

A Meta-Analysis on the Community of Inquiry Presences and Learning Outcomes in Online and Blended Learning Environments

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Abstract

The Community of Inquiry (CoI) framework describes three essential presences (i.e., teaching presence, cognitive presence, and social presence) and how these presences interact in providing an educational experience in online and blended learning environments. This meta-analysis examined 19 empirical studies on the CoI Presences (teaching presence, social presence, and cognitive presence) and their correlations with learning outcomes, including actual learning, perceived learning, and satisfaction. It was found that teaching presence and actual learning were moderately positively correlated, ($r = .353$). There was a weak correlation between cognitive presence and actual learning, ($r = .250$) and social presence and actual learning, ($r = .199$). For the correlation between the presences and perceived learning, cognitive presence and perceived learning was found to be strongly correlated, ($r = .663$), followed by the moderate correlation between social presence and perceived learning ($r = .432$), and teaching presence and perceived learning, ($r = .392$). With respect to satisfaction, the correlation between cognitive presence and satisfaction ($r = .586$), and between teaching presence and satisfaction was strong ($r = .510$), but the correlation between social presence and satisfaction was moderate ($r = .447$). The findings have implications for designers and instructors who design and teach online and blended courses to include these presences.

Keywords: Community of Inquiry, teaching presence, cognitive presence, social presence, online learning, blended learning, meta-analysis

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Online and blended learning has increased in the last decade (Seaman et al., 2018), so has the challenges that come with it. Several challenges exist in online learning including student isolation and dropout due to the lack of interaction and engagement (Ali & Smith, 2015; Croft et al., 2010; Xie et al., 2006, 2011). Some online courses are designed to be self-paced without any interaction between students and their instructors and peers. This has resulted in students not being engaged in learning. Research has emphasized the importance of interaction and presence in the online learning environment (Bolliger & Inan, 2012; Bolliger & Martin, 2018). Presence within the context of this study can be explained through the Community of Inquiry (CoI) framework, which suggests three types of presence, including teaching presence, cognitive presence, and social presence, are necessary to develop a deep and meaningful learning experience supported by the educational community (Garrison, 2007). An educational CoI is “a group of individuals who collaboratively engage in purposeful critical discourse and reflection to construct personal meaning and confirm mutual understanding” (Garrison, 2011, p. 2).

The CoI framework created by Garrison et al. (2000; 2001) focuses on the process of learning. It was created consistent with John Dewey's work on community and inquiry where he emphasized that educational experience is a process of reflective inquiry (Dewey, 1933). Building on Dewey's work, the CoI framework was developed focusing on asynchronous online discussions where collaborative learning experience was involved instead of self-paced individual online learning (Garrison, Anderson et al., 2010). Through the CoI framework, this study examines the associations between the three types of presence including, teaching presence, cognitive presence, and social presence, and students' actual learning, perceived learning, and satisfaction. Rather than collapsing all learning outcomes together, studies were analyzed for each of the three outcome variables individually. While examining perceived learning and satisfaction has been conducted in other CoI meta-analysis (Caskurlu et al., 2020; Richardson et al., 2017), this study in addition examines actual learning, which is a critical learning outcome.

Community of Inquiry Presences

Cognitive presence focuses on students constructing meaning through critical reflection and discourse and is defined as “exploration, construction, resolution, and confirmation of understanding through collaboration and reflection in a Community of Inquiry” (Garrison, 2007, p. 65). This is operationalized through the practical inquiry model where the four phases are triggering event, exploration, integration, and resolution (Garrison et al., 2001). It applies a cycle of inquiry where participants deliberately move from the problem or issue to exploration, integration, and resolution of the problem. Using application-focused discussion questions or collaborative problem solution help the learners in moving to the resolution phase (Fiock, 2020). Cognitive presence focuses on higher-order thinking through collaboration and instructor and peer facilitation with community members during the critical inquiry process (Chen et al., 2019; Galikyan & Admiraal, 2019; Garrison et al., 2001; Gašević et al., 2015). CoI survey-based research revealed students reporting high levels of cognitive presence (Shea & Bidjerano, 2009a), and variation in technology use based on cognitive presence (Kovanović et al., 2017). However, the transcript analysis in asynchronous online discussions revealed low levels of discourse and knowledge construction. While 53.32% of the online discussions focused on exploration, and 26.05% was on integration, only 10.84% of the online discussions focused on trigger and 9.79% on resolution (Kanuka et al., 2007). Research has found positive relationship

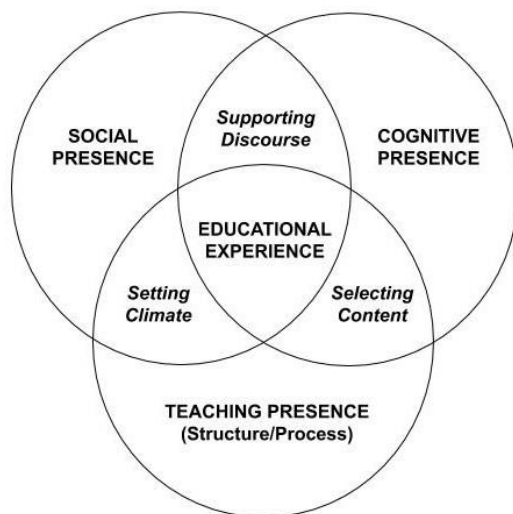
between cognitive presence and student learning and student satisfaction (Hosler & Arend, 2012; Kang et al., 2014).

