
Education 3.0: the impact of collaborative online teaching platforms on student academic performance and engagement

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Abstract: This study examines the impact of online teaching methods on student academic performance. Much research to date exposes the importance of integrating collaborative online tools into academic learning paths in order to enhance learning. However, the effectiveness of these tools on student academic performance is questioned. Our study presents findings from a qualitative analysis of student satisfaction from their online learning experience. Secondly, a quantitative analysis, using a two-sample t-test compares the academic results of the same students following the same course, who were split into two groups, one online and one in class. The originality of this research stems from its quantitative approach to measuring academic performance in an online format vs. in class context. Despite a positive appreciation from students of their online learning experience, online collaborative learning does not appear to improve the overall performance of the students, compared to instructor-led students in a classroom.

Keywords: millennials; collective intelligence; blended learning; social learning; e-learning.

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1 Introduction

In the 1990s, a conceptual model was developed which examined the effectiveness of different learning processes on individuals (Jennings and Wargnier, 2015; Clardy, 2018). This model was subsequently used as a basis for the development of professional training programs. The model outlined that 70% of student learning and capacity development stems from practical experience, 20% from interaction with others outside of formal learning institutions and 10% from a formal education environment. This model challenges the role and scope of teaching practice today as it argues that only 10% of an individual's learning process is associated with in-class pedagogy. Such a declaration poses a challenge to academic institutions in an increasingly competitive academic environment (Malik and Agarwal, 2012; Boelens et al., 2018; Kerry, 2020) that need to build effective teaching practices to attract new students. The higher education sector currently faces the challenges of a democratised education sector due to an increased globalisation of teaching, where education must strive to become an actor in the development of global knowledge (Hans de Wit, 2011; McPherson and Bacow, 2015; Boelens et al., 2018; Kerry, 2020). Students no longer need to be physically present in class to benefit from learning paths offered by even the most prestigious academic institutions (Katsomitros, 2011; Boelens et al., 2018). As a result, e-learning solutions provide an opportunity to challenge McCall's conceptual model through the introduction of digital teaching methods and learning management systems (LMS). The integration of such tools in a learning path has given rise to the concept of blended learning; a concept that has been exposed to a number of interpretations over the last two decades (Driscoll, 2002; Sharma, 2010) and will be examined in the literature review of this paper.

The initial and principal use of blended learning was to optimise costs through the use of online teaching videos and exercises to replace costly classroom teaching resources (Driscoll, 2002; Sharpe et al., 2006; Boelens et al., 2018). However, the learning behaviour of millennials (Bal et al., 2015; Mostafa, 2015; Selwyn and Stirling, 2016) and of future generations of students challenges the existing blended learning model and has brought to the fore a new utility of blended learning as a means of building contextual value into their learning experience via collaborative platforms.

Therefore, the higher education sector is now facing new challenges that the current Generation Z will bring (Botelho, 2008; Henry, 2006; Herbison and Boseman, 2009; Wordon, 2009; Reinikainen et al., 2020; Kerry, 2020). A generation born between 2000 and 2010, that is 100% digitally native in developed economies, mobile and constantly connected to the internet (Bennett et al., 2012; Wesner and Miller, 2008; Francis and Hoefel, 2018). However, this generation is also lacking necessary professional digital skills for their future employment (Green and Hannon, 2007). Blended learning will be challenged by the evolving demands of this new profile of student, who is heavily influenced by social media, peer influence and mobile technologies in its

decision-making processes (Seemiller and Grace, 2017; Reinikainen et al., 2020). What does this say about Generation Z students' behavioural requirements? And what lessons need to be learned and developed from existing studies to provide a suitable value proposition that breaks the current boundaries (Prescott et al., 2013; Bal et al., 2015; Selwyn and Stirling, 2016; Seemiller and Grace, 2017) on the current use of these digital technologies in an academic environment?

