Deeper Learning Methods and Modalities in Higher Education: A 20-year Review

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Deep Learning or Deeper Learning (DL) theory has gained traction as a helpful framework for designing higher education curricula in face-to-face (F2F), hybrid, and online settings. Although many research studies have been published testing DL methods in higher education, it is difficult to apply the results without an overview. This review applies a scientifically-informed search approach to select a sample of 127 peer-reviewed articles (representing 176 experimental groups) published from 1999 through 2019 on the topic of DL in higher education, classifies and extracts data from them, and presents a descriptive analysis of the findings.

Keywords: Deep Learning, Deeper Learning, Techniques, Higher Education, Face-to-Face, Online, Hybrid

BACKGROUND

Among modern educational theories, deep learning or deeper learning (DL) theory has gained increasing attention in recent years, and DL principles have been recognized as critical to knowledge acquisition and retention (Wickersham & McGee, 2008). DL has been defined as the type of learning which - in contrast to traditional lecture or "chalk and talk" methods - activates the learner, and motivates them to actively explore, engage with, reflect on, and produce knowledge, rather than having them simply recall and regurgitate information (Gilbert, 2012; Maycock, 2019; Wickersham & McGee, 2008). Today, many studies exist in the peer-reviewed literature that demonstrate superiority of so-called DL methods over traditional lecture with respect to learning in higher education (Danker, 2015; Heijne-Penninga, Kuks, Hofman, & Cohen-Schotanus, 2011; Osman & Herring, 2007; Pegrum, Bartle, & Longnecker, 2015; Stott & Hattingh, 2015; Tsaushu et al., 2012). Because DL methods appear to consistently outperform traditional methods in research studies, many authors strongly recommend considering DL methods when designing higher education courses (Boyce, Williams, Kelly, & Yee, 2001; Hill & Woodland, 2002; Skiba, 2016).

While a general consensus exists that higher education courses deploying DL methods are likely to be more effective at teaching than courses that do not, the evidence base behind this consensus has not been organized into a framework. First, what exactly constitutes "DL methods" in higher education has yet to be defined, although Wickersham and McGee (2008) provide a useful framework, including nine DL

characteristics on a continuum that can be considered in instructional design. Next, it is not clear overall what DL methods higher education faculty have developed and actually studied in their classes, and what they have generally found in terms of impact on learning.

While DL theory has been in existence prior to the rise of online educational programs, it has recently become more popular as a useful framework to consider when designing online curricula in higher education (Skiba, 2016; Wickersham & McGee, 2008). It is important to acknowledge that educational methods aimed at implementing DL principles, such as peer interaction and discussion activities to facilitate social and active learning, would need to be implemented in different ways depending upon the modality of the course: traditional face-to-face (F2F), online only, or a mix of the two (hybrid). Further, the actual DL method might have a modality that is different than the course modality (e.g., a hybrid course that assigns an online discussion board exercise). As there has been a shift from F2F to hybrid and online modalities in the higher education setting in recent years (Seaman, Allen, & Seaman, 2018), findings pertaining to online DL methods and courses in higher education would be especially valuable to post-secondary educators.

While many articles exist studying various DL methods using different modalities in different types of higher education students and classes, without a general summary or overview of the themes and findings from these studies, it is difficult to envision actionable recommendations with respect to applying or conducting future studies of DL methods in the higher education setting. Therefore, the purpose of this review is to apply a scientifically-informed search approach to select peer-reviewed articles on the topic of DL in higher education for review, then characterize the prevalence of the different DL methods studied in higher education over time in terms of their modalities (F2F, online, or hybrid), the class modalities in which the DL methods were studied, and their comparative impact on learning in the higher education classroom.

METHODOLOGY

Study Design

This study was designed to be a meta-synthesis (Prüss-Üstün, Bonjour, & Corvalán, 2008; University of Toledo Libraries, 2019). Qualification criteria were established to define the sample of DL methods and articles under study. A search strategy was applied to several scientific databases to extract qualified articles. Articles needed to meet all qualifications to be included in the sample reviewed. Once the sample of articles was identified, the articles were reviewed and coded with respect to several attributes, thus forming a database. This database was analyzed to answer the research questions. These processes are described in detail below.

Qualification Criteria

The following qualification criteria were developed and utilized to determine the sample of DL methods and articles:

a) Articles not focused on at least one DL method were disqualified.
b) Articles focused on at least one DL method that did not document applying an intervention were also disqualified.
c) Only articles focused on a higher education setting were retained.
d) Articles that were not empirical, meaning they did not use a scientific method to evaluate the interventions tested, were disqualified.
e) Articles that could not be obtained were also excluded.

