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Published

2019

Journal Title

Internet and Higher Education

Version

Accepted Manuscript (AM)

DOI

[10.1016/j.iheduc.2019.03.003](https://doi.org/10.1016/j.iheduc.2019.03.003)

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Towards a Framework for Quantitatively Assessing Teachers' Online Participation in Institution-wide Blended Learning Implementation

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Abstract

Not much has been reported regarding a comprehensive assessment of the extent of blended learning (BL) implementation at an institutional level. Even littler is known about the institution-wide BL participation scale by the teacher, and the ways to quantitatively measure such participation. This research first developed a framework for assessing teachers' online participation in BL, and then evaluated the framework with data regarding 7272 teachers' blended learning involvement in 15128 courses from six universities in China. To achieve this, a quantitative approach was adopted to investigate the intensity, regularity and interactivity of these teachers' online teaching presence in BL. Two key findings emerged from this research: 1) the framework can accurately describe the degree and features of teachers' online participation in BL implementation, and 2) the results from the evaluation of this framework facilitate our understanding of BL implementation in terms of teachers' online participation in BL. Such findings can help institutions to gain a fuller picture of their BL implementation so as to refine their BL strategies and advance their BL agenda.

Highlights:

- A framework was proposed for quantitatively assessing teachers' online participation in institution-wide BL implementation.
- Institution-wide BL participation scale by the teacher was indicated with three dimensions: the intensity, regularity and interactivity of teachers' online teaching presence in BL.
- The framework was applied to the evaluation of online teaching presence in six universities in China.
- The framework facilitated our understanding of BL implementation status.
- The overall teaching presence matched the BL stages that the universities were categorized to be in but the boundary between the stages was not clear-cut.

Keywords: Blended Learning; Teacher Online Participation; Blended Learning Adoption Stages; Online Teaching Presence; Quantitative Analysis, Analytic Framework

1 Introduction

In terms of institutional blended learning (BL) implementation, much of the current research has been centred around the three-stage framework proposed by Graham, Woodfield and Harrison (2013) (e.g., Taylor & Newton, 2013; Porter, Graham, Spring & Welch, 2014; Porter, Graham, Bodily, & Sandberg, 2016; Porter & Graham, 2016). However, not much has been reported regarding a comprehensive assessment of the extent of blended learning (BL) implementation at an institutional level. Even littler has been reported in regard to teachers' degrees of participation in BL at an

institutional level, although scholars such as Porter and Graham(2016: p.749) have realized the importance of institution's identification of "their faculty's innovation status". Studies on teachers' technology adoption in teaching often focus on their perspectives of the factors impeding or facilitating faculty adoption (e.g., Porter & Graham, 2016), their experiences in adopting technologies in teaching and learning (e.g., Oh & Park, 2009; Buchanan, Sainter, &Saunders, 2013; Scott, 2013), and teachers' ICT competency (e.g., Sua' rez-Rodri' guez & Gonzalo Almeric, 2018). To our knowledge, no study has been published, quantitatively measuring the institution-wide status of teachers' BL participation and exploring the implications of such a status to institutional policy, structure and support, the three key markers of the BL adoption stages proposed by Graham et al. (2013) in their institutional BL adoption framework.

In addition, surveys and interviews are the most frequently used methodologies in existing BL research regarding institutional involvement. While they are important instruments for gauging individual opinions, different approaches are needed to complement one another in order to gain a fuller picture of teachers' involvement in BL. In view of these needs, this research first developed a framework that can be used by institutions to quantitatively and objectively assess their teachers' online teaching participation in BL implementation. The proposed framework was then evaluated through applying it to the assessment of the teachers' BL participation in six universities in China. Such data can be used as a reference to target institutional support to the specific needs of teachers involving in different levels of online and blended learning. And such an evaluation can help institutions to gain a fuller picture of their BL implementation so as to refine their BL strategies and advance their BL agenda.

2 Literature review

2.1 Assessing institutional BL implementation

BL implementation at an institutional level has received considerable attention in the last few years as exemplified by a series of studies including Graham et al. (2007, 2013), Lim and Wang (2016), Porter et al. (2014) and Porter et al. (2016). Among them, the study by Graham et al. (2013) is the most frequently cited because of the three-stage framework they proposed for institutional adoption and implementation of BL in higher education. Based on data from interviews with administrators of institutions of higher learning in the US, their study identified three key drivers or key markers, in BL development, namely, strategy, structure and support. Each driver has its own set of subthemes. There are five subthemes in strategy including purpose, definition, policy, advocacy and implementation. Structure comprises governance, BL models, scheduling and evaluation. Support encompasses technical support, pedagogical support and faculty incentives. These three drivers and subthemes were then "differentiated across three stages of adoption to show how institutions move from interest in BL towards a mature institutionalization of it" (Graham et al., 2013, p.7). Thus, Stage 1 is an awareness and exploration phase, Stage 2 is characterised by adoption and implementation and Stage 3 moves towards maturity and growth. Applying this framework, the more recent study by Porter and Graham (2016) surveyed 214 teachers in an American University and analysed faculty's perspectives in regard to the factors that facilitated and impeded faculty's BL adoption. This study finds that adequate infrastructure, technological and pedagogical support, evaluation and an institution's purpose for BL adoption were the significant factors that influence faculty's involvement in BL. It also calls for institutional identification of teachers 'innovation adoption status and addressing the needs of innovation adopters at an institutional level.

Han, Wang, Li and Cheng (2016) and Wang and Han(2017)extended these studies by applying this framework to the assessment of BL implementations in universities and vocational colleges in China. These studies validated the framework through the identification of the roles that the institution played in policy making, support strategy formulation and infrastructure renovation to promote and

facilitate the implementation of BL. However, no quantitative assessment of institutional BL implementation was found and teachers' participation was not the focus of the above studies.

2.1 Assessing teachers' online participation in BL implementation

Valuable as it is, the framework proposed by Graham et al. (2013) does not include the teacher as a key marker in assessing institutional BL implementation. In other words, the framework only addresses institutional measures to advance BL implementation, and keeps the faculty in the background. According to Rogers (2003, p.429), "One important factor in explaining the degree to which an innovation is sustained by an organization is participation, defined as the degree to which members of the organization are involved in the innovation process(Green,1986)". In this sense, we can argue that the degree of the success and sustainability of BL as a process of "diffusion of innovations" (Rogers, 2003), is largely determined by the degree of the teachers' participation in BL.

