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Students' Learning Support and Perceptions in an Online Mathematics Course in a Business Faculty

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Abstract
Online courses are growing in higher education, resulting from an increased access to information and communication technologies. While such courses allow time and/or space flexibility for both students and instructors, they also promote active learning and require more autonomy from the students. In this paper, we present the main design features of a new prerequisite mathematics online course in a business faculty. While most of the course was designed in an asynchronous mode, it also includes blended synchronous support sessions that students can attend each week. As a Scholarship of Teaching and Learning (SoTL) project, we related the design features of the course to students' learning support and perceptions by analyzing the content of the learning management system as well as students' narrative comments in course teaching evaluations over five semesters. The main themes reported concerned the appreciated course design and structure, the enhanced instructor's presence through commented slideshows and support sessions, the instructor's accessibility and care, a challenging but relevant course, and collaborative practice with a software application. In particular, the instructor's presence and follow-up throughout the semester was highlighted by the students as a means to support their learning. Furthermore, most students' comments reported positive perceptions about the online course and specific design features. Several comments also allowed to identify potential areas for change in a future version on the course, as part of the SoTL research that focuses on teaching and learning improvement.

Les cours en ligne sont en augmentation en enseignement supérieur, du fait d'un meilleur accès aux technologies de l'information et de la communication. Outre une flexibilité accrue en termes de temps et/ou d'espace tant pour les étudiants que les enseignants, ces cours favorisent également l'apprentissage actif et exigent plus d'autonomie de la part des étudiants. Dans cet article, nous présentons les caractéristiques principales de conception d'un nouveau cours prérequis de mathématiques en ligne dans une faculté d'administration des affaires. Bien que la majeure partie du cours ait été conçue en mode asynchrone, le cours comprend également des séances de soutien en mode synchrone mixte auxquelles les étudiants peuvent participer chaque semaine. Dans le cadre de ce projet d'Avancement des Connaissances en Enseignement et en Apprentissage (ACEA), nous avons mis en relation les caractéristiques de conception du cours au soutien des apprentissages et aux perceptions des étudiants en analysant le contenu du portail de cours en ligne ainsi que les commentaires des étudiants dans les évaluations de l'enseignement au cours de cinq semestres. Les thèmes principaux rapportés concernent l'appréciation de la conception et de la structure du cours, la présence renforcée de l'enseignant par le biais de diaporamas commentés et des séances de soutien, l'accessibilité et l'attention de l'enseignant, un cours exigeant mais pertinent, et la pratique en collaboration avec une application logicielle. En particulier, la présence de l'enseignant et le suivi tout au long du semestre ont été soulignés par les étudiants comme un moyen de soutenir leur apprentissage. De plus, la plupart des commentaires des étudiants ont fait état de perceptions positives concernant le cours en ligne et ses caractéristiques spécifiques de conception. Plusieurs commentaires ont également permis d'identifier des éléments de changements potentiels pour une version future du cours, en tant que recherche en ACEA qui se concentre sur l'amélioration de l'enseignement et de l'apprentissage.

Keywords
online learning, higher education, learning support, mathematics; apprentissage en ligne, enseignement supérieur, soutien à l'apprentissage, mathématique

Cover Page Note
We would like to thank the two anonymous reviewers for their constructive comments, which helped improve the quality of submitted work.

Online and blended learning are rising in higher education (Seaman et al., 2018; Siemens et al., 2015), with many post-secondary institutions delivering online courses for 15 years or more in North America (Bates, 2018). Over the 2011-2016 period, the percentage of institutions offering such courses in Canada has increased by around 2% per year (Bates, 2018), growing to approximately 83% in 2018 (Donovan et al., 2019). Furthermore, over one in five Canadian post-secondary students were taking at least one online course for credit in 2016-2017 (Donovan et al., 2019). The popularity of online courses comes from their flexibility, resulting in an increased access to higher education (Audet, 2011; Charrier & Lerner-Sei, 2011; Denami & Marquet, 2015). Post-secondary institutions are now able to attract a large pool of students that includes those living in remote areas or even evolving in a different time zone. Even for students living close to an institution, online courses allow them to balance their academic, personal, and professional lives more effectively (Audet, 2011; Baker & Hjalmarson, 2019; Blackmon & Major, 2012; Charrier & Lerner-Sei, 2011; Denami & Marquet, 2015).

While the information and communication technologies (ICT) provide time and/or space flexibility for both students and instructors in online courses, they also open avenues to promote active learning (Charrier & Lerner-Sei, 2011; Manganello et al., 2019; Peraya, 2011). Hence, the students are led to play a central role that requires autonomy and responsibility in their learning (Blackmon & Major, 2012; Cosnefroy, 2012; Dussarps, 2014; Manganello et al., 2019). As this can be seen as an advantage and as a challenge, students need to be supported appropriately, i.e., both emotionally and cognitively so that they can achieve the course learning objectives (Lee et al., 2011; Lee et al., 2015). Therefore, online courses have to be thoughtfully designed to guide and support students' learning (Anderson, 2004; Lee et al., 2011; Swan, 2001). As a facilitator, the instructor guides the students through the course learning objectives and activities, in a learner-centered approach (Kaser & Hauk, 2016; Ma et al., 2015; Robinson et al., 2017). Still, online courses can remain less popular than face-to-face courses (Guest et al., 2018), and student satisfaction has been shown to be slightly lower than in face-to-face courses (Siemens et al., 2015). Reasons for this include the risks of isolation due to the higher transactional distance (Moore, 2013), the lower quality or even a lack of interactions (Dumford & Miller, 2018; McBrien et al., 2009), the lesser presence of written emotional support (Dussarps, 2014; Ferone, 2011), or the less effective teaching practices (Dumford & Miller, 2018). As a consequence, online courses should carefully take the above factors into consideration to support students' learning and foster a positive experience.

