The International Journal of Management Education 19 (2021) 100532

Contents lists available at ScienceDirect

The International Journal of Management Education

journal homepage: www.elsevier.com/locate/ijme

Exploring cross-disciplinary differences in course mode, instructional tools and teaching methods in online courses in business & management

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ARTICLE INFO

Keywords:
Instructional tools
Teaching methods
Online education
Online tools
Learning technologies
Pedagogy
Course mode
Cross-disciplinary research

ABSTRACT

Building on research from past decades, this paper explores cross-disciplinary curricular and teaching differences in online, blended and web-facilitated business and management courses. Based on an online survey of 240 USA, Canadian and European university instructors, the authors examine if faculty differ in their preferred course mode (the degree of online delivery), instructional tools used, and teaching methods, by discipline types (hard or soft) and five subject groups. The research found cross-disciplinary differences in the use of some of the 29 instructional tools surveyed (e.g. online group projects, group tools like wikis, and specialized software) and in teaching methods (didactic, dialectic dialogic, dialectic collaborative and heuristic). No significant disciplinary differences were found in the instructor's choice of course mode perhaps pointing to wider engagement in online learning in all business and management disciplines.

1. Introduction

We have seen a significant and accelerating growth in the use of online technologies in higher education internationally over the last decade (Allen et al., 2016; Brown, 2016; Kumar et al., 2019; Nakos & Whiting, 2018). From 2012 until 2016 in the United States, the proportion of university students who took at least one course at a distance grew from 25.9% to 31.6% (Seaman et al., 2018), and in fall of 2018 they constituted 34.7% of all enrollments (US Department of Education, 2019). In Canada, Bates et al. (2017) reported that the number of university courses offered for credit at a distance increased from 69,197 in 2011 to 104,801 in 2017. Brown (2016) commented on the increased use of online tools in face-to-face teaching and the blended model becoming the 'new traditional' (p. 1).

The rapid growth in the proportion of higher education students who take online courses has led to a rising body of research exploring the use of digital tools and technologies in both traditional and online business and management education (BME) classrooms (Arbaugh, 2013; Benson & Kolsaker, 2015; Hwang, 2018). We can expect that the 2020–21 push toward online learning urged on by an international pandemic will continue to accelerate research in this field. Although Arbaugh and Warell (2009) called for more comparative and cross-disciplinary research on online technologies used in BME, current research continues to reveal several gaps.

Some of these gaps stem from a significant number of contributions specific to a particular academic discipline or focused on a

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https://doi.org/10.1016/j.ijme.2021.100532
Received 16 October 2019; Received in revised form 31 May 2021; Accepted 13 June 2021
Available online 23 June 2021

single digital tool and therefore miss the broader comparison between disciplines (Brennan & Vos, 2013; Carnaghan et al., 2011; Huang & Hsu, 2011; Lojo, 2016). Also, few studies have integrated the views of faculty or explored issues in teaching and curriculum design for online learning (Brown, 2016; Kumar et al., 2019). The focus of this study was to gain deeper insight into the nature and extent of online technology use in teaching and learning across the BME field, drawing on instructor accounts. Since instructor decisions are key to the design and delivery of technology-enhanced courses, we examined the views of faculty by exploring their patterns of choice or preferences in the use of digital tools.

As a first step, this study sought to provide insights into the development of disciplinary differences in the use of online tools comparing the first and second decades of the 21st century through a detailed literature review; this was performed in addition to our survey. Arbaugh and collaborating authors (Arbaugh et al., 2009, 2010; Arbaugh & Rau, 2007) were among the researchers who compared curricular design differences in technology mediated courses across types of disciplines (hard vs soft) and by discipline groupings. We inventoried the works of BME authors on online teaching and learning to identify any possible trend in the focus of research over time. As a second step, the researchers sought to provide information on the choices BME instructors made to integrate online technologies in their courses through a research survey. Since the study was undertaken pre-COVID, it may provide an empirical baseline from which future research can compare some of the 'before picture'.

Drawing on empirical data obtained through the online survey of instructors in the BME field, we explored three significant areas of curricular discipline differences: 1) course mode (the degree of online delivery); 2) use of tools for online learning and teaching (total of 29 tools); and 3) teaching methods (one or two-way communication as an example).

From our overview of the literature on BME discipline research for teaching and curriculum issues, we expected that hard vs. soft disciplines would choose different pedagogies and tools – the content of some disciplines, for example, would require more repeated practice exercises while others would need more reflection and group work. We also expected that with a greater number of tools available, instructors who are teaching online would make use of a wider cross section of technological tools.

The methodology segment provides information on the survey instrument, sampling procedures, measures and statistical tests used. Results are presented first based on the statistical analysis, followed by a discussion on the most important findings. Opportunities for further study are presented along with study limitations and the conclusion summarizes the statistically significant results regarding the instructor's choice of curriculum design (namely of course mode, instructional tools used and teaching methods) preferred by BME disciplines.

2. Literature review

2.1. The progress of BME disciplines online

By 2010, a number of reviews on the state of knowledge in business and management concluded that the pace and nature of integration of online teaching and learning had been uneven (Arbaugh et al., 2009, 2010; Arbaugh & Warell, 2009). Researchers suggested that advances in teaching methods and instructional tools used in one discipline were not well shared, with most studies focused on a specific discipline or a particular tool (Arbaugh et al., 2009, 2010; Arbaugh & Warell, 2009). In addition, Smith et al. (2008) confirmed that "discipline is often overlooked in research on the instructional design of e-learning" (p. 63) so not only were advances not well shared, but online practices often neglected to consider discipline-related impacts and opportunities. Some researchers called for more collaboration, integration across disciplines, and the innovative use of technologies to solve the complex and messy problems found in today's dynamic social and business environments (Bratianu, 2015; Buttermore, 2010).

Kumar et al. (2019) concurred with earlier reviews on the uneven degree of integration of online tools into teaching and learning in BME disciplines. For example, whilst they found that every discipline had publications relating to online delivery, the majority of publications came from Information Technology, General Business and Management disciplines. Our own extensive literature review and physical count on the use of digital tools in BME disciplines in both leading general management education journals (e.g. Journal of Management Education, International Journal of Management Education, and others), and in discipline-specific journals (e.g. Accounting Education, Issues in Accounting Education, Journal of Accounting Education, Journal for Advancement of Marketing Education, Marketing Education Review, and others) between 2010 and 2019 supported the conclusions of Arbaugh et al. (2009), Arbaugh and Warell (2009) and Kumar et al. (2019) that differences continue to exist in the use of online technologies across types of business disciplines (i.e. hard vs soft and pure vs applied), but also within these types.

To illustrate, our review of literature over the last decade unveiled that "hard" disciplines (Accounting, Finance, Economics, Operations, Production/Supply Chain and Information Systems/Informatics) focused on researching the effectiveness of online technological tools, such as simulations, games, online textbooks and integrated software packages. While within the Accounting, Finance and Economics (AFE) discipline grouping, Economics education had more research on the comparison between traditional methods vs. technology-enhanced settings and those using experimental research methods (e.g. Carter & Emerson, 2012; Olitsky & Cosgrove, 2014). In another example, Management, Business and Marketing (MBM) as a group of disciplines (see 2.3 discussion below) were more likely to research collaborative and interactive tools and technologies. Within the latter group, Marketing education research showed greater interest than any other disciplines on the implications of digital marketing and social media for education (Brocato et al., 2015; Cowley, 2017; Crittenden & Crittenden, 2015).