This paper examines existing research on digital technologies and education (Bal et al., 2015; Buzzard et al., 2011; Dowell and Small, 2011; Hollenbeck et al., 2011; Greenhow and Lewin, 2016; Mayo, 2005; Selwyn and Sterling, 2016) in order to understand how current blended learning techniques can be enhanced by using online collaborative platforms. The study exposes limitations of research to date and presents a study of collaborative online teaching within a French business school. Media rich theory (Daft and Lengel, 1986), self-efficacy theory (Bandura, 1977, 2009) and social constructivism (Vygotsky, 1978) provide a theoretical framework which underpins the research design. We revisit the notion of millennials and Generation Z students' social media consumption and examine how innovative learning techniques reflecting their social media behaviour help to satisfy a digital cohort that struggles to adapt to an education system that was built to fulfil the needs of previous generations (Seemiller and Grace, 2017). Our study is specific to a postgraduate level of education.

The concept of blended learning has been developed based on 'social learning' (Bandura, 2009) and collective intelligence. The individual becomes a participant of his own learning path within a mobile community and not purely an individual actor, and the teacher facilitates this new approach in a shared, collaborative, real-time learning environment. A learning environment underpinned by social constructivism theory (Vygotsky, 1978; Windschitl, 2002) is examined within the chosen business school, applying the notions of informal learning as an effective approach through the collaboration and interaction of many participants (Vygotsky, 1978; Bandura, 2009). An evaluation of its effectiveness is drawn from both students and academic staff, in order to determine whether such platforms can provide an effective online learning environment, whilst equipping students with necessary digital skills (Selwyn and Stirling, 2016) for their future professional integration. Literature to date has not examined the impact of online collaborative tools on the academic performance of students and this is the original development piece of the study that will contribute to literature through a quantitative analysis of datasets from two student cohorts. The paper concludes with a discussion on the suitability of online collaborative learning platforms with recommendations on subsequent research possibilities to develop its initial findings.

2 Literature review

2.1 Millennials and Generation Z students

Millennials and Generation Z students are two generations of learners who have evolved in an entirely different way to previous generations, through their ability to integrate multiple channels of information simultaneously (Igel and Urquhart, 2012; Delzio, 2014; Shatto and Erwin, 2017; Reinikainen et al., 2020), within a complex and fast evolving digital landscape (Selwyn and Stirling, 2016). The paradox of this environment is that, as a consumer generation they base a substantial percentage of their decision-making

processes on social network interactions (Hinson et al., 2012; Rapp et al., 2013; Selwyn and Stirling, 2016). Moreover, literature exposes that in the space of a decade the preferred social media channels have changed between millennials, who prefer Facebook compared to Generation Z, who prefer Instagram, Snapchat and Instant messaging (Shatto and Erwin, 2017). The principal reason for this is that Generation Z is a more mobile and connected generation who adhere to an extensive network of social circles with varying degrees of intimacy (Shatto and Erwin, 2017; Reinikainen et al., 2020). Rapp et al. (2013) developed a 4E model of the real world use of social media for consumer engagement, which was essentially to excite, to educate, to enable experience and to engage. Millennials' and Generation Z's behaviour on social networks supports this theory by their constant quest to interact and become accepted in various social networks. Their adhesion to these different networks is based on the individual's perception of the network being an effective pathway to news and information that is pertinent to them as a person. The success of such networks reinforces Bandura's (1977) work in his article on social learning. His study illustrates a direct correlation between a person's perceived self-efficacy and behavioural change. Self-efficacy comes from four sources: "performance accomplishments, vicarious experience, verbal persuasion, and physiological states" (Bandura, 1977).

These four sources are a direct reflection of the structures and functions of social media today which strive to engage through their experiential and social capabilities. From a learning perspective, this means that a successful integration of collaborative online tools to enhance a learning experience requires an optimal balance between experiential design and emotional fulfilment (Selwyn and Stirling, 2016; Tapscott, 2008; Shatto and Erwin, 2017). Social participation needs to be stimulated to change the behavioural attitudes of students (Greenhow and Lewin, 2016; Reinikainen et al., 2020) in order to develop an attraction for collaborative online learning tools (Junco and Cotton, 2013; Prescott et al., 2013).

