Flow and business simulation games: a typology of students

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Abstract

In the context of management training business simulation games are increasingly emerging as pedagogical tools for motivating and engaging players actively in the learning experience. Business simulation games provide opportunities for students to enter the flow state. However, few studies have applied flow theory in this specific context. Using data from a two-wave longitudinal study with a sample of 430 students who played a business simulation game, this research draws on the four-channel model of flow to identify subgroups of students based on their levels of skill and challenge and to analyse the evolution of their optimal experience of flow. In addition, it explores whether students in flow achieve higher learning outcomes; in particular, students' perceived learning, satisfaction and skills development.

Keywords: gamification; business simulation games; flow; learning outcomes; cluster analysis; typology

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- This paper analyses business simulation games (BSGs) through the flow theory.
- This paper provides a framework for classifying students based on their skills and the challenge they face.
- This paper analyses the evolution of the optimal experience of flow among students.
- This paper examines students’ learning outcomes related to states of mind while playing BSGs.

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Abstract

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1. Introduction

Games and gamification have gained recognition within education in recent decades due to their engaging and motivating power (Majuri, Koivisto, & Hamari, 2018). In parallel, the unprecedented advance of new information technologies has enabled the development of innovative educational tools to improve students' learning experiences (Matute-Vallejo & Melero-Polo, 2019). In the context of management training, the combination of these two trends has resulted in the use of business simulation games as pedagogical tools for motivating and engaging players actively in the learning experience.

Business simulation games are virtual representations of real commercial situations that allow students to manage companies in risk-free environments (Pando-García, Periañez-Cañadillas, & Charterina, 2016) and enable instructors to provide a bridge between theory and practice (Loon, Evans, & Kerridge, 2015). By simulating market trends, business simulation games provide an overall view of corporate strategic functions and allow students to address educational contents in interactive and enjoyable ways (Pando-García et al., 2016).

One of the most important aspects to consider when games are used for learning purposes is the game-playing experience of the players (Hou & Li, 2014). In this sense, the concept of flow is commonly used to describe the psychological state of the players. Flow is a state of optimal experience where concentration is so intense that nothing else seems to matter, time becomes distorted, and selfconsciousness disappears (Csikszentmihalyi, 1975). As a result, the activities that produce such experiences are characterised as pleasant and intrinsically rewarding (Csikszentmihalyi, 1990). Flow occurs when challenges and skills are high and in balance (Csikszentmihalyi & Csikszentmihalyi, 1988). By contrast, according to the four-channel model of flow, three additional states of mind are identified when challenge and skill are not in balance, or both fall below a critical threshold: boredom, apathy and anxiety.

Previous research in game-based learning contexts has acknowledged that experiencing flow is important for students (Hamari et al., 2016). However, although business simulation games provide opportunities for students to enter the flow state, only a few studies have applied flow theory in this specific context, with some limitations. First, previous research has analysed the playing experience focusing on the flow construct (Kiili, Lainema, Freitas, & Sylvester, 2014), which means that the states of mind related to boredom, apathy and anxiety have been neglected. Second, existing studies have used cross-sectional research designs (Buil, Catalán, & Martínez, 2018) and, therefore have not been able to investigate the evolution of flow among students while the business simulation game evolves. Finally, despite the importance of flow for learning, previous research in this context has not analysed the influence of flow on learning outcomes (Matute-Vallejo & Melero-Polo, 2019). To bridge these gaps, this research draws on the fourchannel model of flow (Hoffman & Novak, 1997) to classify subgroups of students based on their levels of skill and the level of challenge they face while playing business simulation games into students in flow, bored, anxious and apathetic. In addition, this longitudinal study examines students' states of mind at two measurement points (at the beginning and at the end of the business simulation game) to analyse the evolution of the experience among students. Finally, it explores whether students in flow states achieve better learning outcomes than those not in flow state; in particular, students' perceived learning, satisfaction and skills development are examined.

