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Does gamification mediate the relationship between digital social capital and student Performance? A survey-based study in Spain

José M. Fortuna *, Gabriel de la Fuente, Pilar Velasco

Universidad de Valladolid, Department of Finance and Accounting, Avenida Valle del Esgueva, 6, 47011, Valladolid, Spain

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ABSTRACT

This article aims to investigate the potential mediating role of gamification in the relationship between students' digital social capital and their academic performance. Social networks are informal platforms where students can develop their own skills in order to adapt to the digital environment and where there is visibility in public rankings. Consequently, we argue that digital social capital developed through the use of social networks can promote student motivation and engagement in online gamification practices, which in turn might help to enhance their course performance. Our empirical study applies a survey-based approach on a sample of 133 undergraduate students enrolled in a hybrid course in corporate finance at a Spanish public university during the COVID-19 pandemic. Empirical evidence suggests that stronger digital social capital (i.e. a greater number of following contacts in social networks) increases a student's propensity to participate in *Kahoot!* gamification. Additionally, digital social capital has a positive indirect effect on a student's academic performance, with this relationship being mediated by *Kahoot!* participation. This educational research encourages links between different digital technologies to be exploited to a greater extent in order to strengthen student engagement and maximize their academic performance.

1. Introduction

The COVID-19 pandemic –and subsequent social distancing restrictions– forced many universities to replace traditional face-to-face teaching with hybrid courses (having some students in class, and others following the class online) (Ives, 2021; Kortemeyer et al., 2023). Such a shift in the teaching environment has significantly accelerated the integration of digital technologies into the educational domain. Evidence of this can be found in the use of videoconferencing for classes and tutorials (Correia et al., 2020), and in the expansion of e-learning tools such as Blackboard and Moodle (Aljawarneh, 2020). Given the less direct interaction between teacher and student under the hybrid teaching model (Fang et al., 2023), one primary challenge comes from the need to ensure students' motivation and their follow-up in the courses. Class attendance forces students to participate in onsite activities. However, hybrid teaching weakens monitoring and allows students to freely decide whether to physically attend classes or not, and which particular activities to join in with. Consequently, stimulating a student's engagement in the learning process becomes of the utmost importance in this hybrid setting (Tang et al., 2021). Moreover, endowing students with a practical set of skills to succeed in real-world decision-making is taking on a key role in terms of boosting student employability in the job market, which again urges looking at active learning methodologies (Okolie et al., 2022; Muñoz Miguel et al., 2023; Yesildag & Bostan, 2023).

* Corresponding author.
E-mail addresses: jfortuna@uva.es (J.M. Fortuna), gabriel.fuente@uva.es (G. de la Fuente), pilar.velasco@uva.es (P. Velasco).

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Among the range of innovative teaching strategies, gamification has increased in popularity in recent years. Gamification extends game attributes to non-game environments in order to influence people's learning-based behaviour or attitudes (Landers, 2015; Landers & Landers, 2015; Sanchez et al., 2020). Recent studies reveal the benefits of using gamification in the classroom to support student learning, such as through greater motivation (Göksün & Gürsoy, 2019; Ekici, 2021), stronger class cohesion (Candan & Basaran, 2023), enhanced academic performance (Dias, 2017; Ekici, 2021; Ortiz-Martínez et al., 2022), and richer learning outcomes from other teaching strategies (Ekici, 2021; Candan & Basaran, 2023), to name but a few. Again, such digital-based learning requires students to display enough motivation to materialize the benefits of gamification activities into learning outcomes. Some works alert to the need to improve gamification design frameworks (Mora et al., 2017; Murillo-Zamorano et al., 2023) and to tackle the potential exhaustion of student engagement after the repetitive use of gamification (Sanchez et al., 2020), which poses a particular challenge to teachers.

In an effort to address this weakness of gamification, another strand of literature has highlighted the motivational role played by social networks in the higher education context, which is felt to improve the teaching-learning process (Ranieri et al., 2012; Hortigüela-Alcalá et al., 2019; Mishra, 2020). This becomes a key issue for the current student generation -the so-called Generation Z-whose daily life flows naturally around Internet and social media (Biro, 2014). Much of the research into gamification has focused on the impact of using *Kahoot!* on student performance, either considering gamification in isolation or in combination with other active learning methodologies such as flipped classroom (Eriki et al., 2021). In contrast, our study examines the implementation of *Kahoot!* in combination with student use of social networks, which are a kind of digital community platform where students develop additional digital and social skills by themselves. This becomes even more relevant in the hybrid-learning context given the lack of social interaction and subsequent feeling of isolation that the COVID-19 pandemic has induced amongst students (Elmer et al., 2020). Recent works point out that digital social capital[1] can boost student academic performance indirectly (Salimi et al., 2022), which leaves room to explore alternative channels through other variables. On the other side of the coin, other studies have also alerted to the harmful effects of 'too much of a good thing' in the form of an overuse of social networks, which can lead to student distraction and therefore, impair their academic performance (Zimmer, 2022).

We investigate the association between social network use, gamification engagement, and academic performance. We focus on this three-pillar set of variables, since research has thus far mostly addressed them separately, although the current demands facing the higher education environment have led them to coexist in many university courses. Extending our knowledge of the potential complementarities of social networks and gamified techniques thus proves crucial vis-à-vis maximizing student academic performance. Our teaching experience was conducted at a Spanish public university during the autumn semester of the 2020/2021 academic year, as a part of an innovative teaching project based on the use of gamification via *Kahoot!* in several undergraduate corporate finance courses. This teaching experience is targeted at improving teaching quality as well as promoting active student learning in the hybrid-learning teaching context prompted by the COVID-19 pandemic.