The teachers' participation was described by Garrison, Anderson, and Archer (2000) as teachers' presence in their Community of Inquiry model (CoI) (also see Anderson, Rourke, Garrison, & Archer, 2001; Shea, Li, &Pickett, 2006). CoI sees educational experience as an interplay of three core elements of a learning community – cognitive, social and teaching presence. Teaching presence in CoI is defined as "the design, facilitation and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes" (Anderson et al, 2001, p.5). Shea et al. (2006, p.177) further argued that "active learning can be effectively orchestrated by the three elements of teaching presence: effective design, facilitation, and direction of cognitive and social processes on the part of online instructors".

According to Anderson et al. (2001), the process of design and organization begins well before actual online teaching and continues throughout the course. This includes curriculum design and redesign, resource development and building, setting up group and individual activities and providing guidelines and guidance for the use of different online tools. Facilitation refers to the teacher's interaction with the student throughout the learning discourse, such as providing regular feedback on student progress, guiding online discussions and assessing students' progress. In the final category of teaching presence, direct instruction, teachers impart their subject matter knowledge and expertise with students directly.

The direct and significant impacts of teaching presence on student learning have been validated by some studies (e.g., Shea et al. 2006; Shea & Bidjerano 2009; Garrison, Cleveland-Innes, & Fung, 2010; Richardson et al. 2015, 2016). Studies on teaching presence were also conducted outside the CoI research and a positive impact of instructors' participation in discussion forums on student engagement was established (e.g., Beer, Clark, & Jones, 2010). However, it has to be pointed out that these studies all investigated teaching presence in online discussions, not online teaching in the sense of BL per se, and none of them adopted a quantitative approach using teacher produced data.

In terms of the importance of teaching presence, the literature concerns with its impact on student learning, not on the BL implementation of an institution. At an institutional level, we are still unclear to what extent teachers have engaged in BL implementation. As BL is becoming more mature than 10 years ago, it is time that teachers' online presence was measured more accurately and comprehensively in order to inform an institutional BL endeavour.

3 Proposing a conceptual framework for quantitatively assessing Teachers' online presence in BL implementation

The above mentioned gaps led this research to the development of a framework for measuring teachers' presence in BL. We argue here the more frequent, regular and interactive the teaching presence is, the more facilitating it would be to learning engagement. Maintaining ongoing teaching presence is instrumental to promoting student motivation and engagement. Besides, the importance of

interaction between the teacher and student in online learning has been recognized in the literature (see Swan, 2001; Alley, 2008). Sheridan and Kelly (2010) also found that clear course requirements, responsiveness to students' needs, timeliness of information, and instructor feedback are crucial success factors in online learning. Regular communication with the instructor and instructor feedback was among the top three students' expectations found in the study by Mupinga, Nora, and Yaw (2006). Ma, Han, and Cheng (2015) took a learning analytic approach to track and analyse the log data of teaching and learning activities in all the courses in one university in China, and their study confirmed that the teachers' preparation and support had a significant impact on student engagement.

Informed by these perspectives and the studies reviewed in Section 2, and through a preliminary analysis of the log data relevant to teachers in BL courses offered by 395 universities on a Learning Management System (LMS) called TsingHua EducationOnLine (THEOL), we formulated a framework to qualitatively assess the teaching online presence based on such data. This framework, named Quantitatively Assessing Online Teaching Presence (QAOTP) in BL implementation (see Fig. 1), consists of three key constructs—the intensity, the regularity and the interactivity. The degrees of each construct can be quantitatively measured.

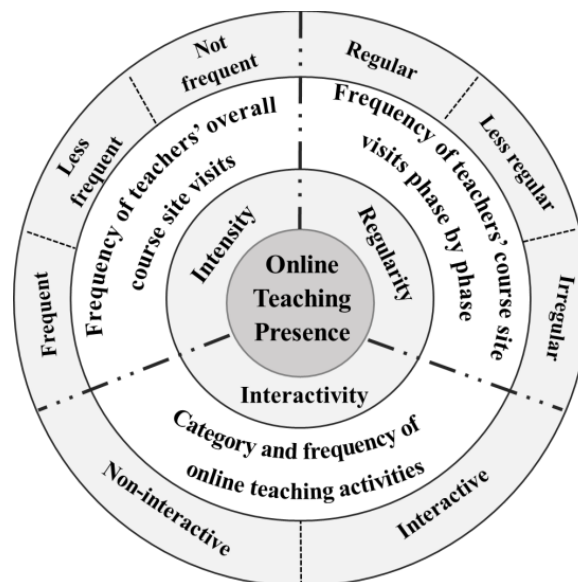


Fig. 1. The Framework for Quantitatively Assessing Online Teaching Presence (QAOTP) in BL implementation

The intensity of online teaching presence can be measured by the frequency of teachers' overall course site visits in any given period of time (e.g., an academic year, or a semester). In other words, the more visits to the course sites, the stronger the teaching presence would be in this period. Thus the frequency that teachers visit their course sites is a primary indicator of the developmental stages of BL at an institution. A more detailed picture can be depicted by grouping teachers according to the number of course visits and calculating the percentage of each group to see the frequency of course visits by each group.

The regularity of online teaching presence can be assessed through the frequency of teachers' course visits in different phases within the same given period. The unit for the phases can be month, week or any meaningful division of time period. This is the second primary indicator indicating the level of BL normalization by checking the regularity or irregularity of the teachers' course site visits incrementally throughout the whole period under investigation. This will further explain the first construct by showing a more detailed course site visit status phase by phase. Hypothetically and ideally, along with the normalization of BL, in normal teaching weeks (excluding exam and self-study weeks) in a semester, the number of teachers' visits to the course site should be evenly distributed

throughout the semester. Thus, if the total number of teachers' course visits is 100% for the teaching weeks in a semester, the average percentage of visit per teaching week should be 100% divided by the number of teaching weeks in the semester. This average can be used as a baseline to judge how much the number of teachers' visits deviate from the baseline to determine whether a teacher visits the course site on a regular basis throughout the semester.

The third construct is the key indicator of online teaching presence. This dimension seeks data on the level of interactivity that a teacher engages students online. We focus on the first two categories of teaching presence proposed by Anderson et al., 2001, that is, the design and facilitation. Based on the definition of design, the teaching activities in this category are non-interactive while in facilitation, teachers engage with learners in a more interactive fashion. This dimension should cover all the activities generated by the teacher in the categories of course design and facilitation in teaching presence, including both interactive and non-interactive activities, and the frequency of each activity during the period under investigation. We hypothesise that the more non-interactive the online teaching activities are, the weaker the teaching presence is indicated, while the more interactive the online teaching activities are, the stronger the online teaching presence should be. Our assessment of all the courses on THEOL captured the types of activities generated by the teachers, as summarized in Table 1. Those activities can be used as a reference by individual studies.