2. Theoretical framework and hypotheses development

2.1. Flow theory

As Zichermann and Cunningham (2011, 16) argued: 'at the heart of the success of games is an idea called flow'. Flow theory has its origin in Csikszentmihalyi's desire to understand enjoyment. Csikszentmihalyi (1975) explored why some people were willing to invest great amounts of time and effort in undertaking activities that provide no external reward. He found that this group of people felt rewarded by executing actions per se, experiencing high enjoyment and fulfilment from the activity in itself. Those activities were characterised to be autotelic (from Greek auto = self, telos = goal) or intrinsically motivating, and the optimal experience derived from performing them was labelled 'flow' (Csikszentmihalyi, 1975). The flow construct was described as a 'crucial component of enjoyment' (Csikszentmihalyi, 1975, p. 11), and the flow experience was defined as 'the holistic sensation that people feel when they act with total involvement' (Csikszentmihalyi, 1975, p. 36).

Among the different approaches to measuring flow, derived unidimensional measures of flow are commonly used. These measures aggregate components related to flow into an overall measure. This is the case of the four-channel model of flow, in which flow is determined by the congruence of two components: skill and challenge, which been claimed to be the most important flow antecedents (Csikszentmihalyi, 1990). The original flow model specified that it occurred when there was an equal match between challenge and skills (i.e., both equally high and equally low) (Csikszentmihalyi, 1975). Suboptimal scenarios arose where situations were too challenging, which led to anxiety, or insufficiently challenging, which led to boredom. Later empirical formulations (Csikszentmihalyi & Csikszentmihalyi, 1988) proposed that, for flow to occur, both challenges and skills had to be high, and in balance, leading to the four-channel model of flow (Hoffman & Novak, 1997) (see Fig. 1). According to this model, the opposite pole of flow is apathy, in which both challenges and skills are equally low.

Drawing on the four-channel model of flow, we propose:

Hypothesis 1. Four subgroups of students' states of mind can be identified based on their skill levels and the challenge they face while playing a business simulation game:

a) boredom, characterised by low scores in challenge and high scores in skill

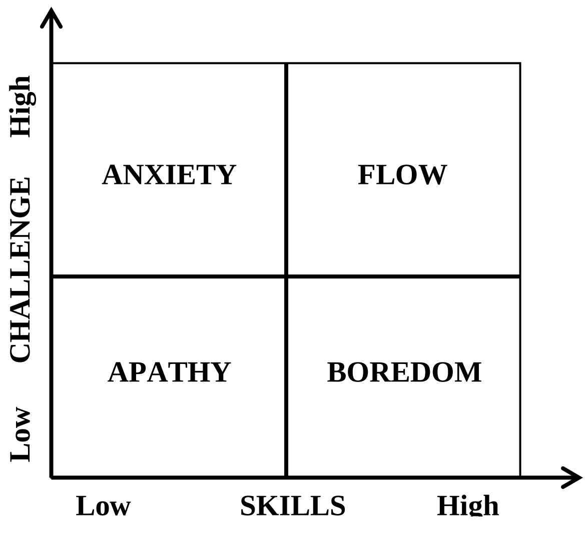
b) anxiety, characterised by low scores in skill and high scores in challenge

c) apathy, characterised by low scores in skill and challenge

d) flow, characterised by high scores in skill and challenge

We classify the students based on their levels of skill and challenge at two measurement points to investigate the evolution of the optimal flow experience.

Figure 1. The four-channel model of flow (Hoffman & Novak, 1997, p. 10)