Teaching presence focuses on instructor interactions with students and content and was defined by Anderson et al. (2001) as “design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educational worthwhile learning outcomes” (p. 5). This includes moderation and guidance of the inquiry, and involves design and organization, facilitating discourse, and direct instruction. Primary studies have found a positive relationship between teaching presence, and student perceived learning (Arbaugh, 2008; Kranzow, 2013; Shea et al., 2005), and student satisfaction (Abdous & Yen, 2010; Akyol & Garrison, 2008; Shin, 2003).

Social presence examines the human experience of learning and is defined as “the ability of participants to identify with the community, communicate purposefully in a trusting environment, and develop inter-personal relationships by way of projecting their individual personalities.” (Garrison, 2009, p. 352). The “social presence” in the CoI framework is multidimensional and includes affective expression, open communication and group cohesion. Social presence has a connection to teaching and learning elements (Garrison, Cleveland-Innes, et al., 2010). Research has shown that social presence can support cognitive engagement in online courses (Xie & Ke, 2011) and also can reduce the presence of social conflict (also known as conflictual presence) in the learning community (Xie et al., 2013, 2017). Social presence was found to have no relationship on learning outcomes (Joo et al., 2011; Shin, 2003) though it was associated with satisfaction (Akyol & Garrison, 2008; Richardson & Swan, 2003; Swan & Shih, 2005).

The CoI framework (Figure 1) discusses the ways in which these presences interact with each other in an online course. Besides the three presences interacting to provide an educational experience, the interaction of social and cognitive presence results in supporting discourse, the interaction of social and teaching presence results in setting the climate, and the interaction of teaching and cognitive presence results in selecting content.

Figure 1
Community of Inquiry Framework (CoI Framework, 2020)



The interaction of teaching and cognitive presence results in selecting the content (Garrison, Cleveland-Innes et al., 2010; Hosler & Arrend, 2012). Research has found cognitive presence to have strong relationship between teaching and social presence, and teaching presence to significantly predict cognitive presence (Kozan & Richardson, 2014). Research has also found social presence to mediate between teaching and cognitive presence (Shea & Bidjerano, 2009b). Primary studies have found cognitive presence to have stronger relationships with learning and satisfaction in comparison to teaching presence (Akyol & Garrison, 2008) and that cognitive presence is achieved by instructors' skills in fostering teaching presence and students' abilities to establish social presence (Shea & Bidjerano, 2009b).

Community of Inquiry Instrumentation

In order to facilitate research based on the CoI framework, survey instruments have been created and validated in various studies. Among them is the CoI Survey that was initially developed by Arbaugh et al. (2008) and validated by Swan et al. (2008). The CoI survey is currently in its 14th version (CoI, 2020) and has 34 items, of which 13 items focus on teaching presence, 9 items on social presence, and 12 items on cognitive presence. Arbaugh et al. (2008) administered the 34-item CoI survey to students enrolled in graduate-level courses in either Education or Business across four institutions in the United States and Canada. Internal consistency (Cronbach's alpha) with 287 students were reported as .94, .91, and .95 for teaching presence, social presence, and cognitive presence, respectively. Table 1 provides a description of items aligned with the CoI framework for the three presences.

Table 1
CoI Survey Items

Type of Presence	Number of items	Description
Teaching Presence		
Design and Organization	4 items	Learners describe instructors communicating course topics, course goals, providing instructions to participate in course learning activities and communicating due/dates and time frames for learning activities.
Facilitation	6 items	Learners describe instructor's helpfulness in helping the students learn course topics, understanding of course topics to clarify thinking, engaging the participants in a dialogue, keeping the participants on task, encouraging them to explore new concepts and develop a sense of community among the participants.
Direct Instruction	3 items	Learners describe instructor's guiding discussion on relevant issues, providing feedback to the student based on their strengths and weakness in the course and providing timely feedback.
Social Presence		
Affective Expression	3 items	Learners describe getting to know the other course participants, form distinct impressions of some participants

		and affirming that online or web-based communication supports social interaction.
Open Communication	3 items	Learners describe comfort among the students for conversing in the online medium, participating in discussions and interacting with other course participants.
Group Cohesion	3 items	Learners describe feeling comfortable to disagree with other course participants, feeling one's point of view being acknowledged and affirming that online discussions helping to develop a sense of collaboration.
Cognitive Presence		
Triggering Event	3 items	Learners describe instructional problems that increased participant interest, course activities that stimulated curiosity, and motivation to explore content related questions.
Exploration	3 items	Learners explore problems through a variety of information sources, identifying relevant information to address content related questions, and affirming the value of online discussion to appreciate diverse perspectives.
Integration	3 items	Learners combine information to address questions, using learning activities to construct explanations, reflection on the course to understand fundamental concepts.
Resolution	3 items	Learners describe ways to apply knowledge, developing solutions to course problems and applying the knowledge beyond the course.