2.2. Definition of discipline

Dressel and Mayhew (1974) provide some useful definitions of discipline as a "general body of knowledge", a "sequence of learning

topics needed to acquire subject matter expertise", an "accepted body of theory" and describe it is as a technique that focuses research, allows for the aggregation of common methodologies and a useful construct for theory testing and analysis (1974, pp. 3–4).

Arbaugh's (2005) article on the relevance of subject matter in pedagogy examines the relationship between disciplinary effects and course outcomes in online MBA courses and further supports the use of 'subject matter', 'subject' and 'discipline' as interchangeable terms.

2.3. BME discipline classification

Biglan (1973) aptly points out that universities and colleges are organized by 'subject matter', 'department' and 'discipline', which are basically aligned in most higher education institutions. His seminal research separates disciplines into three dimensions: 1) 'hard-soft' 2) 'applied-pure' and 3) 'animate-inanimate'. Building on Biglan (1973) and Kolb (1981), Neumann et al. (2002) proposed a framework for categorizing academic disciplines based on epistemological principles. From our literature review, Biglan's (1973) third dimension (animate vs inanimate) was quickly eliminated as a non-differentiator in the business disciplines, leaving only two dimensions (which we call 'types'): hard vs soft and pure vs applied. Disciplines that were classified as 'hard' disciplines viewed knowledge as ordered and cumulative, "subscribed by all members of the field", whilst 'soft' disciplines had a more fluid and constructivist base of knowledge, where "content and method … tend to be idiosyncratic" (Biglan, 1973, pp. 201–202).

Biglan (1973) and Neumann et al. (2002) also distinguished between 'pure' disciplines, with primary emphasis on knowledge acquisition, versus 'applied', which were focused on practical knowledge application. Neumann et al. (2002) argued that these disciplinary differences manifested themselves through different approaches to curriculum design, assessment, and in the roles of the teacher and the learner. That is, curricula of hard pure subjects had a quantitative bias and emphasized linear gradual building of knowledge, whilst soft pure subjects had a qualitative bias and more iterative, loosely structured approaches to curriculum design. In terms of teaching methods, hard pure courses were often delivered in large lecture classes supplemented with laboratory sessions or fieldwork activities, while soft pure courses tended to minimize lectures and placed more emphasis on activities and interactions in smaller group settings, including those delivered via the Web.

On these cross-disciplinary differences, researchers described the BME field as largely applied and soft in its orientation with the exception of Accounting, Finance and Operations/Logistics Management, which were identified as hard applied disciplines (Arbaugh et al., 2009; Biglan, 1973; Neumann et al., 2002). Due to this finding, we reduced the discipline type in our research to the comparison between hard and soft subjects.

There has been significant research aiming to explore Biglan's (1973) framework in relation to academic work (Clark, 1987; Smeby, 1996), academic supervision practices (Becher et al., 1994), course structures (Donald, 1983), curriculum and assessment (Braxton, 1995; Smart & Ethington, 1995), and differences in students' theories of knowledge acquisition (Paulsen & Wells, 1998). Most of these studies supported differences in academic traditions, conventions and practices in relation to both teaching and learning across groups of disciplines. One would expect a greater degree of convergence of disciplines in the 21st century due to the integration of online media and content (and consequently opportunities to borrow educational practices from one disciplinary context to another) and more emphasis on interdisciplinary studies, especially in the hard and natural science fields (Tripp & Shortlidge, 2019). However, a recent study by Simpson (2016), who explored patterns of disciplines in UK higher education, confirmed the prominence of disciplinary differences transcending not only institutional, but also national boundaries.

Student perceptions of pedagogical approaches in BME disciplines showed differences between discipline pedagogies (Arbaugh, 2013). For example, teaching in hard disciplines was described as more teacher-centered and instructive, while teaching in soft disciplines as more interactive and constructive with emphasis on student-student interaction and group work. Consequently, the perceptions of instructor roles and desirable behaviors by students varied across different academic disciplines. Instructors in harder subjects were more likely to adopt the role of content experts whereas in softer subjects they acted closer to facilitators of discourse. Although both higher education and management education literature shows a close relationship between instructor behaviors and learner experiences (Guo et al., 2019; Kumar et al., 2019), previous research has mostly been focused on views of the learner, even when aspects of online teaching were researched. Perspectives of BME instructors received far less attention and few, if any, comparative studies focusing on the practices of online instructors in the various BME disciplines have been conducted since 2015, a topic particularly important with the growth of online learning, the focus on assurance of learning, student satisfaction, quality, transferability, and concerns over developing sound pedagogy in higher education.

Instructors construct the fundamental components of the learning process by their selection of course design and curricular elements including degree of online delivery, instructional tools (such as lectures, presentation, video captures, group discussion, team collaboration, group work, cases, games, reflection and exercises), best pedagogy methods (such as didactic, dialectic and heuristic approaches) and assessment tools to accomplish course learning outcomes (Mehta et al., 2017). Academics play a central role in enhancing the quality of online learning for optimal student performance and satisfaction when they effectively align technology with course content/discipline, instructional methods and support for the learner (Kauffman, 2015; Nemetz et al., 2017; Rogerson-Revell, 2015).

Groupings were identified in Arbaugh et al. (2009) who categorized BME disciplines into seven groups: Management, Information Systems, Accounting, Marketing, Operations/Supply Chain Management; Finance, and Economics. A more recent overview of extant research by Kumar et al. (2019) used eight discipline groupings, adding Business as a separate group.

In this research, we described disciplines by two types (hard, soft) and five groupings (AFE, OPI, MBM, STRAT, OBHR). In our *Framework of Disciplines* (Appendix A), soft disciplines included MBM, OBHR, and STRAT groups while AFE and OPI groups were classified as hard disciplines.

In addition, courses served as a proxy for discipline (both type and group). For example, Microeconomics and Macroeconomics were classified as hard disciplines and included in the AFE group. Introduction to Business and Entrepreneurship courses were categorized as soft disciplines and included in the MBM group. Supply Chain Management and Information Systems courses were identified as hard discipline and classified in the OPI grouping. Appendix A '*Framework of Disciplines'* provides a more detailed picture of this classification of discipline and groupings.

Arbaugh et al.'s (2009) summary of 182 articles supported clustering of Accounting, Finance and Economics (AFE group) as well as collapsing Operations/Supply Chain Management and Information Systems (Informatics) forming the OPI group.

Simpson's (2016) research lent additional support for the three BME discipline groups of AFE, MBM (which included Management, Business Studies, Law and Marketing) and OBHR (both Organizational Behavior and Human Resources were part of the 'soft' field of 'Management Studies') because of their high similarity in assessment practices. Other studies (Arbaugh et al., 2009; Chen & Paulraj, 2004; Keebler, 2000) showed a significant overlap in the remit of research in Logistics, Supply Chain Management, Operations Management, Production Management, Statistics and Informatics (OPI) describing them as 'hard' sciences.