Context and Problem

Within the Faculty of Business Administration at Université Laval (FSA ULaval), the development of online courses is put forth in the Faculty strategic plan both at undergraduate and graduate levels (FSA ULaval, 2016). Out of a total of 680 courses at the faculty in 2018, 270 courses were offered online at least once during the year with about 130 at the graduate level. Various graduate-level programs are offered, including diverse Master's of Business Administration and business postgraduate diplomas. Most of these programs, however, include mathematics admission requirements. As time evolved, the program management observed that an increasing number of future students could not meet such requirements and decided to offer students an alternative pathway. Since 2016, the students have been able to satisfy the mathematics requirements by successfully completing the "Mathematics Course for Business" at the faculty. This new prerequisite course is offered online three semesters per year. It welcomes around 150 students annually, many of whom are adult students who work part-time or full-time while taking several courses in business.

Developing the Mathematics Course for Business was challenging. As a three-credit course, it spans various post-secondary mathematical contents that are usually addressed in pre-university programs. More particularly, it addresses basics of algebra, calculus, linear algebra, descriptive statistics, and probability. However, the course was specifically designed for future business students by focusing on relevant applications and problem solving. Furthermore, we were aware of a great variability in the students' profiles, with several students whose last mathematics course dated back ten years ago or more. Hence, the course would (a) address various mathematical contents, (b) be relevant for future business students, and (c) assume the fewest prerequisite knowledge. The instructor (who is also the first author of this paper) and related team in charge of the course development were sensitive to the course's pedagogical aspects. Even though it would only be delivered online, the Mathematics Course for Business should support students' learning throughout the semester. Furthermore, since mathematics is not many students' preferred subject, especially for students who do not satisfy the admission requirements, we wanted them to appreciate their mathematics online experience.

This study reports on course features that were implemented to support students' learning and presents their perceptions regarding to the online Mathematics Course for Business. In the following sections, we first present the theoretical framework and course design. Next is the method section, followed by the results and discussion. Finally, we state some limitations of the Scholarship of Teaching and Learning (SoTL) project and present a conclusion.

Theoretical Framework

Supporting students' learning in online courses can be achieved in various ways, in which both course design and instructors play critical roles (Lee et al., 2011; Richardson et al., 2015; Richardson et al., 2016). According to Lee et al. (2011), "learning environments should provide proper support as well as appropriate structure of course materials and activities, effective means of communication in order to decrease the transactional distance and optimize student learning" (p. 159). Notably, the instructor's accessibility has a large impact on students' perceptions (Blackmon & Major, 2012; Bolliger & Martindale, 2004). The instructor's presence in the course enhances students' experiences, while his or her absence yields students' feeling dismayed because of uncertainties about expectations and a sense of instructor's inaccessibility (Blackmon & Major, 2012; Dussarps, 2014).

Effective communications are also crucial, since more interaction opportunities between the students and with the instructor have been shown to enhance social presence (Lee & Huang, 2018). They help students to feel connected to the course (Bigatel & Edel-Malizia, 2018) and their peers, thus creating a sense of belonging to a learning community (Bigatel & Edel-Malizia, 2018; Blackmon & Major, 2012; Garrison, 2011). Therefore, regular interactions improve students' experiences, while irregular or less appropriate ones may affect them negatively (Bolliger & Martindale, 2004; Thorpe, 2002). The instructor's immediacy has also been found to support students' learning and foster positive experiences (Baker, 2004; Bialowas & Steimel, 2019; Deschryver, 2008). Furthermore, the instructor's feedback guides the students throughout the course content. Specific, constructive, and timely feedback thus provides positive outcomes (e.g., student satisfaction) and supports students' learning (Lee et al., 2011).

In addition to interactions between the students and with the instructor, Moore (1989) emphasized a third type of interaction in online courses, namely student-content interactions. As part of the design of online courses, these represent "a continuous process of engagement with resources on an online learning platform" (Larbi-Siaw & Owusu-Agyeman, 2017, p. 459). While very few researchers have investigated the effects of such interactions, Martin and Bolliger (2018) mentioned that they support students' learning by engaging them with instructional resources and

activities. Bolliger and Martin's (2018) results indicated that authentic problems allowing students the opportunity to mobilize the course content are among the most engaging student-content interactions, according to instructors' perceptions.

Finally, note that the increased number of ICT facilitates synchronous interactions in online courses (Peterson et al., 2018; Watts, 2016). While asynchronous interactions grant flexibility (Robinson et al., 2017) and reflexivity (Tallent-Runnels et al., 2006), adding synchronous interactions gives a sense of immediacy (Robinson et al., 2017) and lessens transactional distance (McBrien et al., 2009). As Watts (2016) points out, "Both formats play a part in keeping students connected, learning the content, and providing satisfaction in the classroom" (p. 30). Therefore, effectively combining asynchronous and synchronous interactions should be taken into consideration when designing an online course, as it helps to support students' learning and foster positive experiences.

Grounded in a practice-based context, this SoTL project aims to connect the development of the online Mathematics Course for Business with the literature "to reflect on and initiate positive changes to their [faculty members] teaching and learning practices" (Hubball & Clarke, 2010, p. 1). It addresses the following research question: According to students' perceptions, how is their learning supported in the online Mathematics Course for Business?