2.2. States of mind and learning outcomes

Flow theory has been widely associated with learning (e.g., Hoffman & Novak, 1996; Shernoff & Csikszentmihalyi, 2009; Skadberg & Kimmel, 2004). Previous studies have reported flow as a strong predictor of students' learning in different contexts, such as computer-based instructional environments (Wang & Hsu, 2014), online learning (e.g., Esteban-Millat, Martínez-López, HuertasGarcía, Meseguer, & Rodríguez-Ardura, 2014; Shin, 2006) and game-based learning (Barzilai & Blau, 2014; Bressler & Bodzin, 2013; Buil, Catalán, & Martínez, 2019b, 2018; Hamari et al., 2016). In addition, flow has been found to influence the development of various skills (Buil, Catalán, & Martínez, 2019a, 2018; Klein, Rossin, Guo, & Ro, 2010), which is of particular importance in the specific context of business simulation games, and student satisfaction (Joo, Joung, & Kim, 2013; Joo, Lim, & Park, 2011; Klein et al., 2010; Lee & Choi, 2013; Shin, 2006; Wang & Hsu, 2014). On the other hand, boredom has been associated with lower levels of selfesteem, and pessimism about the future (Hunter & Csikszentmihalyi, 2003), and has been reported as detrimental to students' motivation (Pekrun, Goetz, Titz, & Perry, 2002). Similarly, apathy has been negatively related to affect, concentration, contentment and motivation (Konradt, Filip, & Hoffmann, 2003). Finally, anxiety has been associated with decreased levels of motivation (Jain & Sidhu, 2013) and learning performance (Chou, 2001) and higher levels of cognitive load (Hwang, Hong, Cheng, Peng, & Wu, 2013).
Therefore, we propose:
Hypothesis 2. Students in flow will show higher levels of (a) perceived learning, (b) satisfaction, and (c) skills development than those who are not in flow.

3. Methodology

3.1. Data collection and participants

The empirical study was carried out with a sample of final-year business students who played a business simulation game in a semester-long marketing course at a major Spanish university. The data was collected from the same marketing course over three academic years, from 2016 to 2019. The players were asked to answer a self-administered questionnaire at two measurement points: at the beginning of the simulation competition (T1) (having had two sessions to practice an entire decision-making cycle) and at the end of the competition (T2). Self-reported measures of flow are particularly useful when the purpose of the study is to measure the flow experience or differences in its occurrence across contexts or individuals (Nakamura & Csikszentmihalyi, 2009), as in our case. Participation in the study was voluntary and the students were assured that non-participation would not affect their grades in any way. The participants were assured of the anonymity and confidentiality of the data they supplied. After discarding incomplete and non-valid questionnaires, we obtained a final sample of 430 individuals.

3.2. Procedure

During the first course sessions, the students were given a user manual, which was supplemented by explanations given in the classroom. The instructors explained the objective and operation of the business simulation game and how to use the software. The study employed a browser-based business simulation game developed by the Spanish company Gestionet. To familiarise themselves with the simulation game, the students were allowed two sessions to practice an entire decision-making cycle. After the game had been explained, the participants were divided into teams of 4–6 members. Each team had to manage a company in competition with companies run by other students. In each round of decision-making, the students had to manufacture and sell air-conditioning products in different markets, and to make strategic decisions about which products to commercialise in which markets. They had to deal with inventory, quality control, outsourcing, new machinery procurement, and human resources management. They also had to make decisions on marketing and finance. After each round the simulation game awarded an overall score to each group, up to maximum of 1000 points, based on the decisions the students had made and the results they obtained. The students were able to monitor their progress through different forms of feedback, such as financial statements, market share and positioning studies. Based on this information, the students evaluated their strategy and recalibrated it for the following round. During the competition the students were also required to write reflective essays to draw conclusions about factors that might have affected their competitive position in different markets, and the reasons for success and/or failure.

3.3. Measurement instrument

To measure the constructs included in the study, well-established scales taken from previous literature were used (see Table 1). The measures were carefully adapted to ensure that the items fitted the context. 7-Point Likert-type scale items were used, ranging from 1 (strongly disagree) to 7 (strongly agree). First, to classify the students, their perceptions about their skills (Cronbach's α T1 = 0.77; α T2 = 0.80) and the challenge (α T1 = 0.84; α T2 = 0.88) presented in the game were measured at T1 and T2, following Novak, Hoffman, and Yung (2000). Second, to corroborate the students' states of mind, we also included a holistic measure of flow following the three-dimensional conceptualisation proposed by Bakker (2008), which includes three measures: absorption (α T1 = 0.89; α T2 = 0.93), which refers to a state of total concentration and immersion in an activity; enjoyment (α T1 = 0.92; α T2 = 0.95), which refers to the individual's assessment of the quality of an activity; and motivation (α T1 = 0.88; α T2 = 0.91), which refers to the desire to perform a certain activity in order to experience the pleasure and satisfaction derived from undertaking the activity. The items used at T1 and T2 were adapted from Khan and Pearce (2015), who applied Bakker's measures in a business game context.