In terms of the qualification criteria, articles were excluded if they did not include a DL method because the focus of this study was on understanding these methods. Only articles that involved an intervention were included because the intent was to study effects of the DL methods, and that would only be possible where articles documented intervention research. The article sample was limited to studies of DL methods in higher education because the goal of this review is to provide recommendations for higher education faculty, administrators and researchers. Empirical studies were reported in articles where the

authors formed a research study around the intervention and collected data about its effects. Only empirical studies were retained in this review because if the authors did not form a research study around the intervention, the results could not be considered.

Databases Included

The search for qualified articles was limited to databases relating to education, psychology, and communications that were available through EBSCO or ProQuest (see Table 1).

TABLE 1
EDUCATIONAL, PSYCHOLOGICAL, AND COMMUNICATIONS DATABASES UTILIZED IN REVIEW

Type	Name	Search Application
Education	Academic Search Ultimate	EBSCO Education
	Education Source	EBSCO Education
	ERIC	EBSCO Education
	Education Database	ProQuest
	Educators Reference Complete	Educators Reference Complete
Psychology	PsycArticles	EBSCO Psychology
	Psychology and Behavioral Sciences Collection	EBSCO Psychology
	PsycINFO	EBSCO Psychology
	Psychology Journals	ProQuest
	Social Science Database	ProQuest
Communications	Communications Source[a]	EBSCO

[a]None of the articles identified through this source were included in the final analysis as they all fell out when qualification criteria were applied.

Search Strategy

Although this review was intended to be a meta-synthesis, the search strategy and reported results are in accordance with the applicable sections of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement (Moher, Liberati, Tetzlaff, & Altman, 2009). To develop search terms, key concepts were first delineated; these were determined to be Deep Learning, Methods, Higher Education, and Modality. Next, search terms associated with each key concept were derived (see Table 2 for key concepts and search terms).

TABLE 2
CATEGORIES OF INTEREST AND RELATED TERMS SYSTEMATIC REVIEW

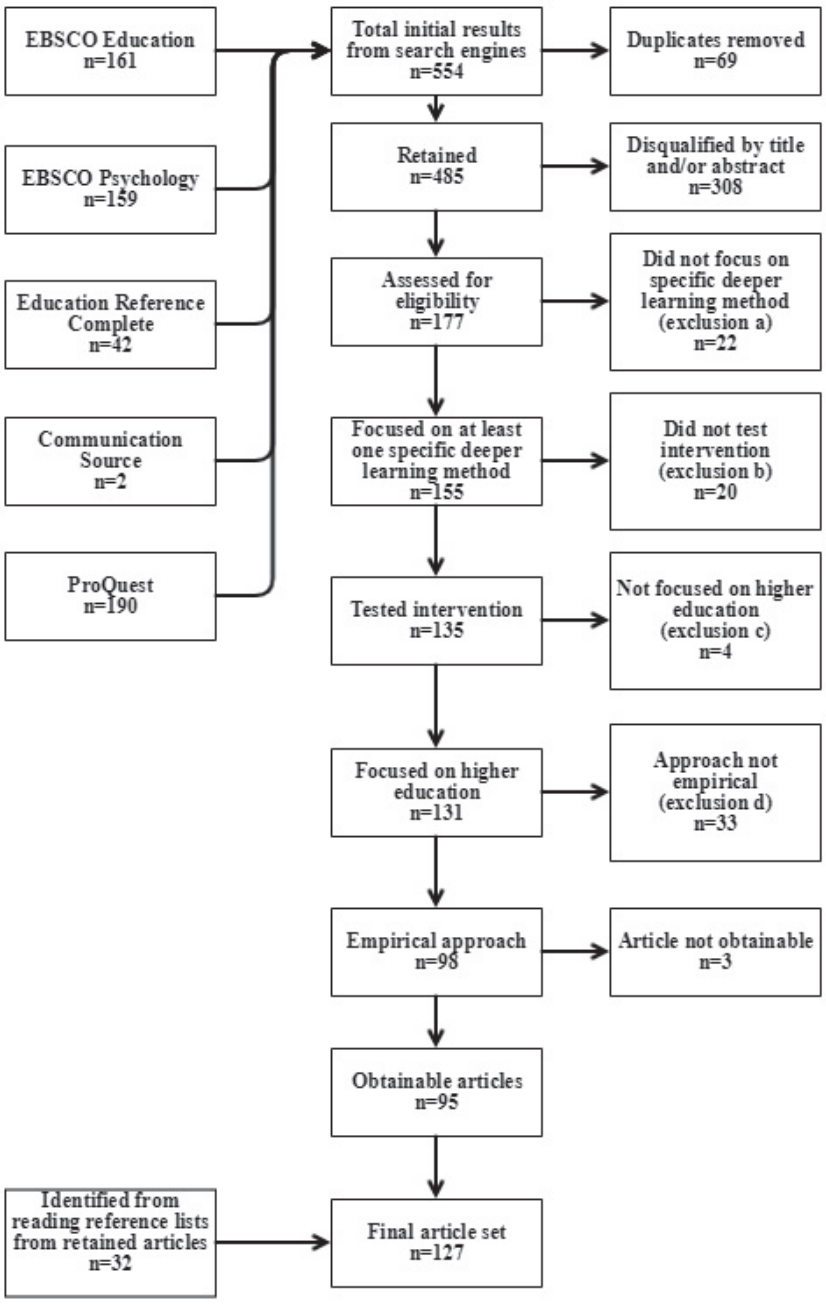
Key Concepts	Search Terms	Applied to Database Hosts
Deep Learning	"deep learning," "deeper learning"	EBSCO, ProQuest, and Educators Reference Complete
Methods	method*, technique*, process*, procedure*, strategy*	EBSCO, ProQuest, and Educators Reference Complete
Higher Education	"higher education," college*, university*, "tertiary school*," "postsecondary education," "graduate school*," education	EBSCO, ProQuest, and Educators Reference Complete
Modality	F2F, F-2-F, "face to face," face-to-face," inperson, "in person," hybrid, online, "blended learning"	EBSCO