The rest of the article is structured as follows. Section 2 reviews the literature about the learning value of digital gamification and how digital capital from social networks reinforces student motivation. This constitutes the theoretical base to formulate our hypotheses. Section 3 explains the data collection process based on a survey carried out amongst students, and describes the sample, variables, models, and estimation method. Section 4 presents the empirical findings, while Section 5 provides a discussion thereof. Finally, Section 6 offers a number of conclusions, implications for teaching practice and future research avenues to improve our understanding about how to exploit the educational potential of gamification in full.

2. Theoretical background

2.1. Gamification

The latest research in education underscores how important acquiring essential practical skills and active learning are nowadays (Okolie et al., 2022; Muñoz Miguel et al., 2023; Yesildag & Bostan, 2023). Prior works point out the usefulness of a number of innovative educational methodologies, such as collaborative learning (Okolie et al., 2022; Muñoz Miguel et al., 2023), service learning (Hébert & Hauf, 2015), simulation-based experiential learning (Tiwari, Nafees & Krishna, 2014; Bakoush, 2022), and movie analysis (Yesildag & Bostan, 2023), to name but a few examples.

In the field of management education, many studies advocate the need to endow students with experiential learning experiences so as to engage them in the world of real-life business decision-making (Tiwari et al., 2014; Yesildag & Bostan, 2023). Bakoush (2022) applies simulation learning using a stock market analysis project and argues that this practical method boosts student satisfaction. This in turn is found to discourage students from surface learning, and provides them with an advantage to succeed in deep learning strategies. Active teaching strategies geared towards endowing students with first-hand experience and with assigning them a leading role in their learning process seem to have become a platform through which to improve academic performance in the current educational context.

One active learning methodology to have become widespread in recent years is gamification (Subhash & Cudney, 2018; Candan & Basaran, 2023). According to the theory of gamified learning (Landers, 2015; Landers & Landers, 2015), gamification applies game-based elements outside the game context in order to influence students' behaviour and attitudes, which can result in enhanced

[1] Clouder et al. (2019) define digital social capital as "the benefit derived from the individual or group's social connections and networks based on their socialisation into the use of technology and the investment of time in developing technical knowledge and competence".

learning outcomes, either directly or indirectly. Among all the gamification platforms used for educational purposes, *Kahoot!* is one of the most popular in higher education[2] (Candan & Basaran, 2023; Sevim-Cirak & Islim, 2023). *Kahoot!* is a game-based learning application which combines Student Response Systems (SRS) developed in the sixties (Judson & Sawada, 2002), game-based learning methods (Gee, 2003), social learning (Sarkar et al., 2017), and student familiarity with digital devices (Wang, 2015) in order to increase student engagement in classroom activities and efficiently implement formative assessment (Sharples, 2000). Such enhancing engagement strategies prove particularly useful for online learning, which is where students are more prone to boredom (Baker et al., 2010). Extensive research documents a number of benefits attached to the application of gamification in the learning process, such as the increased level of student motivation, attentiveness and participation (Dias, 2017; Ekici, 2021; Göksün & Gürsoy, 2019; Qiao et al., 2022; Subhash & Cudney, 2018); stronger knowledge retention (Putz, Hofbauer & Treiblmaier, 2020); and superior academic performance (Dias, 2017; Ekici, 2021; Ortiz-Martínez et al., 2022)

Nevertheless, it is worth acknowledging that recent works also alert to certain concerns which might limit the effectiveness of applying gamification to learning. For instance, Sanchez et al. (2020) report evidence of a 'novelty effect' in gamification, which leads to its benefits for academic performance weakening over time. One plausible explanation is that learners might perceive the gamified activity as less enjoyable and useful as a result of its repeated implementation. Greater use of gamification may exhaust student motivation and prove counterproductive for student performance (Sanchez et al., 2020). These weaknesses suggest that gamification is not *per se* a never-ending source of motivation for students and that, therefore, paying closer attention to maintaining student engagement throughout its use over time is by no means a trivial matter.

2.2. Digital social capital

Other student motivation drivers that are external to the academic environment –such as peer pressure and social relationships– might prove key to maintaining their involvement in gamified learning over time. In this regard, interestingly, one stream of works shows that social networks can strengthen student motivation in the teaching-learning process (Ranieri et al., 2012; Hortigüela-Alcalá et al., 2019; Mishra, 2020). The role played by social networks has become core amongst the current generation of students –the so-called Generation Z– for whom much of their communication in daily life takes place through the Internet and social media (Biro, 2014). Indeed, social media are even more motivating for them because they are digital natives who have lived in an instant-reaction world that is rife with social media rewards (Gabrielova & Buchko, 2021).

Social networks allow people to connect with others who display common interests or goals. Such networks may serve as an escape mechanism to recharge student motivation in another digital –albeit more informal– environment which may relieve them from the pressure of a more formal academic atmosphere. Relationships between individuals forged within social network sites constitute a type of asset known as digital social capital (Clouder et al., 2019; Pérez-Hernández et al., 2023). Therefore, social networks are widely believed to provide students and professionals with digital (or online) social capital, which has supported learning (Ranieri et al., 2012), particularly since the outbreak of the COVID-19 pandemic (Salimi et al., 2022). Our research is also particularly timely because we focus on the context of the COVID-19 pandemic, whose health and safety restrictions aggravated students' feeling of social isolation and impaired their motivation and enthusiasm.

Mishra (2020) emphasizes how useful social capital is in terms of improving academic performance, especially in the case of minority students, who find it more difficult to access and integrate into the higher education system. In another work, Salimi et al. (2022) find that digital social capital improves student academic performance indirectly, through the mediation of knowledge sharing in the online setting. Complementarily, one group of studies underscores the relevance of also taking into account the quality of online interaction, which is viewed as a key factor in the development of digital social capital (Zheng et al., 2020). Previous works have also reported evidence concerning the motivation-enhancing effects prompted by digital social capital in other contexts such as entrepreneurship. For instance, Pérez-Hernández et al. (2023) show that digital social capital has a positive effect on entrepreneurial intention.