Strategy (STRAT), including Strategic Management and Strategic Marketing, has been considered an integrative subject taught as a senior-level capstone course and an 'applied soft' discipline (Jarzabkowski & Giulietti, 2007). Biglan's (1973) paper found that Strategy had both research and practical application paradigms which qualified it as its own academic discipline group (see Appendix A).

2.4. Course mode

An important variable of interest in this study centered around *course mode* in e-education. Allen et al.'s (2016) work placed online learning on a continuum from fully online to face-to-face. For the purpose of this study, the 'traditional' face-to-face course delivery method or mode was not included. The Allen et al. (2016) continuum describes the degree of online delivery as:

- Fully online: 80% or more of course activities and interactions are online;
- Hybrid or blended: 30–79% of course activities and interactions are online;
- Web facilitated: 1–29% of course activities and interactions are online;
- Traditional: 0% (so no online components).

A number of researchers reported on the relative merit of online learning in multiple disciplines (Callister & Love, 2016; Gill & Mullarkey, 2015; Horspool & Lange, 2012; Strang, 2019) while others had contradictory points of view. Some researchers believed certain courses were more difficult to teach online due to their complex content or in their need for modeling and problem solving (Bassili, 2008; Smith et al., 2008). For example, in their meta-analysis of Economics courses, Sohn and Romal (2015) found students performed better in face-to-face courses and similar findings were reported by Faidley (2018) in Accounting classes. This pattern appeared more prevalent in quantitative or hard disciplines including Mathematics, Operations, Finance, Business Statistics and Business Research (Mayer et al., 2017). Other researchers, however, found that in comparative empirical studies, online teaching is just as effective for student performance and satisfaction as face-to-face instruction regardless of the discipline type or grouping studied (Cao, 2011; Cavanaugh & Jacquemin, 2015; Guest et al., 2018).

In one of the rare cross-disciplinary comparative studies found, Sanford et al. (2014) examined four BME disciplines across three course modes and found that Management majors positively associated the online format with perceived learning, while face-to-face classes were positively associated with learning satisfaction. In contrast, Marketing majors indicated that the face-to-face format was negatively associated with perceived learning.

Accounting and Finance majors indicated that the online and face-to-face formats did not associate with either satisfaction or perceived learning, but Accounting students preferred a blended course format (Fortin et al., 2019). Choice of *course mode* has been identified as an important factor in the effectiveness of online education (Garnjost & Lawter, 2019; Kumar et al., 2019; Means et al., 2013). However, none of these studies employed cross-disciplinary comparisons or presented convincing evidence on the likelihood of a particular discipline's tendency to choose an online or blended mode. Most of the previous research was discipline-specific, student-related, and contradictory on the impact that the subject matter has on choice of online delivery. We therefore propose the following null hypothesis:

Hypothesis 1. There will be no significant difference in academics' choice of course modes by discipline (as defined by type or subject groups).

2.5. Instructional tools

We wanted to understand the effect of discipline on the choice of tools. *Instructional tools* are defined by the Association for Learning Technology as 'the broad range of communication, information and related technologies that can be used to support learning, teaching and assessment' (Association for Learning Technology, 2018). They are also called 'teaching tools' and include materials and learning technologies (computers, software applications, audio and video conference, artificial intelligence, etc.) which define a range of strategies used to teach. We identified 29 examples of instructional 'tools' in our survey, however there are more and new additions each year.

The instructors' strategic choice of tools is linked to pedagogical approaches and classified in various taxonomies (Caladine, 2006;

Kumar et al., 2019; Laves, 2010; Liu et al., 2009) and although we recognize that other factors, such as student feedback, learning objectives and assessment outcomes have a bearing on professor's choices (Chapman & Sorge, 1999), the latter were out of the scope for this study.

Older studies of Lindblom-Ylanne et al. (2006) and Smith et al. (2008) showed disciplinary differences in tools used. The latter found that the use of documents, dropbox, messages and email was significantly higher in 'applied' compared to 'pure' disciplines. Moreover, from 2002 to 2007, the use of documents and dropbox was growing for applied and decreasing for pure disciplines. The tools for creating test pools for example (usually available in LMS - learning management systems) were more prevalent in 'hard' applied disciplines. Students in soft applied disciplines had more experience using asynchronous discussion boards for active learning in group dialogs and projects (Burke, 2011; Lam et al., 2014).

Osama and Andres (2016) demonstrated that faculty in hard disciplines were more dependent on teacher-centered approaches primarily using tools for lecturing (i.e. in-class, video, audio, podcast) than those in soft disciplines who relied mainly on student-centered approaches using engagement tools for group discussions, group projects/exercises and student presentations (i.e. discussion boards, wikis, group collaboration tools, file-sharing). These soft discipline student-centered tools also positively impacted students' levels of deep learning (reflection, integration and higher order learning skills) when compared to the hard disciplines' toolkit.

Disciplines such as Accounting and Economics are more likely to recommend using specialized software tools (advanced excel, taxation packages, broadcasts) and Strategy courses to use presentations and case studies to give students some hands-on experience according to Helms and Whitesell (2017). Simulation and games are frequently used and seen as effective pedagogies in Accounting, Finance, Operations, Production, and Information Systems courses (Campbell, 2017; Hwang & Hsu, 2018; Lojo, 2016). Tools facilitating group dialog and journaling are well suited to topics and theories in MBM and OBHR because they foster "a deeper reflection of self and adaption to different perspectives, thus creating a richer learning environment in the classroom" (Parent & Lovelace, 2011, p. 28).

Since there were few cross-disciplinary BME comparison studies on tool use and evidence from research appears to indicate disciplinary distinctions, this led us to the following hypothesis:

Hypothesis 2. Faculty's choice of tools will be influenced by discipline (soft/hard types; five discipline groups) taught. That is,

a) Hard disciplines will prefer lecturing tools, test creation tools, specialized software and online homework tools whereas soft disciplines will use more discussion boards and group work tools.
b) AFE and OPI subjects will more often use specialized software, games and simulations; STRAT will prefer cases, presentations and simulations; MBM and OBHR will use more group work, discussion board, and reflective journaling tools.

2.6. *Teaching or pedagogical methods*

There is a significant canon of older and perhaps foundational literature on methods of instruction providing broad categorizations (e.g. Adler, 1982; Brown & Atkins, 1988; Piaget, 1979) as well as the more granular approaches classifying instructional tools. The growth of online and hybrid or blended learning has produced more frameworks and a need to account for the new techniques and tools being used by Faculty. Caladine (2006) proposed a *Taxonomy of Learning Technologies Framework* based on the nature of communication (one-way or two-way) described as representational or collaborative, and categorized instructional tools (such as web cast and wikis) by fit in 'learning technology' definitions, as well as by fit in synchronous (real time) and asynchronous (flex time) modes of delivery. The representational technologies parallel traditional didactic methods and the collaborative correspond with dialectic methods. The latter is split into dialogic tools, such as discussion forums and collaborative tools, such as wikis.