To make the results from such a long timeframe manageable, for the non-EBSCO databases, the search terms from only the key concepts of Deep Learning, Methods, and Higher Education were applied. For the EBSCO databases, the search terms for these three key concepts as well as the ones for the key concept of Modality were applied. The search term category keywords were combined using an 'and' statement, and for the Deep Learning and Higher Education categories, searches were limited to article metadata including abstracts. As another step to make the results more manageable, all searches were automatically set to filter in only English articles and articles that were peer-reviewed. The search was completed on February 22, 2019, and included all articles that met the qualification criteria up to that date.

Applying Qualification Criteria

Figure 1 illustrates the flow chart of how qualification criteria were applied to derive the final sample of articles reviewed from the results of the search strategy. As shown in Figure 1, the initial application of the search strategy identified a total of 554 articles from their abstracts. After applying each exclusion, 98 articles were targeted for inclusion, but three were not available, making the total obtainable articles 95. To identify any applicable articles that might have been missed in the search strategy, the references of these 95 articles were reviewed. This process identified 32 additional qualified articles, making the final sample of articles a total of 127. For a list of these articles, see the Appendix.

FIGURE 1
ARTICLE FLOW DIAGRAM



Data Extraction

Each article was manually reviewed by both authors. One author (ASP) initially reviewed the articles and extracted the variables, and the second author (MMW) reviewed her work. Where there were disagreements, the authors met and decided together on a course of action. This resulted in data collected about all 127 articles, with the variables and definitions listed in Table 3.

TABLE 3
VARIABLES COLLECTED ABOUT ARTICLES

Variable	Definition	Level Definition
Identifier	Code assigned to articles in analysis	
Year	Year of article publication	
Source	The source database from Table 1	
Type of student - classified into six categories	Adult learning	Adult learning outside of a degree program.
	Undergraduate only	Includes community college and open access.
	Graduate or post-graduate only	Includes doctoral students, student teachers, and post-graduate certificate.
	Mixed	Mix of undergraduate, graduate, and/or post-grad.
	Medical students	Medical students
	Unknown	Not clarified in text.
Professional type - classified into six categories	Clinical profession	Includes professions in medical, nursing, psychology, social work, pharmacy, veterinary science fields, and involving any patient care.
	Education profession	Includes students in education professions, including teaching, student teaching, pre-service, and practicum.
	All others/mixed	Includes students not in any specific profession, as well as students in other professions.
	Unknown	Not clarified in text.
Analytic approach - classified into six categories[a]	Not assessed	Statistics or evaluation processes used did not assess efficacy at imparting DL. This category also includes articles where no assessment was made at all, as well as incorrect application of statistics meant to evaluate efficacy at imparting DL.
	Thematic	Qualitative study, so cannot asses method efficacy.
	Descriptive	Descriptive analysis suggests efficacy of modality or modalities used, but no statistical tests.
	Reject null	Study contained control condition with one or more DL conditions which showed statistical superiority in DL over the other condition or conditions on at least one measure.
	Fail to reject null	Study contained control condition with one or more DL conditions which *did not show* statistical superiority in DL over the other condition or conditions on any measures.
Number experimental groups per article	Collected from article	

[a]If more than one analytic approach was used, the article was coded as using the most rigorous of the approaches used.

Because by definition, each article included at least one experimental group but may have contained more, it was discovered that data needed to be collected separately about each experimental group represented in each article as well. These variables are listed in Table 4. As shown in Table 4, each experimental group was classified as to the method used in the intervention. Each potential classification and its definition is listed in Table 5.