Course Design

The online format of the course implied that the students would be autonomous in their learning. Although the course could have been implemented through synchronous online instruction simulating a face-to-face environment (Fadde & Vu, 2014), this would have forced all students to attend virtual course sessions at the same time each week. However, such a design goes against the usual practices at the faculty and could have been problematic for students living in different time zones. Therefore, most parts of the course were designed through asynchronous online instruction while ensuring to support students' learning and to foster positive experiences through several specific design features. To facilitate navigation through the course contents in the learning management system (LMS), the course is organized in weekly modules of similar internal design with blocks for learning objectives, presentations, practice problems, and a link to the discussion forums. A welcome video and an introduction page are also presented in the LMS to greet the students at the beginning of the course and to describe its organization. The introduction page also explains the main design features of the online course and how students should use them.

The first main design feature of the online course consists of commented slideshows (iSpring[1] style) for each content module: students read each slide while listening to the instructor explanations. Contrary to a video capsule, students can go backward or forward slide by slide. This feature allows them to watch some slides several times without the potential difficulty of finding the right content in a whole video. All problems that are presented relate to business: revenues, costs, profits, investments, supply and demand, break-even point, market segments, and so on. Practice business problems are also offered on the LMS to complement each content module and that students solve autonomously. Discussion forums and external Web resources are also available to answer questions and support learning.

The second main design feature of the online course consists of weekly support sessions offered by the instructor for students in a blended synchronous format (Bower et al., 2015). Before the beginning of the semester, the instructor selects an appropriate schedule (ideally, late in the afternoon or in the evening to accommodate the largest number of students), announces and sets the sessions schedule through the LMS while requesting a classroom in the faculty building. Every

[1] See https://www.ispringsolutions.com/.

week, the students can attend the support session either in face-to-face (by meeting the instructor in the classroom), synchronous online (by joining the virtual session in Adobe Connect[2]) or asynchronous online (by watching the session recording). It is important to notice that such blended synchronous sessions were not designed to teach new content but to synthesize weekly content and guide the students' learning process. During the support sessions, the instructor solves several selected problems step-by-step while carefully highlighting important points. Students have the opportunity to ask questions at any time during a problem resolution, and details about more complex calculations are provided by the instructor. Sessions usually last about one and a half hour. As all support sessions are automatically recorded and placed on the LMS for the whole semester, students can access them later, for instance, when studying for an exam.

Finally, the course assessments consist of midterm and final exams, as well as two asynchronous collaborative works. In the exams, the students are asked to solve business problems similar to those that have been presented in the commented slideshows or support sessions, step-by-step. The collaborative work assessments were designed to explore the use of Microsoft Excel as one of the most common personal and professional applications in business. Indeed, the instructor concluded in other courses that several students have difficulties with it or fear the software application. Such collaborative works allow students to progress, ask questions, and be ready for using software in subsequent courses. Throughout the course, the instructor provides step-by-step help documents that allow students to integrate the learning contents with a software application, i.e., Microsoft Excel. For instance, the students learn how to create a table of values for a function and then graph it in the application. While this can be easy for a basic linear or quadratic function, it becomes trickier for students when asking them to represent more complex or specific functions (e.g., piecewise). As part of another collaborative work, the students design an automatic procedure that solves a system with three equations and variables using matrices (through Gauss-Jordan elimination). They also learn to compute descriptive statistics, correlation coefficients, and scatterplots. Two specific collaborative assessments using the software application are assigned during the semester. These assessments also foster collaborative learning, which prepares the students for a professional career in business. Furthermore, the instructor wishes that the students help and enhance each other's skills through effective collaboration.

Method

This study used a qualitative methodology (Merriam & Tisdell, 2016) to explore students' perceptions of an online mathematics course to support their learning. By means of sharing main insights of the course development, design and students' perceptions, this study aimed to understand student learning in a specific context (Gale, 2008) in order to ultimately improve student teaching and learning as part of SoTL research (Hubball & Clarke, 2010).

The data used in this project are twofold. First, the LMS was used to observe course design features. Because some of its sections contain information regarding students' identification (e.g., discussion forums), students' anonymity was preserved by not relating to any specific comment or question in the LMS. Furthermore, students' perceptions are critical in SoTL research to identify the strengths and weaknesses of a course in its current design since these perceptions nurture the evaluation stage of an SoTL project (Hubball & Clarke, 2010). Therefore, data collection was completed through students' anonymous narrative comments in course teaching evaluations (CTE) collected at the end of five semesters in 2017 and 2018. CTEs were received from 125 students (out of a total of 220 students who were registered in the course). Since the CTEs directly refer to teaching and learning situations, such narrative comments also hold a strong external validity

[2] See https://www.adobe.com/fr/products/adobeconnect/learning.html.

(Harvey, 2016). As such, they help to understand students' perceptions about the online course and highlight potential improvements for the future (Simmons & Marquis, 2017).

Data analysis was performed through a hybrid process of inductive and deductive thematic analysis (Le et al., 2018). First, the course LMS was inductively analyzed through a constant comparison approach between data and interpretations (Leech & Onwuegbuzie, 2007). Since we were also interested in students' perceptions of the course design features, their anonymous narrative comments were then scanned on a deductive basis (Hyde, 2000). As one of the researchers was also the course instructor, the data and interpretations were next compared and discussed by both researchers until an agreement was reached, which ensured the credibility of this project (Guba, 1981).