De Juan Vigaray et al. (2010, p. 3685) produced similar definitions in an empirical study of teaching methods used on various modules of a business programme at a Spanish university. The study combined Piaget's (1979) four general teaching methods; didactic, dialectic: dialogic, dialectic: collaborative, and heuristic, with granular categorizations to classify instructional tools by their fit into each of these categories. For example, lectures were classified as didactic, tutorials as dialectic-dialogic and essays as heuristic. De Juan Vigaray et al. (2010) showed there were differences in teaching methods used between these categories but did not discuss the patterns observed between different disciplines.

Kember and Leung (2011) differentiated teaching methods between hard sciences and softer business disciplines and found that hard disciplines used more *didactic* teaching and teacher-centered learning tools as compared to the softer business disciplines. Management and Marketing as examples of soft disciplines, emphasized more *dialectic* pedagogies.

Haarala-Muhonen et al. (2011) explored differences in students' perceptions of their teaching–learning environments and the teaching culture in different discipline types. In both soft and hard subjects, "lecturing is the most common teaching method", but in the hard disciplines, didactic lectures are accompanied by practical exercises, homework and lab work as well as frequent testing, with softer subjects using more "active teaching methods" such as scenarios, case discussions and more essay type of evaluations. "Hard subjects have cumulative knowledge and teach in a hierarchical manner", whereas soft subject curriculum is "based on theory and knowledge", organized by "independent concepts and modules" (pp. 166–167).

In addition, our research of papers since 2010 found that discipline groups of Accounting, Finance, Economics – AFE, and Operations, Supply Chain/Production and Information Systems/Informatics – OPI were more likely to research the effectiveness of tools falling in the *didactic teaching method* such as online textbooks, clicker technology (Carnaghan et al., 2011) and integrated software

packages, which include audio/video lectures and electronic homework (Huang & Hsu, 2011; Lojo, 2016; Pasin & Giroux, 2011). For example, Grabinski et al. (2020) note that tools used in the online environment by Accounting professors are primarily *didactic* tools such as webinars, lectures/videos on-demand, and multi-media components (3D presentations, animations, hypertext, hypermedia). Similarly, Economics and Finance professors using online technology overwhelmingly rely on the *didactic* teaching method using tools such as video/audio lectures, podcasts, webinars, videos, downloadable documents/worksheets, social media and PowerPoints (Onjeri, 2017; Picault, 2019).

Discipline groupings of Organizational Behavior and Human Resources (OBHR) and Management, Business and Marketing (MBM) were more likely to report in research the use of:

- *dialectic dialogic methods* with tools, such as asynchronous discussion boards, chats, e-mails, or teleconferencing (Blau et al., 2016) to support higher quality and complex group discussions and the successful development of virtual teams (Arbaugh et al., 2010, p. 42);
- *dialectic collaborative tools* such as file-sharing, shared whiteboards, wikis, blogs or other group tools to complete interactive online group projects such as group papers or presentations (Balan et al., 2015; Bull Schaefer & Erskine, 2012; Carriger, 2016); and.
- *heuristic teaching methods* using tools such as reflective journals or summarizing research from academic papers (Schmidt-Wilk, 2018; Simpson, 2017; Taylor et al., 2020). As previously noted, many of these studies focus on one or two teaching methods and are often limited to a small number of institutions.

In the STRAT subject courses, research shows that students found the use of *dialectic dialogic* methods such as the asynchronous discussion board and *dialectic collaborative* methods using online group tools, including wikis, file-sharing, online team case projects and online simulations to be more satisfying and produce greater learning than live, synchronous discussions or in-class team assignments (Loon et al., 2015; Watson & Sutton, 2012).

Since the findings above stemmed from a classification of literature, we augmented findings by collecting data using discipline type and group as the independent variables and formed a third hypothesis:

Hypothesis 3. Course discipline impacts faculty member's choice of preferred teaching methods. Namely,

a. Instructional tools within the didactic teaching method will be preferred in the design of hard discipline courses; tools within the dialectic dialogic or dialectic collaborative teaching methods will be used more often in soft courses.
b. AFE and OPI subjects will use more tools in the didactic teaching method in their design.
c. STRAT, OBHR and MBM will use more tools from the dialectic dialogic toolbox.
d. STRAT will more heavily rely on dialectic collaborative tools to define pedagogy method.
e. AFE, OPI, OBHR and MBM will rely on more heuristic methods in their course design.

3. Methodology

This study employed a comparative survey research design, where comparisons across types and groups of BME disciplines were

Table 1
Classification of tools by teaching methods with totals and percentage use in descending order.

Didactic Tools (13)	**Dialectic Collaborative Tools (7)**
Assignment Grading (205, 85%)*	Case Study (194, 81%)
Online Gradebook (197, 82%)*	Group Projects (160, 67%)
Powerpoint/Prezi (188, 78%)*	Blogs (139, 58%)
Presentation (152, 63%)	Group Tools (Wikis, Googledocs, Collaborate) (115, 48%)
Camtasia/Video Lectures (149, 62%)*	Simulation (93, 39%)*
Streaming Video, Audio or Text (148, 62%) FAQs (Frequently Asked Questions) (133, 56%)	Games (92, 38%)*
Dropbox (118, 49%)*	Formatted for Mobile Learning (76, 32%)
Participation Grading (114, 48%)*	
Audio Lectures (95, 40%)*	
Cycle of Mastery (94, 39%)	
Social Media (79, 33%)*	
Podcasts/Webcasts (75, 31%)*	
Dialectic Dialogic Tools (5)	**Heuristics Tools (4)**
Direct Communication (text messaging, e-mails) (187, 78%)	Research Paper (142, 59%)
Asynchronous Discussion Board (170, 71%)	Journaling/Self Reflections (141, 59%)*
Video/Audio Messaging (120, 50%)*	Portfolios (72, 30%)*
Synchronous Live Chats/Webcam (88, 37%)	Specified Software (Microsoft Project, Advanced Excel, Computer Lab) (69, 29%)
E-Tutoring (87, 37%)*	

Source: An aggregation of Caladine (2006, p. 250); De Juan Vigaray et al. (2010, p. 3689); and similar surveyed tools added by the researchers identified with an *.

used to explore similarities and differences in online technology use and approaches to pedagogical design. The value of comparative survey methods is that they allow the examination of variables from a large number of cases, thus combining the strengths of variable-oriented quantitative research methods with case-oriented qualitative approaches (de Vijver & Leung, 1997).

The snowball sampling technique was used since it was recommended for hard-to-reach survey participants (Heckathorn, 2011; Valerio et al., 2016). Identifying instructors in BME who taught courses using online technology was accomplished by asking Deans and colleagues in BME to refer the online survey to instructors who had experience with e-learning.

To address key research hypotheses, the project team put together a standardized self-completion questionnaire, which was administered online and comprised of three main sections:

1. Background information on research participants and their teaching context;
2. Type of course delivery (fully online, hybrid/blended and web-facilitated)
3. Tools that were employed in the course (yes or no) (29 items)

The first survey section highlighted individual teaching contexts by region, years of teaching experience, and was based on a course that they chose to describe (i.e. its level of study, class size and whether the course was a MOOC). A modified version of Allen et al.'s (2016) typology was used to gain insights into the degree to which online technologies were integrated into teaching, with respondents asked to specify whether the chosen course was delivered fully online or if it was hybrid/blended or web-facilitated. In the third survey section, the participants were asked to identify which tools they used on the chosen course. The research team aggregated the list of instructional tools and the four teaching methods into one table using Caladine's (2006) taxonomy of learning technologies and De Juan Vigaray et al.'s (2010) list of teaching methods, as well as added tools in the survey that were similar in description but not part of either classifications of these authors (presented in Table 1).