2.3. Hypotheses

Drawing on evidence from earlier literature, we expect stronger student engagement in social networks to help develop their digital social capital. Our starting hypothesis is that this digital social capital might foster student motivation and engagement in online gamification practices, given that the latter aligns better with the digital environment and with the visibility of public rankings. In turn, this greater participation in *Kahoot!* is likely to lead to better student academic performance in courses. Consequently, we test whether digital social capital developed through an involvement in social networks might have an indirect effect on student academic performance mediated by their *Kahoot!* participation. Fig. 1 graphically illustrates our hypothesized relationships.

Based on the previous discussion, we propose two hypotheses:

H1. *The greater the student social capital developed through social networks, the greater their participation in Kahoot! games.*

H2. *Student participation in Kahoot! mediates the relationship between student digital social capital and their academic performance.*

[2] See Wang and Tahir (2020) for a recent literature review about the effect of using *Kahoot!* on learning.

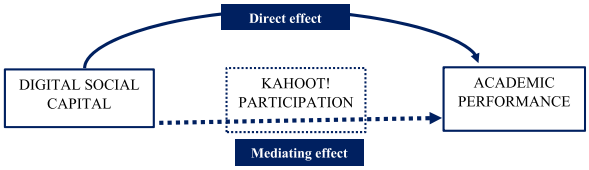

Fig. 1. Illustration of the mediating model.

3. Research methodology

3.1. Study design and sample

Our study relies on a survey-based approach. One major advantage of this quantitative strategy is that it provides direct, recent and rapidly available information about students' profile (Biart & Praet, 1987). Moreover, it allows us to facilitate replication studies and to conduct statistical analyses of a representative sample of undergraduate students so as to generalize the results to larger populations (McClintock et al., 1979; Knoke et al., 2017).

Our research is based on cross-sectional data in the academic year 2020/2021. We choose *Kahoot!* as the gamification platform because it is the most widely used in the higher education context, as shown by recent research (Candan & Basaran, 2023; Sevim-Cirak & Islim, 2023). Sample students took part in *Kahoot!* games during the classes, which were carried out in hybrid mode due to the restrictions imposed by the COVID-19 health crisis. We conducted a survey amongst students at a particular point in time; namely, at the end of the autumn semester in January 2021. In this survey, students were asked a number of questions about their degree of engagement in social networks (in which networks they have a profile, how often they use them, average number of contacts, etc.), in addition to a set of questions about personal details and background (e.g. whether they combine their studies with a paid job, their preference between online/hybrid teaching and onsite classes). This survey was released through the course virtual campus (*Moodle*). Survey data were extended by adding data about academic performance records in the courses analysed as well as students' personal details taken from the university's databases (*SIGMA*). *SIGMA* software is the educational platform for academic and research data management at higher education institutions.

Our sample consists of 133 undergraduate students (58% women and 42% men) enrolled in several corporate finance courses at a public university in Spain. These students belong to three different bachelor degrees at the Faculty of Economics and Business Administration: the Degree in Business Administration (100 students), the Joint Degree in Law and Business Administration (20 students), and the Degree in Finance, Banking and Insurance (13 students).

3.2. Empirical strategy: variables, models and estimation method

Our empirical strategy consists of two stages. First, we analyse whether students' digital social capital affects their likelihood of participating in *Kahoot!* Second, we adopt a mediation approach in order to evaluate whether the impact of digital social capital on students' academic performance is mediated by their participation in *Kahoot!* gamification activities. Table 1 summarizes our research variables.

3.2.1. Dependent variable

The first-stage dependent variable is student participation in *Kahoot!* gamification during the hybrid classes, which is captured by

Table 1
Study variables.

Variable	Definition	Label
Participation in Kahoot! gamification	A binary variable equal to 1 if the student has participated in *Kahoot!* games, and zero otherwise.	*KH_PARTICIP*
	Percentage of *Kahoot!* games each student has taken part in.	*KH_GAMES*
	Percentage of *Kahoot!* class sessions each student has participated in.	*KH_SESSIONS*
Academic performance	Student's overall mark in the exams.	*EXAM_PERFORMANCE*
	Student's overall mark in the course (considering exams and continuous assessment activities).	*COURSE_PERFORMANCE*
Digital social capital	The natural logarithm of the average number of follower contacts	*FOLLOWERS*
	The natural logarithm of the average number of following contacts	*FOLLOWING*
Control variables		
Teaching mode preference	A binary variable equal to 1 if the student prefers online or hybrid teaching, and zero otherwise.	*TEACHMODE*
Repeat students	A binary variable equal to 1 if the student is a repeater, and zero otherwise.	*REPEATER*
Student gender	A binary variable equal to 1 if the student is female, and zero otherwise.	*GENDER*
Working status	A binary variable equal to 1 if the student has a paid job, and zero otherwise.	*JOB*
Dummy variables of the university degree.		

three alternative proxies: *KH_PARTICIP* (a dummy variable equal to 1 if the student has participated in *Kahoot!* games, and zero otherwise); *KH_GAMES* (the percentage of *Kahoot!* games each student has taken part in), and *KH_SESSIONS* (the percentage of *Kahoot!* class sessions each student has been involved in).

In the second stage of the analysis, the dependent variable is student academic performance, which is approximated by two measures: their overall mark in the exams (*EXAM_PERFORMANCE*) and their final mark in the course (*COURSE_PERFORMANCE)*. The final mark in the course considers both exam performance and active participation.

3.2.2. Explanatory variables

In the first stage of the analysis, the explanatory variable is student digital social capital. Similar to the research literature on entrepreneurial finance through digital platforms (e.g. crowdfunding) (Colombo et al., 2015; Butticé et al., 2017), digital social capital is measured by the natural logarithm of the average number of follower contacts (*FOLLOWERS*) and the natural logarithm of the average number of following contacts (*FOLLOWING*).