Note. Descriptions created based on survey items (CoI, 2020).

In addition to the initial validation (Arbaugh et al., 2008; Swan et al., 2008), this CoI survey has been validated by several researchers (Carlson et al., 2012; Caskurlu, 2018) including in many languages (Moreira et al., 2013; Olpak & Cakmak, 2018; Yu & Richardson, 2015). While the 34-item survey is used in several studies, there are also variations of the CoI survey used by researchers. Stenbom (2018) in a systematic review summarized that there were 26 studies that included changes to the CoI tool. Some of the changes proposed by researchers include Arbaugh (2008)—21 items; Chen et al. (2019)—9 items; Choy & Quek (2016)—18 items; Khodabandelou et al. (2014)—60 items; Lin et al. (2015)—31 items; Maddrell et al. (2017)—37 items; Mo & Lee (2017)—32 items; and van der Merwe (2014)—10 items.

In addition, CoI research focusing on presences has been conducted in online (Akyol & Garrison, 2008; Alaulamie, 2014) and blended courses (Choy & Quek, 2016; Maddrell et al., 2017), across undergraduate (Van Schyndel, 2015) and graduate learner levels (Dempsey, 2017; Rockinson-Szapkiw, 2016), in the U.S., and outside the U.S. (Chen et al., 2019; Choy & Quek, 2016).

Elements of Presence

In the CoI research studies, researchers describe various ways in which they created presence in the online and blended courses. Fiock (2019) identified instructional activities for the three presences based on the seven principles of good practice for the online environment (Sorensen & Baylen, 2009), including student-teacher contact, cooperation among students, active learning, prompt feedback, time on task, communicate high expectations, and respect diverse ways of learning. These instructional activities assist practitioners as they design and facilitate courses. Some of the example instructional activities they included were a “Create a

“Meet Your Classmates” section of your course where you and students introduce yourselves to one another (Richardson, Ice, & Swan, 2009) for social presence; reflect on group work or peer-supported learning experiences (Redmond, 2014) for cognitive presence; and promptly answer email (Lowenthal & Parscal, 2008) for teaching presence. Richardson et al. (2010) suggested that the following design elements to be considered during the development of an online instructor: Design for open communication and trust, design for critical reflection and discourse, and create and sustain a sense of community. They also recommended some actions and activities in the process of the creation and facilitation of online courses, such as to ensure that students sustain collaboration, ensure that inquiry moves to resolution, and support purposeful inquiry. In this review, we refer to these as “elements of presence” to describe the instructional and learning activities that are designed and used in online and blended courses.

Learning Outcomes

Actual Learning, Perceived Learning, and Satisfaction

In this meta-analysis, we examine actual learning, perceived learning, and satisfaction of the learning outcomes. Actual learning “reflects a change in knowledge identified by a rigorous measurement of learning” (Bacon, 2016, p. 4). This could include measures of scores from tests, projects, presentations, and performances. Perceived learning denotes “a student’s self-report of knowledge gain, generally based on some reflection and introspection” (Bacon, 2016, p. 4). This includes measures of surveys with Likert type items on their perception of learning. And finally, the third learning outcome we examine is satisfaction which is a commonly studied affective measure and describes the fulfillment of one’s expectations or needs.

Several researchers have examined actual learning, perceived learning, and satisfaction to study various topics in education. Bacon (2016) emphasizes the importance of studying both actual and perceived learning in educational research and the importance of examining them as separate constructs. Some educational researchers have found gaps between these two constructs. Deslauriers et al. (2019) compared students’ self-reported perception of learning with their actual learning in college physics courses and found that evaluating instruction based on students’ perceived learning could inadvertently promote passive pedagogical methods compared to active learning methods as students in active learning classrooms had lower perception of learning. In another study, Carpenter et al. (2013) determined that students’ perceived learning was not based on their actual learning but on instructor’s effectiveness. This shows that there is a difference between these two constructs, and it is important to study them distinctly. Similarly, perceived learning is also different from other affective constructs such as satisfaction and it is important for it to be studied separately. Richardson and Swan (2003) examined effects of social presence in online courses on students perceived learning and satisfaction as separate constructs.