The survey data was analysed using SPSS statistical package and by exploring descriptive statistics for each case (such as mean and percentage scores) as well as for types and groups of BME disciplines. To explore differences between types and groups of BME disciplines, statistical tests used the type or group of BME disciplines as the independent variables and types of course delivery, tools and methods that the instructors employed in teaching as the dependent variables. To conduct comparisons across items with categorical data, chi-squared tests were employed, and for items with interval data, t-tests and multivariate (MANOVA) and one-way analysis of variance (ANOVA) tests were conducted.

MANOVA is employed where the effects of one of more independent variables are explored in relation to two or more dependent variables. T-test and one-way analysis of variance (ANOVA) are widely used data analysis techniques for examining differences between mean scores for two (*t*-test) and three or more groups (ANOVA) of participants in a sample (Howell, 2002). For ANOVA, post-hoc comparisons were employed to identify which pairs of comparisons across groups of BME disciplines were statistically significant. Since statistically significant differences may be small in size (Cohen, 1988), power analysis complemented data on effect size. We used Cohen's d for t-tests and eta squared ($\eta 2$) for univariate ANOVA and Chi-square tests. Where associations between independent variables were observed (i.e. region and level of study) additional analyses in the form of three-way cross-tabulations and analyses of co-variance (in the form of MANCOVA and ANCOVA) were employed to account for the effects of these variables on participants' reported use of technology tools and pedagogical methods.

A total of 301 participants responded to the survey. The sample size was subsequently reduced to 240. Of those eliminated, nine had no online components in their course (question on course mode), eight were in non-BME disciplines (not the focus of the study) and 44 were missing important information (where more than half of the answers were blank).

4. Results

Appendix B provides sample characteristics from the 240 useable survey respondents: it is heavily weighted toward North American participants (85%); adequately represented by the five discipline groupings (from 13% to 34%); slightly over-represented by soft disciplines (62%). Most respondents (74%) taught at the undergraduate level. There was positive association between level of study (i.e. graduate vs undergraduate) and disciplinary groupings ($\chi 2$ (4) = 18.19, p = .001), as a higher proportion of Strategy and OPI respondents taught at the postgraduate level compared to AFE subjects, which were more likely to be undergraduate-level offerings. There were regional variations across the five discipline groupings ($\chi 2$ (8) = 18.47, p = .018) - European respondents were

Table 2
Comparison of course mode by disciplines (types and groups) (% and count).

Course Mode/Disciplines (Count)	Web Facilitated 14.2% (33)	Hybrid/Blended 35.2% (82)	Fully Online 50.6%, (118)	Chi-Square Statistics Mean Percentage Use (n = 233)
HARD (89)	**19.1 (17)**	**36 (32)**	44.9 (40)	$\chi^2 = 3.43$ df = 2, p = .180
SOFT (144)	11.1 (16)	34.7 (50)	**54.2 (78)**	
AFE (47)	**23.4 (11)**	36.2 (17)	40.4 (19)	$\chi^2 = 14.18$, df = 8, p = .077
OPI (42)	14.3 (6)	35.7 (15)	50 (21)	
MBM (80)	7.5 (6)	33.8 (27)	58.8 (47)	
STRAT (34)	14.7 (5)	**50 (17)**	35.3 (32)	
OBHR (30)	16.7 (5)	20 (6)	**63.3 (19)**	

NOTE: Highest percentage value for each course mode is BOLDED within discipline types and groupings.

predominantly in AFE and OPI disciplines (e.g. 55% compared to 35.2% of North American respondents). Instructors based in Europe were also more likely to teach undergraduate courses compared to North American instructors ($\chi 2\ (2) = 11.181$, $p = .003$). In further analyses, region and level of study were used as the covariates for the analyses of differences across five discipline groupings. Differences in other demographic characteristics (i.e. class size, MOOC-massive open online course, teaching experience) across types of disciplines and discipline groupings were not statistically significant.

4.1. Hypothesis 1

We theorized that there would be no significant difference in an academic's design of course modes by discipline (as defined by type or subject groups) based upon conflicting research on the topic. As identified in Table 2, there were no significant cross-disciplinary differences in the choice of *course mode* (web-facilitated - 14.2%; hybrid/blended - 35.2%; fully online - 50.6% of total sample) found across hard/soft discipline type ($\chi 2 = 3.437$, $p = .189$) and 5 discipline groupings ($\chi 2 = 14.18$, $p = .077$). Analyses of three-way cross-tabulations (using region and course level) showed no relationships between types and groups of disciplines and course mode. As a result, our first hypothesis is confirmed - there is no statistical significance associated with the faculty's choice of course mode (% of online delivery) by BME disciplines (type or subject grouping). This research clarifies that course mode as a curricular element is not strongly influenced by an academic's discipline.

4.2. Hypothesis 2

We proposed that faculty's choice of tools would be influenced by discipline (soft/hard types; five discipline groups). That is.

a Hard disciplines will prefer test creation, specialized software and online homework tools whereas soft courses choose discussion boards and group work tools.
b AFE and OPI associates with specialized software, games and simulations; STRAT with cases, presentations and simulations; MBM and OBHR with group work, discussion board and reflective journaling.

Chi-square tests showed that there were differences between the two types of disciplines (hard and soft) at a statistically significant level. Soft disciplines were more likely to use case studies (87%), group projects (78%), presentations (68%) research papers (68%), journals (66%), and group tools (55%) thus confirming most of the expectations in Hypothesis 2a (see Table 3).

Also used frequently, but with variations in their uses that were not statistically significant across hard and soft disciplines or the five discipline groupings were: Assignment grading (85%), online gradebook (82%), PowerPoint (78%), direct communications with students (78%), asynchronous discussions (71%), Camtasia/video lectures (62%), and streaming video, audio or text (62%) (refer back to Table 1). We expected discussion board use would be significantly higher for soft disciplines as compared to hard disciplines but that was not the case, contradicting Hypothesis 2a. The technological diffusion of discussion boards seems to be more universal and not dependent on the discipline type.

When Chi-square tests were conducted across the five discipline groups, group tools were significantly more pervasive in STRAT (60%) and OBHR (61%) as compared to the AFE discipline group (26%) with a medium size effect ($\eta^2 = .059$) thus supporting Hypothesis 2 b. Strategy instructors used case study (91%) (Hypothesis 2 b) and group projects (89%) more frequently than instructors in AFE (70%, 43%) and OPI (74%, 58%). Journals were also used most frequently in the OBHR group (81%) (partially supporting of Hypothesis 2 b) while disciplines such as AFE and OPI showed significantly lower use of this tool (50%, 47%).