Therefore, educational establishments need to optimise how information is processed by individuals (Daft and Lengel, 1986) whereby communication effectiveness is based on the type of media that delivers the information. Media richness theory (Daft and Lengel, 1986) is highly applicable to the education sector, where the use of different media provides varying levels of efficiency in information processing amongst students, depending on the level of equivocality of the message. As social media joins the different information processing channels in education, media richness theory, self-efficacy and social constructivism (Gaytan, 2013) play their part in determining the effective use of these platforms.

2.2 The digital transformation of the pedagogical framework – a disruptive learning innovation

Disruptive innovation is a term applied to the use of technology and its application to fulfil low-end consumer requirements or deliver unmet market demands (Christensen et al., 2008). From an educational perspective, much of the debate around disruptive innovation lies in the understanding of barriers between formal and informal learning, and what constitutes knowledge when these boundaries fusion (Greenhow and Lewin, 2016; Milićević et al., 2021). Within this context, research to date has examined the integration of information and communication technologies (ICTs) and its acceptance by

teaching staff in a learning environment (Yoon et al., 2005; Lindberg et al., 2017; Vrasidas and Glass, 2002). Christensen et al. (2008) also applied his disruptive innovation strategy to learning, by examining how e-learning can satisfy learning needs via the development of networks of individuals sharing information outside of a classroom and a single teacher. This combined development of networks and technology has given rise to blended learning in the digital transformation of education.

Blended learning underlines the need for an individual to connect to teaching materials and interact with a teacher resource to define a learning path appropriate to his manner and pace of learning. Recent digital developments facilitated the development of this learning format via the use of LMSs. However, this model supposes that the student does not participate in the creation of course content and cannot influence the development of their learning materials. Despite substantial effectiveness in the academic achievement of individuals (Hedberg, 2006) via blended learning, its current format may not reflect the evolving importance of social behaviour that is highlighted in social constructivism (Vygotsky, 1978; Windschitl, 2002; Young, 2007; Kalina and Powell, 2009) which emphasises the importance of context and circumstance in a collaborative and interactive environment. It also does not accommodate the new consumer of education, the millennial and Generation Z, who is an advocate of peer-reviewing systems that, within a community of contributors, benefits from perspectives deemed less bias (Dede, 2008; Igel and Urquhart, 2012; Surowiecki, 2004; Bennett et al., 2012; Reinikainen et al., 2020). We can question therefore whether today's blended learning technologies in their actual format are limited in effectiveness as a contributor of academic value to the future pedagogical landscape, and consequently the millennial student.

Social constructivism has therefore been identified in previous academic studies as a relevant theory to examine the effectiveness of social media in formal education (Anjali et al., 2015; Greenhow and Lewin, 2016; Selwyn and Stirling, 2016; Buzzard et al., 2011). It accommodates the individual and the context of learning, which is situated and located in an informal social context, contrary to traditional learning, which is free from social or contextual influence (Colley et al., 2003).

Epistemologically, the Web 2.0 is an architecture suited to an informal learning environment (Dede, 2008; Milićević et al., 2021) for experiential and cultural communities which determine the components of relevant experience and knowledge. Consequently, it is essential to understand how individuals benefit from these communities to shape future beliefs and practices (Mayo, 2005; Ilon, 2012; Reinikainen et al., 2020). Saul (2001) argues that societies would be more effective if able to build collective common sense. We can compare this argument with the concept of collective intelligence (Leimeister, 2010; Surowiecki, 2004; Bennett et al., 2012), where the 'collective' is described as a group of individuals not required to have the same attitudes or viewpoints, and 'intelligence' means the ability to learn understand, and adapt to an environment by using one's own knowledge.

Research to date has therefore raised the need for contextual learning, and the importance of collective approaches to enhance the learning process of individuals in further education study paths (Shatto and Erwin, 2017; Seemiller and Grace, 2017). However, extant literature does not fully examine the role of collaborative learning platforms to motivate students in becoming actors of their collective academic intelligence nor provide a quantifiable argument to the impact they have on students' academic performance.

