Exploratory Research on Online Learning in Quantitative Business Disciplines

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ABSTRACT

The purpose of this research is to analyze the optimal pedagogical tools and methods for teaching quantitative disciplines in the newest delivery modes of blended and online education. This study will focus on a comprehensive literature review of quantitative disciplines in business and related areas. Which pedagogies are the same and which are different based on discipline? Practices, tools and approaches that are used and deemed effective in online learning will be overviewed and analyzed across disciplines in this exploratory research. The top rated skills and competencies for each quantitative discipline will be reviewed and summarized for similarities and differences. From this preliminary research, specific research proposals will be recommended for future research on quantitative discipline-specific best practices in the blended/online delivery of such courses.

INTRODUCTION

Given the increasing numbers of students taking online or blended courses and even full programs being offered online, we are interested in examining how quantitative disciplines are operating in these new environments. Often the quantitative disciplines are lumped together in the literature but do quantitative disciplines differ in their pedagogical approaches from one another in blended/online courses or is there a convergence in approaches? For this research, we will compare the following 6 quantitative disciplines in a comprehensive literature review as exploratory research and subsequently, recommend research propositions for future research to be conducted. The 6 disciplines will include: 1) Accounting, 2) Finance, 3) Economics, 4) Operations or Production Operations Management, 5) Supply Chain Management, and 6) Information Systems/Computer Science. The research will examine and summarize the literature review by most highly rated skills or competencies, most often reported use and effectiveness of tools and particular pedagogical approaches recommended in the research across the various quantitative disciplines.

In general, assessment links pedagogical tools and practices with the expected course learning and program learning outcomes for each discipline. We believe tools and innovative methods should result in better student outcomes. Quantitative analytical results indicate that "student–student interaction has a greater impact on student learning outcomes", for example (Ahn, 2017, 1). Using more interactive activities thus becomes a "best practice" for teachers to design and implement their online/blended courses. Program or major specific learning outcomes are often more generic competencies such as communication, analytical, leadership or global understanding skills; course learning objectives tend to be more discipline-specific skills and competencies. We often wonder if students are being prepared for the "real world" as they take their various courses in each major or discipline area. This research will analyze the different top-rated skills and competencies expected across each of the quantitative disciplines.

In the blended/online learning arena, new technologies are being developed rapidly to facilitate learning and we need to adapt to these changes in business education to stay competitive and relevant (Cortiz & Silva, 2017; Utoware, Kren-Ikidi & Chamberlain, 2013). These tools include virtual reality, blogging, wikis, gaming, simulations, cases, journaling, podcasting, video streaming, specialized software, social media, online group tools, computerized iterative learning assessments and others. How are quantitative disciplines using these new technology tools and which tools are considered to be most effective for each discipline?

Lastly, are there different pedagogical approaches (i.e. synchronous vs asynchronous, didactic vs dialectic/collaborative, media richness choices, heuristic) that fit different quantitative disciplines more appropriately? Should some quantitative disciplines, such as accounting, only be taught in the traditional manner synchronously, for example? Is simulation optimal in all quantitative disciplines or just a few?

LITERATURE REVIEW

COMPETENCIES AND SKILL DEVELOPMENT

Research into the "efficacy of employability initiatives has typically focused on specific discipline related skills" but there is a growing gap between what employers need and what students who are graduating in business can deliver, particularly on generic skills such as leadership, communication and teamwork (Cameron, Freudenberg & Brimble, 2011, 1). To this end, in the past decade accreditation bodies have pushed for program outcomes that emphasize such generic skillsets and require assessment of these outcomes with dynamic feedback loops for continuous improvement. Obviously students want to find positions when they graduate and therefore need to be more familiar with the importance of both generic and specific competencies within their majors/disciplines. Employers often believe discipline specific skills are a given (particularly if the student has a high GPA in their major), but work skills and competencies such as work ethic, coming to work on time, ethical integrity as well as communication and collaboration competencies are often found lacking in entry level business graduates. The question to be addressed in this research is: Are all quantitative disciplines equally likely to emphasize the same generic skills? Are there more differences in competencies sought by employers and faculty when it comes to specific discipline related skillsets?