Therefore, only secondary data were used to enlighten the interpretations, namely, students' anonymous narrative comments provided in course teaching evaluations. According to article 2.4 of the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (RCC, 2014), "review is not required for research that relies exclusively on secondary use of anonymous information, […] so long as the process of data linkage or recording or dissemination of results does not generate identifiable information" (p. 17), and we were exempted to ask for an ethical evaluation.

Results and Discussion

In the following sections, we present and discuss the main themes reported in students' narrative comments. These are (a) appreciated course design and structure, (b) enhanced presence through commented slideshows and support sessions, (c) instructor's accessibility and care, (d) challenging but relevant course, and (e) collaborative practice with a software application.

Appreciated Course Design and Structure

The course teaching evaluations suggest that most students appreciated the Mathematics Course for Business, with a global satisfaction rate of 95% over five semesters (with a global 57% CTE response rate). Some students mentioned that it was their first online course and a positive experience. "For my first experience in an online course, I find it very well designed. I generally appreciated it" (Fall 2018). Moreover, most comments suggested that the course structure was appreciated, even when students were not able to participate in the synchronous support sessions. "Thanks for the semester; I followed the course asynchronously because of my professional schedule, but I appreciated its design very much" (Summer 2018).

Although no student commented on this, the course design and structure were communicated asynchronously to the students from the beginning of the course, as a way to guide and facilitate students' navigation in the course LMS. The welcome video and introduction page explained how the online course was organized and how its different features (commented slideshows, support sessions, practice problems, discussion forums) should be exploited by the students. Indeed, students often need to get accustomed to online learning, which changes the learning process itself (Kaser & Hauk, 2016). The introduction page also encouraged students to ask questions and stated that they will be supported in their learning throughout the semester. It also emphasized problem solving as a core course learning objectives. As such, the welcome video and the introduction page established the instructor presence from the beginning of the semester. Written in an informal style, the introduction page also sought to develop students' social presence by insisting on open communications to support students' learning and foster positive experiences in the online course.

Enhanced Presence Through Commented Slideshows and Support Sessions

The commented slideshows and support sessions helped the students to progress through their learning thanks to detailed explanations about the course content. "A lot of content but very clear explanations. The commented slideshows and support sessions helped me a lot to progress through the content and to revise [for the exams]" (Fall 2017). Some students indicated that the commented slideshows enhanced the structure of the course. "The course is very well designed and presented. The commented slideshows, with detailed explanations, able even beginners to understand contents they have never seen before" (Winter 2017). Indeed, these slideshows supported students' learning by ensuring a teaching presence for each content module through direct instruction (Armellini & Stefani, 2016) but also by enabling student-content interactions with the instructional resources (Larbi-Siaw & Owusu-Agyeman, 2017). The support sessions reinforced both instructor's and students' social presences, as shown in the following comment. "Although it was an online course and I did not happen to meet with the instructor personally, I greatly appreciated her teaching. The explanations were concise and relevant. The virtual [support] sessions were dynamic and the examples were interesting" (Fall 2017). The support sessions also allowed students who participated synchronously to ask questions and interact with the instructor on a weekly basis, in addition to engaging in the asynchronous discussion forums. Such regular interactions between students and the instructor are important in online course (Bolliger & Martin, 2018; Thorpe, 2002), as they foster social presence (Lee & Huang, 2018) and enhance student satisfaction (Bolliger & Martindale, 2004; Lee et al., 2011). On several occasions, the instructor also encouraged the students to take some time (e.g., pausing the video if they were in asynchronous mode) to solve a problem by themselves, thus encouraging student-content interactions (Bolliger & Martin, 2018).

However, some students would have preferred that the course content be taught through lectures. Students suggested that synchronous online sessions should have taken place early during the week to allow the instructor time to teach the content, letting more time afterwards for practicing problems.

> I believe that the weekly meetings [support sessions] are fine, but I would change the concept. Instead of having a two-hour session devoted to problem solving (supposing that we already went through the content by ourselves), I would use this time to explain the content and demonstrate some problems. (Fall 2017)

We acknowledge that some students may have been more accustomed to lecture courses, especially in business or mathematics face-to-face courses. According to Farashahi and Tajeddin (2018), lectures still are "the most common teaching method in business schools" (p. 133). In addition, the format of an online course is different and usually requires more autonomy from the students. Therefore, as many other courses in the graduate program are also offered online, this prerequisite online course represented an opportunity for students to get used to progress through learning objectives and activities by themselves.

Several students mentioned that some content of the commented slideshows was difficult to understand with the instructor's voice only. They would have preferred that complex calculations had been explained in more detail or items highlighted by underlining or circling in the slides. As the first issue concerning more detailed resolutions or explanations could be resolved in a future version of the course, the second unfortunately cannot within a commented slideshow format. Indeed, these link audio recordings to slides, but such a format does not allow writing on the slides at the same time.

Nonetheless, both commented slideshows and recordings of support sessions provided students with an opportunity to watch any portion of these several times throughout the semester. As shown in the literature about mathematics courses (Cascaval et al., 2008; Yoon et al., 2014), such convenience supports the students in their learning process. Matzakos and Kalogiannakis (2018) have pointed out that students who do not understand the mathematical content the first time will review it through the recordings. The latter can also be used when studying for the exams, which is a great opportunity to support students' learning that often does not exist in face-to-face courses.

