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The factor structure of teaching development needs for distance-delivered e-learning

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The purpose of this study was to better identify directions for addressing the needs of academics in institutions of higher education who teach technologically-mediated, distance-delivered courses. This single-case study aimed to examine the factor structure of a 16-item survey. The data for this study were drawn from a larger survey which examined the structures and practices that can improve technologically-mediated distance-delivered teaching practices. The participants ($n=187$) from this study were from a dedicated distance delivery institution in Canada. The findings revealed a four-factor model: (1) technical (Internet/Web resources); (2) social (interpersonal skills); (3) pedagogical (cognitive); and (4) managerial (teaching). The constructs identified were associated with the unique characteristics of teaching distance-delivered courses using Web and Internet-based communication tools – or ‘e-learning’. The findings of this study should be of value to faculty developers whose institutions also offer distance-delivered e-learning courses and programs.

Le but de cette étude était de mieux identifier les façons avec lesquelles répondre aux besoins des universitaires qui enseignent dans le cadre de cours donnés à distance, à l'aide de technologies. Cette étude de cas visait à examiner la structure factorielle d'un sondage à 16 items. Les données de cette étude ont été tirées d'un sondage plus vaste ayant examiné les structures et les pratiques permettant d'améliorer les pratiques enseignantes à distance soutenues par les technologies. Les participants ($n=187$) à cette étude proviennent d'une institution vouée à l'enseignement à distance au Canada. Les résultats indiquent la présence d'un modèle à quatre facteurs : (1) technique (ressources Internet/Web), (2) social (compétences interpersonnelles), (3) pédagogique (cognitif) et (4) managérial (enseignement). Les éléments identifiés étaient associés aux caractéristiques particulières de l'enseignement de cours à distance faisant appel au Web et à des outils de communication reposant sur l'Internet (le « e-learning »). Les résultats de cette étude devraient être utiles pour les conseillers pédagogiques provenant d'institutions offrant des cours et des programmes à distance au moyen du e-learning.

Keywords: internet and web; distance education; higher education; faculty development; confirmating factor analysis; e-learning; teaching development

Introduction

The widespread perception that technologically-mediated distance education is growing globally in scale and delivery capacity (Banas & Emory, 1998) due, primarily to the diffusion of ubiquitous Internet and Web-based communication technology (Bryant, Kahle & Schafer, 2005) has not yet been fully supported by research. There is some evidence that there is an increasing growth in certain countries (e.g., the USA – see Allen & Seaman, 2005 and NCES, 2001) but

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recent research by the Centre for Educational Research and Innovation (CERI) (2005) revealed that student enrolment for Internet and/or Web-based distance-delivered courses (or simply *e-learning*) in higher education fell well under 5% of the total enrolments. However, at this point in time, while fully distance-delivered e-learning may not be mainstream in many higher education institutions, it is currently offered – in one form or another – by most institutions of higher education (e.g., hybrid/blended learning). Indeed, according to Daniel (2000), today no self-respecting university president can admit to not offering e-learning courses.

For those responsible for the design, development and delivery of either blended or fully distance-delivered e-learning courses, it is essential they have a sound understanding about e-learning (Kanuka, 2006; Kreber & Kanuka, 2007). In many instances, technologically mediated distance teaching involves unique faculty development requirements, requirements that go beyond the everyday concerns of on-campus teaching. While it is true that much of what we currently know about teaching and learning can be applied to the theory and the practice of technologically-mediated distance education, research has revealed that if the degree of separation is great, it can transform traditional expository teaching so significantly that alternative ways of teaching are needed (Moore, 1991; Moore & Kearsley, 2005). Examples of frequent transformations arising related to distance-delivered e-learning courses have revolved around the need for understanding the impact of technology selection and preferences, increased course development time, and reduced autonomy and flexibility in developing and delivering courses (Bates, 2005). Such issues, if not acknowledged and resolved, can result in underdeveloped and poorly delivered e-learning courses causing not only negative attitudes and opinions for both students and academics, but may also cause low course completion rates for students and an inability for institutions to recruit and retain instructors for their e-learning courses (Kanuka & Rourke, 2006).

The purpose of this study was to better identify directions for addressing the needs of academics in institutions of higher education who teach e-learning courses. We begin this paper with a review of related and relevant literature on the theoretical framework guiding this study, followed by a description of the methodology for this project and a discussion of our findings. We conclude with recommendations and implications for faculty development related to e-learning practices.