3 Research design and methodology

3.1 Research design

3.1.1 Qualitative study 1

Digital pedagogy and its impact on the collective learning experience. The study was undertaken at a French business school in a cost accounting and project management module from the marketing master's program. Seventy students in total were exposed to the use of the collaborative online platform in a blended learning approach. Previously the course had been delivered using traditional classroom led practices at the business school. It was decided to pursue an innovative pedagogical approach in order to continue offering the course to students. The objective was to evaluate the pedagogical value of the collaborative online platform and measure whether it enhanced student engagement. The collaborative online platform enabled easy access for both students and the instructor, with collaborative working sessions and a delivery mechanism that would provide a suitable alternative to the real-time classroom environment. However, it was necessary to understand the capacity of digital technology as a participative creative tool (Green and Hannon, 2007; Shatto and Erwin, 2017) and look at how technology can disrupt learning boundaries (Greenhow and Lewin, 2016).

Twenty two hours of teaching were delivered by a remote teacher, in an online learning environment for the cost accounting and project management marketing module. In order to let students benefit from the instructor's expertise it was essential to build a virtual learning scenario giving access to this qualified teaching resource.

The students were divided into groups of five but they were not required to be physically grouped together as the platform enabled students to regroup virtually in a 'classroom' environment, via a personal internet access, a webcam and microphone. An initial exploratory mail was sent to students prior to the course to prepare them for using the platform, to give them access to the platform and present its functionality. Since the platform enabled social login students could easily access the platform. Once signed in the students adjusted to a real-time online classroom environment where the teacher was visible and her teaching materials were accessible to all students connected. It was deemed necessary, by both the instructor and the students, that each sub-group of five students had an ambassador who was attributed additional access rights on the platform. These included vocal access to raise questions whilst in lecture format and the possibility to interact with the teaching material to highlight or pinpoint a particular aspect of the course presentation materials that were not clearly understood. The principal thought process behind this approach was that within all educational activities, group leaders are required to collectively gather and manage the group's participation. These ambassadors had received a 30-minute training session via the platform to familiarise themselves with the platform and its functionality and in an attempt to encourage their colleagues to sign up and use the platform.

The first part of each session was structured as a lecture (with slides uploaded to the platform) completed by feedback at various points during the presentation. The teacher explained theories and concepts from their presentation materials as if in an amphitheatre and the students then proceeded to a more interactive session in the virtual classroom groups to work on the continuous assessments.

3.1.2 *Quantitative study 2*

The impact of digital pedagogy on student academic performance. In the second study an interactive online tool was added to the existing platform. In this second study the student group consisted of 45 students. In order to test the impact on students' academic performance using collaborative digital platforms the study split the groups into two subgroups. One group of 20 students followed the course in classical classroom style format with a teacher physically present and the second group of 25 students followed the same course using the collaborative platform and an interactive activity tool in online sessions, with the remote instructor. The course content, evaluations and final exam were identical.

Various conditions had to be met to eliminate all potential bias or external factors that could affect the study results. All students included in this second study were screened to ensure that they had followed the same curriculum for their previous three years of study. Consequently, the sample set was confirmed as having had the equivalent amount of accounting courses in their Bachelor study program.

As a consequence, the following hypothesis was tested:

H1 There is no significant difference in grades between the group of students following the course online and the group of students following the course in class.

3.2 *Research methodology*

In order to compare the academic performance of students in two sub-groups, a T-test was applied to the final grade (the average), which was calculated from all the course grades within this course (continuous assessment and final exam).

Subsequently, in order to eliminate any form of bias, a second control T-test was applied to the students' grades from the previous year in the same subject. It is important to mention that the students that joined the master's program from a different academic institution and for whom we did not have their academic level in the discipline were rejected from the sample set (3 students out of 48).

4 **Results and analysis**

4.1 *Results*

The results below reject the notion of there being a significant difference between the levels of the two groups. The results from the t-test confirm that the students had the same level of knowledge of the discipline before beginning the course as the results illustrated that there was no significant difference between the grades of the two groups from their previous year of study in the same discipline.