TABLE 4
VARIABLES COLLECTED ABOUT EXPERIMENTAL CONDITIONS

Variable	Definition	Level Definition
Article code	Code linking experimental group to article	
Experimental group code	Unique identifier for experimental group	
Method used in intervention for experimental group	These include specific deeper learning methods as well as a placebo control.	See descriptions in Table 5.
Modality of method - three classifications	F2F	Experimental method was delivered in a face-to-face setting.
	Hybrid	Experimental method was delivered in a hybrid setting, including both face-to-face and online/digital.
	Online/digital	Experimental method was delivered in an online/digital setting.
Modality of course in which experimental method was used – three classifications	F2F	Experimental method was tested in a face-to-face course.
	Hybrid	Experimental method was tested in a hybrid course, meaning the delivery of the course involved both face-to-face and online/digital settings.
	Online/digital	Experimental method was tested in an online/digital course.

TABLE 5
EXPERIMENTAL METHODS AND DEFINITIONS

Experimental Methods Classification	Definition
Bring your own device (BYOD) and mobile technology	Method included learner-owned smartphone or mobile technology integrated into an online classroom.
Case- and problem-based activities	Method included problem-based and/or case-based assignments, activities or projects.
Closed/open book examinations; complex exam questions	Method included closed and/or open book exams or complex exam questions.
Collaborative peer learning	Method included group projects or work, interactive shared learning, collaboration between students, team-based learning, student-led activities, collaborative question-writing, active learning groups, peer teaching or near-peer teaching assistants, collaborative blended learning, peer learning facilitated by study groups, paired or multiple placement of student teachers, peer learning, cooperative learning, student-led discussions or classes, online seminars in a collaborative space where students share learning experiences, and discussion forum with peer review.
Continuous assessment and scaffolding	Method included continuous assessment, scaffolded learning, and scaffolded discussions.
Experiential learning	Method included incorporating foreign fieldwork, having parent of sick child included in tutorial, clinically-oriented physiology teaching, using a clinical learning environment, participating in a real-world development project, using an industry-engaged learning environment, service projects/learning, community organizing or activism, and field trips.
Interactive, game-based, and simulation activities	Method included role-playing, simulation, concept maps, game-based learning, clickers, scenario-based computer-delivered assessment, and interactive activities.
Media	Method included student generation of media. This classification was further broken into sub-classifications as to type of media generated: Blog, digital storytelling, ePortfolio, podcast, and video.
Online discussion forums and virtual classrooms	Method included any of the following: synchronous chat, Adobe Connect virtual classroom, online discussion forums, and online individual learning spaces. This classification is different from "online social networks" because it refers to leveraging educational technology to facilitate discussion by setting up an online educational setting specifically intended for discussion (e.g., using a course management system such as Blackboard to facilitate a discussion).

Experimental Methods Classification	Definition
Online social networks	Method included facilitated online communities, online social networks, and Facebook. This method is different from "online discussion forums and virtual classrooms" because in this method, platforms that were not set up for educational purposes were utilized for connecting learners (e.g., establishing a class group on a social media platform such as Facebook).
Other deeper learning method	Method studied was a deeper learning method, but did not fall into the other classifications.
Placebo condition	When deeper learning methods were tested against a control or placebo condition, this classification was assigned to the control condition. This condition represents the control setting for the course, whether it was face-to-face, hybrid or online. It represents the condition in the study that did *not* use the deeper learning method.
Reflective activities and focus groups	Method included assigning learners to create reflective journals in a variety of formats (e.g., DVD, diary, essay). This classification also includes focus groups, other reflective learning, and assignments focused on group reflection or self-reflection. Assignments of journal entries and response notebooks are also included.
Self-directed learning	Method included virtual training in self-regulation, supported self-directed learning, and personal note-taking.
Teaching design approach	Method included incorporating learner-centered clinic instructors into teaching environment, tailored explanations combined with impasse-triggers, learner-centered pedagogy, forward thinking design, holonomic instructions, constructively-aligned courses, dialogical pedagogy, teacher-centric approaches, and flipped classroom.
Tutorials, tutors, and labs	Method included electronic tutor, mathematics lab, tutors, video tutorials, recorded questions, parent course paired with supplemental course, and traditional tutorials.

Data extracted were entered into and stored in Microsoft Excel spreadsheets, with one for article data and the other for experimental group data.

Statistical Approach

A descriptive analysis was conducted on data collected about articles and experimental groups. A time series analysis of articles and groups studied over time was also conducted. Analyses were completed in R software (R Core Team, 2014).

RESULTS

Data were collected from 176 experimental groups represented in the 127 articles retained in the study sample. Table 6 provides descriptive results of the articles in the sample, and Table 7 presents descriptive results of the experimental groups.