Methodology

Theoretical framework guiding the study: community of inquiry

A number of notable theoretical frameworks have been developed with the aim of explaining essential constructs required for successful e-learning. These theoretical frameworks are premised on two assumptions: (1) dialog is essential to successful distance-delivered e-learning; and (2) successful e-learning requires the cognitive dimensions to be addressed. The cognitive dimension has been expressed as higher, intellectual levels of learning (e.g., critical, creative and complex thinking skills). The dialog dimension has most often been expressed in association with social and teaching constructs. One of the first models designed for distance-delivered e-learning was developed by Henri (1992). Her framework identified both social and cognitive constructs as essential aspects of e-learning within the following four dimensions: content reflecting the social dimension; content relating to the interactive dimension; content indicating the application of cognitive skills; and content showing metacognitive skills.

About the same time, Berge (1995) also developed a theoretical framework on the essential roles of instructors facilitating e-learning. Berge's model identified four necessary conditions for effective e-learning: technical; managerial; social; and pedagogical. The technical role requires instructors to have the necessary knowledge, skills, and comfort of the communication tools being used to facilitate the learning process. The managerial role involves the organizational,

procedural and administrative tasks associated with most credentialed and institutional learning environments. The social role centers on the need to create a friendly and social environment necessary for ongoing and interactive communication. Finally, the pedagogical role encompasses the areas of intellectual development and execution of learning tasks.

Building on constructs of Henri's (1992) model – but also incorporating a pedagogical (intellectual/cognitive) construct similar to Berge's (1995) model – Garrison, Anderson and Archer (2000, 2001) identified the essential properties of asynchronous learning networks: teaching presence, social presence and cognitive presence. This model, called the community of inquiry (CoI), is more complex than the prior models cited and as such this model provides wider explanatory power within each of the theoretical constructs. Social presence in this model involves the ability of students to project and establish personal and purposeful relationships and includes affective communication, open communication and group cohesion. Teaching presence involves interaction and discourse as well as structure (design) and leadership (facilitation and leadership) falling within the categories of design, facilitation and direct instruction. Cognitive presence is the most complex of the constructs in the CoI model and has a model within the model, which the authors' have referred to as the practical inquiry model. It is defined as the exploration, construction, resolution and confirmation of understanding through collaboration and reflection in a CoI.

The CoI model has received considerable attention in the e-learning research arena, with over 200 studies using this model as a theoretical framework. Moreover, it has proven to be useful as a methodological solution for researchers and has been validated (Garrison, Cleveland-Innes & Fung, 2004). As such, this model was deemed to be an appropriate choice to frame our survey results. However, based on our own experiences in facilitating teaching development workshops, we could not ignore the technological aspects that other similar models include, such as Berge's (1995) model. Specifically, the CoI model assumes that the technology used to facilitate the learning will be text-based, asynchronous computer conferencing. At the time the model was developed, this was an appropriate assumption. However, with the more recent emergence of social software (e.g., blogs, wikis) and increasingly pervasive use of ephemeral communication tools (e.g., Elluminate, Centra, iVcoalise, Skype) we felt we had to incorporate a technological factor as well.

In summary, we anticipated four constructs to emerge from the survey data based on Garrison, Anderson and Archer's (2000) and Berge's (1995) models: technical (Web/Internet resources); social (interpersonal skills); pedagogical (cognitive); and managerial (teaching).

Survey data

This single-case study aimed to examine the factor structure of a 16-item survey question on teaching resources at a dedicated distance-delivery university in Canada. What marks this investigation as a single-case study is that the data were drawn from a specific unit of analysis (one institution), and the data were bounded by place and time (Creswell, 1998; Yin, 1994). The data for this study were drawn from a larger survey, which examined the wider structures and practices.

The survey was developed using a five-point Likert-type scale, with the anchors Strongly Disagree (1) and Strongly Agree (5). The committee secured university Research Ethics Board approval for the study and it was then piloted by a small number of colleagues. After the revisions were made based on the pilot feedback, the survey was then hosted at Zoomerang®, which is Internet-based software provided by Market Tools Inc®. For each of the 16 items that described some type of teaching resource, respondents were asked to indicate whether they thought more resources of this type should be provided.