Systematic Reviews and Meta-Analyses on the Community of Inquiry

There has been an increase in the number of primary studies focusing on CoI. This has resulted in secondary research; there have been three systematic reviews published recently (Jan et al., 2019; Redstone et al., 2018; Stenbom, 2018) and two meta-analysis (Caskurlu et al., 2020; Richardson et al., 2017). Despite the comprehensiveness of the secondary research made, research has not focused on all presences of CoI (Richardson et al., 2017) or could not consider performance in the analysis (Jan et al., 2019). Redstone et al. (2018) categorized the existing research on CoI into four themes, testing the instrument, measuring CoI presence in different learning environments, examining causal relationships, and exploring potential revisions to the model. It is unclear what databases were used to identify the 24 studies included in this

systematic review. Testing the CoI instrument resulted in eight studies and measuring CoI presence in different environments resulted in another eight. There were four studies in their review that examined causal relationships among elements and five studies that focused on exploring potential revisions to the framework. While this study identified four themes of research, they did not focus on the learning outcomes in relation to the presences. This review also identified the learning environment (online, blended, F2F) and methodology (Quantitative) of the studies included in the systematic review. Six out of the twenty-four studies used mixed methods while the rest were quantitative. Eleven studies were on online learning, while four studies were on blended learning and the remaining included both blended and online learning.

Stenbom's (2018) identified 103 studies examining the CoI in a systematic review. In this review, Stenbom provided details about the publication patterns and demographic contexts where the CoI survey has been used. In addition, the author reviewed the purposes and research designs used in CoI research and major results and conclusions. Stenbom concluded that Garrison had published nine articles, which was the largest number of articles on CoI by an author. *Internet and Higher Education* had published 22 articles, which was the most articles a single journal had published. This review confirmed that the CoI survey provided valid and reliable results and has been used in various contexts. Primary research has examined both causal and correlational relationships between CoI. The Stenbom review confirmed that CoI has been used in online and blended learning (Akyol, Garrison et al., 2009; Kucuk & Sahin, 2013; Shea and Bidjerano, 2013), and to examine synchronous (Claman, 2015) and asynchronous (Rockison-Szapkiw et al., 2010; Rockinson-Szapkiw & Wendt, 2015) interaction. Disciplinary differences (Arbaugh et al., 2010; Arbaugh, 2013) and learner characteristics such as age, gender, and academic level (Akyol, Arbaugh et al., 2010; Shea & Bidjerano, 2009b) were found in some of these studies in Stenbom's review.

Jan et al. (2019) performed a systematic review about the use of social network analysis (SNA) for studying online learning communities and included CoI as an element in addition to Communities of Practice (CoP). Their review included 10 studies, of which nine used the CoI framework while one used the CoP framework. The nine CoI focused individual studies were conducted in online or blended settings. The goal of the review was to extract the structural components of CoP and CoI that have been researched using SNA. Their findings were mixed on the effectiveness of SNA to identify different presences in CoI. One of the limitations they highlighted was the lack of use of student attributes (e.g., self-efficacy, goal orientation), or performance examined in most of the studies.

In addition, Richardson et al. (2017) published a meta-analysis focusing on social presence. Although this does not include all presences of CoI, it contributes to the social presence construct. Richardson et al. included 26 studies in their meta-analysis in which they studied the relationship between social presence and student satisfaction and learning in the online environment. Their study showed a moderately strong positive relationship between social presence and satisfaction ($r = .56, k = 26$) and social presence and perceived learning ($r = .51, k = 26$). Their moderator analysis results found that course length, discipline, and scale used significantly moderated the relationship between social presence and satisfaction, and course length, discipline, and target audience moderated the relationship between social presence and perceived learning. Caskurlu et al. (2020) published a meta-analysis focusing on teaching presence but included instruments in addition to the CoI survey. They found moderately strong correlation between teaching presence and perceived learning ($r = .602, k = 23$) and teaching presence and satisfaction ($r = .59, k = 26$). They found course length and audience as moderators

for perceived learning and course length, discipline, and teaching presence scale as significant moderators for satisfaction. Table 2 provides a summary of the systematic reviews on the CoI framework.

Table 2
Systematic Reviews and Meta-Analyses on CoI

Year	Authors	Title	Number of Articles	Type of Review
2020	Caskurlu et al.	A meta-analysis addressing the relationship between teaching presence and students' satisfaction and learning	23 articles for perceived learning and 26 for satisfaction	Meta-Analysis
2019	Jan et al.	Social Network Analysis and Learning Communities in Higher Education Online Learning: A Systematic Literature Review	10 articles of which 9 articles use CoI	Systematic Review
2018	Stenbom	A systematic review of the Community of Inquiry survey	103 articles	Systematic Review
2018	Redstone et al.	MEASURING PRESENCE: A Review of Research Using the Community of Inquiry Instrument	24 articles	Systematic Review
2017	Richardson et al.	Social presence in relation to students' satisfaction and learning in the online environment: A meta-analysis	26 articles of which 6 articles use the CoI Survey	Meta-Analysis

Purpose of the Study and Research Questions

There has been an increasing number of primary studies using the CoI survey examining the relationship between presences and learning outcomes. Richardson et al. (2017) conducted a meta-analysis focusing on social presence and Caskurlu et al. (2020) conducted a meta-analysis on teaching presence in the online learning environment. Their studies, however, used several other scales in addition to using CoI as one of them. There is still a gap to quantitatively examine the relationship between the three types of presences to actual and perceived learning and satisfaction and specifically from only using the CoI instrument. Also, the prior meta-analysis focused only on online courses and this meta-analysis examines both online and blended courses. This results in a need for a meta-analysis to examine the relationships between each of the three presences and their learning outcomes. This study seeks to meet this gap by addressing the following research questions:

1. What is the relationship between each CoI presence (teaching presence, social presence, and cognitive presence) and actual learning, perceived learning and satisfaction as measured by the CoI survey?
2. What are the various elements of teaching presence, social presence, and cognitive presence described in the studies reviewed?