USE AND EFFECTIVENESS OF TECHNOLOGICAL TOOLS

In general, we see qualitative and quantitative growth in research on teaching and learning in online and blended learning settings for all business disciplines in the second decade of the 21st century. At the end of the first decade, Arbaugh, Godfrey, Johnson, Pollack, Nendorf & Wresch (2009) and Arbaugh, Desai, Rau & Sridhar (2010) observe that business discipline research mostly explores student attitudes towards online mode of delivery and focuses on comparisons between online and more traditional face-to-face instruction. Although comparison studies remain one of the themes in the past decade, they grow in sophistication by exploring different modes of online and blended delivery (Scherrer, 2011) and finding the optimal mix of types of delivery at various stages of the course (Bordoroi, 2016). Unfortunately, most of the studies report findings in one discipline, in a selected course and in a few selected tools only. This siloed approach makes it very difficult to recommend which tools would be best for different disciplines as cross discipline comparisons for a wide variety of tools are rare.

PEDAGOGICAL APPROACHES

The most comprehensive model of teaching/learning methods using innovative technology tools in the online business education environment is Caladine's (2006) model. Three categories are defined: 1) synchronous (real time) vs. asynchronous (teacher and learner are not face to face and communicate at different times) learning; 2) one-way (representational or didactic) or two-way (collaborative or dialectic) teaching; and 3) media richness of text (level 1-low), audio (level 2-medium) and/or video (level 3-high). Piaget's (1983) terms of 'didactic' and 'dialectic' correspond to Caladine's model as mentioned above. De Juan Vigaray, Lopez, Peris, Yanez, Martinez, Cuevas, Posadas & Valles (2010) add to the discussion by describing another pedagogical category called "heuristic" where students are on their own and find solutions or models that organize or reflect on what they research or experience in different learning situations. Please see Exhibit 1 for a comprehensive listing of the pedagogical methods by specific tools used. This research will report recent research findings on pedagogical methods as they pertain to the quantitative disciplines.

METHODOLOGY

This exploratory research uses a comprehensive literature review, following the methodology guidelines of Tranfield, Denyer and Smart (2003) and the process designed by Kitchenham (2004). We use the same keywords as Arbaugh et al. (2009) but extend the range of scholarly journals to include education/technology and discipline specific titles to ensure that present day research, inspired by the conclusions drawn by Arbaugh et al. (2009), is also included in our search. A systematic review of all titles in these journals for the past 10 years allows the researchers to detect the optimal tools and methods for each business discipline. Skills and competencies from meta-surveys of business faculty and employers for the disciplines of interest are part of the exploratory study as well. Preliminary findings will inform the recommendation of future research questions

ACCOUNTING (ACCT)

When comparing disciplines, some researchers study the competencies and skills needed by specific majors. Researchers report faculty and employers highly value problem solving, (DiGabriele, 2008; Jackling & De Lange, 2009) strong communication and analytical skills (DiGabriele, 2008, Jones & Sin, 2003) for accounting graduates. Accounting students tend to perceive technical skills as more important than do employers and underestimate the importance of "ethical awareness" and "pressure resistance" demanded by employers (Klibi1 & Oussii, 2013). Both accounting and finance majors need advanced excel, strong data analytics, and accounting practices knowledge say Philbrick, Maryott and Magnuson (2017). Accounting employers prefer confidentiality, math, GAAP, general ledger account analysis and journal entry skills (Philbrick et al., 2017).