Analysis

Exploratory Factor Analysis using SPSS® version 14.01 was used to extract factors using an unweighted least-squares method of extraction. Factors are latent constructs which cannot be measured directly (Hair, Anderson, Tatham & Black, 1998). We analyzed the data using both the orthogonal rotation (varimax) and non-orthogonal rotation (oblimin). The varimax rotation technique gave us a more interpretable solution. We therefore used varimax rotation and 0.30 as a cut-off to identify items with high loadings for inclusion with each factor. Eigenvalues greater than 1 were used to extract reliable factors. We anticipated a factor structure that would map onto the four constructs identified in our theoretical framework. To assess the fit of our model, confirmatory factor analysis (CFA) was performed using AMOS® version 7.0 in order to calculate a goodness-of-fit measures and assess the significance of the multivariate relationship between the factors. We specifically chose to use CFA to determine if the number of factors and the loadings of measured (indicators) variables conform to what we expected on the basis of the literature reviewed. Our *a priori* assumption was that each factor would be associated with the specified subset of indicator variables – or more specifically, to determine if the measures we created to represent our latent variables really belong together. The sample size of 187 was adequate for a small-to-medium size model (Tabachnick & Fidell, 2000).

Results

The survey was sent to all staff members ($n=609$) involved in the design and delivery of course materials. We had 187 responses to the survey for a response rate of 31%. We attribute the high response rate to our following the practices advocated by Couper (2000) and Fowler (1993). The majority of respondents were between the ages of 50–59 ($n=80$), followed by 40–49 ($n=48$), under the age of 40 ($n=39$), and 60 or older ($n=17$). The majority of respondents were female (male: $n=65$; female: $n=117$; missing: $n=5$). Most respondents were relatively new hires, with five or fewer years of experience from the date of hire ($n=103$; pre-1983: $n=20$; 2000–1983: $n=63$). Our exploratory factor analysis results are presented in Table 1.

Consistent with our expectations, four factors were extracted that mapped onto the four constructs outlined earlier. The first factor accounted for 14% of the variance and consisted of five items related most strongly to the technical construct. The sixth item (assessing student contributions in online discussions) was equally associated with Factor 4. The second factor accounted for 13.6% of the variance and was associated with items most strongly related to the social construct. The third factor accounted for 12.1% of the variance and was associated with three items strongly related to teaching in an online discussion forum. The final factor accounted for 9% of the variance and was associated with two items related to the moderation of discussion forums. There was one item that was not clearly associated with any one factor and was dropped from the CFA along with the sixth item that loaded on two factors.

Using AMOS® version 7.0, maximum-likelihood CFA was conducted to assess the generalizability of the four-factor model. Three practical measures of fit, the Comparative Fit Index (CFI, values close to 1), the Root Mean Square Error of Approximation (RMSEA, values less than 0.10), and the adjusted minimum discrepancy value (CMIN/DF, values less than 3) were used as the evaluation criteria for adequacy of the model (Cole, 1987). The following values of: CFI = .89, the RMSEA = .09 and the CMIN/DF = 2.42 for the four-factor model in this study indicated a good fit to the observed data. The loadings of the item to each of the factors are presented in Figure 1.

Table 1. Rotated component matrix for teaching resources.

Teaching resources	Factor 1: Technical	Factor 2: Social	Factor 3: Managerial	Factor 4: Pedagogical
Q 13: How to effectively use Web logs (blogs) with my students	.747			
Q 14: How to effectively use wikis with my students	.698			
Q 9: How to conduct different instructional methods in an online classroom (e.g., debates, Webquests, case studies, problem-based learning, invited guest, nominal group technique)	.509			
Q 16: How to effectively use online student assessment tools (e.g., quizzes or exams)	.476			
Q 15: How to use Learning Management Systems (LMS) (e.g., Moodle) to improve learning	.441			
Q 3: How to assess student contributions in online discussions	.418			.418
Q 10: How to ensure I am using proper etiquette with my students in synchronous communication		.849		
Q 11: How to ensure I am using proper etiquette with my students in asynchronous communication		.804		
Q 8: How to deal with difficult students in synchronous communication		.654		
Q 7: How to deal with difficult students in asynchronous communication		.408		
Q 4: How to start effective asynchronous discussions			.755	
Q 6: How to maintain meaningful asynchronous discussions			.670	
Q 5: How to bring closure to asynchronous discussions			.618	
Q 1: How to effectively moderate text-based synchronous discussions				.792
Q 2: How to moderate text-based asynchronous discussions				.636
Q 12: How to engage learners with motivations strategies				

Note: Extraction method: Principal Component Analysis; Rotation method: Varimax with Kaiser normalization.