Methods

This study followed the meta-analysis process as described by Wilson (2014). The steps included are: (1) identifying the right question; (2) determining eligibility criteria; (3) conducting a literature search and review; (4) calculating effect size; and (5) analysis. The methodology used in the meta-analysis is described in the sections below.

Data Sources and Search Strategies

We conducted a broad search of journal articles and doctoral dissertations published between 2000 and 2019 using the search term “Community of Inquiry” in the “Title” and “Subject” fields. We chose 2000 as the starting point, as this was when the CoI framework was first developed. An electronic search was conducted in six databases that included Academic Search Complete, Communication & Mass Media Complete, Education Research Complete, ERIC, Library, Information Science & Technology Abstracts with Full Text, and PsycINFO in November 2019.

Inclusion and Exclusion

Table 3

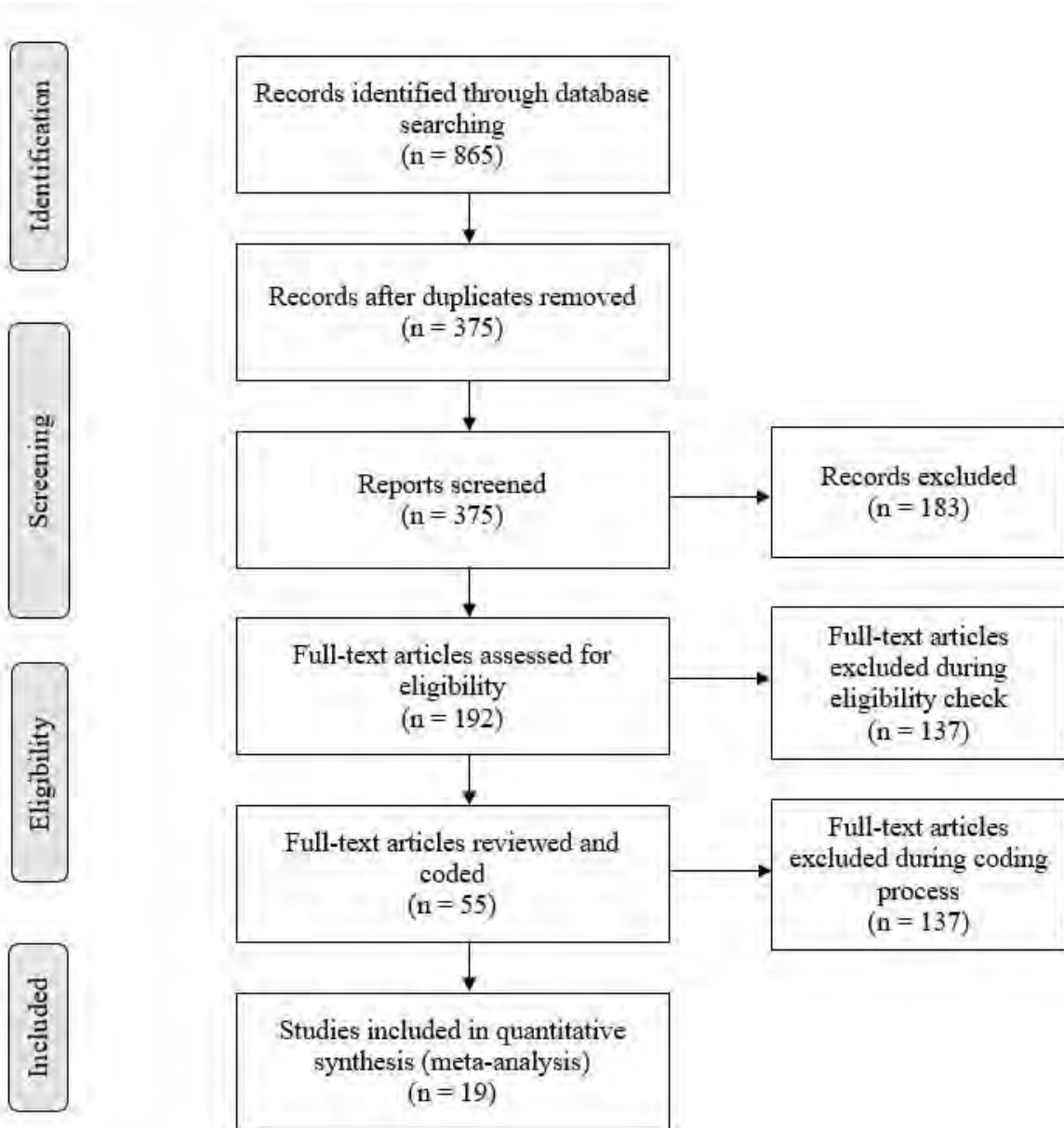
Inclusion/Exclusion criteria

Criteria	Inclusion	Exclusion
CoI Focus	Studies that used CoI framework	Studies that did not focus on CoI
Publication date	2000 to 2019	Prior to 1999 and after 2019
Publication type	Scholarly articles of original research from peer reviewed journals and dissertations	Book chapters, technical reports, or proceedings
Language	Journal article or dissertation was written in English	Languages other than English
Research Design	Correlational and Regression design with learning outcome	Research designs that do not include correlational or regression studies
Results of Research	Adequate data for calculating effect sizes	Effect size was not reported or there was insufficient information provided for researchers to calculate effect size.
Learning Outcomes	Clear learning outcomes (Actual Learning, Perceived Learning or Satisfaction)	There were not clear learning outcomes in the study. For example, Pellas (2017) examined the interrelationships among presence indicators, but learning outcomes were not the focus of the study

Process Flow

We used the PRISMA flow model (Figure 2) to document the process flow of identification, screening, eligibility, and inclusion of studies. The PRISMA guidelines were proposed by the Ottawa Methods Center for reporting items for systematic reviews and meta-analyses (Moher et al., 2009).

Figure 2
PRISMA flow diagram for CoI review



When the records were screened, we found several studies that used the term “Community of Inquiry” but were focusing on Dewey’s theory on social learning and not on presence in online learning. These studies were excluded. In addition, during full-text screening, we found several studies that did not use the CoI survey to measure presences which was the focus of this meta-analysis. During the coding process, we found that some studies did not provide the sufficient data for data extraction which were also excluded.

Study Coding