Table 1
Categories and Indicators of online teaching activities, the third dimension in the QAOTP framework

Category of online teaching activities	Indicators
Non-interactive	updating teachers' information
	Setting up course site structure (e.g., creating content links and folders, designing course navigation)
	Setting up online learning spaces (e.g., online classrooms, discussion forums, blogs)
	Creating/updating online learning content (e.g., lecture notes, PowerPoint slides, mini video lectures, online quizzes, links to online resources)
	Creating/updating assessment items (e.g., test briefs, online submission mechanisms)
	Uploading homework requirements
	Uploading/updating learning resources such as lecture notes, PowerPoint slides as needed
	releasing online tests
	Uploading test results
	releasing course surveys
Interactive	posting discussion topics (on Discussion forum or blogs)
	Sending out announcements
	Online marking
	replying to students 'posts (e.g., on Discussion Form or blogs)

answering student questions in Q/A

Providing feedback on student homework

Facilitating online teaching in synchronous online classrooms

In summary, using a quantitative approach, the QAOTP framework assesses online teaching presence that emerges from the key aspects of a BL course. This is only a conceptual framework designed with special attention to its applicability and replicability in that all the three dimension are only broadly defined with no specific requirements for how data should be categorized and treated. This leaves room for individual studies to effectively interrogate data within the broad boundary of this. It is hoped that the three constructs in the QAOTP framework complement one another to depict an accurate and comprehensive picture of the degrees and features of online teaching presence in an institution's BL implementation.

4 Methods

4.1. Research Questions

As this research aims to propose and evaluate a framework for assessing teaching presence in BL implementation, results from this evaluation were analysed to inform the following research questions:

1. To what extent does the proposed framework assess the features and degrees of online teaching presence in BL implementation?
2. In what ways does the proposed framework facilitate our understanding of the progress of BL implementation at an institutional level?
3. Is the proposed framework user-friendly, and if so, in what ways?

4.2. Background and research procedures

In view of the above mentioned research questions, we decided to examine online teaching presence in BL implementation stage by stage and through comparisons between the different stages to gain a fuller and more detailed picture of teachers' participation. To achieve this, we used the markers contained in the three-stage BL adoption framework proposed by Graham et al. (2013) as criteria when determining which of the three stages (Awareness/Exploration, Adoption/Early implementation, and Mature implementation/Growth) a university should be in. As the research team (the authors and four research assistants) had followed all the universities on the THEOL platform for a number of years and had a good knowledge of the progress of BL implementation in each university, we selected eight universities which we believed could represent a spread of the three stages. This was followed by a perusal of all the information regarding BL implementation that we could obtain from the eight universities. Such information included policy documents obtained from the IT and administration departments of each university regarding strategies (e.g., BL policies, advocacy and definition), structures (e.g., BL models, evaluations) and support mechanisms (e.g., grants, IT support, blended learning advisors, incentives). We also collected information on each university's LMS, including the number of years that BL had been implemented in each university, the number of BL courses, the announcements published on the universities course sites relating to BL course development initiative, teacher training and professional development, support and incentives etc. This process informed our decision on six universities to be included in this study. To protect their anonymity, they are represented here as University A, B, C, D, E, and F.

All the six universities are comprehensive universities offering both STEM and arts and humanities courses. A survey was then sent to the administrative departments of each university, seeking confirmation of information regarding the total number of years of BL implementation, the number of teachers teaching online and the BL courses offered on THEOL in the fall semester between September 2017 and the end of January 2018. Table 2 summarizes the data we received from each university.

Table 2 General BL implementation information of six universities in China in the fall semester of 2017.

University	No. of years of BL implementation	No. of teachers teaching BL courses	No. of BL courses
A	2 years	289	518
B	1 year	1280	2871
C	5 years	1464	2964
D	12 years	1370	2748
E	8 years	1588	3139
F	3 years	1281	2888
Total		7272	15128

The evaluation of the proposed framework started with collecting data from each university's LMS relating to the three constructs of the framework, that is, intensity, regularity and interactivity. A mixed methods design was adopted to both quantitatively and qualitatively assess online teaching presence in each university. In such an analysis, comparisons were made between the universities and the stages to explore the depth and breadth of teachers' online participation, and to understand BL implementation progress from the view of online teaching presence.

4.3 Data collection

4.3.1 Qualitative data collection

The data we collected from the six universities' policy documents and their LMSs (see above) were organized using the matrix developed by Graham et al. (2013, p.7) as shown in Appendix 1. Following this initial assessment, we then emailed a checklist to the administrative and IT departments in each university seeking their confirmation of the indicators that marked their university's achievements in BL up to the end of January 2018. The checklist contains similar key indicators of each stage as defined by Graham et al. (2013) (see Appendix 1). This serves as a cross-check measure to confirm our initial classifications.

The data collected through the checklist were compared with the information used for the initial classification of the three stages. Telephone interviews were conducted when information was missing or confusing in the completed checklists.

It has to be pointed out that the three-stage framework proposed by Graham et al. (2013) was useful for analysing the features of each stage to inform policy formulation and support mechanisms. However, when it comes to classifying the universities into a distinct stage, it can only be used as a reference as BL is a complex and dynamic process, and the boundaries between stages were not as

discrete as suggested in the framework. There was overlapping in certain categories and stages, and discrepancies in others. This is especially true with universities in the transiting stage of BL such as universities B、 C、 D and E, as they were in transition from one stage to the next. It was relatively easy to identify starters and mature adopters of BL as in the case of universities A and F. University A was clearly in Stage 1 as it just started its BL implementation in 2016, while University F was easily classified as a Stage 3 university with mature BL strategies, structures and support measures. In view of this difficulty, we eventually used a scoring system to decide on the BL status of a university. To be more specific, the more indicators of a university had for one stage, the higher the score would be for that university. The highest score gained in a stage for a university would determine the stage that the university would be in. This process resulted in the classification of University A and B to Stage 1, University C and D to Stage 2 and University E and F to Stage 3.

