New exploratory and confirmatory factor analysis insights into the community of inquiry survey

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ABSTRACT

This study has the aim of investigating the factor structure of an adapted version of the Community of Inquiry survey developed by Arbaugh et al. (2008). For this purpose, both exploratory and confirmatory analyses were employed in addition to a parallel analysis using two different samples. The results indicated a three-factor structure as well as high reliability indices for each subpart of the survey. More specifically, the three factors identified appear to correspond to three presences: teaching, cognitive, and social presences. Moreover, results of the study did not reveal any substantial changes that need to be made to any survey items. All these align completely with the theoretical assumptions of the Community of Inquiry Framework (e.g., Garrison & Akyol, 2013a, b), and call for further factor analytic studies on the survey.

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1. Introduction

Given the increasing number of enrollments in at least one online course in recent years in the US (e.g., Allen & Seaman, 2010, 2011, 2013), and the highly growing preference for online higher education (Lloyd, Byrne, & McCoy, 2012), it has become important to evaluate online higher education programs (Kozan & Richardson, 2014). Online learning or education theoretical frameworks are important to such evaluation attempts (Kozan & Richardson, 2014). In this respect, originating in higher education computer conferencing or asynchronous textual group discussions (Garrison, Anderson, & Archer, 2010), Community of Inquiry (CoI) Framework (Garrison & Akyol, 2013a,b; Garrison, Anderson, & Archer, 2000, 2001; Garrison & Arbaugh, 2007) may be helpful greatly for formative evaluation attempts to ensure quality of online education and learner retention (Boston et al., 2009). Additionally, a common instrument has been developed by Arbaugh et al. (2008) for use with online learning environments that allows for the collection of empirical data regarding the process of learning.

What is as important as the development of such an instrument is validation and refinement studies using different learner groups and learning contexts. Given the dynamic and process-oriented nature of the CoI Framework which may be highly dependent on learner profile and learning context to a certain extent (Kozan & Richardson, 2014), validating and refining the CoI survey carries great importance in terms of increasing the validity and reliability of evaluation of online learning experiences. Therefore, it is not surprising that, in their pioneering work, Arbaugh et al. (2008) highlighted the importance of refinement studies. To serve this purpose to a certain extent, the current paper reports a multiphase exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) study using data collected from the CoI instrument.

1.1. The CoI Framework

Focusing on a socio-cognitive side of learning (Shea et al., 2011), the CoI Framework is primarily concerned about the learning process (Akyol et al., 2009; Swan, Garrison, & Richardson, 2009), which aligns with its social-constructivist approach to learning (Akyol & Garrison, 2011; Akyol, Ice, Garrison, & Mitchell, 2010; Akyol et al., 2009; Shea et al., 2011; Swan & Ice, 2010; Swan et al., 2009). The CoI Framework presumes three types of presence: (a) teaching presence, (b) cognitive presence, and (c) social presence. These presences are assumed to be closely related to each other and it is argued that educational experience happens within the intersection of the three (e.g., Arbaugh et al., 2008; Garrison et al., 2000).

Teaching presence comprises design and organization, facilitating discourse and direct instruction (Akyol & Garrison, 2008; Anderson, Rourke, Garrison, & Archer, 2001; Garrison, 2013). Anderson et al. (2001) described design and organization as designing "the process, structure, evaluation and interaction" (p. 5) and "providing guidelines and tips and modeling" (p. 6). As for facilitating discourse, it is the encouragement of reflective and sustained discourse including learners' engagement, and evaluation of the effectiveness (Anderson et al., 2001). Such a discourse consists of a critical and reflective dialogue purporting to collaboratively resolve cognitive conflicts (Garrison, 2013). Finally, direct instruction is the integration of subject matter

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and pedagogy knowledge as well as working out technical problems and guiding students towards further resources (Anderson et al., 2001).

Moreover, Garrison et al. (2000) stated that, through designing instruction and facilitating learning, teaching presence serves fostering cognitive and social presence. Likewise, Garrison and Akyol (2013a) claimed that teaching presence is essential regarding both learning consequences and alignment of social and cognitive presence. Additionally, Garrison (2011) asserted that teaching presence is the building block of a community of inquiry and aligns with learning outcomes, learner needs and capabilities of learners.

Cognitive presence is learners' capability of constructing and validating meaning through critical and continuous communication and thinking (Garrison et al., 2000, 2001). More specifically, cognitive presence is deliberately and iteratively progressing through triggering event, exploration, integration and resolution phases (Garrison & Arbaugh, 2007). Achieving these also corresponds with accomplishing a high level of learning through (a) starting with a problem to solve, (b) exploring ideas, (c) integrating them to the extent possible, and (d) choosing and applying the best solution. As a result, according to Vaughan and Garrison (2005), cognitive presence provides insights into what is accomplished through a learning experience. Kozan and Richardson (2014) further suggested that cognitive presence can mediate the relationship between teaching and social presences depending on learner priorities. For instance, what matters for learners outmost would be learning results and they might be inclined to employ social interactions to serve enhancement of learning (Kozan & Richardson, 2014).