The research team developed and used a survey form using Qualtrics to code the variables described in Table 3. The form was divided into four sections to include study identification, outcome features, methodological features, pedagogical features, and demographics. There are four members in the research team, including three faculty members with expertise in online learning and one doctoral student majoring in research methodology. All the faculty members involved in the study have extensive coding experience. They provided training to the second author, the doctoral student, and supervised the entire coding process. The initial coding was performed by the second author and the third author. The two researchers initially coded the same eight articles with an inter-rater agreement of 86.84%. The entire research team met biweekly to discuss any coding related questions. The researchers discussed the areas of disagreement before further coding. The lead researcher then worked with the fourth author from the team for the effect size extraction.

Table 4
Description of the Coded Elements for Each Research Study

Element	Description
Article Information	Full reference including author(s), year of publication, article title, journal name, and type of publication (journal article, dissertation or other).
Outcome Type	Coded as Actual Learning, Perceived Learning and Satisfaction. Actual learning included measures such as final score, academic achievement, GPA, while perceived learning and satisfaction included measures of perceived learning and satisfaction.
Outcome Measures	Outcome measures were coded for each type of outcome variable.
Research or Analytical Methods	Correlation, Path analysis, Regression, Structural Equation Modeling.
Type of Online Course	Coded as an open-ended item.
Course Duration	The different options for course duration included, less than 15 weeks, 15 weeks, more than 15 weeks, and unknown.
Instructional Method	This was open coded as Blended or Online.
Technology Used	This was open coded.
Demographics	Types of learners (K-12, undergraduate, graduate, military, industry/business, professionals), discipline, gender and age of participants, and country were coded.
Effect Sizes	Statistical information to extract effect sizes were coded.

Dependent and Moderating Variables

Based on prior meta-analysis, we included perceived learning and satisfaction as outcome variables. In addition, we also included actual learning as a learning outcome. While it was our initial intent to examine pedagogical, methodological, and demographic moderators, due to the low frequency of studies for each outcome, we did not proceed with the moderator analysis.

Effect Size Calculation

Descriptive statistics were reported to address publication trends. The software Comprehensive Meta-Analysis software, Version 3.3.070 (CMA; Borenstein et al., 2014) was used to calculate the effect sizes. Effect size was calculated as the correlation between one of the three presences (teaching, social and cognitive presence) and one of the three learning outcomes (actual learning, perceived learning, and satisfaction). Initially, 102 effect size statistics were collected from 19 studies, including 93 Pearson's r from 17 studies and 9 standardized β from two studies. We contacted the authors of the two articles that reported standardized β and gathered the corresponding effect size estimates in the forms of Pearson's r for generating more

accurate results. Cohen's (1988) effect size conventions for Pearson correlation coefficient was used for interpretation: .1 as small effect, .3 as medium effect, and .5 as large effect. .