4.3.2 Quantitative data collection

Following the QAOTP framework, with the consent from all six universities, three groups of institutional data regarding teaching presence were collected from their blended learning courses offered in the fall semester in 2017, namely, teachers' overall course visit status, teachers' weekly course visit status, and teachers' online teaching activities. These were all teacher-produced data collected from the log files of the six universities on the THEOL LMS. In this paper,

To understand the intensity of teaching presence, we collected the number of teachers' course visits to all the BL courses in each of the six universities throughout the semester, covering a total of 15128 courses and 7272 teachers. Following this, data assessing the regularity of online teaching presence were collected in the form of the frequency of teacher's weekly course site visits, focusing on the 16 teaching weeks excluding two weeks for self-study and two weeks for examinations. Data regarding the interactivity of online teaching presence came from the online teaching activities in each of the 15128 courses offered on the THEOL platform. These data covered 14 kinds of activities (see Table 3). In line with the QAOTP framework, we first grouped our data into two categories, non-interactive and interactive, and then further divided the data into three groups, two under the non-interactive category, labelled as "course structure and content design", and "non-interactive facilitation", and one under the interactive category, labelled as "interactive facilitation". This sub-categorization was informed by the three indicators of teaching presence put forward by Anderson et al. (2001), that is, design, facilitation and direction. Furthermore, by separating course structure and content design from other activities relating to course facilitation, we were able to discriminate between lower levels of online teaching presence represented by basic BL course design related activities and higher levels teaching presence represented by more active activities associating with course facilitation.

Table 3.
Categories and data sources of online teaching activities in six universities

Category of online teaching activities	Indicators	Data source (log data from the THEOL LMS)
Course structure and content design	updating teachers' information	1) updating teachers' information
	Setting up course site structure (e.g., creating content links and folders, designing course navigation)	
	Setting up online learning spaces (e.g., discussion forums, blogs)	2) Creating teaching resources
	Creating/updating online learning contents (e.g., lecture notes, mini video lectures, online quizzes, links to online resources)	3) Creating mini video lectures
	Creating/updating assessment items (e.g., test briefs, online submission mechanisms)	4) Creating assessment items
Non-interactive course facilitation	Uploading homework requirements	5) Uploading homework requirements
	releasing online tests	
	Uploading test results	6) Uploading online tests
	releasing course surveys	7) releasing course surveys
Interactive course facilitation	posting discussion topics (on Discussion forum or blogs)	8) posting discussion topics 9) posting blogs
	Sending out announcements	10) Sending out announcements
	Online marking	11) sharing teaching reflections
	replying to students 'posts (e.g., on Discussion Form or blogs)	12) replying to students 'posts (e.g., on Discussion Form or blogs)
	answering student questions in Q/A	13) answering student questions in Q/A
	Providing feedback on student homework	14) providing feedback on student homework

4.4 Data analysis

4.4.1 Assessing the intensity of online teaching presence in BL implementation

For ease of analysis, we categorized the 7272 teachers into four groups according to the number of course site visits in the semester, i.e., inactive adopters, less active adopters, active adopters and mature adopters. We calculated the percentages of each group in each university and compared them across the six universities. Table 4 summarizes the attributes of each category of adopters.

Table 4.
Categories of BL adopters based on the number of course visits

Category	Number of course visit per semester	characteristics
Inactive adopters	1-14 visits	They adopted blended learning but stopped visiting the course site at some stage during the semester. Online teaching presence ceased.
Less active adopters	15-48 visits	They reached the minimum number of course visits required for BL. Online teaching presence was low and mostly non-interactive.
Active adopters	49-80 visits	They visited the course sites more than 3 times a week. Online teaching presence was stable, both interactive and non-interactive.
Mature adopters	Over 80 visits	They visited the course sites almost every working day. Online teaching presence was frequent, both interactive and non-interactive.

This categorization is based on the assumption that the minimum number of course visits was 3 per week, being twice before class for making announcements and assigning learning tasks, and once after class for checking and assessing students' homework. Thus, the minimum total number of course visits should be 48 per course in a 16 teaching week period. Here we referred to the BL definition by Allen and Seaman (2003, p.6) as a guidance to determine the minimum number of course visits per semester. That is, a BL course should have 30% -79% contents online. Thus, the minimum number of course visits used for this research is 14.4 (48*30%) per semester. We recognized that this classification was arbitrary, and only served the purpose of visualizing our data for better understanding of the depth of BL implementation.

4.4.2 Assessing regularity of online teaching presence in BL implementation

Each teacher's weekly course site visit frequency during the 16 teaching weeks was calculated and arranged into four periods, for ease of analysis and more vigorous data presentation. If we treated the total number of course visits by the teachers during the 16 weeks as 100%, the average number of course site visits for each of the four periods should be 25% as shown in Table 5, indicating a regular course visit pattern and a sustained online teaching presence.

Table 5.
The baseline for teachers' course visits during a semester

Period	Period 1: Weeks 1-4	Period 2: Weeks 5-8	Period 3: Weeks 9-12	Period 4: Weeks 13-16
baseline	25%	25%	25%	25%

The best goodness of fit or deviation of teachers' course visits during the semester was determined against this baseline. The deviation was worked out according the following formula:

$$B = \sum_{i=1}^n (p_i - p_{i0})^2$$

B represents the deviation for the period, while \sum is the square root of the difference between the percentages of visits in any given four-week period and its baseline (25%). P_i represents the percentage of course visits per period by a teacher, and P_{i0} is the baseline percentage, i is any given teaching period in a semester, and n is the last period in a semester. The greater the value of B has, the greater the deviation is, and the lower the goodness of fit is.

4.4.3 Assessing Interactivity of online teaching presence in BL implementation

Online teaching activities were measured by the percentages of the teachers' online course related actions in each university throughout the semester. The log data showing the number of times of a particular action was performed by a particular teacher were calculated into percentages for comparison. In this paper, we grouped the 14 kinds of activities in to three broad sets of data as shown in Table 3, namely, course structure and content design, non-interactive course facilitation and interactive facilitations. It was hypothesized that the more interactive the teaching activities were, the stronger the teaching presence would be.

5 Results

This section presented the data collected and initial discussion of findings in regard to the three dimensions in the proposed QAOTP framework. Findings were compared between the universities in different stages of their BL adoption to better understand the degrees and features of the teachers' engagement in BL. Reasons for the features were also probed and discussed together with our qualitative data. Furthermore, findings were also corroborated between the three dimensions in the QAOTP framework for a more accurate understanding.

5.1 Overall course site visits by teachers in the six universities in the fall semester of 2017

Fig. 2 shows that the overall semester course visits by the teachers across the six universities appeared to be consistent with the stages in which each of the universities was classified to be.