Instructor Accessibility and Care

The students usually commented about the instructor's accessibility and availability. "The instructor is available and attentive to the students to answer their questions. I appreciated her course" (Fall 2017). They liked that the instructor would reformulate mathematical content through different explanations when needed. They also appreciated the follow-up and care throughout the semester, which supported their learning. "The instructor is doing an excellent follow-up work and ensures that the students have all required elements to prepare themselves for the exams and upcoming courses in the curriculum" (Fall 2018). In the course LMS and during the support sessions, the instructor encouraged the students to persevere, addressing them by name and welcoming them to ask further questions asynchronously on the discussion forums, thus fostering interactions with the students (Bolliger & Martin, 2018). Such demonstrations of an instructor's interpersonal abilities encourage open communication and risk-free expressions from the students, as part of social presence (Garrison, 2011; Yang, 2017). These also contribute to an increased sense of the instructor's presence by showing his or her accessibility and care, which are at the center of an online course and provide support to students' learning (Robinson et al., 2017).

Challenging but Relevant Course

Not surprisingly, the students commented on the density of the course content. Nonetheless, the comments usually denoted positive perceptions about course material. "Surely the course is dense, but I appreciated following it" (Fall 2017). Several students also indicated that the first half of the course was denser than the second, and that changes in the structure of the modules should be addressed. From a mathematical standpoint, the first half of the course represented a considerable amount of content since it covered the basics of algebra, particular functions, and calculus. The second half of the course concerned linear algebra, optimization, descriptive statistics, and probabilities. Since the last two modules were an introduction to the next mathematics course in the program, they were not as detailed as the previous ones. Therefore, the module organization and distribution throughout a semester should be addressed in a future version of the course.

Furthermore, several students found the course demanding and challenging. "Challenging course that demands a lot of time and practice" (Fall 2018). However, some other students indicated that the workload is appropriate: "The course was interesting and the workload was adequate. We reached various contents without going too far in the details, which was perfect in my opinion" (Fall 2018). Differences in the above comments can be explained by students' level in mathematics at the beginning of the semester. There are experienced students who, while lacking some mathematics requirements to enter the graduate program, can manage the course content without too much difficulty. On the contrary, students who had minimal pre-university mathematics experience found it demanding and had to work hard to succeed. Still, the challenge could be overcome and was appreciated by some students. "I have always feared mathematics. But

this course gives me the feeling that mathematics as accessible as the alphabet. Thanks" (Summer 2017). "The instructor brought me to like maths… a very difficult task!" (Fall 2017).

The students also appreciated that the content was linked to business problems. "I liked the course very much. The instructor makes the connection between the content and the applications in our future professional life" (Fall 2018). Some emphasized the relevance of the problems for a future manager. "The proposed mathematical problems reflect the reality of a business company and the examples are relevant for a future manager" (Summer 2017). They understand that the mathematical content would be needed later in the program or in professional settings. "I am extremely happy that I decided to follow this course, since it brings me solid grounds for the program" (Summer 2017). Such problems encouraged student-content interactions, which supported them in their learning process. Further, professional or personal relevance of content and activities enhanced students' positive perceptions of the course through motivation and cognitive engagement (Park & Yun, 2018; Robinson et al., 2017).

Collaborative Practice with a Software Application

First, note that the choice of integrating a software application in a mathematics course has been recommended in the literature (Matzakos & Kalogiannakis, 2018; Yang, 2017) to illustrate the learning content (in another way than manual calculations). This increases students' interest in mathematics through relevance, which, in turn, improves their perceptions (Robinson et al., 2017). The students usually appreciated this because they got the chance to integrate the content while practicing or improving their skills in Microsoft Excel. "I particularly liked the Excel applications. It was very nice to practice! :)" (Winter 2017). Several students commented on the relevance of such activities for business or their personal lives. "This course was very useful in my everyday life. Better understanding Excel features is truly an asset nowadays" (Fall 2017). However, some students did not understand the purpose of such work, probably because they already knew the application well. Some students mentioned that the instructions relating to the Excel activities were confusing or not detailed enough. Also, they would have liked more direct instruction about these activities, for instance additional video capsules explaining how to deal with matrices. Although some capsules were provided in the LMS about descriptive statistics and scatterplots, additional ones could be integrated to a future version of the online course to better support the students in their learning.

Regarding the collaborative work assessments, some students indicated that they would have preferred to have worked individually. "Two collaborative work assessments are a big risk to take, especially since the marks are determining our admission in the program, thus more individual assessments" (Fall 2017). Some also mentioned difficulties to ensure an equal workload of all teammates, which has been indicated as a challenge in literature (Le et al., 2018). While a peer evaluation system has been included in the assessments to ensure teammates' conscientiousness and equal division of workload (Robinson et al., 2017), narrative comments suggested this was not enough. Since learning to work collaboratively is very important for business students, future improvements of the course should find suggestions to balance the workload between all teammates and foster effective collaboration despite the asynchronous context of the course. Still, although some students would have preferred to work alone, they learned to effectively communicate and interact with their peers, which is part of the required managerial skills for the 21st century in business (Farashahi & Tajeddin, 2018).

Limitations

A first drawback to this project is that no primary data were collected, therefore limiting evidence of capturing students' experiences in the online course. The use of students' narrative comments in CTE can also be criticized because of an answer rate below 60% or because such data were not collected for the specific purpose of studying how their learning is supported. However, the examination of the course LMS and students' narrative comments (collected over five semesters in CTE) are eloquent and provide relevant information about teaching and learning in the online course. Such qualitative data are also among those cited by Hubball and Clarke (2010) for SoTL research projects. While maintaining students' anonymity, they enlighten several main features of the online course and bring ideas for future improvements. A second limitation is that the course instructor is also the first author of this paper, which was disclosed in the context and problem section. Discussions with the second author and researcher, however, helped to bring a fresh and neutral look on the course. They also ensure that narrative comments illustrated both positive and negative aspects about the online course design. A next SoTL project could analyze these to identify, implement, and evaluate improvements to the online course.

