purpose you are pursuing? perhaps you are more interested in eliminating a rival piece, than any other option, this is related in SM to	15.1 Vision, purpose and objectives of the company	4.25(5)	14
		15.2 Strategic planning	4.58(5)	2
16	Before making a move, the player evaluates his opportunities and threats due to the opponent's positioning, this is related in SM to	16.1 Analysis of the specific environment of the company	4.52(5)	5
		16.2 Metodología de las cinco fuerzas de Porter	4.32(5)	10
17	Before making a move, the player evaluates and uses his strengths and reflects on how to cover the weaknesses of his positioning, this is related in SM to	17.1 Internal firm analysis (Value chain)	4.52(5)	6
		17.2 Vertical and horizontal links	3.46(3)	44
		17.3 Coordination and optimisation activities	4.14(5)	20
18	In chess, it is necessary to study the present in depth and evaluate alternate moves for the following moves, this is related in SM to	18.1 Scenery analysis	4.55(5)	4
		18.2 Decision Trees	4.25(5)	15
19	In chess the anticipation of the opponent's move involves developing inductive and deductive procedures (each move follows a plan, our plan induces our move while from the opponent's move we must try to deduce his plan), this is related in SM to Guerras Martín and Navas López (2007)	19.1 Change management and strategic thinking	4.49(5)	8
		19.2 Leadership	3.55(3)	42
20	Chess players often analyse their own moves to correct mistakes and design strategies.	20.1 Strategic implementation	3.97(5)	26
		20.2 Organisational adjustment and change	4.23(5)	17
		20.3 Knowledge management (learning by doing, proactivity)	4.51(5)	7
		20.4 Evaluation and selection of strategies	4.28(4)	12
		20.5 Strategic adaptation (relationship between strategy and the company's mission and objectives)	3.94(4)	28
		20.6 Strategic feasibility (possibility of implementing a strategy)	3.88(4)	31
		20.7 Strategic acceptability (consequences of choosing a strategy)	3.97(4)	27

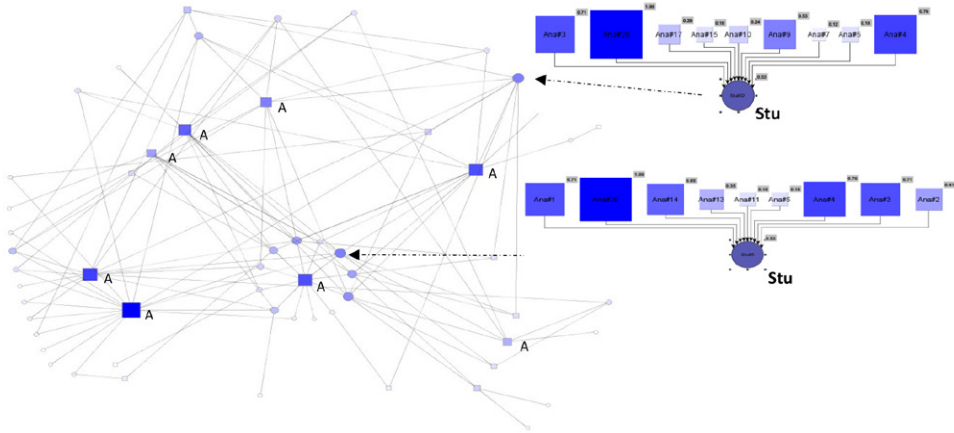


Figure 5. Network analysis (source: own elaboration)

Course 2018/19

In the second year of the experience analysed instead of providing the associated analogy of chess with the strategic management, so that it would be valued by the students, it was they who should look for such a connection, as it was commented. In order to interpret the results of the analysis, a network analysis was applied. Figure 5 shows the network analysis associating 69% (37) of the students who performed the analogy test (henceforth Ana#).

The left side of Figure 5 shows the network, where six Ana# have an important representation; Ana#20; Ana#4; Ana#1; Ana#3; Ana#14 and Ana#9. While Ana#8 or Ana#12 among others has the minimum density with the association of only one student. On the right side of Figure 5, two of the students, stu#32 and stu#5, are shown with the highest ratio in the recognition of a total of nine analogies.

2.3. Cluster analysis 2017/18 and 2018/19

By means of cluster analysis, applying the Ward grouping method (Ward, 1963) and the Euclidean distance squared, three groups of students have been obtained for each year. The groups are defined according to the average values of their degree of valuation according to; the association of chess with the strategic management, with business management in general and the recommendation to continue using chess in future courses. Table 6 and 7 show the results of the cluster and discriminant analyses, respectively.

The average values of each group and year are usually high, for the three items, with the exception of group #3 of course 2018/19, which shows the lowest values. Table 6 shows the high percentages of successes in the classification, 100% and 98.1% of the 2017/18 and 2018/19 courses of the students in each group according to the discriminant analysis, as well as the values of the tests and the statistical significance of the classification functions.