In the second set of analyses, student participation in *Kahoot!* gamification serves as an explanatory variable in the model (i.e. mediating variable). As described earlier, we rely on the same alternative proxies: *KH_PARTICIP, KH_GAMES* and *KH_SESSIONS*.

3.2.3. Control variables

In all the estimations, we control for a number of factors which might also influence student performance in some way, both in terms of participation in *Kahoot!* and academic performance. Our set of control variables is made up of: teaching mode preference (the dummy *TEACHMODE*, which takes the value of 1 if the student prefers online or hybrid-teaching, and zero otherwise), repeat students (the dummy *REPEATER*, which equals 1 if the student is a repeater, and zero otherwise), student gender (the dummy *GENDER*, which equals 1 if the student is female, and zero otherwise), and working status (*JOB*, which equals 1 if the student has a paid job, and zero otherwise). Additionally, we include dummy variables to control for the university degree in which the student is enrolled.

3.2.4. Empirical models and estimation method

In the first stage of the analysis, in order to examine the effect of digital social capital on student *Kahoot!* participation, we specify the following equation [1]:

$$KAHOOT_i = \beta_0 + \beta_1 \bullet FOLLOWERS_i + \beta_2 \bullet FOLLOWING_i + \beta_3 \bullet CONTROLS_i + \varepsilon_i \quad [1]$$

where *KAHOOT* denotes the alternative proxies for student participation in *Kahoot!*, *FOLLOWERS* and *FOLLOWING* indicate the two dimensions of digital social capital measurement, subscript i represents each student, and ε_i is the random disturbance. Since *KH_PARTICIP* is a binary variable, when we use it as the dependent variable to proxy *Kahoot!* participation, a probit regression is applied to estimate the model. However, when we draw on *KH_GAMES* and *KH_SESSIONS* as alternative dependent variables, we run Tobit estimations since these dependent variables are censored (Amore & Murtinu, 2021).

We then assess the potential mediating role of *Kahoot!* participation in the relationship between student digital social capital and student performance. For this purpose, Baron and Kenny (1986) posited a mediation approach[3] based on the fulfilment of four conditions: [i] a direct effect, namely a significant relationship between the independent variable (digital social capital) and the dependent variable (academic performance); [ii] a significant relationship between the independent variable (digital social capital) and the mediating variable (*Kahoot!* participation); [iii] a significant association between the mediator and the dependent variable; and [iv] the effect of the independent variable weakening (partial mediation) or losing its statistical significance (full mediation) once the mediating variable is included. Equation [1] previously indicated tests for condition [ii]. The remaining conditions can be examined by these three additional equations [2] to [4]:

$$PERFORMANCE_i = \gamma_0 + \gamma_1 \bullet FOLLOWERS_i + \gamma_2 \bullet FOLLOWING_i + \gamma_3 \bullet CONTROLS_i + \varepsilon_i \quad [2]$$

$$PERFORMANCE_i = \delta_0 + \delta_1 \bullet KAHOOT_i + \delta_2 \bullet CONTROLS_i + \varepsilon_i \quad [3]$$

$$PERFORMANCE_i = \alpha_0 + \alpha_1 \bullet FOLLOWERS_i + \alpha_2 \bullet FOLLOWING_i + \alpha_3 \bullet KAHOOT_i + \alpha_4 \bullet CONTROLS_i + \varepsilon_i \quad [4]$$

where *PERFORMANCE* denotes student academic performance, *KAHOOT* represents the alternative proxies for student participation in *Kahoot!*, *FOLLOWERS* and *FOLLOWING* indicate the two dimensions of digital social capital measurement, subscript i represents each student, and ε_i is the random disturbance. Equations [2], [3] and [4] test for Baron and Kenny's (1986) conditions [i], [iii] and [iv], respectively. Given that the dependent variable is continuous and censored, we again apply a Tobit estimation procedure.

Finally, it is worth noting that later studies such as Zhao et al. (2010) alert to a possible misapplication of Baron and Kenny's former perspective to identify mediating effects. They point out that it is not essential to require the existence of a significant relationship between the independent variable and the dependent variable, as established in condition (i). Mediation can still apply in this case in the form of indirect-only mediation, in which only the indirect effect displays statistical significance.

[3] This econometric approach to test mediation has been widely applied by previous studies (Müller & Wulf, 2022; Wittmann & Wulf, 2023).

4. Results

4.1. Descriptive statistics

Table 2 summarizes the main descriptive statistics of our sample. Almost 82% of sample students took part in *Kahoot!* games in the hybrid courses. On average, each student was involved as a participant in approximately 64% of *Kahoot!* games/sessions. As far as digital social capital proxies are concerned, slightly higher dispersion was seen in terms of the number of followed contacts compared to following contacts. Almost a quarter of the students had a paid job, which they combine with their university studies.

Table 3 shows pairwise correlations. All the proxies for *Kahoot!* participation display strong correlation (above 0.80), which supports their use as alternative proxies for the same construct. Interestingly, these variables of *Kahoot!* engagement have a positive and statistically significant correlation with the variables of student academic performance (both *EXAM_PERFORMANCE* and *COURSE_PERFORMANCE*), with the correlation ranging between 0.30 and 0.41. Digital social capital variables present no statistically significant correlation with either *Kahoot!* participation variables or academic performance variables. The pairwise correlation between *FOLLOWING* and *FOLLOWERS* is about 0.33 in our sample, such that there are no concerns about potential collinearity problems of adding both of them simultaneously.