Finally, to examine whether students in flow achieve better learning outcomes, perceived learning, satisfaction and skills development were measured at T2. Perceived learning (α T2 = 0.90) was adapted from Tiwari, Nafees, and Krishnan (2014). Satisfaction with the business simulation game (α T2 = 0.92) was measured following Kettanurak, Ramamurthy, and Haseman (2001). To measure skills development (α T2 = 0.87), we included various skills which have been highlighted in previous studies as the most important in business simulation games (e.g., Borrajo et al., 2010; Fitó-Bertran, Hernández-Lara, & Serradell-López, 2014; Loon et al., 2015).

Table 1. Constructs, items, sources, and descriptive statistics

Constructs, items and sources	Mean T1	SD T1	Mean T2	SD T2
Challenge (Novak et al., 2000)	4.78	1.01	4.95	1.06
C1. Playing the business simulation game (BSG) challenges me. C2. Playing the BSG challenges me to perform to the best of my ability. C3. Playing the BSG provides a good test of my skills. C4. I find that the BSG stretches my capabilities to the limits.				
Skills (Novak et al., 2000)	4.05	0.90	5.00	0.92
S1. I am extremely skilled at playing the BSG. S2. I consider myself knowledgeable about playing the BSG. S3. I know somewhat more than most of my colleagues about the BSG. S4. I know how to find what I am looking for when playing the BSG.				
Absorption (Khan & Pearce, 2015)	4.27	1.16	4.79	1.27
When I am playing the business simulation game… A1. I think about nothing else. A2. I get carried away by the game. A3. I forget everything else around me. A4. I am totally immersed in the game.				
Enjoyment (Khan & Pearce, 2015)	4.87	1.09	5.17	1.18
E1. Playing the BSG gives me a good feeling. E2. I get a lot of enjoyment from playing the BSG. E3. I feel happy whilst playing the BSG. E4. I feel cheerful when I play the BSG.				
Motivation (Khan & Pearce, 2015)	4.08	1.24	4.41	1.29
M1. I would play the BSG, even if I was not rewarded for it. M2. I find that I want to play the BSG in my free time. M3. I play the BSG because I enjoy it. M4. I get my motivation from playing the BSG, and not from the reward of winning.				
Perceived learning (Tiwari et al., 2014)	N.A.	N.A.	5.44	0.93
PL1. The BSG helped me understand the practical integration of business functions. PL2. The BSG helped me develop and analyse competitive advantages for my business. PL3. The BSG gave me a thorough understanding of the target market. PL4. The BSG gave me a thorough understanding of the products' positioning.				
Satisfaction (Kettanurak et al., 2001)	N.A.	N.A.	5.59	0.88
SAT1. Overall, I found the BSG valuable. SAT2. Overall, I was very satisfied with the BSG. SAT3. Overall, I had a very positive learning experience.				
Skills development	N.A.	N.A.	5.82	1.01
SD1. Decision-making SD2. Working under pressure SD3. Adapting to new situations SD4. Teamwork SD5. Applying theory to practice				

Note: SD: standard deviation; N.A.: not applicable

4. Analysis of results

4.1. Subgroups of students' states of mind (Hypothesis 1)

Two cluster analyses were used to classify the respondents based on their levels of skill and challenge at T1 and T2. SPSS 20 was employed.

In the first cluster analysis (see Table 2) a single composite measure for each construct (i.e., skill and challenge at T1) was calculated to form the clustering variables. A two-step approach was employed. First, Ward's hierarchical cluster analysis method, using squared Euclidean distance, was used to determine the number of groups. Three-, four- and five-cluster solutions were explored. In addition, the authors examined the dendrograms and the distances at which each cluster was formed, profiled each cluster and used practical judgments and theoretical foundations (Hair, Black, Babin, Anderson, & Tatham, 2006). These indicators suggested that the four-cluster solution was the most appropriate. Thereafter, a K-means clustering analysis was performed for the four-cluster solution. The initial centroids of the four clusters were used as the starting centres for the analysis. This solution provided the greatest contrast between the groups (Hair et al., 2006). Finally, discriminant analysis supported the appropriateness of the four-cluster solution.