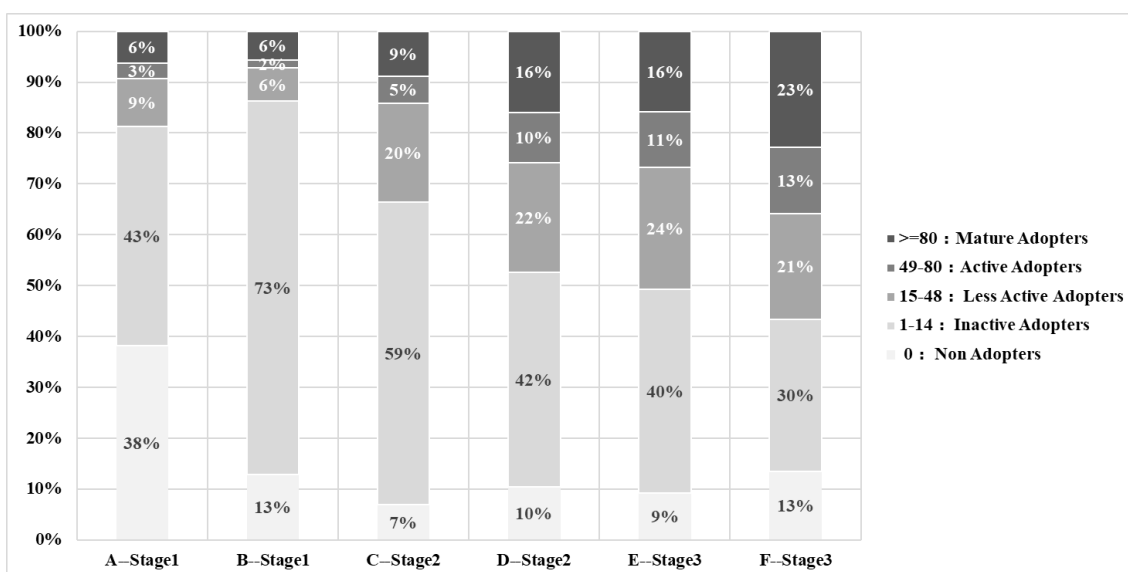


Fig. 2. Percentages of course visits by teachers in the six universities in the fall semester of 2017

That is, the two universities (A and B) in Stage 1 had the lowest percentages of course visits by the three groups of adopters over the threshold of 14.4 per semester (18% comprising 9% less Actively Adopters, 3% Active Adopters and 6% Mature Adopters, and 14% with 6% Actively Adopters, 2% Active Adopters and 6% Mature Adopters, respectively). In contrast, the two universities in Stage 3 had the highest percentages in this regard with 51% (24%+11%+16%) for University E and 57% (21%+13%+23%) for University F. Although there is a considerable difference between the two universities in Stage 2 in terms of the total percentages of teachers' course visits above the threshold, both universities had lower percentages (34%; 48%), when compared with Stage

3 universities. University A also had the highest percentage for Non-Adopters (38%), perhaps because they did not implement BL until 2016. A closer examination of the percentages in Fig. 2 also revealed that, among the six universities, University F had the largest number of Mature Adopters (23%) and Active Adopters (13%) while University B had the smallest number of Mature Adopters (6%) and Active Adopters (2%). However, the two universities in Stage 2 exhibited a more complex picture. The overall statistics about University C indicated that this university was in the early stage of Stage 2, with a low percentage for adopters visiting the courses sites more than three times per week (20% Less Active Adopters, 5% Active Adopters and 9% Mature Adopters), and 59% became inactive during the semester. In comparison, University D appeared to be at the higher end of Stage 2, leaning towards Stage 3, with strong percentages for online teaching presence (22% Less Active Adopters, 10% Active Adopters and 16% Mature Adopters), similar to those of University E in Stage 3.

5.2 Weekly course site visits by teachers in the six universities

Fig. 3 summarizes the percentages of teachers' course visits during each of the four periods in the six universities, and Table 6 provides the deviation percentages for each of the six universities.

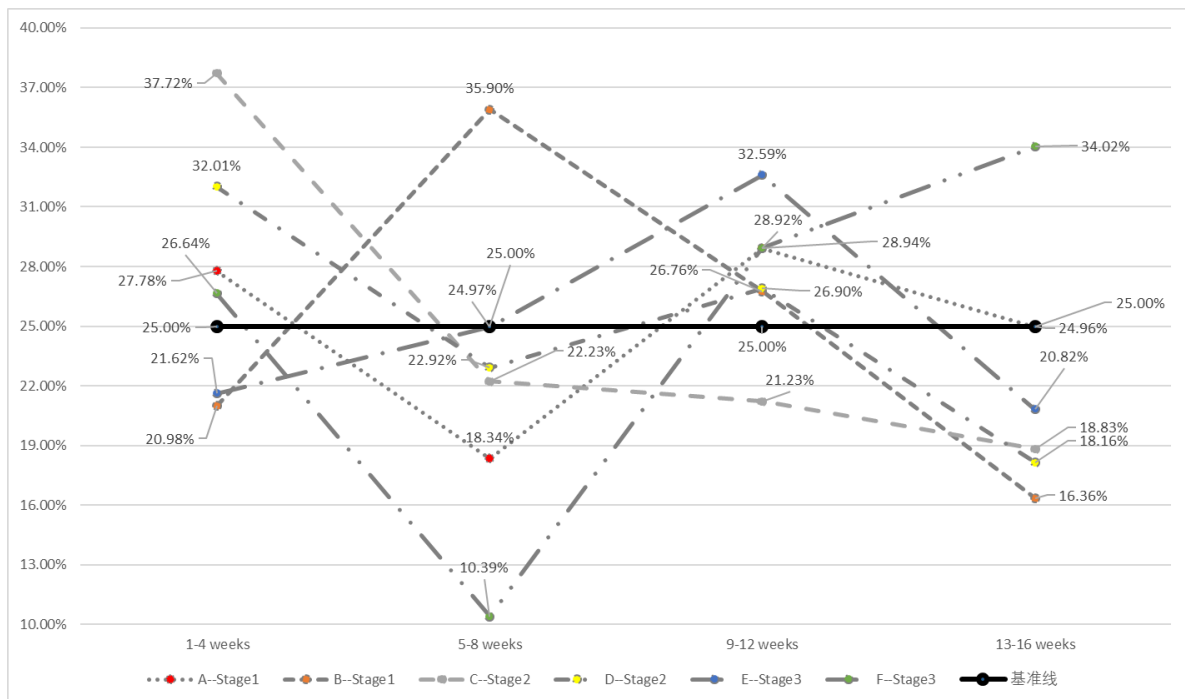


Fig. 3. Teachers' course visits in the four periods in the fall semester of 2017

Table 6. Deviations of teachers' course visits in the four periods in the fall semester of 2017