OPI (49%) instructors used specialized software more frequently than OBHR (16%) matching expectations of OPI in Hypothesis 2 b, but AFE (26%) did not meet the expectations of statistically significant usage of specialized software (not supporting Hypothesis 2 b). The largest size effect, measured with eta squared, was found with group projects ($\eta^2 = 0.103$), while medium to medium-small size

Table 3
Comparisons of tools by disciplines in descending order (%).

Tools (Mean % Use)/ Disciplines	Case Study (80.8%)	Group Projects (66.9%)	Pres'n (63.3%)	Research Paper (59.2%)	Journals (58.8%)	Group Tools (47.9%)	Specialized Software (28.8%)
HARD	71.7**	49.5***	55.4*	44.6***	47.8**	35.9**	**35.9**
SOFT	**86.5****	**77.7*****	**68.2***	**68.2*****	**65.5****	**55.4****	24.3
STATS (df = 1)	**($\chi^2 = 7.96$, $\eta^2 = 0.033$)**	**($\chi^2 = 20.33$, $\eta^2 = 0.085$)**	**($\chi^2 = 4.01$, $\eta^2 = 0.017$)**	**($\chi^2 = 13.17$, $\eta^2 = 0.055$)**	**($\chi^2 = 7.35$, $\eta^2 = 0.031$)**	**($\chi^2 = 8.68$, $\eta^2 = 0.036$)**	**NS**
AFE	70*	42.9***	48	38**	50*	26**	26*
OPI	74.4*	58.1***	65.1	53.5**	46.5*	48.8**	**48.8***
MBM	82.7*	72.8***	64.2	67.9**	59.3*	50.6**	24.7*
STRAT	**91.4***	**88.6*****	**74.3**	**68.6****	65.7*	60**	28.6*
OBHR	90.3*	77.4***	71	67.7**	**80.6***	**61.3****	16.1*
STATS (df = 4)	**($\chi^2 = 9.45$, $\eta^2 = 0.039$)**	**($\chi^2 = 24.56$, $\eta^2 = 0.103$)**	**NS**	**($\chi^2 = 14.63$, $\eta^2 = 0.061$)**	**($\chi^2 = 11.08$, $\eta^2 = 0.046$)**	**($\chi^2 = 14.14$, $\eta^2 = 0.059$)**	**($\chi^2 = 11.72$, $\eta^2 = 0.049$)**

NOTE: *** = p< = .001; ** = p ≤ .01 level * = p ≤ .05; Highest mean % use of each tool is BOLDED within discipline types and groupings; NS = Not Significant.

effects were also shown comparing discipline use of research papers ($\eta^2 = 0.061$), case study ($\eta^2 = 0.039$), journals ($\eta^2 = 0.046$) and specialized software ($\eta^2 = 0.049$) (see Table 3). Additional analyses in the form of three-way cross-tabulations where either region or level of study were used as the covariates showed that the differences across five discipline groups were still statistically significant. The type of tool used, however, differed based on geography and level of study. For example, case study, group projects, group tools and the use of research papers were linked to region and level of study – North American instructors teaching graduate and 'softer' disciplines were more likely to use these tools to support their teaching compared to European instructors.

From the chi-square and eta-squared analysis, Hypothesis 2 was generally supported showing faculty selection of technology and tools significantly dependent on their discipline, as measured by both types and groupings.

4.3. Hypothesis 3

We postulated that course discipline would impact faculty member's choice of preferred teaching methods, namely.

a. Hard disciplines prefer tools from the *didactic* teaching method; soft discipline tools associate with the *dialectic* teaching method (*dialogic* and *collaborative*).
b. AFE and OPI tools will fall in the *didactic* teaching method.
c. STRAT, OBHR and MBM will prefer tools from the *dialectic dialogic* method.
d. STRAT will rely more on *dialectic collaborative* teaching tools.
e. AFE, OPI, OBHR and MBM will prefer tools from the *heuristic* method.

Disciplinary differences in teaching methods or pedagogy were found in our research. Based upon Caladine's, (2006) and De Juan Vigaray et al.'s (2010) classifications, the 29 surveyed instructional tools (including totals and percentage use) were grouped into the four teaching methods (refer back to Table 1).

Analysis of t-tests on the use of different teaching methods across the two types of disciplines (soft vs hard) showed that soft disciplines favored more active approaches and reported higher scores for *dialectic collaborative* (Cohen's d of 0.34 is a relatively small size effect) (supporting Hypothesis 3a) and *heuristic* (Cohen's d = 0.38, a small-medium size effect) pedagogical methods as seen in Table 4. In other words, instructors of 'soft' disciplines were more likely to integrate collaborative and reflective activities in their teaching.

This was followed by a series of MANOVA and MANCOVA tests, where the five discipline groups were used as the independent variable, region and level of study as the covariates and types of teaching methods as the dependent variables. Discipline (as measured by membership in the 5 groups) had a significant multivariate effect on the use of teaching methods ($F(16, 709) = 2.15$, $p = .006$; Wilk's $\Lambda = 0.87$, partial $\eta 2 = 0.04$). There was no association between region of study and use of teaching methods, whilst differences in teaching methods across levels of study were significant ($F(4, 218) = 5.33$, $p < .006$; Wilk's $\Lambda = 0.91$, partial $\eta 2 = 0.089$). When region and level of study were used as the covariates using the MANCOVA procedure, differences across the five discipline groups were also at a statistically significant level ($F(16, 666) = 2.18$, $p = .005$; Wilk's $\Lambda = 0.086$, partial $\eta 2 = 0.04$). Further analyses using a series of ANCOVA tests showed that the use of the *dialectic collaborative* method proved to be different across the five groupings ($F(4,221) = 3.23$, $p = .011$, partial $\eta 2 = 0.06$) (partially supporting Hypothesis 3). Pairwise post-hoc comparisons using Scheffe's procedure showed that there were significant differences in the use of *dialectic collaborative* tools (such as group tools, case study, simulation, group projects) between AFE compared to STRAT ($p = .009$) (supporting Hypothesis 3d) – Strategy instructors were using these tools to a greater degree than instructors of the Accounting, Finance and Economics fields.

5. Discussion

Arbaugh's (2005) question on whether subject still matters was answered in the affirmative. The findings have not only confirmed

Table 4
Comparison of four pedagogical methods by disciplines using mean sum of tools.

Pedagogical Methods (Mean Sum of Tools)/Disciplines	Didactic (7.3)	Dialectic Dialogic (2)	Dialectic Collaborative (3.6)	Heuristic (1.5)
HARD	7	1.9	3.2*	1.2**
SOFT	**7.5**	**2.1**	**3.9***	**1.7****
STATS (df = 238)	t = 0.99	t = 0.84	t = 2.58, Cohen's d = 0.34	t = 2.88 Cohen's d = 0.38
AFE	6.6	1.8	2.7*	1.1
OPI	**7.6**	2.1	3.9*	1.4
MBM	**7.6**	2.0	3.8*	1.6
STRAT	7.4	2.1	**4.3***	**1.7**
OBHR	7	**2.2**	3.7*	**1.7**
STATS (df = 4, 221)	F = 0.99	F = 0.39	F = 3.23, η2 = 0.06	F = 2.6

NOTE: *** = p< = .001; ** = p ≤ .01 level * = p ≤ .05 (*t*-test or one-way ANCOVA with region and course level as the covariates); Highest mean sum of tools is BOLDED within discipline types and groupings.

the salience of disciplinary differences established in 21st century research (Arbaugh, 2013; Arbaugh & Rau, 2007), but also elucidated their nature by suggesting that discipline types (hard vs soft) and their subject groups (such as Accounting, Finance and Economics – AFE) still influence online and blended choice of tools and teaching methods. We forecast that cross-disciplinary differences in patterns of technology use and pedagogical practices in online settings are likely to continue to affect the BME field in the third decade of this century.