4.2. Regression estimates

Table 4 displays the results of the first stage of our analyses, in which we evaluate the influence of student digital social capital on their *Kahoot!* engagement. Columns (1) and (2) report the results using *KH_PARTICIP* as the dependent variable. Since *KH_PARTICIP* is a binary variable, we report probit estimation results. Our evidence suggests that stronger digital social capital –as measured by *FOLLOWING*– has a positive and statistically significant impact ($\beta = 0.2895$, $p < 0.10$) on student willingness to participate in *Kahoot!* gamification. In contrast, no statistically significant effect is found for *FOLLOWERS* ($\beta = -0.1663$, $p > 0.10$). In the subsequent columns of this same table, we run additional robustness estimations by considering *KH_GAMES* and *KH_SESSIONS* as dependent variables, alternatively. Since these variables are censored, Tobit estimations are applied in columns (3) to (6). Results remain similar when applying these alternative proxies. For instance, if *FOLLOWING* increases by one percentage point, student participation in *Kahoot!* games (*KH_GAMES*) rises by 0.08 percentage points.

As far as the second part of the study is concerned, we examine whether *Kahoot!* participation plays a mediating role in the relationship between student digital social capital and student academic performance. For this purpose, we evaluate Baron and Kenny's (1986) remaining conditions, in addition to the condition [ii] already tested in the results described previously. To do this, we run Tobit regressions, since the alternative dependent variables –either *EXAM_PERFORMANCE* or *COURSE_PERFORMANCE*– are continuous censored variables. Table 5 reports these estimations. Column (1) considers only control variables in the estimation. Column (2) tests for condition [i], columns (3) to (5) test for condition [iii], and finally, columns (6) to (8) assess condition [iv].

Panel A in Table 5 displays the results based on *EXAM_PERFORMANCE*. As regards the control variables in Column (1), only *GENDER* and *JOB* display statistical significance. A student's academic performance decreases by about 1.12–1.40 points if they have a paid job, which is consistent with the idea that work commitment reduces the time available to devote to studying. Column (2) additionally enters the digital social capital proxies. As shown, digital social capital from social networks carries no significant effect individually on students' overall mark in the final course exam. In columns (3) to (5), we consider *Kahoot!* participation as the explanatory variable, measured by the three alternative proxies. We find that *KH_PARTICIP* has a positive effect on students' academic performance, which is statistically significant at the 1% level ($\delta = 1.4082$, $p < 0.01$). This result strongly supports Hypothesis 1. This evidence remains robust to the use of the two alternative proxies; namely, *KH_GAMES* ($\delta = 1.8870$, $p < 0.01$) and *KH_SESSIONS* ($\delta = 1.8281$, $p < 0.01$).

Finally, columns (6) to (8) enter the digital social capital proxies and *Kahoot!* participation simultaneously. The lack of statistical

Table 2
Summary statistics.

	No. of Obs.	Mean	Median	Std. Dev.	Min.	25th perc.	75th perc.	Max.
Kahoot participation								
KH_PARTICIP	133	0.8195	1	0.3860	0	1	1	1
KH_GAMES	133	0.6372	0.7308	0.3770	0	0.4091	1	1
KH_SESSIONS	133	0.6460	0.7500	0.3765	0	0.4286	1	1
Academic performance								
EXAM_PERFORMANCE	133	4.1218	4.1100	2.0785	0	4.1100	5.6200	8.5333
COURSE_PERFORMANCE	133	5.0060	5.3000	2.6449	0	3.1000	7	10
Digital social capital								
FOLLOWING	122	6.2813	6.3808	0.8444	0.3365	6.0426	6.8024	7.6009
FOLLOWERS	122	6.4297	6.4068	0.9989	4.0943	5.9914	6.8957	14.247
Control variables								
TEACHMODE	133	0.4060	0	0.4929	0	0	1	1
REPEATER	133	0.2932	0	0.4570	0	0	1	1
GENDER	133	0.5789	1	0.4955	0	0	1	1
JOB	133	0.2406	0	0.4290	0	0	0	1

Table 3
Pairwise correlation matrix.

	1	2	3	4	5	6	7	8	9	10	11
1. KH_PARTICIP	1.000										
2. KH_GAMES	0.796***	1.000									
3. KH_SESSIONS	0.808***	0.994***	1.000								
4. EXAM_PERFORMANCE	0.304***	0.374***	0.362***	1.000							
5. COURSE_PERFORMANCE	0.346***	0.418***	0.406***	0.981***	1.000						
6. FOLLOWING	0.119	0.086	0.071	0.057	0.057	1.000					
7. FOLLOWERS	−0.120	−0.086	−0.107	−0.136	−0.128	0.328***	1.000				
8. TEACHMODE	−0.209**	−0.205**	−0.195**	−0.070	−0.070	0.057	−0.049	1.000			
9. REPEATER	−0.299***	−0.336***	−0.350***	−0.035	−0.065	0.058	0.099	0.107	1.000		
10. GENDER	−0.004	0.039	0.028	0.211**	0.223***	0.131	0.076	−0.008	0.081	1.000	
11. JOB	−0.239***	−0.245***	−0.245**	−0.185**	−0.185**	0.083	0.187**	0.072	0.217**	0.052	1.000

***, ***, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 4
Kahoot! participation and digital social capital.

	PANEL A: Probit regressions		PANEL B: Tobit regressions			
	Dependent variable: KH_PARTICIP		Dependent variable: KH_GAMES		Dependent variable: KH_SESSIONS	
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	1.2987*** (0.2843)	0.5246 (1.1818)	0.9054*** (0.1140)	0.7018** (0.3342)	0.9265*** (0.1136)	0.7999** (0.3333)
FOLLOWERS		−0.1663 (0.1520)		−0.0644 (0.0448)		−0.0735 (0.0450)
FOLLOWING		0.2895* (0.1581)		0.0828* (0.0461)		0.0798* (0.0459)
Control variables						
TEACHMODE	−0.1258 (0.3032)	−0.1526 (0.3283)	−0.0834 (0.0842)	−0.1078 (0.0849)	−0.0708 (0.0839)	−0.0945 (0.0845)
REPEATER	−0.6695** (0.3054)	−0.7792** (0.3305)	−0.2611*** (0.0840)	−0.2752*** (0.0854)	−0.2711*** (0.0837)	−0.2884*** (0.0849)
GENDER	−0.0916 (0.3001)	0.1032 (0.3230)	0.0222 (0.0758)	0.0906 (0.0780)	0.0125 (0.0755)	0.0816 (0.0776)
JOB	−0.7629** (0.3331)	−0.5389 (0.3700)	−0.2283** (0.0898)	−0.1452 (0.0912)	−0.2265** (0.0894)	−0.1410 (0.0907)
University degree dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	100	91	133	122	133	122
Log likelihood	−47.7128	−41.2615	−82.7580	−71.3002	−82.5377	−71.0089
P-value Chi2	0.0052	0.0382	0.0001	0.0006	0.0000	0.0005