stage	university	Period 1: weeks 1-4	Period 2: weeks 5-8	Period 3: weeks 9-12	Period 4: weeks 13-16	Deviation from the base-line
Stage1	A	27.78%	18.34%	28.92%	24.96%	0.67%
	B	20.98%	35.90%	26.76%	16.36%	2.13%
Stage2	C	37.72%	22.23%	21.23%	18.83%	2.22%
	D	32.01%	22.92%	26.90%	18.16%	1.04%
Stage3	E	21.62%	24.97%	32.59%	20.82%	0.87%
	F	26.64%	10.39%	28.94%	34.02%	3.13%

In brief, Table 6 and Fig. 3 demonstrate that University A had the best goodness of fit with 0.67% deviation, followed by university E (0.87%), while University F had the greatest deviation

(3.13%), with Universities C and B in tow. However, the greatest deviation from the baseline happened in different periods for different universities with University F in Period 2 (10.39%), University B and C in Period 4 (16.36% and 18.83%, respectively).

The above presented data indicate that the course visit deviation from the baseline could happen to any university in any of the four periods. For example, the greatest deviation among all the universities happened to University F, a Stage 3 university. Their course visits by the teachers were all well above the baseline exception in period 2 when there was a sharp decrease to 10.39%. Our interview with the manager of the university’s IT support unit confirmed that this decrease was mainly caused by restricted access to the university’s intranet due to reasons beyond the university’s control.

The case was different for University B’s drop in course visits from 26.76% in Period 3 to 16.36% in Period 4, the lowest among all the universities in this period. Cross-checking with Fig. 2, we found that a large number of teachers (73%) became inactive after their first attempt at BL (see Fig. 2), which might explain why the course visits plunged by more than 10%. Furthermore, our qualitative data show that this university just started BL in the fall semester of 2017. Although strong strategies, structures and support were in place, the instability of their intranet in the first 4 weeks of the semester affected the teachers’ active online access to their courses. However, teachers’ course visits peaked between Period 2 reaching 35.90%, the highest in the same period among all universities, and maintained above the baseline in Period 3 thanks to the strong institutional support and the need for course site design and online content development. This need was further attested by Fig. 4 showing that 76.47% of teachers’ online activities were course building. Thus the fact that this was their first semester of BL implementation could explain this uneven distribution of the teachers’ course visits.

5.3 Assessing online teaching activities in the six universities

Three groups of data were presented in Fig. 4, the percentages for course structure and content design, non-interactive course facilitation and interactive course facilitation, for each university.

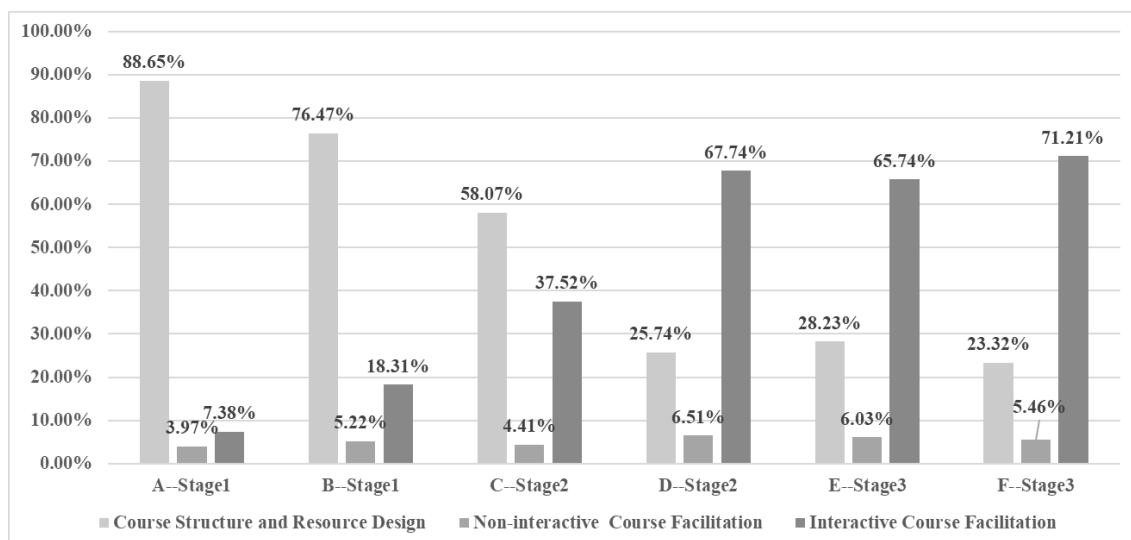


Fig. 4. Percentages of online teaching activities regarding course structure and content design, non-interactive course facilitation and interactive course facilitation

As shown in Fig. 4, the two Stage 1 universities had the highest percentages in instructional course design (88.65% and 76.47%), distinctively contrasting with those for Stage 3 universities

(28.23% and 23.32%). In terms of interactive course facilitation, the opposite trend emerged, with the two universities in Stage 3 showing much stronger interactive course facilitation (65.74% for University E and 71.21% for University F), forming a sharp contrast to the very weak interactive teaching presence in the Stage 1 universities (7.38% and 18.31%). Again, a discrepancy existed between the two universities in Stage 2, with University D showing a much stronger interactive teaching presence, even stronger than that of University E.

5.4 Summary of key findings in regard to BL implementation in the six universities

Finding 1: Using the QAOTP framework, we were able to find that the overall teaching presence proved to be in conformity with the stages that the universities were categorized to be in using the three stage framework proposed by Graham et al. (2013). To be more specific, universities in earlier stages of their BL (e.g., Universities A, B and C) exhibited lower percentages of mature and active adopters and a larger portion of course design and building in teachers' online activities. On the contrary, universities at more advanced BL stages (e.g., Universities D, E and F) showed higher percentages of mature and active adopters and more interactive course facilitation emerging from their teachers' online activities.