Dusing, Hosler & Ragan (2012) describe a graduate accounting course using synchronous learning each week through the use of live Wimba chat sessions (which are archived), asynchronous learning through weekly threaded discussion board questions, pre-recorded Captivate presentations, clicker hand raise technology and online quizzes. The researchers believe accounting educators need to find "optimal ways to integrate state-of-the-art technology into an online teaching model" and explore "ways to increase

EXHIBIT 1
CATEGORIZATION OF TOOLS BY TEACHING/LEARNING METHODS

Synchronous	Asynchronous	Representational (Didactic)	Collaborative (Dialectic)	Richness of Media	Heuristic
Real time discussions	Asynchronous discussion boards	PowerPoint/Prezi	Simulation	Media Level 1: Text only- PowerPoint/Prezi, FAQs, news/ announcements, blogs,	Research paper
Face to face lectures	Camtasia/ video lectures	Camtasia/video lectures	Case Study	Media Level 1 (continued) -texting, case study and discussion online, dropbox, Googledocs, e-presentations,	Journal/Self-Reflections
Face to face or real time tutorials	E tutoring	Audio lectures	E tutoring	Media Level 1 (continued) - journaling, portfolios, lit reviews	Portfolios
Live presentations	E-presentations/ taped podcasts	Podcasts	Presentations (group)	Media Level 2: Audio only - Audio lectures, Skype, telephone,	Lit Review
Live chats	Online portfolios, Online journals	Video/audio messages	Synchronous live chats	Media Level 3: Text, audio, and video/ animation-Camtasia/ video lectures,	Modeling
Streaming video, audio or text	Pre-taped audio lectures	Streaming Video, audio or text	Blogs/forums	Media Level 3 (continued) - podcasts, streaming video, social media, Skype video chats, video/audio messages,	
Live interactions on forums, webinars	FAQs, Online blogs	FAQs	Group work tools – wikis, Googledoc, collaborate	Media Level 3 (continued) - You Tube, live chats, games, simulations, video case discussions, live presentations, virtual reality software	
Instant messaging	Googledocs or file sharing	Online lecture notes	Social Media (LinkedIn, Facebook, Twitter)		
	Dropbox	Dropbox	E tutoring		
	You Tube	YouTube	Specialized software, e.g. Microsoft project		
	News/ announcements	News /announcements	Asynchronous discussion		
	Virtual research paper or lit reviews		Group projects		
Skype, telephone	Texting, emails		Skype, phone, texting, emails		
Live games, simulations and specialized software	Virtual games, simulations, and specialized software		Games		

effectiveness of online delivery" (p. 359). Fajardo (2014) reports implementation of best practices in his accounting course which uses a variety of teaching methods and technology tools of synchronous chats, asynchronous discussion board, excel use in homework submissions through dropbox, a practice CPA simulation, and a heuristic individual research project.

He found students had more "positive attitudes and higher levels of performance" when the course design was highly interactive (p. 37).

Although there are some case studies of uses of online tools and asynchronous methods, a majority of accounting professors still prefer more synchronous and one way approaches (synchronous over asynchronous, didactic over dialectic/collaborative group work) to create successful courses in their fields. They often use tools as an add-on web-mediated approach to in-class lectures, such as a dropbox (to grade problem based or excel homework), pre-recorded video lectures, or online grading of homework in cycle of mastery systems such as Aplia or MyLab (Collins, Deck & McCrickard, 2008; De Lange, Suwardy & Mavondo, 2003; Jebeile & Abeysekera, 2010; Savage, 2009; Taplin, Low & Brown, 2011).

FINANCE (FIN)

General business skills such as collaboration and strategic planning are becoming increasingly important aspects of finance positions by organizations (Skills Gap, 2015). Company recruiters also want finance students to apply finance to other business areas and understand financial applications and formulas (Philbrick et al., 2017).