Standard errors are reported in parentheses under the estimated coefficients. ***, ***, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

Table 5
Academic performance and digital social capital: the mediating role of Kahoot! participation.

	PANEL A Dependent variable: EXAM_PERFORMANCE							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	5.9276*** (0.5221)	6.2347*** (1.5444)	4.3558*** (0.7133)	4.2665*** (0.6370)	4.2803*** (0.6410)	5.0729*** (1.5709)	5.0346*** (1.5098)	4.9306*** (1.5280)
KH_PARTICIP			1.4082*** (0.4526)			1.2935** (0.4983)		
KH_GAMES				1.8870*** (0.4511)			1.7456*** (0.4909)	
KH_SESSIONS					1.8281*** (0.4554)			1.6781*** (0.4961)
FOLLOWERS		−0.2813 (0.1893)				−0.1988 (0.1837)	−0.2014 (0.1785)	−0.1913 (0.1799)
FOLLOWING		0.1818 (0.2160)				0.0759 (0.2145)	0.0750 (0.2080)	0.0844 (0.2088)
Control variables								
TEACHMODE	0.3139 (0.3801)	0.1577 (0.4017)	0.3799 (0.3681)	0.4429 (0.3589)	0.4168 (0.3601)	0.2204 (0.3925)	0.3153 (0.3853)	0.2872 (0.3865)
REPEATER	0.3467 (0.3754)	0.3688 (0.3992)	0.5965 (0.3717)	0.7514** (0.3661)	0.7572** (0.3692)	0.6148 (0.4007)	0.7677* (0.3966)	0.7746* (0.4006)
GENDER	0.6398* (0.3426)	0.7476** (0.3673)	0.6775** (0.3314)	0.5936* (0.3224)	0.6123* (0.3239)	0.7121** (0.3584)	0.6181* (0.3519)	0.6386* (0.3531)
JOB	−1.4007*** (0.3994)	−1.1169*** (0.4293)	−1.1380*** (0.3952)	−1.0650*** (0.3841)	−1.0773*** (0.3859)	−0.9667** (0.4226)	−0.9103** (0.4131)	−0.9243** (0.4148)
University degree dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	133	122	133	133	133	122	122	122
Log likelihood	−269.0522	−247.4126	−264.3597	−260.8009	−261.4191	−244.1165	−241.3705	−241.9168
P-value Chi2	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	PANEL B Dependent variable: COURSE_PERFORMANCE							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Constant	7.1246*** (0.6719)	7.4712*** (1.9867)	4.8236*** (0.9080)	4.7446*** (0.7984)	4.7631*** (0.8125)	5.7393*** (2.0024)	5.7224*** (1.9136)	5.5662*** (1.9390)
KH_PARTICIP			2.0609*** (0.5762)			1.9252*** (0.6352)		
KH_GAMES				2.7027*** (0.5710)			2.5419*** (0.6220)	
KH_SESSIONS					2.6200*** (0.5772)			2.4499*** (0.6293)
FOLLOWERS		−0.3269 (0.2393)				−0.2160 (0.2341)	−0.2221 (0.2262)	−0.2071 (0.2281)
FOLLOWING		0.2231 (0.2778)				0.0657 (0.2733)	0.0677 (0.2636)	0.0809 (0.2648)
Control variables								
TEACHMODE	0.4705 (0.4889)	0.2766 (0.5165)	0.5674 (0.4685)	0.6553 (0.4543)	0.6179 (0.4565)	0.3702 (0.5001)	0.5061 (0.4882)	0.4657 (0.4903)
REPEATER	0.2111 (0.4829)	0.2566 (0.5134)	0.5764 (0.4730)	0.7907* (0.4633)	0.7993* (0.4679)	0.6224 (0.5105)	0.8373 (0.5024)	0.8488* (0.5080)
GENDER	0.8716** (0.4406)	1.0176** (0.4723)	0.9268** (0.4218)	0.8053** (0.4081)	0.8320** (0.4104)	0.9646** (0.4567)	0.8289** (0.4458)	0.8584* (0.4478)
JOB	−1.7026*** (0.5139)	−1.3601** (0.5521)	−1.3185*** (0.5030)	−1.2217** (0.4861)	−1.2391** (0.4891)	−1.1369** (0.5385)	−1.0591** (0.5234)	−1.0789** (0.5262)
University degree dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs.	133	122	133	133	133	122	122	122
Log likelihood	−301.5871	−277.1362	−295.4493	−291.1909	−291.9691	−272.6809	−269.2719	−269.9545
P-value Chi2	0.0000	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Standard errors are reported in parentheses under the estimated coefficients. ***, ***, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

significance of the direct effect of *FOLLOWERS* and *FOLLOWING* should not rule out the presence of mediation (Zhao et al., 2010). Since *FOLLOWING* has a significant impact on *KH_PARTICIP,* and the latter significantly affects *PERFORMANCE*, this is a sign of the existence of indirect-only mediation. Zhao et al. (2010) explain this on the grounds that the effect of the independent variable on the dependent variable is capturing the total effect, as given by the sum of the indirect and direct paths, which would take the opposite sign and thereby offset each other. Therefore, these empirical findings lead us to the conclusion that there is an indirect effect of digital social capital in terms of following contacts (*FOLLOWING)* channelled by participation in *Kahoot!* In other words, the effect of digital social capital from social networks on overall academic performance in the course is mediated by participation in *Kahoot!* (indirect-only mediation), which lends support to Hypothesis 2. Robustness analyses are conducted by taking *COURSE_PERFORMANCE* as a dependent variable. These results are shown Panel B of Table 5, with results proving to be robust.