Table 2. Clusters, ANOVA and post-hoc analyses (T1)

	Cluster 1 *Boredom*	Cluster 2 *Flow*	Cluster 3 *Anxiety*	Cluster 4 *Apathy*	F-value	Post-hoc test
Skill	4.65	4.84	3.33	3.25	269.41**	1-2, 1-3, 1-4, 2-3, 2-4
Challenge	4.30	5.74	5.25	3.56	297.92**	1-2, 1-3, 1-4, 2-3, 2-4, 3-4
No. cases	108	115	115	92		
%	25.1	26.7	26.7	21.4		

Note: **p<0.05

In the second cluster analysis (see Table 3), again a single composite measure for each construct (i.e., skill and challenge at T2) was calculated to form the clustering variables. Ward's hierarchical cluster analysis method was used to determine the number of groups. The four-cluster solution was the most appropriate. This estimate was prespecified in a

K-means cluster analysis. This solution provided the greatest contrast between the groups (Hair et al., 2006). Discriminant analysis also supported the appropriateness of the four-cluster solution.

Table 3. Clusters, ANOVA and post-hoc analyses (T2)

	Cluster 1 *Boredom*	Cluster 2 *Flow*	Cluster 3 *Anxiety*	Cluster 4 *Apathy*	F-value	Post-hoc test
Skill	5.48	5.69	4.48	3.63	236.91**	1-2, 1-3, 1-4, 2-3, 2-4, 3-4
Challenge	4.02	5.92	5.12	3.36	380.53**	1-2, 1-3, 1-4, 2-3, 2-4, 3-4
No. cases	90	145	143	52		
%	20.9	33.7	33.3	12.1		

Note: **$p<0.05$

Based on the respondents' average ratings of skills and challenge (Dean, 2010), the four clusters obtained at T1 and T2 were labelled as ‘boredom’, ‘flow’, ‘anxiety’ and ‘apathy’, in accordance with the four-channel model of flow (Hoffman & Novak, 1997). An analysis of variance (ANOVA) was conducted to test for differences among the four clusters at T1 and T2. To test for the existence of significant group differences among means, post-hoc multiple comparison tests, using Tukey's HSD for equal variances and GamesHowell for unequal variances, were performed.

The results revealed that students in the boredom state (cluster 1) reported at T1 a medium level of skills (MSkill T1 = 4.65) and a low level of game challenge (MChallenge T1 = 4.30). At T2, students in the boredom state reported higher levels of skills (MSkill T2 = 5.48) due to their experience of playing the game, although the game challenge was even lower (MChallenge T2 = 4.02). Students in the flow state (cluster 2), in contrast, showed the highest levels of skills and game challenge in the class, both at the beginning (MSkill T1 = 4.84; MChallenge T1 = 5.74) and at the end of the simulation (MSkill T2 = 5.69; MChallenge T2 = 5.92). In contrast to the boredom state, students in the anxiety state (cluster 3) reported at T1 a low level of skills (MSkill T1 = 3.33) and a high level of game challenge (MChallenge T1 = 5.25). Although at T2 their skills levels had increased as a consequence of playing the game (MSkill T2 = 4.48), they were still perceived as too low to face the challenges of the game (MChallenge T2 = 5.12). Finally, students in the apathy state (cluster 4) reported the lowest level of skills and game challenge in the class, both at the beginning (MSkill T1 = 3.25; MChallenge T1 = 3.56) and at the end of the simulation (MSkill T2 = 3.63; MChallenge T2 = 3.36). Hence, Hypothesis 1 is supported. The results also revealed that, overall, the tendency was for the students to perceive that their skills were higher after taking part in the business simulation game, and that the game challenge became lower as a consequence of playing it.

As previously explained, to corroborate the four clusters obtained through relying on the students' perceptions of skill and challenge, we also compared, for each cluster, the three dimensions of flow proposed by Bakker (2008), absorption, enjoyment and motivation (see Tables 4 and 5). The results demonstrated that at both T1 and T2, students in flow (cluster 2), who showed the highest levels of skills and challenge, also showed the highest levels of absorption, enjoyment, and motivation. At the opposite pole, students in the apathy state (cluster 4), who showed the lowest levels of skills and challenge, also showed the lowest levels of absorption, enjoyment, and motivation. Therefore, based on the three-dimensional conceptualisation of flow (Bakker, 2008), these results confirm that the four clusters identified previously are appropriate.