In the discipline area of finance, Arbaugh et al (2009, 78) discusses the findings of Reimers and Singleton (2008) on the use of podcasting, which was well received by students in MBA-level courses in investment management and financial statement analysis. Mariola and Manley (2002) reported their experiences with teaching an online course on derivatives, focusing primarily on course design issues. They managed the course using a synchronous chat format, and recommended raising student comfort level with chats before moving to more difficult course topics. Olivea, Carrea, Cuadrosa, Gonzalez-Sabatea & Serrano (2015, 197) show that positive outcomes from a finance simulation are "students stayed active, focused their work on key actions, … worked where the instructor wanted them to work,,,", "knowledge acquisition"; and the "activity was well-accepted by the students".

For the most part, finance educators are similar to accounting teachers in that they prefer synchronous and didactic pedagogical approaches. However, there appears to be limited interest in the richest of media which uses video tutorials (Laosethakul, Tarasovich & Boyer, 2016).

ECONOMICS (ECON)

Three top-rated skills which appear to require the most attention to improve economic students' employability are abstraction, communication of complex concepts and communication in writing and two knowledge competency gaps exist in developments in economic policy and interdependency of markets and economic welfare (Street & Webber, 2007).

A teaching-learning activity that is advocated by several economists is the use of classroom games and simulations to create more enthusiasm and active learning (Baye, 2009; Cheung, 2003; Schmidt, 2003). Some studies show attempts to engage students during lectures using web based tools such as clicker personal response systems and problem-based learning (PBL) (Elliot, 2003; Ghosh & Francesco, 2009; Salemi, 2009; Sharp, 2003; Wentland, 2004). However, many economics professors still believe lectures or one-way communication approaches are optimal to convey the vast body of economic knowledge to students (Becker & Watts, 2001). "Almost no studies have measured the impact of using Internet technology on student learning and retention, perceptions of instructor effectiveness, and changes in attitudes toward economics" (Agarwal & Edward, 2010). Computer lab assignments are increasingly common in econometrics/statistics courses and Internet database searches were used by a growing (though still small) minority of instructors in all types of classes in economics (Becker, Watts, & Becker, 2006).

The research also reveals that teacher effectiveness in designing interesting and engaging instructional activities was positively related to students' academic achievement in economics (Adu, 2015). Barlett & King (2014, 181) recommend teaching economics as a laboratory science, using computer lab exercises and simulations resulting in students learning to "think like economists." For the most part, economics research in pedagogies that effectively use advanced technologies, collaboration, heuristics or rich media approaches is limited in scope and number (Watts & Schaur, 2010).

OPERATIONS MANAGEMENT (OM) OR PRODUCTION OPERATIONS MANAGEMENT (POM)

Sodhi & Son (2008) report that employers of OM (Operations Management) or POM (Production Operations Management) graduates consistently require modeling, statistics, programming, and general analytical skills in an operations management context as their primary requirements regardless of sector, function within company, and even degree type. These employers also require communication, leadership, project management, spreadsheet and database, and team skills. Brandon-Jones, Piercy & Slack (2012) describe OM as an applied field, where the focus is on the application of knowledge in real-life contexts rather than simply teaching an established body of knowledge.

Two highly used and effective technology tools in OM/POM are simulations and specialized software. Using a simulation in their quality systems production course, Snow, Gehlen & Green (2002) find simulation to be highly effective in: 1) creating high group cohesion, 2) providing the opportunity to practice decisions beforehand, 3) giving students extended periods of time to analyze

decisions, and 4) motivating students by giving a higher grade weighting for the simulation. These factors influence "actual effort made, perceived effectiveness in the game, and its value as a learning experience" (Snow et al., 2002, 526). Research on simulation effectiveness shows the "higher the level of interactivity with respect to visualization of the simulation the higher is the learning" (Plass, Homer & Hayward, 2009, 23). Learning by using simulation is considered to provide "more practice of the concepts learnt and also increases confidence, motivation and efforts put into the learning process" (Snow et al., 2002, 526). Arenas-Marquez, Machuca & Medina-Lopez (2012) develop an online interactive software for materials resource planning material for their Operations Management courses and report higher satisfaction levels by students and similar test scores when compared to traditional in-class methods.