Five studies in the meta-analysis used multiple measures representing the same construct. Therefore, the weighted averaging procedure was conducted by employing a calculator created by Lenhard and Lenhard (2014) to address the dependence issue (Borenstein et al., 2009). For example, Arbaugh (2013) reported the correlation coefficients between facilitating discourse and perceived learning, and between direct instruction and perceived learning to represent the correlation between teaching presence and perceived learning. The two coefficients were transformed into a Fisher's z value using the calculator mentioned above. After conducting all transformations, 78 effect sizes, including 67 Pearson's coefficients and 11 Fisher's z , were entered into CMA for further analysis.

Handling Dependence of Effect Size

It is worth noting that most of the studies in the meta-analysis reported multiple effect sizes to indicate the relationship between social, teaching, cognitive presences, and actual learning, perceived learning, and/or satisfaction. For example, Maddrell et al. (2017) reported six separate effect sizes to show the correlations between each of the three presences and perceived learning and satisfaction. Although these effect sizes were based on the same sample, they were treated independently because the major goal of the research is to detect the strength of the relationship between individual presence and specific types of learning outcomes. The overall effect of the combined presences on learning outcomes is not the focus of the study. Therefore, the effect sizes of the correlation between each presence and each learning outcome reported from one study are calculated separately.

Data Analysis

The CMA software during analysis converts Pearson's r to Fisher's z to calculate averaged Fisher's z scores and then converts back to correlation r (Borenstein et al., 2009). The current study does not use Pearson's correlation r because variance heavily depends on the correlation (Borenstein et al., 2009). In addition, Fisher's z transformation was used to normalize the sampling distribution of Pearson's r . CMA software calculates the effect sizes using the following equations (Borenstein et al., 2009).

Pearson's r can be transformed into Fisher's z using equation (1):

$$z = 0.5 \times \ln \left(\frac{1+r}{1-r} \right) . \quad (1)$$

The standard error of Fisher's z can be obtained by using equation (2):

$$SE_z = \sqrt{\frac{1}{-3}} . \quad (2)$$

Equation (3) can be used to convert the Fisher's z back to correlation r :

$$r = \frac{e^{2z}-1}{e^{2z}+1} . \quad (3)$$

There are two commonly used models to estimate effect sizes of a meta-analysis, including fixed-effects model and random-effects model. The two models not only have distinct underlying assumptions, but also influence the analysis and interpretation of the statistics (Borenstein et al., 2010). Fixed-effects model assumes that there is one common effect size across all studies. This model may manifest Type I bias in significant tests for the estimated

effect sizes and produce biased confidence intervals that is smaller than their normal width if the assumption does not hold (Hunter & Schmidt, 2000). However, random-effects model allows that the studies to have varied effect sizes in the population, which is likely to generate appropriate Type I error rates and confidence intervals. For a meta-analysis, it is common to see that the effect sizes and the measures used across studies are different. Therefore, we employed a random-effects model in this meta-analysis study. In this study, we conducted nine subgroup meta-analysis:

- (1) Teaching presence on actual learning
- (2) Cognitive presence on actual learning
- (3) Social presence on actual learning
- (4) Teaching presence on perceived learning
- (5) Cognitive presence on perceived learning
- (6) Social presence on perceived learning
- (7) Teaching presence on satisfaction
- (8) Cognitive presence on satisfaction
- (9) Social presence on satisfaction

Forest plots were included to show the visual representation of the studies and the effect sizes.

Sensitivity Analysis

In meta-analysis studies, it is important to address the issue of publication bias, which refers to the phenomenon that studies get published based on certain direction or strength of the findings (Dickersin & Min, 1993). Rosenthal (1979) used a term “file drawer problem” to describe the fact that journals are filled with the 5% of studies showing Type I errors whereas the rest of the studies with nonsignificant results are left in the drawers. In this meta-analysis, both journal articles and dissertations were included, but there is still the risk of having publication bias because unpublished work was not under the investigation. Several strategies were used to examine publication bias. Funnel plots were used to detect bias by showing visual representation of the studies included in a meta-analysis (Egger et al., 1997). Funnel plots illustrate the effect sizes from each study on horizontal axis against the standard error on vertical axis. A symmetrical funnel will be displayed if bias does not exist, and vice versa (Egger et al., 1997; Sterne & Harbord, 2004). In addition, Classic Fail-safe N (Rosenthal, 1979) that represents the number of missing studies to bring the p value to a non-significant level was included. Finally, Orwin’s Fail-safe N (Orwin, 1983), which assists in computing the number of missing studies to bring the summary effect to a level below the specified value other than zero, was examined.

All statistical analyses using CMA used the z -transformed correlations. We report the effect size in this meta-analysis using Pearson r for the ease of interpretation. Publication bias was reported in Fisher’s z .

Results

Publication Pattern

The publication trend for the results included in this CoI meta-analysis is provided in Figure 3, and the publication source of the journal articles and dissertations is included in Table 5.