Table 4. Comparison of Bakker (2008)'s dimensions across the four clusters (T1)

	Cluster 1 *Boredom*	Cluster 2 *Flow*	Cluster 3 *Anxiety*	Cluster 4 *Apathy*	F-value	Post-hoc test
Absorption	4.17	4.94	4.30	3.50	32.27^{**}	1-2, 1-4, 2-3, 2-4, 3-4
Enjoyment	4.99	5.41	4.94	3.96	40.16^{**}	1-2, 1-4, 2-3, 2-4, 3-4
Motivation	4.08	4.69	4.18	3.19	30.28^{**}	1-2, 1-4, 2-3, 2-4, 3-4

Note: **p<0.05

Table 5. Comparison of Bakker (2008)'s dimensions across the four clusters (T2)

	Cluster 1 *Boredom*	Cluster 2 *Flow*	Cluster 3 *Anxiety*	Cluster 4 *Apathy*	F-value	Post-hoc test
Absorption	4.42	5.57	4.78	3.33	62.33^{**}	1-2, 1-4, 2-3, 2-4, 3-4
Enjoyment	5.07	5.88	5.08	3.55	78.18^{**}	1-2, 1-4, 2-3, 2-4, 3-4
Motivation	4.17	5.22	4.30	2.87	65.16^{**}	1-2, 1-4, 2-3, 2-4, 3-4

Note: **p<0.05

Despite the similarities among the clusters at T1 and T2, not all students were classified into the same subgroups at both measurement points. To analyse the changes in students' subgroups between T1 and T2, Table 6 presents the percentage of students classified into a given subgroup at T2, based on their classification at T1. Of those students classified in the boredom group at T1, 35.2% also belonged to this cluster at T2, but 29.6% had migrated to the flow cluster and 24.1% to the anxiety subgroup. In contrast, only 11.1% were reclassified into the apathy cluster. Of the students in the flow subgroup, 53% remained there between T1 and T2. However, 27% were reclassified into the anxiety cluster at T2. In this case, only 15.7% migrated to the boredom and 4.3% to the apathy subgroups. With regards anxiety, 50.4% of students classified as being in this group at T1 also belonged to it at T2, but 30.4% were reclassified into the flow cluster. In contrast, only 9.6% migrated to the boredom cluster and, again, only 9.6% migrated to the apathy cluster. Finally, of those students classified in the apathy group at T1, only 26.1% remained there at T2, and the remainder migrated to the boredom (25%), flow (18.5%), and anxiety (30.4%) clusters. Across all four subgroups, 42.1% of the sample was classified as being in the same cluster at T2 as at T1.

Table 6. Distribution of cluster membership at T2 on the basis of cluster membership at T1

			Cluster membership (T2)				
			Cluster 1 *Boredom*	Cluster 2 *Flow*	Cluster 3 *Anxiety*	Cluster 4 *Apathy*	No.
Cluster membership (T1)	Cluster 1 *Boredom*	n %	38 (35.2%)	32 (29.6%)	26 (24.1%)	12 (11.1%)	108 (100%)
	Cluster 2 *Flow*	n %	18 (15.7%)	61 (53%)	31 (27%)	5 (4.3%)	115 (100%)
	Cluster 3 *Anxiety*	n %	11 (9.6%)	35 (30.4%)	58 (50.4%)	11 (9.6%)	115 (100%)
	Cluster 4 *Apathy*	n %	23 (25%)	17 (18.5%)	28 (30.4%)	24 (26.1%)	92 (100%)
	No.		90	145	143	52	430

4.2. The effect of flow on learning outcomes (Hypothesis 2)

To examine whether students in flow achieved higher levels of learning outcomes than those not in flow, we conducted three ANOVAs, one for each dependent variable: students' perceived learning, satisfaction and skills development (see Table 7).