In the last decade researchers moved towards exploring approaches to pedagogical design (e.g. in the form of experiential learning, Percy et al., 2012 and problem-based learning, Muńuzuri et al., 2016) and technological affordances, such as in the form of interactive software (Nurre & Weir, 2017) and video-tutorials (Sharke & Nurre, 2016). This emphasis of practice-based methodologies, combined with the growing body of research on games and simulation (Kouvelis, Chambers & Wang, 2006), are prevalent in OM and POM teaching (Lojo, 2016; Pain & Giroux, 2011; Snider & Balakrishnan, 2013; Vaz de Carvalho, Lopes & Ramos, 2014).

SUPPLY CHAIN MANAGEMENT (SCM) OR PROJECT MANAGEMENT (PM)

In their research, Philbrick and others (2017) find that SCM students are expected to have the highest competencies in organizational processes and methods, SCM processes and best practices, PM (Project Management), changing to the environment, procurement practices, advanced excel, strong data analytics, optimization processes and lean operations. However, little SCM research seems to "investigate how to develop superior skills, capabilities, and experience" of SCM professionals (Van Weele & Van Raaij, 2014, 63).

In SCM studies we reviewed, gaming and custom software use and effectiveness seem to be at the top of researcher's toolkits. Sinn (2007) reports positive outcomes by using custom courseware for PM (Project Management) indicating that students could 'take control of their desired course outcomes, and position their work to demonstrate accomplishment' (p. 91), as well as on the effectiveness of FAQs, reflection journals, and online chats to answer student questions, encourage team decision making, and provide ongoing feedback. In the field of supply chain management, the use of the "beer" game is quintessential and has now been developed as a totally online game (Sarkar & Kumar, 2016). Ke (2009, 20) reviewed 65 game effectiveness studies and the majority of researchers reported significant positive effects (such as "self-efficacy", "skill development" and increased "motivation" to learn) of computer-based games. "Computer games can invoke an intensity of engagement in learner" and increase learning outcomes in "cognitive strategies and problem solving" (Garris, Ahler & Driscoll, 2002, 441).

INFORMATION SYSTEMS/COMPUTER SCIENCE (IS/CS)

Competencies most sought after for IS/CS students include project management and seeing the connections between IT and other departments (Philbrick et al., 2017). Systems thinking, helping to solve problems across departments, effective communication/ liaising are also touted as highly important skills needed in IS/CS fields. The top technology skills include: SQL technical support, Oracle. business process, LINUX, JAVA, system and network configuration, collaboration, UNIX and

software installation followed by top rated general skills in communication, organization, writing, problem solving, troubleshooting, project management and planning (Murphy, 2015).

The constructivist theory provides effective theoretical guidance to the "interactive course design and the development of undergraduate teaching sources for computer science areas", specifically the use of the FPGA-based software tool to process and analyze algorithms for video processing which "encourages undergraduate students to construct knowledge actively and intentionally in authentic scenarios" (Garcia, Guzmán-Ramírez & Gonzalez-Rojas, 2013, 1465). In addition to specialized software, IS/CS field also often uses computer labs to teach skills such as programming, networking and systems analysis. Frezzo (2009), in a classroom based case study, using a computer network virtual lab, finds learners able to acquire planning, implementing, troubleshooting, and modeling skills in self-directed inquiry sessions. The majority of the research on virtual labs found "no significant difference in learning" when compared to on the ground computer labs (Lampi, 2013, 19). Wright and her team (2006), however, found that across people and situations, games and interactive simulations are more dominant for cognitive gain outcomes, and extremely important when students were learning on their own, such as in an online environment.

Two-way dialectic (interactive with feedback on the game/simulation) and heuristic approaches (individual study and research using labs or software) where students are guided to make deductions and conclusions are at the forefront of teaching in the IS/CS fields. Please refer to Exhibits 2-4 for a summary of the emphasis of research from the literature review by discipline area in top-rated competencies/skills, highest use/effectiveness of tools, and best practice pedagogical methods.