Finally, Figure 6 shows the clouds of words, wherewith greater size, those more referenced appear, from the opinions of the students for the two courses, analysed.

The main results reveal the existence of different learning groups in relation to the times and levels of difficulty by activities in 2017/18. Likewise, different learning patterns have been identified; given that, as Howard (2014) mentions, there are no unique forms of learning curves for the full range of skills and abilities of individuals. In general terms, an increase in the level of learning in the game of chess is detected, with the predictions made by the different models despite the degree of difficulty of the levels, especially the seventh and eighth levels. 64% of the students would keep time constant for future activities, 12% would reduce time, and the remaining 24% would share proportionally an increase or oscillation of time in the above-mentioned course.

One of the main contributions of the work relates to the association of the game of chess with the concepts of the SM. The underlying idea is the motivation that the game of chess exerts on students to foster greater understanding. In the academic year 2017/18, analogies were proportionate, and students evaluated the grade according to them. In spite of the results achieved with high values on a Likert scale in that year (as shown in Table 5), in the academic year 2018/19, it was the students who had to look for this relationship in an autonomous way, looking for a greater process of connection with the concepts. The network analysis shows a satisfactory result where at least 69% of the students recognise between 1 and 9 analogies, and none of them remains unrecognised. The simultaneous learning of chess with the concepts in management could have a kind of virtuous circle by means of which the increase of cognitive abilities could be related to the domain in the field of management and vice versa.

This new experience in Spain contributes to filling a perhaps significant gap in the literature. In parallel, the practice of chess in the classroom has corroborated a level of commitment and motivation of students in the knowledge of the concepts of strategic management, as well as the concept of practical intelligence, especially in terms of problem-solving, creativity and future scenarios. The results achieved could suggest the incorporation of chess practice as a motivating factor in management subjects.

Limitations and future research directions

Possible extensions of this work could relate to the introduction of time limit monitoring in activities or sub-activities. Also, a different sequencing to that maintained in this work, reducing the number of levels in the degree of complexity. In relation to the limitations, the size of the classroom and the different initial levels of knowledge of chess, have been a real challenge to carry out this work. Finally, the combination of activities, between chess and the experience of strategic management are complicated to manage, requiring large doses of planning. These limitations are perhaps challenging to solve, although possible help could be associated with a higher number of teachers involved in the process.

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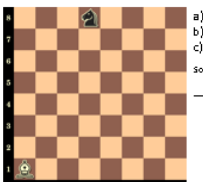
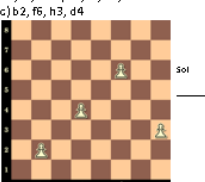

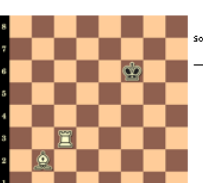




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Appendix

Table A1. Example of activities

Id	Activity	Time	Comprehension level
	<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>Minimum number of moves required by the white horse to reach the black tower</p>  <p>a) 5 b) 3 c) 4 Sol: _____</p> </div> <div style="width: 30%;"> <p>Minimum number of moves required by the white a1 file to reach the black horse</p>  <p>a) 2 b) 3 c) 4 Sol: _____</p> </div> <div style="width: 30%;"> <p>What coordinates are the pawns in? a) b2, d4, f6, h3 b) h3, f6, d4, a2 c) b2, f6, h3, d4</p>  <p>Sol: _____</p> </div> </div>		<input type="checkbox"/> 1.0% <input type="checkbox"/> 2.25% <input type="checkbox"/> 3.50% <input type="checkbox"/> 4.75% <input type="checkbox"/> 5.100%
	<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>In how many moves did the white pawn reach the black horse?</p>  <p>Sol: _____</p> </div> <div style="width: 30%;"> <p>It's double check? a) yes b) no</p>  <p>Sol: _____</p> </div> <div style="width: 30%;"> <p>¿What would be the most effective way to combat bishop check??</p>  <p>Sol: _____</p> </div> </div>		<input type="checkbox"/> 1.0% <input type="checkbox"/> 2.25% <input type="checkbox"/> 3.50% <input type="checkbox"/> 4.75% <input type="checkbox"/> 5.100%
	<div style="display: flex; justify-content: space-between;"> <div style="width: 30%;"> <p>Look at the moves divided into four. What's the situation with the black king? Sol: _____</p>  </div> <div style="width: 30%;"> <p>Can white pieces checkmate in 3 different ways? a) true b) false. Sol: _____</p>  </div> <div style="width: 30%;"> <p>If it was the turn of the black pieces, what play would you make? Sol: _____</p>  </div> </div>		<input type="checkbox"/> 1.0% <input type="checkbox"/> 2.25% <input type="checkbox"/> 3.50% <input type="checkbox"/> 4.75% <input type="checkbox"/> 5.100%

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