TABLE 6
DESCRIPTIVE RESULTS OF ARTICLES RETAINED IN SAMPLE

Category	Level	All n, %	Clinical Profession n, %	Education Profession, n, %	All Others/ Mixed, n, %
All	All	127, 100%	32, 25%	18, 14%	77, 61%
When published	Before 2000	1, 1%	0, 0%	0, 0%	1, 1%
	2000 through 2004	7, 6%	2, 6%	0, 0%	5, 6%
	2005 through 2009	19, 15%	8, 25%	2, 11%	9, 12%
	2010 through 2014	64, 50%	11, 34%	12, 67%	41, 53%
	2015 through 2019	36, 28%	11, 34%	4, 22%	21, 27%
Source	EBSCO Education	49, 39%	8, 25%	9, 50%	32, 42%
	EBSCO Psychology	22, 17%	4, 13%	4, 22%	14, 18%
	Education Reference Complete	8, 6%	2, 6%	1, 6%	5, 6%
	ProQuest	38, 30%	15, 47%	4, 22%	19, 25%
	Identified from Reference Lists	9, 7%	3, 9%	0, 0%	6, 8%
	Not Available	1, 1%	0, 0%	0, 0%	1, 1%
Targeted Student Audience	Adult learning outside a degree program	5, 4%	1, 3%	2, 11%	2, 3%
	Undergraduate only	80, 63%	13, 41%	9, 50%	58, 75%
	Graduate or post-graduate only	18, 14%	4, 13%	7, 39%	7, 9%
	Mixed undergraduate, graduate and post-graduate	12, 9%	3, 9%	0, 0%	9, 12%
	Medical students	11, 9%	11, 34%	0, 0%	0, 0%
	Not clarified in text	1, 1%	0, 0%	0, 0%	1, 1%
Number of Conditions Tested in Study	1	88, 69%	22, 69%	13, 72%	53, 69%
	2	31, 24%	9, 28%	3, 17%	19, 25%
	3	7, 6%	1, 3%	1, 6%	5, 6%
	4	0, 0%	0, 0%	0, 0%	0, 0%
	5	1, 1%	0, 0%	1, 6%	0, 0%
Findings on Efficiency of DL Conditions Tested	Efficacy not assessed	6, 5%	0, 0%	2, 11%	4, 5%
	Qualitative study - thematic findings	42, 33%	10, 31%	5, 28%	27, 35%
	Descriptive analysis suggests efficacy	37, 29%	8, 25%	7, 39%	22, 29%
	Null was rejected on some hypotheses tested	42, 33%	14, 44%	4, 22%	24, 31%

As shown in Table 6, almost two thirds of the articles focused on a general professional population, and about a quarter were focused on medical students. Although the earliest article included was published in 1999, 78% of the articles reviewed were published in 2010 and later. In terms of source,

almost 40% were identified from EBSCO education, and another 30% from ProQuest. With respect to student audiences, over half (63%) were studies of undergraduates, and about 70% of articles tested only one condition. In terms of statistical findings, in over two thirds of the studies, no analytic statistics were conducted. When analytic statistics were conducted, many statistical tests were used, such that all 42 articles that approached the analysis this way found that at least one of their tests was statistically significant, thus rejecting the null. No analytic studies failed to reject the null on all tests conducted.