5. Discussion

5.1. Social network use and participation in gamification

This study looks at the relationship between student social network use and the impact on academic performance of gamification in hybrid university courses. We document that engagement in social networks improves student willingness to participate in *Kahoot!* gamification. This evidence ties in with previous literature, such as Ranieri et al. (2012), Hortigüela-Alcalá et al. (2019), or Mishra (2020), emphasizing the motivational role played by social networks in education. In addition, this finding also provides a ray of hope for prior literature which alerted to the potential exhaustion of student motivation after repetitive participation in gamification activities. Our evidence suggests that it is possible to recharge motivation levels, for example by decongesting students from the overuse of active learning methodologies and by supporting these methods with social networks. The latter are a kind of community digital platform which can grant students the possibility of engaging in more informal relationships with their classroom peers in a digital but less formal academic atmosphere, which in turn can also provide benefits in course activities.

5.2. Social network engagement and student academic performance: the indirect channel through gamification participation

Our results also confirm that participation in gamification practices in class is valuable in higher education courses. Our results concur with existing evidence in the literature supporting the positive impact of gamification on student engagement and academic performance (Subhash & Cudney, 2018; Candan & Basaran, 2023; Ekici, 2021; Göksün & Gürsoy, 2019). Our findings also agree with another main stream of research which demonstrates that the more satisfied students are and the more active the role they have in their learning process, the better academic performance they will achieve (Bakoush, 2022). Moreover, our research reveals an indirect causal pathway through which a student's engagement in social networks can materialize into better academic performance. Our evidence of the mediating effect of gamification in the relationship between digital social capital and academic performance ties in with recent research which points out that the effect of digital social capital is channelled by other variables (Salimi et al., 2022).

The empirical findings of our study tie in with the latest research in education, emphasizing the value of practical skills acquisition and learning (Hébert & Hauf, 2015; Muñoz Miguel et al., 2023; Okolie et al., 2022; Tiwari et al., 2014; Yesildag & Bostan, 2023) in terms of promoting the use of effective teaching strategies to improve student engagement. Turning students into very active participants in their learning process is key to boosting their learning outcomes. In the field of management education, this becomes a matter of primary importance vis-à-vis encouraging students to put their acquired knowledge and competences into practice in a context of real-life business decision-making (Tiwari et al., 2014; Yesildag & Bostan, 2023). Nevertheless, as some works have pointed out (Hébert & Hauf, 2015), such a shift towards more practical teaching methods will also require rethinking the traditional assessment techniques applied to evaluate academic performance at universities.

6. Conclusions

This innovative teaching experience was conducted in several undergraduate corporate finance courses at a Spanish public university during the academic year 2020/2021. At the time, COVID-19 restrictions were still in force in Spanish educational institutions, which led to having some students attending lessons onsite and to others following the class online. Integrating digital technologies into university lectures was neither the result of lecturers' choice (as it had been up until then) nor due to any particular fashionable trend in education. Rather, the coronavirus pandemic marked a turning point towards merging digitalization and traditional teaching practice as two strategic allies aimed at endowing the educational context with the much-needed flexibility it requires to reshape itself in response to student needs and the inevitable disruptions caused by the health crisis.

Our findings reveal that stronger digital social capital (based on a larger number of following users in social networks) encourages students to participate in *Kahoot!* gamification to a greater extent. Moreover, we show that digital social capital improves student academic performance indirectly, with this relationship being channelled through *Kahoot!* participation. As a whole, the results of this study point to a bright side in the role of digitalization in our daily life: i.e., student use of social networks promotes their engagement in educational practices based on digital technologies, which seems to propel their academic achievement.

The contribution of our research to the literature is threefold. First, we help to further identify mechanisms that enhance students' positive attitudes towards online learning. The literature sees gamification as a double-edged sword in terms of it being an active learning methodology: its *raison-d'être* lies in its triggering motivation in students while at the same time it is subject to the "too much of a good thing" effect, since overuse thereof can exhaust student attentiveness and motivation. Our research reveals the usefulness of

student engagement in social networks as a tool to drive their motivation and to escape from the detrimental effects of gamified learning. In so doing, we also complement recent works that advocate improving gamification design frameworks (Mora et al., 2017; Murillo-Zamorano et al., 2023) so as to overcome the challenges posed when applying this learning methodology in the higher education context.

The second contribution comes from the particular context in which our study is carried out –namely the COVID-19 pandemic. Governments worldwide imposed severe health and safety restrictions which affected not only the educational context but most areas of people's daily life. These restrictions led to social isolation, which substantially increased the threat of demotivation and –in the more extreme cases– depression. The unique context of the coronavirus pandemic thus demanded further motivation and engagement, which was also intensified by the more distant teacher-student and student-peer interaction. Most of our current students belong to the Generation-Z, for whom the Internet and social media play a central role in their daily life (Biro, 2014) and in their reward prioritization in society (Gabrielova & Buchko, 2021). Communication networks are used naturally and intuitively by them and are therefore likely to spark a reward system grounded on socially-based recognition in gamification activities. Our study makes an interesting contribution by theorizing and empirically testing why social networks can emerge as a motivation vehicle to enhance gamification engagement and –through it– trigger an indirect and positive impact on student academic performance.

Third, we expand recent literature concerning the interest in identifying indirect causal channels which can relate digital-based tools with student academic performance and satisfaction in higher education (Murillo-Zamorano et al., 2023). In our study, we show that student engagement in social networks carries no direct beneficial effect on academic performance, but rather does so by restoring student motivation levels to participate in gamification, which is in turn reflected through better course grades.