Social presence includes not only social interaction but also encouragement of critical thinking and higher level learning (Garrison & Akyol, 2013a), thus being "an element central to learning in an online community of inquiry" (Garrison, Cleveland-Innes, & Fung, 2010, p. 32). Arguing that the original definition of social presence was not inclusive enough, Garrison (2009) described it as "the ability of participants to identify with the community (e.g., course of study), communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities."(p. 352). Then, it is reasonable to assume that under the facilitative guidance of teaching presence, social presence can establish the social context in which cognitive presence can flourish. This concurs with Garrison and Arbaugh's (2007) idea that "social presence in a community of inquiry must create personal but purposeful relationships" (p. 160).

In this respect, affective or emotional expressions, a part of social presence, constitute interpersonal communications (Garrison & Akyol, 2013a). Furthermore, open communication is reciprocal and respectful communication (Garrison et al., 2000). The third component, group cohesion, establishes and maintains a feeling or sense of a community fueled by a feeling of belongingness (Garrison et al., 2000). Given that teaching presence should encourage both social and cognitive presences (Garrison, 2011; Garrison & Akyol, 2013a; Garrison et al., 2000), and that social presence should go beyond social communications thus enhancing cognitive presence (Garrison & Akyol, 2013a), it becomes essential to test these assumptions through a measurement instrument.

1.2. The CoI instrument

Arbaugh et al. (2008) developed a 34-item survey (the CoI survey) in order to measure the presences within online learning environments based on a single instrument. The survey consists of three subparts (corresponding to the three presences) each of which includes a different number of items that purport to measure each presence type. There has been some previous research aimed at establishing the validity and reliability of this survey. For instance, through a principal component analysis, Arbaugh et al. (2008) claimed that their results point to the construct validity of the presences as measured by the CoI survey.

Specifically speaking, Arbaugh et al. (2008) implemented a principal component analysis (PCA) using a multi institutional graduate student sample (N = 287). The results yielded four factors with eigenvalues bigger than 1. It is noteworthy to state here that while the first factor (teaching presence) had an eigenvalue bigger than 17, the eigenvalues of the other three factors fanged from 1.18 to 1.92, which was depicted in the scree plot as well. The researchers reported a total of 61.3% with the first factor explaining 51.1% of it. A 3-component solution reached in the study accompanied factor loadings that are equal to or bigger than .425. Consequently, Arbaugh et al. (2008) claimed that their results align with the theoretical assumptions of a 3-component CoI Framework accepting that there might be a fourth factor, or that it would be possible that the teaching presence part of the survey could be divided into further subscales.

Similarly, Swan et al.'s (2008) CFA produced the triple structure suggested by the CoI Framework. Swan et al. (2008) also reported high reliability indexes (Cronbach's Alpha) for each part of the CoI survey focusing on teaching, social and cognitive presence respectively: (a) teaching presence = 0.94; (b) social presence = 0.91; (c) cognitive presence = 0.95. Further, the authors stated that "As such, confirmatory factor analysis, using principal component analysis with obliminal rotation was utilized." (p. 6). Swan et al. (2008) concluded that their results confirmed the three-part structure of the CoI Framework.

Another study, Diaz, Swan, Ice, and Kupczynski (2010), employed a PCA on multiplicative scores that are ratings on the CoI survey multiplied by the importance ratings of the CoI survey items. Results with no specific number of components set before suggested existence of four components with eigenvalues larger than 1. The first of these (cognitive presence) had an eigenvalue of 15.02 while the eigenvalues for the other two were 2.45 and 3.59. In line with Arbaugh et al. (2008), the authors asserted that the fourth component may be a subpart of teaching presence without constituting an independent component on its own.

Additionally, studies by Garrison, et al. (2010), and Shea and Bidjerano (2009) both ran factor analyses and structural equation model analysis (SEM) using the CoI survey. According to authors of both studies, SEM analyses suggested a mediating effect of social presence between teaching presence and cognitive presence, and teaching presence has both direct and total effects on cognitive presence. Shea and Bidjerano (2009) also employed an EFA (using principal axis factoring) with oblimin rotation. Claiming that a three-factor structure worked better, the researchers also tried a four-factor solution. Overall, the results produced three factors with eigenvalues bigger than 1. The first factor (i.e., cognitive presence) had an eigenvalue of 17.02 while the other two eigenvalues were 1.33 and 3.27. These explained 63% of the total variance with reliability indexes bigger than .91. Garrison, et al (2010) also ran a PCA with oblimin rotation on the CoI survey data resulting in a three-component structure. Teaching presence had an eigenvalue of 13.08 while social presence had 2.09 and cognitive presence had 3.06. The total variance explained was 53.6% with reliability scores above .86 for each subpart.

Given the differences between EFA and PCA in terms of their purposes and models tested (e.g., Bandalos & Boehm-Kaufman, 2009; Schmitt, 2011) or possible differences regarding solutions (e.g., Field, 2009), it may be worthwhile to further the research on this instrument. For instance, while Shea and Bidjerano (2009) and Diaz et al. (2010) reported cognitive presence with the highest eigenvalue, Arbaugh et al. (2008) and Garrison et al. (2010) stated that teaching presence had the highest. Moreover, exploratory analysis depends on the shared variances among the items only while PCA works on the total variance in the items (Gaskin & Happell, 2014). Likewise, Mertler and Vannatta (2002) stated that while factor analysis focuses on shared variance among the variables, PCA deals with unique, shared and error variances. Therefore, it seems statistically appropriate to run an EFA while determining the factor structure of an instrument since factors would be determined based on the intercorrelations among the items not the total