Conclusion

This paper reports on the main features of an online mathematics course, as perceived by the students and to support their learning. In addition to an observation of the course design features in the LMS, students' perceptions were collected through anonymous narrative comments in course teaching evaluations. The main themes reported in students' comments refer to their appreciation of the course design and structure, the enhanced instructor's presence through the commented slideshows and support sessions, the instructor's accessibility and care, the challenging but relevant course, and collaborative practice with a software application. Most comments suggest that these features support their learning in the online course, especially through the strong instructor's presence and follow-up throughout the semester.

Several comments also pinpoint ideas for future improvements such as balancing the modules' organization, providing additional video capsules to illustrate more complex mathematical content, or refining the collaborative work assessments. Between the first and the final version of this paper, the online Mathematics Course for Business has benefitted from this SoTL project. First, the organization of modules has been revised to better balance its first and second half. Second, many video capsules have been added to each module of the course to better explain complex content, enhance interactions, and support students' learning.

This paper reports on what is considered a satisfactory experience about online course development in a business faculty. While there is a growing body of literature about online learning, it remains an uncharted territory for many instructors. Five years ago, the mathematician and course instructor would have said that an online course was appropriate for courses that had discussions such as in the social sciences, but not for a prerequisite mathematics course. Today, both authors are convinced that an online course can be suitable for the fields of mathematics with appropriate features supporting students' learning. The instructor's presence, in particular, has to be developed the right way to ensure that students are properly supported in their learning and that they appreciate the online experience.

As for the practitioner who would like to get additional recommendations on the development of an online course, let us start by an obvious (but somewhat neglected) advice, i.e., the pedagogical alignment of an online course, which includes didactic, pedagogical (and learning evaluation) as well as technological planning, must be reflected in an active and collaborative logic to enhance students' learning experience. Finding ways to guide and support students' learning in

an online course should be a main concern, which explains why it has been the focus of our attention in this study. In particular, the instructor's presence, accessibility, and care have major impacts on students' perceptions in an online course. In addition to fostering positive experiences, the instructor's presence can encourage students to engage in a wide variety of active and collaborative learning scenarios. When planning an online course, it is therefore necessary to demonstrate a capacity for technopedagogical innovation to put students at the center of their learning, without exceeding the instructor's comfort zone. Finally, develop a first version of the online course knowing it will not be the last. The development of an online course requires adjustments and refinements, and instructors will appreciate seeing how it evolves over time. By adopting a SoTL reflexive strategy of professional development, the instructor can keep a critical posture in the planning, design, and organization of the course with a view to continuous improvement and self-regulation of instructors' professional interventions.

References

Audet, L. (2011). Regards sur l'évolution de la formation à distance au Canada francophone. *Distances et savoirs*, *33*(9), 313-330. https://doi.org/10.3166/ds.9.313-330

Anderson, T. (2004). Teaching in an online learning context. In *Theory and practice of online learning*, *273-294.* Athabasca University Press.

Armellini, A., & De Stefani, M. (2016). Social presence in the 21st century: An adjustment to the Community of Inquiry framework. *British Journal of Educational Technology, 47*(6), 1202-1216. https://doi.org/10.3166/ds.9.313-330

Baker, J. D. (2004). An investigation of relationships among instructor immediacy and affective and cognitive learning in the online classroom. *The Internet and Higher Education*, *7*(1), 1-13. https://doi.org/10.1016/j.iheduc.2003.11.006

Baker, C. K., & Hjalmarson, M. (2019). Designing purposeful student interactions to advance synchronous learning experiences, *International Journal of Web-Based Learning and Teaching Technologies*, *14*(1), 1-16. https://doi.org/10.1016/j.iheduc.2003.11.006

Bates, T. (2018). The 2017 national survey of online learning in Canadian post-secondary education: methodology and results. *International Journal of Educational Technology in Higher Education*, *15*(1). https://doi.org/10.1186/s41239-018-0112-3

Bialowas, A., & Steimel, S. (2019). Less is more: Use of video to address the problem of teacher immediacy and presence in online courses. *International Journal of Teaching and Learning in Higher Education*, *31*(2), 354-364.

Bigatel, P. M., & Edel-Malizia, S. (2018). Using the "Indicators of Engaged Learning Online" framework to evaluate online course quality. *TechTrends*, *62*(1), 58-70. https://doi.org/10.1007/s11528-017-0239-4

Blackmon, S. J., & Major, C. (2012). Student experiences in online courses: A qualitative research synthesis. *The Quarterly Review of Distance Education*, *13*(2), 77-85.

Bolliger, D. U., & Martin, F. (2018). Instructor and student perceptions of online student engagement strategies. *Distance Education*, *39*(4), 568-583. https://doi.org/10.1080/01587919.2018.1520041

Bolliger, D. U., & Martindale, T. (2004). Key factors for determining student satisfaction in online courses. *International Journal on E-Learning*, *3*(1), 61-67.

Bower, M., Dalgarno, B., Kennedy, G. E., Lee, M. J., & Kenney, J. (2015). Design and implementation factors in blended synchronous learning environments: Outcomes from a cross-case analysis. *Computers & Education, 86*, 1-17. https://doi.org/10.1016/j.compedu.2015.03.006

Cascaval, R. C., Fogler, K. A., Abrams, G. D., & Durham, R. L. (2008). Evaluating the benefits of providing archived online lectures to in-class math students. *Journal of Asynchronous Learning Networks, 12*(3-4), 61-70. https://doi.org/10.24059/olj.v12i3.65

Charrier, B., & Lerner-Sei, S. (2011). Rapport au temps et formation à distance. Un point de vue clinique. *Distances et Savoirs*, *3*(9), 419-443. https://doi.org/10.3166/ds.9.419-443

Cosnefroy, L. (2012). Autonomie et formation à distance. *Recherche et Formation, 69*, 111-118.