RESULTS AND DISCUSSION

In the literature, more active learning approaches are applauded to improve skills and application of knowledge in practice (Canon, Geddis and Feinstein, 2014). However, it is difficult to find research that pinpoints the discipline-specific skills that are enhanced. Ruge, Gesa & McCormack (2017, 355) recommend that "student skills for employability are facilitated through: (1) Discipline-based curriculum design linking university and industry skills expectations; (2) Clear interweaving of learning contexts

EXHIBIT 2
TOP-RATED SKILLS ACROSS QUANTITATIVE DISCIPLINES
(SAMPLING FROM THE RESEARCH)

Disciplines/ Skills	ACCT	FIN	ECON	OM/POM	SCM	IT/CS
Generic Skills						
Abstraction			X			
Analytical/Data Analytics	X	X		X	X	
Business Practices						X
Change to Environment					X	
Collaboration		X				X
Communication	X		X	X		X
Confidentiality	X					
Ethics/Morality	X					
Leadership				X		
Math/Statistics	X			X		
Modeling				X		
Organizational Processes/Methods					X	X
Pressure Resistance	X					
Problem Solving	X					X
Strategic Planning		X				X
Teamwork				X		
Troubleshooting						X
Specific Skills						
Accounting Practices Knowledge	X	X				
Advanced Excel	X	X		X	X	X
Application of Specific Discipline to Outside Areas/ Liaison		X				X
Database Knowledge				X		X
Develop Economic Policy			X			
Financial Applications and Formulas		X				
GAAP Knowledge	X					
General Ledger	X					
Interdependence of Economic Policy and Economic Welfare			X			
JAVA						X
Journal Entry	X					

Lean Operations					X	
LINUS						X
Optimization Processes					X	
Oracle						X
Procurement Practices					X	
Programming				X		X
Project Management				X	X	X
Supply Chain Processes/Practices					X	
Software Installation						X
SQL Technical Support						X
System/Network Configuration						X
Systems Thinking						X
UNIX						X

EXHIBIT 3
HIGHLY EFFECTIVE TOOLS USED AND APPEARING IN RESEARCH BY DISCIPLINE (SAMPLING OF RESEARCH)

Disciplines/ Highly Effective Tools Used	**ACCT**	**FIN**	**ECON**	**OM/POM**	**SCM**	**IT/CS**
Asynchronous Discussion Board	X					
Captivate/Camtasia Prerecorded Presentations	X					
Clicker Personal Response Systems	X		X			
Virtual Computer Labs			X			X
Excel in Dropbox Homework	X					
FAQs					X	
Games			X	X	X (Beer)	
Internet Database Searches			X			
Online Grading of Homework	X (Aplia, My Lab)					
Podcasting		X				
Reflection Journals					X	
Simulation	X (CPA Practice)	X	X	X	X	X
Specialized Software				X (MRP, Project MGT)	X (MRP, Project MGT)	X (FPGA)
Synchronous Chat	X	X			X	
Video Tutorials		X		X		

EXHIBIT 4
MOST REPORTED PEDAGOGICAL METHODS BY DISCIPLINE

Disciplines/ Pedagogical Method Most Reported In Research	ACCT	FIN	ECON	OM/ POM	SCM	IT/CS
Asynchronous				X	X	X
Synchronous	X	X	X			
Representational	X	X	X			
Collaborative				X	X	X
Media Level 1 (Text) (Low Richness)	X			X		X
Media Level 2 (Text And Voice/Audio) (Medium Richness)		X				
Media Level 3 (Text, Voice/Audio And Images) (High Richness)		X		X	X	
Heuristic			X	X	X	X

and assessments for students to experience and identify academic and professional learning dimensions (metacognition); (3) Constructive alignment for skills development through scaffolded assessment learning; and (4) A 'constructive, explicit and reflective' teaching approach engaging students in their own generic and professional skills development." The review of research by quantitative disciplines, conducted in this study, highlights that disciplines have wide variations in specific skills and even some differences in the top-rated generic skills sought for their graduates. From Exhibit 2, we can discern three areas of similarities among most of the quantitative disciplines, namely, analytical and communication skills (generic) and advanced Excel competency (specific). On the other skills and competencies, there is little agreement when comparing disciplines. To this end, future empirical research into the differences in the most highly valued skills and competencies across quantitative disciplines is necessary to fill the gap in the current literature.