TABLE 7
DESCRIPTIVE RESULTS OF EXPERIMENTAL GROUPS RETAINED IN SAMPLE

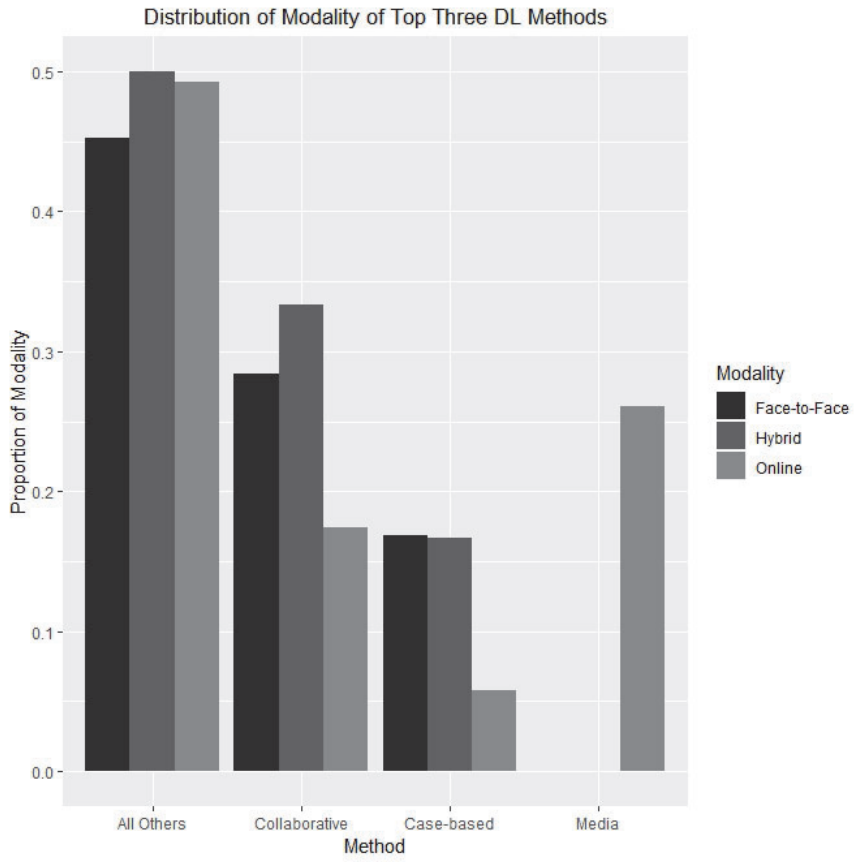
			Deeper learning method modality			Course modality		
Category	Level	All* n, %	Face-to-face n, %	Hybrid, n, %	Online, n, %	Face-to-face n, %	Hybrid, n, %	Online, n, %
All	All	176, 100%	95, 54%	12, 7%	69, 39%	118, 67%	29, 16%	29, 16%
DL method	BYOD and mobile technology[a]	3, 2%	1, 1%	0, 0%	2, 3%	1, 1%	2, 7%	0, 0%
	Case- and problem-based activities	22, 13%	16, 17%	2, 17%	4, 6%	17, 14%	2, 7%	3, 10%
	Closed/open book and complex exam questions	4, 2%	4, 4%	0, 0%	0, 0%	4, 3%	0, 0%	0, 0%
	Collaborative peer learning	43, 24%	27, 28%	4, 33%	12, 17%	29, 25%	8, 28%	6, 21%
	Continuous assessment and scaffolding	3, 2%	3, 3%	0, 0%	0, 0%	3, 3%	0, 0%	0, 0%
	Experiential learning	15, 9%	14, 15%	0, 0%	1, 1%	14, 12%	0, 0%	1, 3%
	Interactive, game-based, and simulation activities	15, 9%	6, 6%	0, 0%	9, 13%	10, 8%	2, 7%	3, 10%
	Media	18, 10%	0, 0%	0, 0%	18, 26%	12, 10%	4, 14%	2, 7%
	Online discussion forums and virtual classrooms	9, 5%	0, 0%	0, 0%	9, 13%	0, 0%	3, 10%	6, 21%
	Online social networks	6, 3%	0, 0%	1, 8%	5, 7%	1, 1%	2, 7%	3, 10%

			Deeper learning method modality			Course modality		
Category	Level	All* n, %	Face-to-face n, %	Hybrid, n, %	Online, n, %	Face-to-face n, %	Hybrid, n, %	Online, n, %
	Reflective activities and focus groups	8, 5%	7, 7%	0, 0%	1, 1%	7, 6%	1, 3%	0, 0%
	Self-directed learning	4, 2%	1, 1%	1, 8%	2, 3%	2, 2%	0, 0%	2, 7%
	Teaching design approach	9, 5%	7, 7%	2, 17%	0, 0%	7, 6%	2, 7%	0, 0%
	Tutorials, tutors and labs	9, 5%	3, 3%	2, 17%	4, 6%	6, 5%	2, 7%	1, 3%
	Other deeper learning method[b]	2, 1%	0, 0%	0, 0%	2, 3%	0, 0%	0, 0%	2, 7%
	Placebo condition	6, 3%	6, 6%	0, 0%	0, 0%	5, 4%	1, 3%	0, 0%

[a]BYOD = Bring Your Own Device
[b]Online knowledge assessments (1) and online course modality overall (1)

As shown in Table 7, a little over half of the experimental groups (54%) tested an F2F DL method, and about two thirds of the time (67%), the DL methods studied were in the context of an F2F course. The top three methods tested overall were collaborative peer learning (24%), case- and problem-based activities (13%), and media (10%). Of the 18 experimental groups that tested a media method, half (50%) assigned video, almost a quarter (22%) assigned blogging, and 11%, 11%, and 6% assigned ePortfolios, digital storytelling, and podcasts, respectively. The top three methods studied are visualized by modality in Figure 2.

FIGURE 2
DISTRIBUTION OF FACE-TO-FACE, HYBRID, AND ONLINE MODALITY OF TOP THREE DEEPER LEARNING METHODS



Note: Collaborative = collaborative peer learning, Case-based = Case- and problem-based activities

As shown in Figure 2, while the DL methods not in the top three were distributed evenly across the modalities, collaborative peer learning and case- and problem-based DL methods were more likely to be studied using a F2F or hybrid modality, while 100% of experimental groups in the media method used an online media modality.

Frequencies of modalities studied for DL methods and for the classes in which the DL methods were used over time were plotted in Figures 3 and 4.