Creswell, J. W. (2007). Five qualitative approaches to inquiry. In *Qualitative inquiry and research design: Choosing among five approaches* (2nd ed.) (pp. 53-84). Sage.

Denami, M. A., & Marquet, P. (2015). Le sentiment d'isolement en formation ouverte à distance (FOAD) : quelle réalité, quelles conséquences? *Frantice.net*, *10*, 47-63.

Deschryver, N. (2008). Interaction sociale et expérience d'apprentissage en formation hybride. Unpublished doctoral dissertation, Université de Genève, Switzerland.

Donovan, T., Bates, T., Seaman, J., Mayer, D., Martel, E., Paul, R., ..., & Poulin, R. (2019). Tracking online and distance education in Canadian universities and colleges: 2018. *Vancouver BC: Canadian Digital Learning Research Association.*

Dumford, A. D., & Miller, A. L. (2018). Online learning in higher education: Exploring advantages and disadvantages for engagement. *Journal of Computing in Higher Education*, *30*(3), 452-465. https://doi.org/10.1007/s12528-018-9179-z

Dussarps, C. (2014). *Dimension socio-affective et abandon en formation ouverte et à distance.* Unpublished doctoral dissertation, Université Michel de Montaigne, France.

Fadde, P. J., & Vu, P. (2014). Blended online learning: Benefits, challenges, and misconceptions. In *Online learning: Common misconceptions, benefits and challenges* (pp. 33-48). Nova Science Publishing.

Farashahi, M., & Tajeddin, M. (2018). Effectiveness of teaching methods in business education: A comparison study on the learning outcomes of lectures, case studies and simulations. *The International Journal of Management Education*, *16*(1), 131-142. https://doi.org/10.1016/j.ijme.2018.01.003

Ferone, G. (2011). Favoriser les interactions à distance en formation des maîtres. *Former et apprendre à distance, 68*, 79-94. https://doi.org/10.4000/rechercheformation.1554

FSA ULaval (2016). *Plan stratégique FSA ULaval 2016-2019*. Internal document. Université Laval, Québec.

Gale, R. A. (2008). Points without limits: Individual inquiry, collaborative investigation, and collective scholarship. In E. Robertson and L. Nilson (Eds.), *To improve the academy: Resources for faculty, instructional and organizational development*, Vol. 26 (pp. 39-52). Jossey-Bass. https://doi.org/10.1002/j.2334-4822.2008.tb00499.x

Garrison, D. R. (2011). *E-learning in the 21st century: A community of inquiry framework for research and practice*. Routledge. https://doi.org/10.4324/9780203838761

Guba, E. G. (1981). Criteria for assessing the trustworthiness of naturalistic inquiries. *ECTJ, 29*(2), 75.

Guest, R., Rohde, N., Selvanathan, S., & Soesmanto, T. (2018). Student satisfaction and online teaching. *Assessment & Evaluation in Higher Education, 43*(7), 1084-1093. https://doi.org/10.1080/02602938.2018.1433815

Harvey, L. (2016). Les évaluations de l'enseignement par les étudiants : vers une démarche abrégée. *Mesure et évaluation en éducation*, *39*(2), 1. https://doi.org/10.7202/1038240ar

Hubball, H., & Clarke, A. (2010). Diverse methodological approaches and considerations for SoTL in higher education. *The Canadian Journal for the Scholarship of Teaching and Learning*, *1*(1), 1-11. https://doi.org/10.5206/cjsotl-rcacea.2010.1.2

Hyde, K. F. (2000). Recognising deductive processes in qualitative research. *Qualitative Market Research: An International Journal*, *3*(2), 82-90. https://doi.org/10.1108/13522750010322089

Kaser, J., & Hauk, S. (2016). To be or not to be an online math instructor? *Grantee Submission*, *7*(3), 41-48.

Larbi-Siaw, O., & Owusu-Agyeman, Y. (2017). Miscellany of students' satisfaction in an asynchronous learning environment. *Journal of Educational Technology Systems*, *45*(4), 456-475. https://doi.org/10.1177/0047239516667499

Le, H., Janssen, J., & Wubbels, T. (2018). Collaborative learning practices: Teacher and student perceived obstacles to effective student collaboration. *Cambridge Journal of Education*, *48*(1), 103-122. https://doi.org/10.1080/0305764X.2016.1259389

Lee, S. J., & Huang, K. (2018). Online interactions and social presence in online learning. *Journal of Interactive Learning Research*, *29*(1), 113-128.

Lee, E., Pate, J. A., & Cozart, D. (2015). Autonomy support for online students. *TechTrends*, *59*(4), 54-61. https://doi.org/10.1007/s11528-015-0871-9

Lee, S. J., Srinivasan, S., Trail, T., Lewis, D., & Lopez, S. (2011). Examining the relationship among student perception of support, course satisfaction, and learning outcomes in online learning. *The internet and higher education*, *14*(3), 158-163. https://doi.org/10.1016/j.iheduc.2011.04.001

Leech, N. L., & Onwuegbuzie, A. J. (2007). An array of qualitative data analysis tools: A call for data analysis triangulation. *School Psychology Quarterly*, *22*(4), 557-584. https://doi.org/10.1037/1045-3830.22.4.557

Ma, J., Han, X., Yang, J., & Cheng, J. (2015). Examining the necessary condition for engagement in an online learning environment based on learning analytics approach: The role of the instructor. *The Internet and Higher Education*, *24*, 26-34. https://doi.org/10.1016/j.iheduc.2014.09.005

Manganello, C., Falsetti, C., & Leo, T. (2019). Self-regulated learning for web-enhanced control engineering education. *Educational Technology & Society*, *22*(1), 44-58.