However, the results of the study also demonstrate a significant difference of 3.59 points between the two sub groups, in favour of the students who followed the course in class with a teacher present. This performance difference is more important for the mid-term grade (17.20 out of 20, compared to 11.35) compared to the final exam grade. It is important to note that this difference cannot be attributed to an impartiality in the students' appreciation of the teachers concerned as both teachers had the same evaluations from the previous year teaching the same discipline.

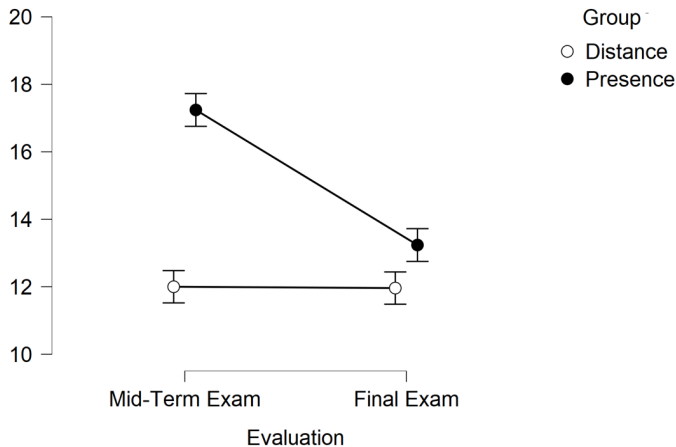
The results of the T-test control applied on the grades of the two sub-groups at the end of the preceding year display no significant difference in student performance.

Table 1 Results of student grades pre and post module

| | Mean difference | T-test |
|---------------|-----------------|-------------|
| Average M2 | 3.59 | 0.00 |
| Final exam M2 | 1.29 | 0.140467611 |
| Mid-term M2 | 5.90 | 0.00 |
| Average B3 | 0.39 | 0.706661438 |

An ANOVA was performed on students' grades with group (presence vs. distance) as between subject factor and evaluation (mid-term vs. final exam) as within-subject factor. This analysis revealed an interaction of the factors group and evaluation, $F(1, 44) = 16.401$, $p < 0.001$, $\eta_p^2 = 0.27$ (see Figure 1). Planned comparisons revealed that the mean grade at the mid-term exam was better for the presence group ($M = 17.24$, $SD = 2.20$) than for the distance group ($M = 12.00$, $SD = 1.76$), $t(44) = 8.99$, $p < 0.0001$, $d = 2.67$. On the contrary, for the final exam, no difference was found between the presence group ($M = 13.24$, $SD = 2.58$) and the distance group ($M = 11.96$, $SD = 2.81$), $t(44) = 1.58$, $p = 0.12$. As a consequence, whereas no difference was found between the main grade for mid-term and final exam in the distance group, $t(25) = 0.06$, $p = 0.95$, students in the presence group obtained better grades at the mid-term exam than at the final exam, $t(19) = 5.83$, $p < 0.0001$, $d = 1.31$.

Figure 1 Mean grades at the mid-term and final exam for the distance and the presence group



The student satisfaction survey results showed that for 99% of students this was the first experience of e-learning with live real-time interaction. Contrary to previous studies on the use of social media (Prescott et al., 2013) 96% of students enjoyed the experience and saw the potential of the online collaborative platform as a formal learning tool, rather than just for course related communication. However, the teacher involved in the experience stressed the importance for students to be motivated, reinforcing observations from past studies (Selwyn and Stirling, 2016; Tapscott, 2008) in order to gain a positive

experience from the exercise. The teacher also stressed how the use of such platforms helps to prepare students for their professional working environments where this type of platform is commonplace, and reinforces past reflections on their value for companies and their new hires (Bal et al., 2015; Dabbagh and Kitsantas, 2012; Wankel, 2009). The need for student cooperation challenges the limits of this platform as a learning tool because the physical boundary does not enable the same interaction and observation that a classroom configuration provides. Interestingly, with the collaborative platform used in the study, 40% of students felt that the experience was the same as group work within a physical classroom.