Table 7. Learning outcomes across the four clusters (T2)

	Cluster 1 *Boredom*	Cluster 2 *Flow*	Cluster 3 *Anxiety*	Cluster 4 *Apathy*	F-value	Post-hoc test
Perceived learning	5.23	5.91	5.33	4.78	27.46^{**}	1-2, 2-3, 2-4, 3-4
Satisfaction	5.61	6.27	5.83	4.84	33.98^{**}	1-2, 1-4, 2-3, 2-4, 3-4
Skills development	5.29	6.06	5.59	4.80	39.18^{**}	1-2, 1-4, 2-3, 2-4, 3-4

Note: **p<0.05

The results indicate a significant difference in perceptions of learning between students in flow (MPL flow = 5.91) and students in boredom (MPL boredom = 5.23), anxiety (MPL anxiety = 5.33), and apathy (MPL apathy = 4.78) (F = 27.46; $p < 0.05$). Similarly, a significant difference in satisfaction was found between students in flow (MSAT flow = 6.27) and students in boredom (MSAT boredom = 5.61), anxiety (MSAT anxiety = 5.83), and apathy (MSAT apathy = 4.84) (F = 33.98; $p < 0.05$). The results also showed a significant difference in skills development between students in states of flow (MSD flow = 6.06), boredom (MSD boredom = 5.29), anxiety (MSD anxiety = 5.59), and apathy (MSD apathy = 4.80) (F = 39.18; $p < 0.05$). Therefore, Hypothesis 2 is supported. In addition, the results confirmed that students in apathy show significantly lower levels of satisfaction and skills development that those who are in flow, boredom or anxiety. Finally, there is no difference in terms of learning outcomes between students in boredom (those who perceive they have high skill levels, but face a low level of challenge) and students in anxiety (those who perceive they have low skills, but face a high level of challenge).

5. Discussion

Business simulation games have increasingly been used in the last years. However, empirical research analysing this phenomenon is scarce. To bridge this gap, this study assessed at two different measurement points the states of mind experienced by students while playing a business simulation game. Specifically, this research drew on the four-channel model of flow (Hoffman & Novak, 1997) to classify students into four different states of mind depending on their perceived levels of skills and challenge, both at the beginning and the end of the simulation.

The data showed that the resulting states of mind into which students were classified while playing the business simulation game were 'boredom' (high level of skills coupled with low challenge), 'flow' (skills and challenge equally high), 'anxiety' (low level of skills coupled with high challenge), and 'apathy' (skills and challenge equally low). The empirical results also demonstrated that these states of mind were consistent at each measurement point with the conceptualisation of flow proposed by Bakker (2008), as students in the flow cluster showed the highest levels of absorption, enjoyment and motivation, whereas students in the apathy subgroup showed the lowest.

This study also analysed the evolution of the optimal flow experience among students. As expected, the results revealed that the tendency was for the students to perceive that their skills were higher after playing the business simulation game, and that the game challenge became lower as a consequence of the experience. The study also showed that, of those students who perceived at the beginning of the simulation that the challenge was not high enough (i.e., those in boredom and apathy), only 35.2% and 26.1%, respectively, stayed in the same subgroup, with most of them perceiving an increase in the challenge at the end of the simulation. In particular, a total of 53.7% of students who were initially bored, and 48.9% of those who were in apathy, perceived an increase in the game challenge and moved into anxiety and flow states. On the other hand, most students who initially perceived that the challenge was high (i.e., those in flow and anxiety) remained in the same subgroups. In particular, 53% of students in flow, and 50.4% of students in anxiety, ended the simulation in the same state of mind in which they started. The second most common outcome for these subgroups was a migration from flow to anxiety and from anxiety to flow. That is, 27% of students in flow perceived their skill levels had decreased in comparison to the challenge they faced, which resulted in them becoming anxious. On the other hand, 30.4% of those who started anxious gained skills as a result of playing the business game and ended the simulation in flow.