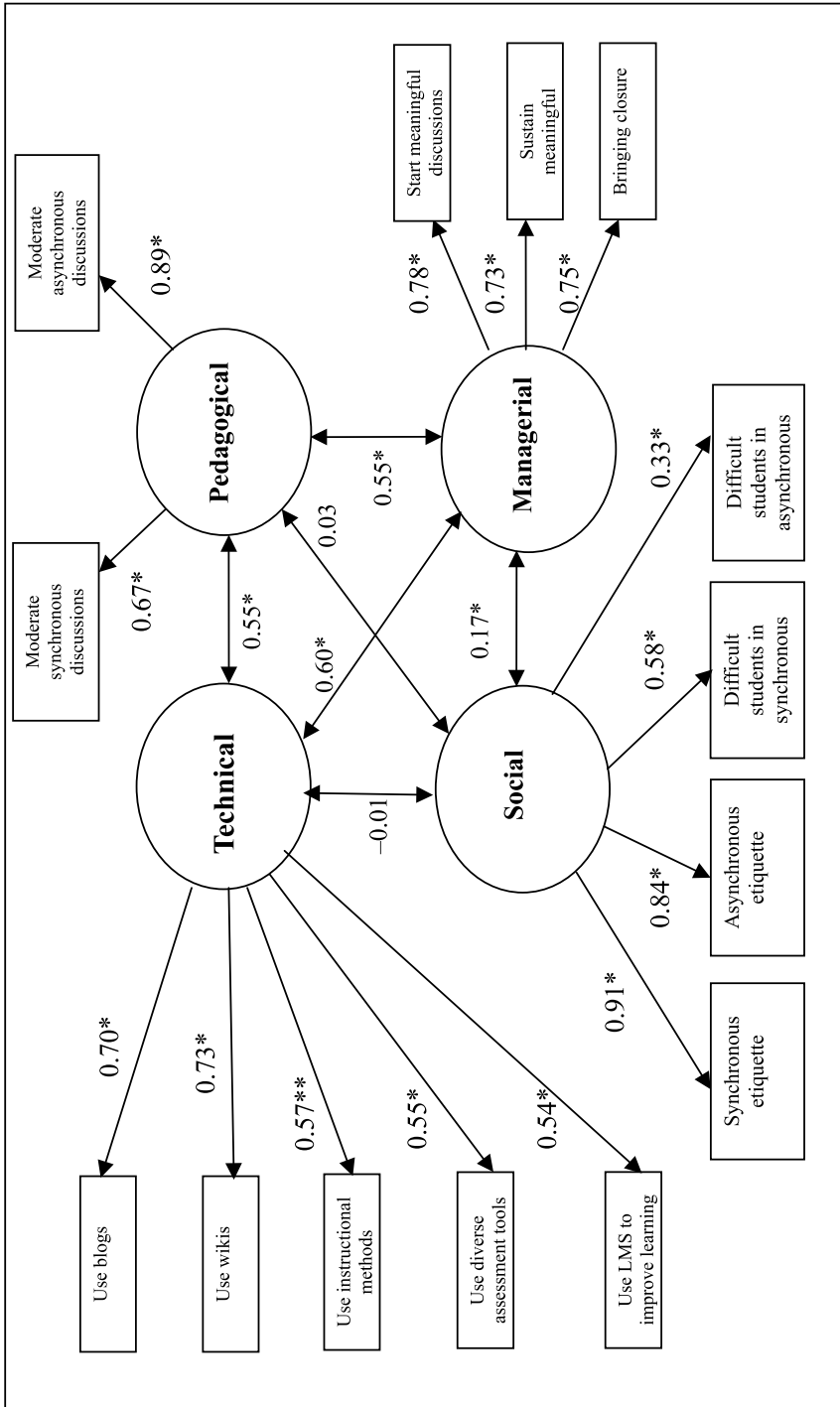


Figure 1. Result of confirmatory factor analysis for teaching development needs.
 Note: * Significant at $\alpha=0.05$.