The notion of millennials not being team players (Igel and Urquhart, 2012) is also questioned. Where 34% student responses disagreed with this statement, 31% agreed that in an academic environment this was the case.

The module that used this platform is from the marketing master's program where one can argue that the use of personal learning environments (PLE) (Dabbagh and Kitsantas, 2012) is more easily applicable (by nature of the course content). However, the cost accounting module focused extensively on accounting tools and formulae and required access to shared Excel documents, thus extending the applicability of such PLE to other disciplines. The main reason stated by the teacher was that the platform reflected a virtual presentation of class, where a teacher delivers, and 'drops-in' to group activity, but with an enhanced delivery mechanism for collective learning. One aspect that requires more reflection is to enable groups to see a macro vision of the work accomplished and the integration of other collaborative desktop tools in a live session could compensate for this feature. Limitations in the effectiveness of the platform for working on accounting exercises were however stressed in the online teaching evaluation survey. Participants expressed difficulty in the cost accounting module for performing calculations with Excel spreadsheets shared by six students on the platform.

Analysis of the feedback from participants was made from a pedagogical enhancement perspective on the need for more online content sharing functions as well as real-time modification of lesson supports that are pre-uploaded onto the platform. Such improvements would engage students further, as they would see their real-time contribution to the course framework. About 30% of the students' responses confirmed that continued investment in innovative digital pedagogy is necessary to enhance the learning path. And whilst a quarter of participants in the second survey expressed a feeling of being an actor in their education, just under 30% felt that they still needed to be stimulated by classroom led interaction. A fundamental conclusion drawn from the feedback of both experiences is that the formal teaching mechanism (i.e., the teacher) is still efficient. However, from the teachers' perspective it was deemed necessary to increase lesson content, as well as to move to bite size teaching. They agreed that an ideal format would be to have two drop-in sessions during the group activity sessions lasting 60 minutes, interspersed with a second 15-minute plenary session and a final plenary contributory session of 15-minutes to complete the lesson.

A sense of efficiency was identified by the online teacher in the group work performance and contributions and the final coursework results were above average for this class, which confirms the importance of self-efficacy (Bandura, 1977) and peer-reviewing mechanisms (Dede, 2008) in a social learning environment. Doubts however were raised on the individual knowledge gained, which subsequently became the core development piece of the second phase of study. In the second study that integrated Klaxoon, an interactive online activity tool, the feedback is not the same. The

majority of the student respondents (95%) felt that use of such innovation enhanced their concentration and their interaction, and they enjoyed studying with a dynamic, entertaining tool.

We can nevertheless illustrate the importance of the teacher's role to validate social constructivism theory (Vygotsky, 1978; Windschitl, 2002) with 71% identifying the need for guidance and context. And although individual learning technologies (e-learning) is perceived as being a positive element in the development of a PLE, with 62% of participants supporting this viewpoint, the collective intelligence from crowds (Leimeister, 2010; Surowiecki, 2004) is highlighted as a beneficial factor by 67% of respondents from online collaborative platforms.

5 Discussion

The aim of this research project was to compare two groups of students taking the same course, one in a traditional in-class format and the other in a 100% online format, using synchronous teaching sessions. The results suggest that, while the entry level of the students was comparable at the beginning of the course (based on their B3 grades), the grades of the in-class group are better than those of the group online. More specifically, the better performance of the face-to-face group seems to be explained by better marks in the continuous assessment, a difference that is not reflected however in the final examination. The survey results suggest that while a large majority of distance learners enjoyed their learning experience, a significant proportion of them, as well as their teacher, point to the need for more synchronous interaction in online teaching. The vast majority of students felt that using an interactive online tool such as Klaxoon was beneficial to their learning. Taken together, these data provide substantial evidence on the pedagogical and motivational issues linked to online teaching and orient us towards an understanding of the psychology of group dynamics from an emotional and motivational perspective.