FIGURE 3
TIME SERIES ANALYSIS FOR MODALITIES OF DL METHODS STUDIED

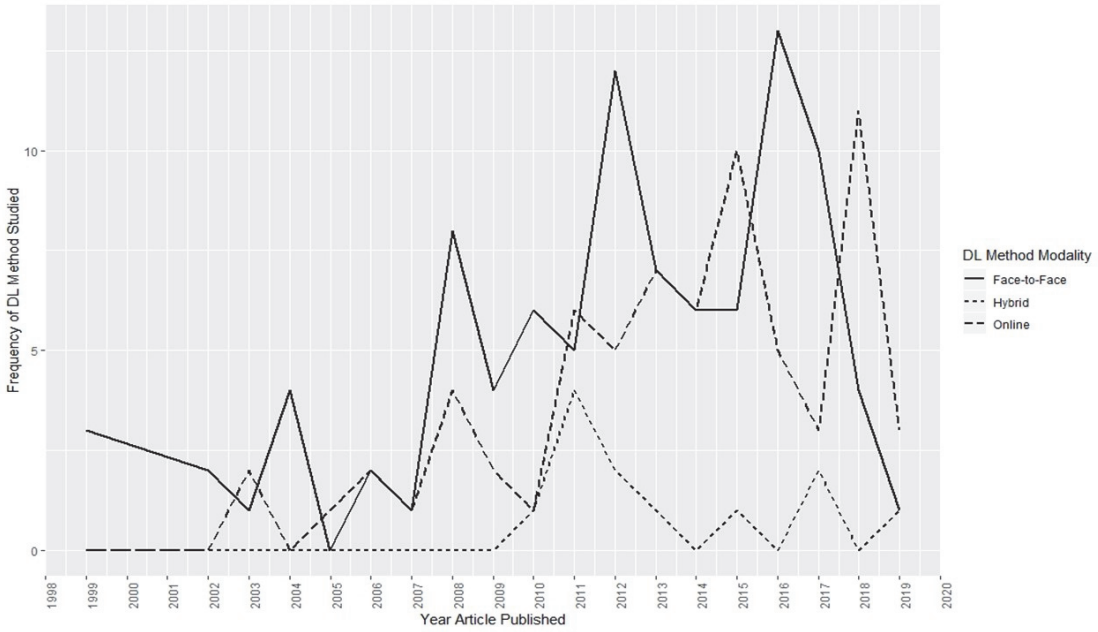
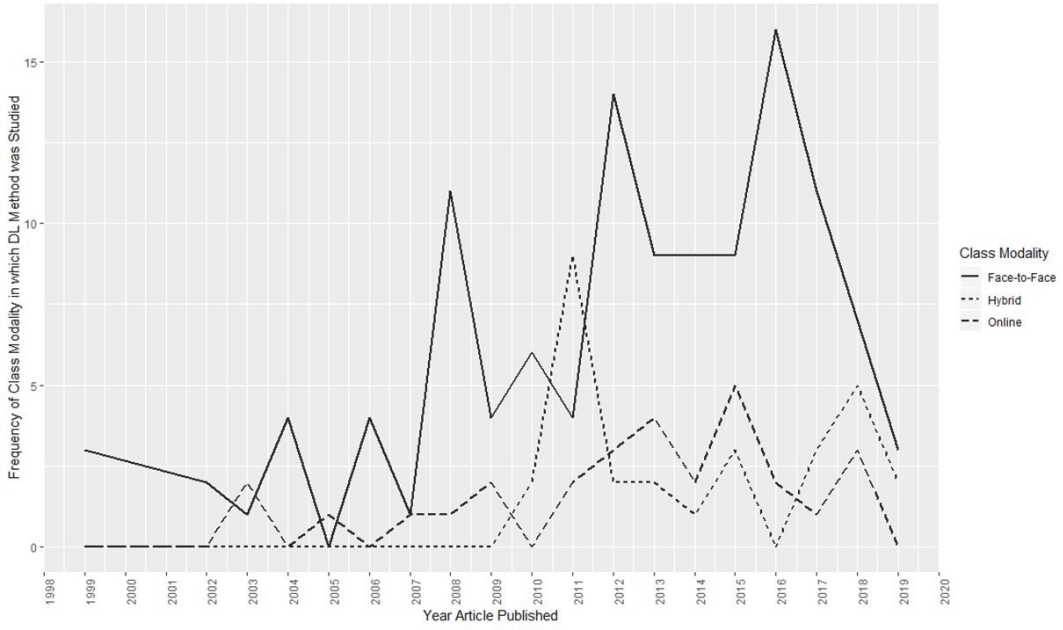


FIGURE 4
TIME SERIES ANALYSIS FOR CLASSES STUDIED



As shown in Figures 3 and 4, although over three-fourths of the articles reviewed were published 2010 or later, during that period, DL methods studied were predominantly in the F2F or online modality (compared to hybrid), and in terms of classes that served as settings for these studies, the highest frequency of class modality studied for most years after 2010 was F2F.