Discussion

The ability to develop well-designed e-learning is critical to the success of the students' learning experiences, and faculty development is a critical component of well-designed e-learning in institutions of higher education (Kim & Bonk, 2006; Sammons, 2003). The purpose of this study was to better identify directions for addressing the needs of academics who teach distance-delivered e-learning courses. The CoI model was used to guide the development of the survey questions, with the aim of identifying valued and needed teaching development activities. The findings confirmed a four-factor model for faculty development concerned with e-learning courses: (1) technical; (2) social; (3) pedagogical; and (4) management. The constructs identified were associated with the unique characteristics of teaching distance-delivered courses using Internet and Web-based communication tools. What follows is a discussion on each factor and their associated constructs and, based on these findings, recommendations for addressing the needs of academics who teach e-learning courses.

Technical (Web/Internet resources)

The findings in this area support the belief that technology is an important aspect of the design and development of e-learning and needs to be an important component of a faculty development program. Prior research by Kim and Bonk (2006) also found that how instructors choose and use technology plays a vital role in the development and expansion of e-learning. These researchers cite several examples that provide evidence of how blogs can support reflective learning, wikis encourage student collaboration, and an increasing number of academics are effectively using podcastings.

However, while the constructs in our survey that are significantly loaded on this factor confirm the need for educators to learn how to use new technologies effectively, this is connected to the perceived need for improved learning through such activities as diverse instructional methods and effective use of course management systems (e.g., Moodle, WebCT, Blackboard, FirstClass etc.). Figure 1 illustrates this point further in that there is a significant relationship with the moderating factor. The moderating factor has been defined as including the cognitive (higher ordered learning) and pedagogical (intellectual) aspects.

Pedagogical (cognitive)

Prior research has provided some evidence that an important skill for instructors to acquire, when using group communication tools, is how to moderate effectively the learning transactions. A conclusion made by Kim and Bonk (2006), for example, based on a large-scale survey was that the most important knowledge and skills for e-learning instructors to acquire over the next few years will be how to moderate effectively using group communication tools and planning for high-quality e-learning courses. Other research in this area provides further evidence of this pressing need (e.g., Salmon, 2000). In particular, substantial research has been conducted on the effectiveness of technologically-mediated group communication to support higher levels of learning, with most of the research focusing on text-based asynchronous computer conferencing and the development of critical thinking skills. A recent and extensive review of this research by Rourke (2005) (see also Veerman, Andriessen, & Kanselaar, 2000) shows that students infrequently engage in the communicative processes that comprise critical discourse, and in the occasional cases when they do, they do not achieve the stated outcomes.

Helping instructors with their understandings on how to moderate discussions effectively using group communication technologies is essential in higher education, as discussions are

often viewed as a central feature of higher education (Kanuka, 2005) – the rationale stemming from a prevalent belief that knowledge construction is a social and linguistic process (e.g., Vygotsky, 1962). Given the emphasis on the social aspects of learning in relation to knowledge construction, we expected that there would be a significant relationship between the pedagogical factor and the social factor. In fact, our data show that there is no significant relationship between these two factors. This was a counter-intuitive finding and worthy of further investigation. Alternatively, there was a significant relationship between the pedagogical factor and the managerial factor.

Managerial (teaching)

Currently, a considerable amount of the opinion literature, in all sectors of education, is encouraging teachers to become facilitators or guides on the side with overarching aims to create self-directed/regulated and responsible learners who, as a result, will have well-developed critical and creative thinking skills. However, recent research is revealing some evidence that in order to achieve higher levels of learning within e-learning environments, there needs to be intentionally designed and structured learning activities with clearly defined roles and responsibilities for teachers and students (Kanuka, Rourke & Laflamme, 2007; Rourke & Kanuka, 2007) – which is in contrast to beliefs that educators should be guides on the side and learners need to be self-directed. Well-structured learning activities require management of the process, including starting, sustaining, and closing learning transactions. Research has also shown, for example, that highly structured discussions (e.g., formal debates) are significantly more effective than less structured discussions (e.g., reflective dialog) at achieving higher levels of learning (Kanuka, 2005).

This research also shows that in order to achieve higher levels of learning in e-learning courses, students need to be explicitly provoked to confront other's opinions and without structure and guidance on how to confront others, in a respectful manner, students tend to either not address differences of opinions or interpret disagreement as personal attacks (Kanuka, 2005; Rourke, 2005). As such, it is important for academics teaching with group communication tools to understand the social, or interpersonal, aspects of this unique environment. Our data support this belief; as Figure 1 shows, there is a significant relationship between the managerial factor and the social factor, though it is weak in comparison with the other correlations.