5.1 *Motivational aspects*

The results analysis shows that while distance learners performed equally well in the continuous assessment and the final exam, this is not the case for face-to-face learners who performed better in the continuous assessment. This difference can be explained by the nature of the continuous assessment, which was group-based work, whereas the final exam was an individual written exam. Indeed, this difference in performance raises questions about the difficulty of creating a group dynamic and the shortcomings that this causes in terms of motivation. On the basis of the satisfaction of these needs, and in alignment with part of this study's theoretical underpinning, the individual constantly evaluates his or her sense of self-efficacy, and modulates his or her expectations according to this evaluation (Bandura, 1977). From this perspective, the more the individual's basic needs are satisfied, the more the individual's sense of efficacy is reinforced, the greater the student's motivation and desire to contribute to the collective good.

In the context of distance learning, it appears that the need for autonomy, the fact of feeling responsible for our actions is stimulated. Following an online course requires a

greater effort of commitment as the pedagogical framework of the classroom is no longer a factor that stimulates the student's participation in the course. Nevertheless, the need for reassurance, to know that we are doing things well, is more difficult to satisfy because positive feedback on students' actions, whether from the teacher or their peers, is rarer and less complete than in the classroom, as expressed by participants in the qualitative study.

5.2 Relational aspects

The same applies to relatedness, to know that we are included and supported in a group during our activity, which is diluted in an impoverished interaction. This poverty of interaction not only complicates the construction of a solid motivation but also the creation of a group dynamic because many elements that allow the exercise of emotional skills (Mikolajczak et al., 2020) and the creation of a relationship between students are impoverished or even lacking. Emotions are a very important source of information about the nature of our interactions with others. They allow us to communicate our intentions, to understand the intentions of the other person and to enter into a relationship by listening to and understanding these emotions. Identifying the emotions of our interlocutor is therefore crucial because it is the starting point of the social sharing of emotions (for a review see Rimé, 2009) at the origin of the creation of a relational dynamic between two people.

However, the use of a videoconferencing tool does not facilitate the interpretation of certain elements of emotional expression, such as non-verbal language (notably facial expressions, movements or postures). Verbal and paraverbal language (e.g., intonations) become the only sources of information in the relationship with another person online. This impoverishment of interaction hinders the emotional contagion that enables an individual to generate empathy towards others and to establish a solid relational space with them (Hatfield et al., 1993, 2011).

5.3 Emotional aspects

Generally speaking, therefore, it might be thought that asynchronous e-learning hinders the creation of a group dynamic by impoverishing relationships through the difficulty of exercising emotional skills. In fact, it is the whole emotional dynamic of learning that is undermined. Indeed, emotions play an essential role in learning (Mazziotti and Sander, 2015), particularly the emotions of achievement, which are highly dependent on the pedagogical framework and which condition student motivation (Pekrun et al., 2007). In particular, it has been shown that joy in learning is positively correlated with intrinsic motivation, whereas boredom is negatively correlated (Pekrun et al., 2010, 2011).

This is where online interactive pedagogical tools, such as Klaxoon, come into their own. The results from the qualitative study clearly indicate the value attributed to such tools by students. By generating interaction through collaborative work (e.g., brainstorming) and quizzes, these tools not only allow for exchanges between students, thus fostering group dynamics, but also the emergence of epistemic emotions such as interest (Silvia, 2005). In order to trigger interest, it is necessary to propose a new engaging task, which allows a better understanding of the subject. Active pedagogy in which the students are stakeholders in the construction of their learning is necessary. They "do things and think about what they are doing" (Bonwell and Eison, 1991). This

pedagogy shows very encouraging results in many fields (Zamora-Polo et al., 2019), especially in management-related disciplines (Auster and Wylie, 2006; Zygmunt, 2006).

5.4 *Pedagogical perspectives*

This evidence suggests that the motivational and relational impoverishment caused by distance learning can be countered by the use of an online interactive tool. Generating interaction not only involves students in the course by providing gamification but also engages them in their learning. Indeed, the research participants expressed how distance learning dehumanises the learning experience. From this point of view, allowing them to interact in the course and among themselves allows them to regain an identity in the class group. This possibility to interact, this active pedagogy, also gives the possibility to produce a behaviour and to appreciate the result instantly during the course. Here we find an essential element of motivation, the ability to nourish our sense of self-efficacy by evaluating the results of our action (Bandura, 1977). This, in turn, allows us to reconstruct the pedagogical framework.