From our review of the literature comparing the quantitative disciplines, we see some tools that are reported in the research most often. The most highly used and effective tool across all of the quantitative disciplines is simulation (see Exhibit 3), At least three disciplines also report games, synchronous chats and specialized software in the research as best practices. However, these last three tools are not consistent among the quantitative disciplines. This begs the question, 'Are these tools more appropriate for certain disciplines?' It is imperative to survey faculty on their use and effectiveness of a wide array of tools in order to gain a fuller picture of the state of technology for quantitative disciplines.

Lastly, in Exhibit 4, we analyze the research on pedagogical methods across disciplines and find that there are some possible defining lines between disciplines. For example, it appears that accounting, finance and economics disciplines are more representational (one way communications such as lectures) and prefer synchronous tools more than asynchronous tools. The other three disciplines (OM/POM, SCM and IT/CS) show an inclination towards more collaborative learning methods (increasing interaction of students/faculty) and using asynchronous settings. FIN, OM/POM and SCM tend to use the richest media (video). Heuristic methods of individual research, literature reviews, modeling and reflection are used by a majority of the quantitative disciplines, excluding accounting and finance. Again, future research using a broader sample of methods to compare the different quantitative disciplines would be useful to collaborate these preliminary findings.

Therefore, our future research propositions include:

P1: There are significant differences among quantitative disciplines on top-rated skills and competencies desired.
P2: There are significant differences among quantitative disciplines based on their use of technological tools in blended/ online course delivery.
P3: There are significant differences among quantitative disciplines based on their effectiveness of technological tools in blended/online course delivery.
P4: There are significant differences among quantitative disciplines based on their pedagogical approaches in blended/ online course delivery.

LIMITATIONS

We use the top rated skills and competencies, reported from meta-surveys of faculty and employers, when compiling the research comparison of disciplines. However, the number of research studies is somewhat limited by our search. Whenever possible, we try to look at current research (within the last 10 years) in discipline-specific and education related scholarly journals due to the fact that technology tools change rapidly and we wish to capture what is of interest in each field. Also new tools are coming in vogue every year, so the list of tools is a dynamic one. Using a wide array of technological tools to compare the quantitative disciplines would help to finalize which tools are best. The pedagogical methods we use in this research are from the Caladine (2006) model (which he adapted to technological tools) so that we could easily capture which methods are being used across disciplines. However, this framework does not cover all types of methods, such as problem based learning or experiential exercises, which may be of interest to our readers. Our research uses both qualitative and quantitative research in the review. There is, however, some unevenness in the types and rigor of research across disciplines, which may have an impact on our exploratory research results.

CONCLUSIONS

Preliminary findings from a systematic and comprehensive review of current research show that quantitative disciplines are not really the same. They often do not teach the same skills and competencies, except for generic skills of communication, analytics and specific competency in advanced excel. There are many gaps between what employers are looking for and what graduates are offering. Employers often rate generic skills highly and many of those skills like leadership, problem solving and teamwork do not seem to be adequate. The most widely reported technological tools in the research are limited and do not conform across disciplines. The only exception is the use of simulations, which is considered to be an effective tool across all quantitative disciplines. The teaching preferences do seem to have more delineation by disciplines according to this preliminary research. Accounting, finance and economics are in the representation (didactic) and synchronous camp, while operations management, production, supply chain management and information technology/computer science fall more in the collaborative (dialectic) and asynchronous arena. From the exploratory research in this study, the authors discuss and recommend four future research proposals.

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