DISCUSSION

The scientifically-informed search strategy yielded a sample of 127 articles reporting the results of research of DL methods in higher education conducted on 176 experimental groups since 1999. Among the articles, the most common DL methods studied were collaborative peer learning, case- and problem-based activities, and media. While DL methods with F2F or online modalities were equally popular to study, the class modality in which the methods were studied was predominantly F2F, even in the last ten years, when many higher education institutions are converting their F2F courses to online (Seaman et al., 2018).

Approximately two thirds of the articles reviewed did not use a study design associated with an analytic approach. In other words, they did not pose even one testable hypothesis, and did not present a statistical plan to test any hypotheses posed. Among the articles that did pose at least one hypothesis, in many cases, the statistical approach was over-complicated – which may be why very few articles reviewed with analytic approaches included actual numbers in their abstracts (Khosa & Volet, 2013; Lazarus, Dos Santos, Haidet, & Whitcomb, 2016). These types of articles typically showed that analytical statistical methods (such as analyses of variance, or ANOVAs) had been implemented, but the actual null hypotheses behind these tests had not been properly set up or explained in the methods, so therefore, both statistically significant as well as non-significant *p*-values could not be reasonably interpreted in the text. In addition, this common design flaw led to articles containing many unclear tests, and this is likely what led to the situation where none of these articles were classified as having failed to reject the null on all tests conducted.

Among the articles not using an analytic statistical approach, one third used a qualitative methodology (thematic), and approximately another third used descriptive statistics (with no statistical tests). As descriptive statistics are extremely useful – especially on small samples – including some descriptive statistics along with thematic results represents a "value-added" component when conducting a predominantly qualitative study. As an excellent example, Hund and Getrich (2015) reported on their pilot study of video tutorials for a biostatistics course; because they chose a mixed-method approach, even though only 16 survey and 12 focus group participants contributed data to the study, their analysis is rich and provides actionable knowledge.

The top three DL methods studied in the articles reviewed involved peer interaction (in the case of collaborative peer learning), working out real-world problems (for case- and problem-based activities), and generating knowledge (in the case of media). While these methods clearly speak to the DL principles of social and active learning (Wickersham & McGee, 2008), it is not obvious why these methods were more commonly studied than the others listed in Table 5. It is possible that media was popular because in the age of smart phones, it is easy to implement a media assignment in an online class setting. According to a recent report, the number of distance higher education students increased by 5.6% between Fall 2015 and Fall 2016, and among all enrolled students, 14.9% are enrolled in exclusively online course programs, and 16.7% are enrolled in hybrid programs (Seaman et al., 2018).

Given that at least one third of higher education students are taking online courses in some capacity and this proportion is likely to increase over time, and because optimal teaching and learning methods for the online setting in higher education are not well-understood, preference should be given to studying DL methods using an online modality, regardless of the modality of the underlying class (although online DL methods tested in the context of an online DL course would be ideal) (Pereira & Wahi, 2018; Seaman et al., 2018; Wickersham & McGee, 2008). That way, the results could inform instructors of both hybrid and online courses in higher education, and work to add clarity as to the most efficacious DL methods to deploy in an online context.

In terms of strengths and limitations, a strength of this review is the scientific application of a highly replicable search methodology to derive the sample articles. It is acknowledged that slight changes in this search strategy or the sources searched would have probably led to a slightly different sample of articles, which is a limitation. A second strength was the scientific approach to data collection on the articles identified; this structured effort suggests that similar efforts using slightly different classifications would

likely largely yield the same results. This article was limited to focusing on DL methods and higher education; findings would likely be different for reviews considering teaching methods applied based on other learning theories, as well as when considering the impact of DL methods in settings other than higher education.

CONCLUSION

In conclusion, this review of 127 articles published over the last 20 years focusing on DL methods in higher education found that the most common DL methods studied were collaborative peer learning, case- and problem-based activities, and media; the most common modalities studied for DL methods were online and hybrid; and the most common class setting in which DL methods were studied was F2F, even though in the last 10 years, there has been a shift from F2F to online classes in the higher education sector. Future studies of DL methods in higher education should aim to research the impact of online DL methods implemented in online courses, as the educational setting of the future in higher education will likely be predominantly online. In terms of study design, analytic studies on the efficacy of DL methods should be developed declaring only a few, testable hypotheses, and should present a reasonable rationale and clear analytic plan so that the null hypotheses behind the tests applied can be discerned. Study designs that do not include statistical testing, including qualitative studies, should include the collection of at least some descriptive data so that the results can be better understood by the readership in academic education.

While this review found that many studies exist of DL methods in higher education, currently, it is difficult to apply their findings in the real world due to challenges in interpreting the data collected in the studies. Improving the design of research into DL methods in higher education, especially in the online setting, could produce a foundation on which to build a framework for optimal online DL learning in higher education in the future.

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