The results of this study suggest that the basic problem of distance learning is a dilution of the pedagogical framework (objectives, group dynamics, communication with the teacher) which hinders pedagogical clarity for students. It therefore seems necessary to reinforce the pedagogical framework in the distance learning phase by allowing them to interact with their peers, with the teacher (thanks to a solid communication thread and a precise monitoring system) and with the subject. The results also suggest that it is more effective to teach. For theory using online interactive tools like Klaxoon. Students become actors of their education and need to fully concentrate on each activity in real-time. Theory and concepts are therefore more understandable as they are taught using an array of activities in structured, shortened format.

The results also show how online teaching tools offer trainers a growing array of choices for matching training programs to millennial student's attitude to learning (Greenhow and Lewin, 2016; Reinikainen et al., 2020; Milićević et al., 2021), existing knowledge set and core competencies. However, this research identifies the need for communicating clear and concise pedagogical objectives to students. These objectives are also a motivational factor of primary importance because they condition the satisfaction of psychological needs and the feeling of personal effectiveness (Bandura, 1977). Learning objectives must be specific and challenging to generate and sustain motivation (Latham and Locke, 1991; Locke and Latham, 2006). Poorly defined e-learning objectives will destroy the motivation of students, who will never be able to measure their progress, either because the objectives are achieved too easily, or because they are too difficult to achieve, or because they are too vague for an outcome to be observed. Future studies should investigate the addition of progress monitoring to the distance learning system to keep students motivated.

Finally, the study suggests that social sciences, like marketing, could see an improved performance from the use of online collaborative learning platforms, over more technical subjects such as cost-accounting and budgeting. Their practical exercises require autonomous research and collective intelligence. This supports previous literature, which identified collective intelligence as a critical success factor to building the social learning environment (Leimeister, 2010; Surowiecki, 2004; Kerry, 2020; Milićević et al., 2021).

The teacher's continuous presence is not essential. Students can move forward in their work alone.

6 Limitations and future research

Whilst the results of this study provide key indicators to the impact of technology in education, it is recommended that the subject matter be explored in depth in order to further validate our initial findings. The focus of the study was on one specific course with a small sample set. It is therefore recommended that the same exercise be performed on a larger sample set of participants.

The study is also restricted to students from a French business school and the same scenario may not play out in the same way for other cultures, where K12 education prepares pupils in a very different manner for higher education.

Finally, COVID-19 has inevitably changed the education sector's priorities on integrating digital technologies into the classroom. The choice of whether to integrate digital pedagogy will give way to questions aligned to the inevitable integration of digitalised teaching methods. It is therefore recommended that comparative studies of online learning collaborative platforms are undertaken in order to provide guidelines to educational institutions in their future investments in online teaching architectures. However, the study also forewarns against focusing primarily on the technology to the detriment of the pedagogy.

7 Conclusions

Pedagogical innovation is a key criterion for higher education organisations to build their strategic value proposition. Faced with an increasingly competitive and globalised sector and a target audience that has changed in its motivations and behaviour for learning, business schools need to embrace technologies that respond to this evolving sector. Collaborative online platforms have the distinct advantage of replicating physical classroom configuration, whilst stimulating engagement via their accessible social interface, and reflect the peer influenced environments that students engage with in their online activities. The informal learning by doing framework that such platforms build enables enhanced student participation in coursework and learning objectives. The findings have identified that students do wish to become actors in their education, in preparation for their future integration into a professional digital environment and that existing traditional formal environments correspond less to their own behaviour and dissuades engagement and learning value. However, improvements to the existing collaborative tools are necessary in order to stimulate student engagement and more importantly deliver increased performance in student academic results. In the future integration of these tools, it is essential to limit their use to the theoretical teachings and not to practical coursework sessions, as the study measures the continued efficiency of traditional face to face teaching methods as a more successful approach for students to achieve success in fulfilling course objectives through group activity.

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