Finally, this research explored whether students' learning outcomes were related to the states of mind experienced while playing a business simulation game. The results empirically demonstrated that the highest levels of perceived learning, satisfaction and skills development correspond to students in flow, whereas the lowest levels correspond to those in apathy. In the middle, there were students in boredom and anxiety, who showed no difference in terms of their learning outcomes. These results are consistent with previous studies that reported flow as a strong predictor of students' learning (Barzilai & Blau, 2014; Esteban-Millat et al., 2014; Hamari et al., 2016; Wang & Hsu, 2014), skills development (Buil et al., 2019a, 2018; Klein et al., 2010), and satisfaction (Joo et al., 2013; Lee & Choi, 2013; Shin, 2006).

5.1. Theoretical and practical implications

This study presents three main theoretical contributions. First, while previous research into game-based learning has acknowledged the importance of flow for students (Hamari et al., 2016), few studies have analysed flow in the context of business simulation games. Therefore, this research advances existing knowledge by applying the four-channel model of flow (Hoffman & Novak, 1997) to identify subgroups of students based on their levels of skill and challenge while playing a business simulation game. In particular, this study addresses the limitations of previous research (e.g., Kiili et al., 2014) by exploring not only the flow construct, but also the states of mind related to boredom, apathy and anxiety. Second, past research analysing flow in this specific context has relied on cross-sectional data (e.g., Buil et al., 2018). Therefore, this study contributes to the literature by examining students' states of mind at two measurement points to analyse the evolution of the optimal flow experience. Third, previous studies have not examined the effect of flow on learning outcomes (e.g., Kiili et al., 2014; Matute-Vallejo & Melero-Polo, 2019). Therefore, this study offers valuable insights into the literature by exploring how the different states of mind associated with the four-channel model of flow relate to positive learning outcomes (i.e., perceived learning, satisfaction and skills development).

This study also provides practical suggestions for designing learning activities using business simulation games. First, instructors are encouraged to monitor the activities by measuring the students' perceptions of their skills and the challenges they face at different points of the simulation. Our findings have shown that, although many students stay in the same clusters during the simulation, others change from one to another. Therefore, taking into account that it takes a comparatively short time to measure the skills and challenges used in this study, it would be worthwhile to monitor students' states of mind at different points and, based on those results, implement solutions to prevent students from suffering boredom, anxiety and apathy, and to encourage flow. Second, as shown in this study, in order to experience flow in game playing, students need to perceive that they are being challenged and that their skills are high enough to face the challenge. Thus, instructors should provide students with a constantly evolving challenge; for example, the algorithm could be programmed so that unexpected events take place during the simulation (e.g., strikes, inflation, etc.), which would make it more challenging. This might reduce the possibility of students becoming bored or apathetic. In addition, instructors might provide students with explanations in class about the functioning of the simulation game and materials (e.g., PowerPoint slides and users' manuals) that would give the students the necessary skills and knowledge to play the game better. Finally, this study has demonstrated that experiencing flow while playing a business simulation game is crucial to reach the highest levels of perceived learning, satisfaction and skills development. Therefore, instructors should encourage this state of mind by favouring its determinants. As proposed by Csikszentmihalyi (1990), as well as ensuring there is a balance between individuals' skills and the challenge presented during the activity, establishing clear goals and providing immediate feedback on performance is essential for helping individuals reach a state of flow. Thus, students need to know how well they are performing during the business simulation game and how the activity is proceeding. One way to do this might be to design the game so that it provides students with relevant information, such as competitors' prices and sales, product cost per unit, etc., so that they can progressively reorient their strategies.

5.2. Limitations and future research

This study has limitations. First, this study describes flow in terms of students' skills and perceived challenge and as a combination of absorption, enjoyment and intrinsic motivation. Although these measures have been widely used in the previous literature, they are not the only ones used. It would be interesting for future studies to use conceptualisations of flow proposed by other authors (e.g., Hoffman & Novak, 1996). A second limitation is the use of retrospective and self-reported measures of flow. In addition, as the questionnaire was answered anonymously, we could not link students' responses to objective measures of learning, such as their grades. Therefore, another avenue for future research could include other measures of learning performance, such as application tests, memory retention or transfer learning, to further explore whether business simulation games and flow influence learning. Finally, socio-demographic information was not recorded. Thus, future research could analyse differences in students' states of mind and their effect on learning outcomes depending on variables such as gender or age.

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