University F exemplified Stage 3 well. Both its mature and active adopters achieved the highest percentages among all universities (23% and 13% respectively), the total (36%) exceeding one third of its total number of teachers. More than half (57%) of its teachers accessed their course sites at least three times a week. It also had the smallest percentage for Inactive Adopters. The strong teaching presence was further confirmed by its online teaching activities. Fig. 4 showed that this university had the highest percentage for interactive course facilitation, the most important indicator of mature BL implementation. According to our qualitative data, this university initiated their BL policies and support in November 2014 and formerly started teaching in BL mode in the spring semester of 2015. Since then, it had established various university-wide BL support mechanisms including grants dedicated to BL implementation to support individual course reform and innovations. They also evaluated those grant-supported courses at the beginning and end of each semester. This could be one of the reasons for the increased number of course visits in the fourth period.

In contrast, University A in Stage 1 represents the opposite end of the spectrum with the highest percentage of Non-adopters (38%) and the lowest percentage for Mature Adopter (6%). As many as 43% became inactive during the semester. Only 18% adopters accessed their courses more than three times per week. Fig. 4 also shows that course structure and content design accounted for 88.65% of its online teaching activities, indicating its low BL implementation status. This might have something to do with the relatively short history of its BL adoption which started in the fall semester of 2016.

Finding 2: An uneven distribution of course visits appeared throughout the semester in all the universities. More specifically, both Figure 2 and Table 6 show that teachers' weekly course visits could deviate from the baseline in any of the four periods. Such data can be useful for the institution to pinpoint the causes for the disruption to regular course visits and intervene timely.

Finding 3: The boundary between the stages of BL adoption is not clear-cut. This finding features strongly in Stage 2 Universities. University D is a good case in point. Although being classified as a Stage 2 university, its percentages for the different adopter groups were very similar to those for University E which was in Stage 3, and its percentages for interactive course facilitation was even slightly higher than University E. This strong online teaching presence was probably brought about by its 12 years of BL implementation. Although our qualitative data did not suggest a strong Stage 3 status for this university, BL had become more or less normalized in the past 12 years at this university. This finding has important implications to the classification of a university into a stage.

Finding 4: Our data indicate that a top-down approach characterised the BL implementation in all the six universities, forming a distinct contrast to what has been reported by studies regarding BL in the US

higher education (see Graham et al.,2013; Porter et al.,2014). For all the six the universities, strong strategy, structure and support, were in place before the teachers embarked on BL design and implementation. In addition to advocacy and policies, different levels and forms of ongoing support were also available university wide. Such strong institutional support is one of the important reasons for University A, although still in Stage 1, to maintain the best goodness of fit in terms of teachers' weekly course visits throughout the semester, and teachers' course visits were above the baseline in the first 4 weeks as several BL courses had been piloted the year before. Seeing a slight decrease in teachers' course visits between weeks 5-8, the university offered a professional development program training teachers on developing and managing online learning, towards the end of week 8. This triggered more course visits by dedicated teachers, reaching above the baseline in weeks 9-12, and hovering around the baseline in weeks 13-16. In addition, the end-of-semester evaluation of the BL courses also sustained the teachers' regular online activities. The effect of the top-down approach was more reflected in the institution-wide adoption in Stage 1, as in the case of University B, with as many as 87% of its teachers engaged in BL at different levels in their first semester of BL implementation (see Fig. 2). A strong institutional role was also exemplified in the case of University E, a Stage 3 university, which achieved the second best goodness of fit in weekly course visits by the teachers. Since 2010, the university further improved its online learning approaches and promoted BL at both the university and department levels through workshops and seminars. Different models for BL implementations were offered, recognizing the special needs of different disciplinary areas. The university ensured that their BL courses were evaluated by external BL experts, teachers and students each semester. Overall, BL had been normalized throughout the university.

6 Discussion

As mentioned before, the aims of this research were twofold: to develop a framework for quantitatively assessing teachers' online participation in BL and to evaluate the effectiveness of this framework. These aims were achieved and important findings had emerged from this research that is worth further deliberation to see in what ways they answered the two research questions. The implications and significance of these findings were also discussed in this section, with reference to existing literature whenever appropriate.

6.1 Findings regarding to research question 1: the extent to which the QAOTP framework assesses online teaching presence in BL implementation

The QAOTP framework proved to be effective in assisting our assessment and advancing our understanding of the degrees and features of institution-wide teachers' participation in BL. More specifically and importantly, the three constructs in the framework, that is, the intensity, the regularity and interactivity of online teaching presence, proved to complement one another to paint a well-defined and comprehensive picture of the teachers' involvement in each stage of the BL implementation at each university. Such large scale quantitative data enabled us to make various vigorous and objective comparisons between the three constructs of online teaching presence and between the six universities, providing a much needed insight into the breadth, depth and features of the teachers' online engagement in different stages of BL implementation. Our findings indicate that data relating to online teaching activities also facilitated our understanding of teachers' online interaction with students. In turn, such an understanding can inform the prediction of the success or failure of a university's BL implementation and help university administration to refine and target, with more precision, their strategy, structure and support, the three BL drivers advocated by Graham et al. (2013). In fact, this research corroborated with Long and Siemens' (2011) recognition of the benefits of using learning analytics in higher education, particularly in terms of informing holistic decision making and resource allocations, and determining values generated by teacher activities.

6.2 Findings regarding to research question 2: the ways in which the QAOTP framework facilitates our understanding of the progress of BL implementation at an institutional level

The QAOTP framework allowed us to assess the progress of BL implementation through the lens of online teaching presence, complementing what could be assessed by using the three-stage framework for BL adoption proposed by Graham et al. (2013). Findings from the evaluation of the QAOTP advance our understanding of institution-wide BL implementation in a number of ways.

Firstly, our findings enriched studies relating to institutional BL adoption. The validity of the three-stage classification by Graham et al. (2013) was confirmed in that the overall teaching presence for each of the six universities largely matched the stages they were classified to be in. That is, the more advanced stage a university was classified to belong to, the stronger the overall teaching presence was, and vice versa. This was evidenced in the increase in the number of mature and active adopters and more intensified interactive course facilitation along with the growth of the universities' BL implementation. This characteristic applies more distinctively to Stage 1 and Stage 3 universities than to Stage 2 universities.

Nevertheless, this finding does not mean that the boundary between the stages of BL adoption became easy to define. In fact, Graham et al. (2013, p.11) also recognized that the boundary of the stages was "fuzzy". When classifying the universities into stages using Graham et al.'s (2013) framework, we also found it hard to categorize some universities into a stage as they had indicators of more than one stage. This was especially true of those universities in transition from one stage to another, universities such as C and D. Take University D as an example, its strategy, structure and support were only indicative of a Stage 2 university, whereas the university's quantitative data show strong traits of a university in Stage 3. This is not surprising as BL is a complex and dynamic system that constantly changes (Wang et al., 2015).