Social (interpersonal skills)

A barrier to higher levels of learning in e-learning courses has been identified as the inability to understand certain interpersonal aspects of technologically-mediated discussions (Rourke, 2005). Garrison (2006) asserts that it is essential that both students and instructors feel secure enough to communicate openly, and in ways that support the educational objectives of the learning activities. Research in this area by Swan and Shih (2005) found that social presence must have personal, but purposeful, relationships. Garrison asserts further that the purpose of social presence is to create the conditions for e-learning interactions to achieve the educational goals – and personal relationships and interaction must be defined in academic terms: 'Social presence for educational purposes cannot be artificially separated from the purposeful nature of educational communication (i.e., cognitive and teaching presence)'. As such, the social factor should be associated with the pedagogical and managerial factors. Figure 1 illustrates that this is not the case. Our findings show a significant relationship with managerial, but not with pedagogical and technical resources indicating that garrison's assumption is only partially true, in that social presence cannot be separated from teaching presence, but it can be separated from cognitive presence.

Recommendations and implications for faculty development

The rapid and incessant developments of communication technologies combined with pressures to integrate these technologies into the higher education learning experience have given rise to questions regarding changing roles and competencies about how to address the needs of academics who teach distance-delivered e-learning courses. The results of this study indicate that programs for faculty development in this area should include the following four areas: (1) technical; (2) social; (3) pedagogical; and, (4) managerial.

In the technical area, the learning activities should include 'how to' courses with course management systems (e.g., Moodle, WebCT, Blackboard, FirstClass, etc.) and their associated assessment tools, as well as social software (e.g., wiki, blogs) – but these activities must be guided by pedagogical underpinnings. Such pedagogical underpinnings include how to use diverse instructional methods (e.g., debates, webquests, case studies, problem-based learning, nominal group techniques, etc.) with e-learning communication tools.

In the social area, the learning activities should include interpersonal skills that encompass the creation of a welcoming community necessary to establish a respectful environment. This is important as both instructors and students may not be familiar about how to interact using e-learning communication tools, and often experience considerable anxiety. In specific terms, this would include information about what is acceptable and appropriate communication in both synchronous and asynchronous environments – sometimes referred to as 'netiquette' in the literature. Another topic that was perceived to be important revolves around how to deal with inappropriate communication in both synchronous and asynchronous environments. This area is of particular importance as most institutions have developed guidelines for acceptable and non-acceptable student codes of conduct in e-learning courses. However, it has been our experience that many academics seem unaware of these policies, and even when they are familiar with them, they often find it difficult to know how to prevent and/or deal with inappropriate student behavior when using Internet and/or Web communication tools.

In the pedagogical area, the learning activities should include how to effectively facilitate the pedagogical tasks necessary to facilitate students' intellectual development. While the CoI model has a complex model for cognitive presence, our findings indicate that instructors' needs are somewhat simpler. Their needs revolved primarily around moderating or how to guide learning activities when using synchronous and asynchronous e-learning technologies.

In the managerial area, the learning activities should include basic and essential teaching tasks related to e-learning technologies. Such tasks include starting and sustaining meaningful technologically-mediated discussions, as well as bringing meaningful closure to mediated discussions. Most important, however, is a desire to gain the knowledge and skills to motivate their learners to be self-directed when working at a distance. Motivating students at a distance is a particularly important element for instructors to understand as there is a connection with motivation and certain aspects of a successful distance-learning experience (i.e., completion rates).

Finally, an important theme connecting each of these four factors is the need for pedagogically sound learning in ways that lead to successful learning experiences. Given this recurring theme in our survey responses, we conclude that faculty development activities should be offered in the areas of basic and essential skill development (e.g., technical matters related to e-learning communication tools) but in ways that are embedded in effective pedagogical practices.

Limitations of the study and further research

As a single-case study with a relatively small sample size, this study is limited in its generalizability. Moreover, since a survey was used, the data are based on self-reported information, with possible respondent bias. Another well-known drawback to surveys is that the results can be

cursory unless combined with in-depth and more sensitive data collection techniques. Hence, further research is needed to provide greater explanatory power from the insiders' perspectives, and to gain greater understandings between the curriculum developers, instructors, courses and programs, as well as possible disciplinary differences and affective aspects.

Notes on contributors

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