Martin, F., & Bolliger, D. U. (2018). Engagement matters: Student perceptions on the importance of engagement strategies in the online learning environment. *Online Learning*, *22*(1). https://doi.org/10.24059/olj.v22i1.1092

Matzakos, N. M., & Kalogiannakis, M. (2018). An analysis of first year engineering students' satisfaction with a support distance learning program in mathematics. *Education and Information Technologies*, *23*(2), 869-891. https://doi.org/10.1007/s10639-017-9641-y

McBrien, J. L., Cheng, R., & Jones, P. (2009). Virtual spaces: Employing a synchronous online classroom to facilitate student engagement in online learning. *The International Review of Research in Open and Distributed Learning*, *10*(3). https://doi.org/10.19173/irrodl.v10i3.605

Merriam, S.B., & Tisdell, E.J. (2016). *Qualitative Research. A Guide to Design and Implementation*. Jossey-Bass Wiley.

Moore, M. G. (1989). Editorial: Three types of interaction. *American Journal of Distance Education*, *3*(2), 1-7. https://doi.org/10.1080/08923648909526659

Moore, M. G. (2013). The theory of transactional distance. In *Handbook of distance education* (pp. 84-103). Routledge. https://doi.org/10.4324/9780203803738.ch5

Park, S., & Yun, H. (2018). The influence of motivational regulation strategies on online students' behavioral, emotional, and cognitive engagement. *American Journal of Distance Education*, *32*(1), 43-56. https://doi.org/10.1080/08923647.2018.1412738

Peraya, D. (2011). Un regard sur la « distance », vue de la « présence ». *Distances et savoirs*, 9 (3), 445-452.

Peterson, A. T., Beymer, P. N., & Putnam, R. T. (2018). Synchronous and asynchronous discussions: Effects on cooperation, belonging, and affect. *Online Learning*, *22*(4). https://doi.org/10.24059/olj.v22i4.1517

RCC, Canadian Institutes of Health Research, Natural Sciences and Engineering Research Council of Canada, and Social Sciences and Humanities Research Council of Canada (2014). *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans*. Government of Canada. http://publications.gc.ca/collections/collection_2015/ger-pre/RR4-2-2014-eng.pdf

Richardson, J. C., Koehler, A. A., Besser, E. D., Caskurlu, S., Lim, J., & Mueller, C. M. (2015). Conceptualizing and investigating instructor presence in online learning environments. *The International Review of Research in Open and Distributed Learning*, *16*(3), 256-297. https://doi.org/10.19173/irrodl.v16i3.2123

Richardson, J. C., Besser, E., Koehler, A., Lim, J., & Strait, M. (2016). Instructors' perceptions of instructor presence in online learning environments. *International Review of Research in Open and Distributed Learning*, *17*(4), 82-104. https://doi.org/10.19173/irrodl.v17i4.2330

Robinson, H. A., Kilgore, W., & Warren, S. J. (2017). Care, communication, support: Core for designing meaningful online collaborative learning. *Online Learning*, *21*(4). https://doi.org/10.24059/olj.v21i4.1240

Seaman, J. E., Allen, I. E., & Seaman, J. (2018). Grade increase: Tracking distance education in the United States. *Babson Survey Research Group*.

Siemens, G., Gašević, D., & Dawson, S. (2015). Preparing for the digital university: A review of the history and current state of distance, blended, and online learning. http://linkresearchlab.org/PreparingDigitalUniversity.pdf

Simmons, N., & Marquis, E. (2017). Defining the scholarship of teaching and learning. *The Canadian Journal for the Scholarship of Teaching and Learning*, *8*(2), 2. https://doi.org/10.5206/cjsotl-rcacea.2017.2.2

Swan, K. (2001). Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. *Distance education*, *22*(2), 306-331. https://doi.org/10.1080/0158791010220208

Tallent-Runnels, M. K., Thomas, J. A., Lan, W. Y., Cooper, S., Ahern, T. C., Shaw, S. M., & Liu, X. (2006). Teaching Courses Online: A Review of the Research. *Review of Educational Research*, *76*(1), 93-135. https://doi.org/10.3102/00346543076001093

Thorpe, M. (2002). Rethinking learner support: The challenge of collaborative online learning. *Open Learning: The Journal of Open, Distance and e-Learning*, *17*(2), 105-119. https://doi.org/10.1080/02680510220146887a

Watts, L. (2016). Synchronous and asynchronous communication in distance learning: A review of the literature. *Quarterly Review of Distance Education*, *17*(1), 23-32.

Yang, D. (2017). Instructional strategies and course design for teaching statistics online: Perspectives from online students. *International Journal of STEM Education*, *4*(1), 34. https://doi.org/10.1186/s40594-017-0096-x

Yoon, C., Oates, G., & Sneddon, J. (2014). Undergraduate mathematics students' reasons for attending live lectures when recordings are available. *International Journal of Mathematical Education in Science & Technology*, *45*(2), 227–240. https://doi.org/10.1080/0020739X.2013.822578