The above finding led to the second contribution of this research to the study by Graham et al. (2013). That is, teachers' online participation should be regarded as an important marker when assessing the progress of an institution's BL adoption. The three-stage framework by Graham et al. (2013) is particularly useful when using institutional implementation markers such as strategy, structure and support, to classify and describe an institution's BL adoption status. However, it does not assess whether or to what extent, the strategy, structure and support were implemented. We argue that as BL advances, more factors should be taken into consideration when evaluating what has been achieved after strategy, structure and support have been in place in an institution, in particular, the degrees of involvement on the part of the teacher and the learner as they are integral to the BL system (Wang et al., 2015). In fact, the crucial role that teachers play in the success of BL has been widely recognized in the literature (e.g., Garrison & Vaughan, 2008) as Lim et al. (2016, p.10) pointed out that "without highly motivated, dedicated and well-prepared teaching staff, blended learning initiatives in HEIs [Higher Education Institutions] are most likely to fail". Thus, online teaching presence should be regarded as a key indicator signifying the stage into which an institution has progress to.

Thirdly, using a quantitative approach, the QAOTP framework enabled us to gain a fuller and more accurate picture of the BL implementation progress in an institution, in comparison to the qualitative nature of the framework by Graham et al. (2013). In other words, the proposed framework complements the existing qualitative approaches and adds a new and an important dimension to the evaluation of institutional BL implementation.

6.3 Findings regarding to research question 3: the user-friendliness of the QAOTP framework

The framework also proved to be user-friendly as it is efficient, flexible and replicable. In comparison to surveys and interviews, the framework allowed us to gather more accurate and comprehensive information in a more efficient way tapping into existing teacher produced data on an LMS. More objective assessments of online teaching presence can be visualized easily through diagrams and graphics, and compared with baseline information to inform practice.

Generic in nature, the framework engenders the flexibility of being customizable by individual studies. This was best exemplified in its accommodation for our adoption of the three-stage framework in our data analysis. Classifying the universities into different stages allowed us to leverage our qualitative data when interpreting the quantitative data gathered using this framework. The proposed framework also had the room for us to group the teachers into different levels of adopters (mature, active, less active and inactive) and examine each group in more depth to generate a more accurate picture of the intensity of online teaching presence. Such data should be particularly useful for institutions to identify individual faculty innovation status and needs, and target support to such needs at the precise time needed.

Replicability is another feature that the framework offers as it is straightforward and can be easily replicated in future studies. Data relating to the three broad constructs of the framework can be easily tracked and quickly collected from an LMS as they are existing teacher produced data. Furthermore, the framework does not specify how such data should be analysed, leaving rooms for future adaption by individual studies according to their own needs.

7 Conclusion

This research first proposed a framework for assessing teachers' online presence quantitatively, and then applied this framework to the evaluation of teachers' online presence in BL in six Chinese universities. The effectiveness of this framework was confirmed in the course of this evaluation as the three dimensions, i.e., the intensity, regularity and interactivity of online teaching presence, informed and complemented one another to depict a detailed picture of the teachers' engagement with BL in each university. Such an understanding of the teacher's BL engagement levels would help the university to develop more effective and targeted strategy, structure and support to advance their BL agenda and sustain BL development. This framework also proved to be easy to use, flexible and can be applied to any quantitative analysis of teachers' online participation and behaviour patterns in BL implementations.

In this evaluation, we also drew from the three-stage BL adoption framework proposed by Graham et al. (2013) and used it as a reference when discussing our findings. We found that the framework was particularly valuable in providing a context for this research to examine and compare data regarding universities at different phases of their BL development. However, we also found that the accuracy of the BL stage classification could be improved by including more indicators such as the teacher's and learner's engagement levels in BL. However, with the focus of this study being on online teaching presence, we could not accommodate the learner factor in this study. Future research could adapt the QAOTP framework in assessing learners' BL participation to further facilitate our understanding of institution-wide BL implementation progress.

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Appendix 1

Matrix representing the categories and stages of the six universities' BL implementation based on Graham et al. (2013)

Category	Stage 1	University	Stage 2	University	Stage 3	University	
S t r a t e g y	Purpose	Individual faculty/administrators informally identify specific BL benefits	A,B	Administrators identify purposes to motivate institutional adoption of BL	C,	Administrative refinement of purposes for continued promotion and funding of BL	E,D,F
	Advocacy	Individual faculty and administrators informally advocate	A,B	BL formally approved and advocated by university administrators	C,	Formal BL advocacy by university administrators and departments/colleges	E,D,F
	Implementation	Individual faculty members implementing BL	A,B	Administrators target implementation in high impact areas and among willing faculty	C,D	Departments/colleges strategically facilitate wide-spread faculty implementation	E,F
	Definition	No uniform definition of BL proposed	A,B,C, D	Initial definition of BL formally proposed	E	Refined definition of BL formally adopted	F
	Policy	No uniform BL policy in place	B	Tentative policies adopted and communicated to stakeholders, policies revised as needed	A,C,D	Robust policies in place with little need for revision, high level of community awareness	E,F
S t r u c t u r e	Governance	No official approval or implementation system	B,C	Emerging structures primarily to regulate and approve BL courses	A,D,F	Robust structures involving academic unit leaders for strategic decision making	E,
	Models	No institutional models established	A,B,C, D,F	Identifying and exploring BL Models	--	General BL models encouraged not enforced	E,
	Scheduling	No designation of BL courses as such in	A,B,D	Efforts to designate BL courses in registration/catalog system	C,,E	BL designations or modality metadata available in registration/catalog system	F

	Evaluation	No formal evaluations in place addressing BL	A,B,D	Limited institutional evaluations addressing BL learning outcomes	C,F	Evaluation data addressing BL learning outcomes systematically reviewed	E
S u p p o r t	Technical	Primary focus on traditional classroom technological support	A,B	Increased focus on BL/online technological support for faculty and students	C,F	Well established technological support to address BL/online needs of all stakeholders	E,D
	Pedagogical	No course development process in place	A,B	Experimentation and building of a formal course	C,D,F	Robust course development process established and systematically promoted	E,
	Incentives	No identified faculty incentive structure for implementation	A,B	Exploration of faculty incentive structure for faculty training and course development	C,D	Well-established faculty incentive structure for systematic training and implementation	E,F