This study also aligned with research findings outside the BME field on the cross-disciplinary differences manifested in different approaches to assessment (Jessop & Maleckar, 2016; Simpson, 2016), on the views of academic staff members on disciplinary cultures (Krause, 2014), on disciplinary epistemologies (Jones, 2009), as well as broader disciplinary teaching norms (Braxton & Hargens, 1996). However, not all studies have found disciplinary differences in teaching. Smeby (1996) considered the fact that teaching norms were usually set and monitored at an institutional level germane to the argument that individual disciplines might have less impact than the institution on the time spent on teaching and the types of teaching chosen by faculty.

The first important insight (also identified by Lindblom-Ylanne et al., 2006) was that differences between hard vs soft disciplines were salient, but at times contradictory to past research. These contradictions may be the result of evolving disciplinary norms or reflect the nature of the BME field, which represents an array of disciplines. Faculty across business disciplines are increasingly expected to develop curricula that increases students' interpersonal, leadership, teamwork and communication skills ('soft' subjects which are commonly emphasized in 'soft' disciplines) along with technical know-how and numerical analysis or 'hard' skills, often acquired in more quantitative disciplines (Arbaugh et al., 2009). However, even in Wilke's (2019) review of the Society for Human Resource Management's *The Global Skills Shortage Report*, these soft skills (critical thinking, teamwork and oral and written communications) were cited by the majority of executives as the most lacking in business graduates overall. Transformative business curriculum will emphasize both soft and hard skills such as communication, critical thinking, problem solving, computing and technical skills, business analysis, teamwork, and analytical reasoning (Washington State University, 2021).

Patacsil and Tablatin (2017) recommended that universities enrich students' softer skills including interpersonal, working with teams, communication and management skills but continue to develop basic entry level hard skills to meet the needs of industry. In Andrews and Higson's (2008) research, employers across four countries in Europe expected business graduates to possess high levels of discipline specific skills synthesized with more generic interpersonal and communication competencies. Certainly, the BME field will continue to value acquisition of sophisticated analytical skills with the evolving importance of new technologies, artificial intelligence and data mining, but BME should find a balanced approach including enhancing human competencies, often emphasized in the soft disciplines, that cannot be easily automated in the future.

Previous studies showed a preference for teacher-centered instructional approaches in hard disciplines (Arbaugh, 2013; Kember & Leung, 2011), but the data from this study showed that the use of didactic instructional approaches was similar between soft/hard disciplines. Instead, it was the use of dialectic collaborative and heuristic pedagogies that distinguished soft from hard disciplines. Soft subjects used more collaborative group work and heuristic independent learning tools than hard disciplines. In other words, instructors in soft disciplines were as likely to use teacher-centered pedagogical approaches, such as streaming audio/video as their harder discipline counterparts. However, the former also embedded more interactive and collaborative methods into their teaching.

The reasons for these choices might stem from a wide range of factors, including the nature of disciplines per se such as perceived difficulties in mastering the subject matter by learners (Asonitou, 2015) or the structure and time allocated to different types of teaching activities in university curricula (Smeby, 1996). Since this study did not collect data on how much content and instructional time each course covered, it is difficult to suggest how much room the instructors had to integrate more collaborative and interactive activities. Our findings might reflect a wider trend of instructors teaching softer, more qualitatively oriented disciplines having more extensive knowledge of the affordances of virtual learning environments and of methods in which digital tools can be used to foster interactivity. The Fathema and Akanda (2020) study concurs and also finds that instructors teaching soft-applied disciplines had more experience using virtual learning environments and used them more often than instructors in 'hard' disciplines.

Second, disciplinary differences were found between the five discipline groups, suggesting that ways teachers used instructional tools were specific to their groupings. Even within the same type of discipline (hard or soft) there were differences in pedagogical design and the use of technological tools. For example, amongst the hard disciplines the OPI subject group was distinct from the AFE group in so far as instructors in this area reported higher use of specialized software in their teaching. Compared to all other disciplines, Strategy instructors reported the highest frequency of using case studies, group projects and research papers. The Strategy discipline also showed distinct patterns on teaching methods and was more likely to draw on the tools in the dialectic collaborative pedagogy method, particularly in contrast to the AFE group of disciplines. OBHR had the highest use of journals, and preference for heuristic and dialectic collaborative tools. Both STRAT and OBHR showed the highest use of group tools (which falls in the dialectic collaborative teaching method). Our extant review of literature suggested that individual BME disciplines are developing an extensive body of scholarship on online and blended teaching and learning, and this provides an opportunity for further comprehensive comparisons across the 'hard' vs 'soft' types of disciplines and different discipline groupings.

Third, cross-disciplinary differences in terms of the use of some teaching tools or technologies were less salient. Paradoxically, even with divergent discipline-specific teaching methods or *pedagogies,* the use of *some instructional tools* showed signs of convergence, i.e. similar sorts of tools were widely used across quite diverse sets of disciplines. These included assignment grading, PowerPoint, online gradebook, direct communication with students, asynchronous discussion boards, Camtasia/video lectures, and streaming content – all used relatively equally across disciplines. We suspect there might be constraints, such as a high learning curve, extra costs to students/university, time commitment by the faculty or disciplinary biases, to using a broader range of tools. Our research showed that 48% or 14 of the 29 tools in this survey were used by fewer than half of the respondents including tools such as games, simulation, synchronous live chats, social media, online portfolios, e-tutoring and podcasts (reported in Table 1).

Upon reflection, faculty, perhaps due to the above constraints or perhaps due to habit, appear to use a relatively similar group of tools that are available and used in traditional face-to-face environments and that are also easily converted for use in online learning. With an increasing number of online tools available to instructors, there may be a need for additional training/support at the institutional level to broaden the variety of tool use and take advantage of effective online technologies. The increase in online delivery prompted by the Covid-19 pandemic may change these patterns and provides scope for future research building on the baselines established by this study and other pre-2020 research.

Pomerantz and Brooks (2017), who surveyed more than 11,000 instructors in 7 countries on their use of technology in teaching, confirmed that a majority of faculty believe that their teaching effectiveness could be improved by the use of new online tools and technologies, particularly with the support of IT staff or instructional design experts at the institutional level. The interests and capabilities of faculty to provide particular educational experiences and the existence of sufficient resources to successfully implement and sustain the planned curriculum have been identified for some time as key drivers of curriculum development in business schools (Morse, 2007). Academic faculty play an integral role in keeping higher education curriculum competitive and relevant by examining and updating courses and by aligning with professional requirements. Administrators must provide support and coordination to university faculty to use innovative teaching methods and technologies which will successfully fulfill these educational and professional outcomes (Arkhipov et al., 2019).