6.1. Implications for teaching practice

Overall, our research suggests a number of interesting implications for teaching practice. First, our evidence reveals one bright side of the use of social networks, which have traditionally been viewed as a distraction for students. When social networks are used appropriately, our results suggest that they can offer a number of advantages in terms of the educational setting as reflected by the supporting role they play in enhancing student engagement in digital-based learning practices. Digital social capital can be a powerful device for university lecturers to create a more cohesive social environment in class, which is today a priority in terms of achieving an inclusive university setting given the increasing diversity of student and lecturer collectives. Second, the present study posits the potential of exploiting the flexibility of hybrid-teaching as well as the relationship between social networks and gamification, which are found to result in stronger student participation in digitally-based class activities and in enhanced academic performance in the course as a whole. This will be an important lesson to take into account as the higher education setting will prioritize digital-based methodologies in the coming years.

Third, teachers should be aware of the vital importance of looking at educational innovation techniques as complementary, rather than implementing each of them in isolation. This latter viewpoint –which seems to be more prevalent in teaching practice– provides a narrow perspective since it views the total performance outcome of combining teaching techniques as summative, thereby obscuring the potential negative or positive effects which might arise from their joint implementation. For example, in the case of our particular experience, if teachers were to also draw on another innovative teaching technique based on the use of social networks, this could strengthen student digital social capital and, consequently, improve gamification performance. As a result, relationships between educational techniques are non-trivial and may explain why certain combinations thereof succeed in teaching practice while others lead to worse than expected outcomes. The possible combined result of using several different techniques should be given careful consideration when designing university courses. Additionally, this will urge a rethink about the conventional assessment methods currently being applied so that these will be able to reflect the full set of learning outcomes as accurately as possible and embed such assessment practices in real-world student experiences in the classroom. This might require lecturers to draw on more qualitative assessment tools to complement quantitative traditional ones. To sum up, digital learning undoubtedly poses a number of challenges for both teachers and students, and these challenges will need to be faced proactively in the near future so that we can make the most of them in order to foster active learning.

6.2. Research implications

A number of research implications emanate from our study. First, we show that students' digital social capital is one missing link in the relationship between gamification and student academic performance. Previous research has shown that gamification can be a useful tool to improve students' academic performance by promoting their motivation and engagement in the learning process. Our research sheds light on one prior step involved in this causal mechanism; namely, that student willingness to participate in gamified learning might depend on their own social and technological skills. Given that social networks are a core aspect of daily life for current Generation Z students, research needs to better account for how digital social capital might shape their learning process in management education.

Second, our research shows an indirect path of causality linking social networks and academic performance, and evidences how gamification can serve as a mediating variable in this relationship. Mediation analyses have proved to be a useful tool for disentangling the links between social digital capital, gamification and academic performance. The same analysis emerges as an appropriate methodology to test the influence of students' personality traits in both the independent and mediator variables. Finally, the educational hybrid model brought about by the COVID-19 pandemic provides a very interesting natural experiment since it has intensified the demand for motivation and engagement from students due to a more distant teacher-student interaction whilst also

driving the important role of social media to sustain students' communication with their peers during times of social isolation. In this paper, we unravel the relevance of social digital capital for current students in such hybrid learning models. Similar motivation drivers could help to explain student involvement and performance in other alternative environments where attention demands are lower.

6.3. Limitations and future research opportunities

Our study presents some limitations which could open further avenues for future research. First, we consider one innovative teaching method (i.e. gamification) individually. Nowadays, combining multiple innovative teaching techniques at the same time is becoming common practice. Future works should explore the relationships between gamification and other innovative education strategies such as flipped-learning, since recent studies suggest there are interacting effects between them (Ekici, 2021). The mix of different innovation techniques could help to mitigate the potential failures of each one in isolation.

Second, our teaching experience is restricted to the use of one single gamification platform, namely *Kahoot!* Recent articles document that learning outcomes from gamification differ across gamification platforms (Göksün & Gürsoy, 2019), as a result of their different functionalities or visual feedback, to name but a few factors. It is therefore worth exploring whether each student's digital social capital may play a different role depending on the degree of interactive functionalities of each gamification platform and their complexity, which may require dissimilar levels of digital skills.

Additionally, further studies should replicate these findings using a larger sample size. Likewise, it would be interesting to compare the results during the enforcement of coronavirus restrictions and after they were lifted. Future research might go beyond a mere static analysis and adopt a dynamic perspective instead. A qualitative method such as in-depth interviews with some students may be useful because of its interactive and flexible structure, which grants interviewers the possibility of posing follow-up questions so as to gain a deeper understanding of participants' answers (e.g. feelings, opinions, …) (Legard, Keegan & Ward, 2003). This would provide a more detailed examination of students' motivations and challenges in each particular course, and clarify more specific factors that are overlooked in larger samples (McClintock et al., 1979). Specifically, future works might seek to investigate whether the beneficial outcomes from the partnership between digital social capital and gamification performance change over time. This will help to determine whether or not the advantages to be gained from the relationship between them are context-dependent, or whether they are evergreen vis-à-vis enhancing student academic performance universally.

CRediT authorship contribution statement

Gabriel de la Fuente: Conceptualization, Data collection and curation, Formal analysis and interpretation of the results, Writing – original draft, Writing – review & editing, Funding acquisition.

José M. Fortuna: Conceptualization, Data collection and curation, Formal analysis and interpretation of the results, Writing – original draft, Writing – review & editing, Funding acquisition.

Pilar Velasco: Conceptualization, Data collection and curation, Formal analysis and interpretation of the results, Writing – original draft, Writing – review & editing, Funding acquisition.

Declaration of competing interest

None.

Data availability

Data will be made available on request.

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