It is also possible that university-sponsored training and current support systems may promote a convergence of tool use, especially within the framework of learning management systems. Even within a smaller number of tools in use, care is needed to implement quality benchmarks – as Lai (2015) suggested with regards to online discussion forums (ODFs) (we called them asynchronous discussion boards in this study) which could be improved with increased structure and leadership. We believe as Hall et al. (2013) suggested that curriculum design and development in BME will continue to transform by becoming more relevant, better integrated around contemporary challenges and more directly attuned to new technologies and innovation.

A fourth point is that no cross-disciplinary differences were found in the mode of delivery among disciplines or groupings of disciplines (web-mediated, hybrid/blended or fully online). This supported the idea that fully online or blended teaching has become a pervasive trend across a wide range of BME disciplines. However, only 44.9% of courses in more quantitatively oriented hard subjects and 54.2% of subjects in the 'soft' category were delivered fully online, suggesting that around 50% of courses in the BME field employed digital technologies for 79% or less of their instructional time. Again, it is likely that the changes to teaching during the pandemic in 2020 will confirm and accentuate this trend – with online teaching comprising a higher proportion of the time allocated for courses. We have an opportunity to study the implications of the rapid conversion to online teaching on the range and nature of digital tool and pedagogy use in different BME disciplines, and contrasting the recent development with the results of this study.

6. Limitations and opportunities for future research

The heavy weighting of soft applied BME disciplines versus hard applied of this study produces a bias in assessing cross-disciplinary differences in the use of digital tools in online and blended learning across the full range of academic disciplines. Sampling and data limitations include the use of a volunteer sample of participants obtained from a snowball technique (considered a convenience sample rather than a randomized sample) as a result of the difficulty in identifying professors who teach web-facilitated, hybrid/blended or fully online courses (Valerio et al., 2016). The data weighs heavily toward a North American perspective (85% of the sample). Preliminary analysis of group differences, such as across levels of study or regions, show that these variables may account for differences in online teaching and learning, however the sample size for disciplines by level or region of study is insufficient to make any generalizations. Although our research analyzes 29 teaching tools across disciplines, future research could expand/refine the list of tools and also add more pedagogical methods to study. As noted in the discussion above, there is also scope for comparative studies gauging the impact of the Covid-19 pandemic on faculty's use of tool, teaching methods and modes of delivery with this research providing a pre-pandemic empirical baseline.

7. Conclusions

This study explored cross-disciplinary differences in online learning in the BME field expanding on research undertaken in the previous decade. It showed that there are significant discipline preferences connected to curriculum design, in the choice of instructional tools and teaching methods or pedagogy, but not in course mode (percentage of the course delivered online) across disciplines. The timeline for the study occurred before the international thrust to online learning brought about by the 2020 pandemic and as such may help researchers to compare and explain evolving patterns.

In the choice of instructional tools to support pedagogical objectives, case study, group projects, presentations, research papers, journals and group tools had significantly higher usage in softer disciplines compared to harder disciplines. In terms of disciplinary differences on instructional tools:

1. Strategy had the highest use of cases, group projects and research papers along with dialectic collaborative tools to support interactive group work;
2. OBHR disciplines showed the highest use of journals, group tools and heuristic pedagogies;
3. OPI was the highest user of specialized software.
4. AFE disciplines had the highest percentage of web-mediated course mode use, the lowest use of group tools, research papers and group projects as well as the lowest number of tools in both dialectic collaborative and heuristic teaching methods.

The didactic teaching method (one way) was used surprisingly extensively and consistently across all disciplines in the online environment. The research also highlighted the fact that the use of some instructional tools, such as assignment grading, online gradebook, and asynchronous discussion board, was increasingly convergent across disciplines.

The under-utilisation of the wide variety of online tools identified in this study was perhaps an area that united disciplines – our collective 'sense of adventure' was not as developed as one would expect at the time of this study. Institutional support was identified as a possible factor, and although some results were reported in our survey, it would require additional research and become the topic of a separate paper.

Author statement

Sylvie Albert: conceptualisation, project administration, funding acquisition, methodology, investigation, writing - original draft, review & editing. **Diane Fulton:** conceptualisation, methodology, investigation, formal analysis, writing – original draft, review & editing. **Alex Janes:** conceptualisation, funding acquisition, methodology, investigation, writing – original draft, review & editing. **Ruslan Ramanau:** conceptualisation, methodology, investigation, formal analysis, writing – original draft, review & editing.

Acknowledgements

This research was supported by a grant from McGraw-Hill Europe and North America. A representative from McGraw-Hill was present at the initial research team meetings and proposed questions and added to the list of tools for the survey but did not participate in other processes such as the collection, analysis or subsequent writing of reports or articles. A written report of the aggregated results was presented to McGraw-Hill at the end of the funding year.

Appendix A. Framework of Disciplines

Discipline groups/ Discipline types	AFE	OPI	MBM	STRAT	OBHR
Hard	***Accounting*[f]** ***Finance*[f]** ***Economics*[g]**	***Operations*[f]** ***Production*/Logistics[f]/ Supply Chain Management[f]** ***IT*[c]/Computer Science[a]** ***IS*[c]/MIS[c]** **Business Statistics[c]/ Statistics[a]** ***Informatics*[g]/Data Analysis[c]/Research[c]**			
Soft			***Management*[f]/Supervision[c]/Leadership[c]** ***Business Studies*[c]/Intro to Business[f]/Small Business Management[f]/Entrepreneurship[f]/ Innovation[f]** **International Business[f]** **Business Environments[f]/Business Law[f]** ***Marketing*[f]/Communications[a]**	***Strategy*[d]** **Marketing** ***Strategy*[d]**	***Organizational Behavior*[b]** ***Human Resource* Management[e]**

NOTE: Items in italics identify the groupings. Informed from: [a]Biglan, 1973; [b]Burke & Moore, 2003; [c]Gardner, 2009; [d]Hafsi & Thomas, 2005; [e]Simpson, 2017; [f]Arbaugh, 2013; [g]Allgood, Walstad & Ziegfried, 2015.

Appendix B. Sample Characteristics

Characteristics	Count (Frequency %), N = 240	Characteristics	Frequency Count (%)
Course Level			
Undergrad	177 (74%)	**Grad**	63 (26%)
Discipline Types			
Hard	92 (38%)	**Soft**	148 (62%)
Discipline Groupings			
AFE	50 (21%)	**OPI**	43 (18%)
MBM	81 (34%)	**STRAT**	35 (15%)
OBHR	31 (13%)		
Class Size			
20 or less	34 (14%)	**21–35**	72 (30%)
36–50	67 (28%)	**51–75**	32 (13%)
above 75	35 (15%)	**MOOC (Massive Open Online Course)**	13 (5%)
Years Teaching			

(*continued on next page*)

(*continued*)

Characteristics	Count (Frequency %), N = 240	Characteristics	Frequency Count (%)
1–4	47 (20%)	**5–10**	65 (27%)
More than 10	128 (53%)		
***Regions** (N = 228, Missing = 12)*			
Europe	35 (15%)	**Canada**	97 (43%)
USA	96 (42%)		

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