Figure 3
 Publication years of studies included in CoI Meta-Analysis

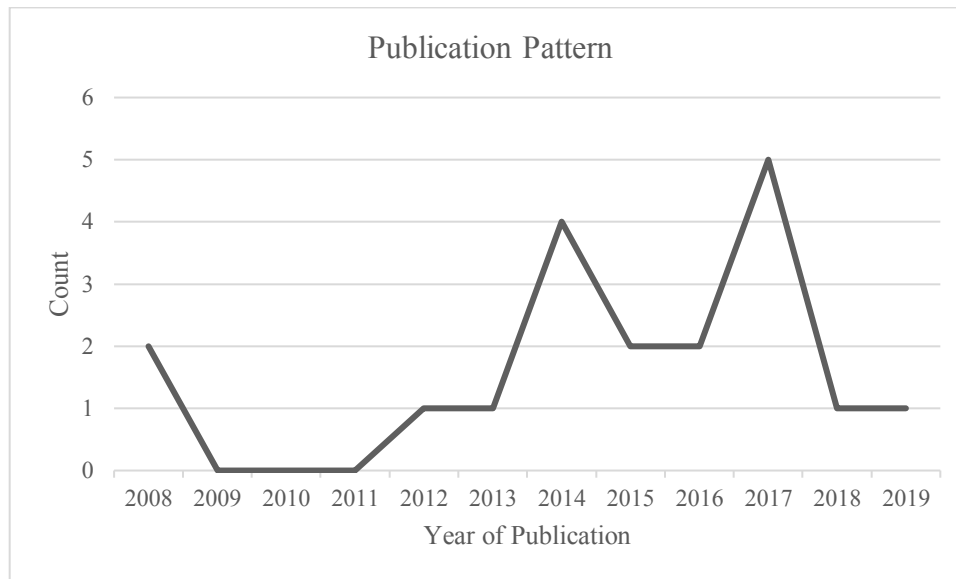


Table 5
 Publication Source of CoI Studies in Meta-Analysis

Journal Articles (n = 11)	Dissertations & Theses (n = 8)
Journal titles	Universities
Australasian Journal of Educational Technology	Indiana University
Behaviour & Information Technology	Liberty University
Contemporary Educational Technology	McKendree University
Distance Education	Ohio University
International Journal of Learning Technology	University of California
International Review of Research in Open and Distance Learning	University of Idaho
Internet and Higher Education	Widener University
Journal of Asynchronous Learning Networks	Western Illinois University
Journal of Interactive Learning Research	
Multimedia-Assisted Language Learning	

Note. International Review of Research in Open and Distance Learning had two articles.

Descriptive Information of Primary Studies

Table 6 below provides a summary of the descriptive information from the 19 studies included in this meta-analysis. The final sample consisted of $k = 78$ effect sizes and $n = 6,459$ participants.

Table 6
Descriptive Information for the Primary Studies

Authors	Document Type	Outcome	Measure	Participants	Modality	Country/region	# Survey Items
Akyol & Garrison (2008)	J	PL; Sat	PL; Sat	Graduate	Online	US	34
	Alaulamie (2014)	D	Sat	Undergraduate	Online	US	34
Arbaugh (2008)	J	PL; Sat	PL; Sat: Delivery medium satisfaction	Other	Online	US	21
	Arbaugh (2013)	J	PL, Sat	Graduate	Online	US	34
Catron (2012)	D	Sat	Sat	Other	Online	US	34
Chen et al. (2019)	J	Sat	Sat	Other	Online	China	9
Choy & Quek (2016)	J	AL; Sat	AL: Academic achievement; Sat: Course satisfaction	Undergraduate	Blended	Singapore	18
	Dempsey (2017)	D	PL	PL: Reflection scores, and critical thinking	Graduate	Online	US
Jones (2017)	D	AL	AL: Online course grade	Other	Online	US	34
Khodabandelou et al. (2014)	J	PL	PL	Undergraduate	Blended	Malaysia	60
Lee & Huang (2018)	J	AL	AL: Final score	Other	Online	US	34
Maddrell et al. (2017)	J	PL; Sat	PL; Sat	Graduate	Blended	US	37
Mo & Lee (2017)	J	PL	PL: Perceived proficiency learning	Other	Blended	South Korea	32
Place (2017)	D	PL	PL	Other	Online	US	34
Rockinson-Szapkiw et al. (2016)	J	AL; PL	AL: Course points; PL: Cognitive, affective, and psychomotor	Graduate	Online	US	34

van der Merwe (2014)	J	AL	AL: Practical portfolio score	Other	Online	South Africa	10
Van Schyndel (2015)	D	Sat	Sat	Undergraduate	Online	US	34
Woiwode & Baysingar (2015)	T	AL	AL: Authentic learning, cumulative GPA, and final course grade	Undergraduate	Other	US	34
Yadon (2014)	D	AL; PL	AL; PL	Other	Online	US	34

Note. Other items in the Level of study included combination of levels, or professionals or studies that did not report the level. Acronyms are used to make the table easier to comprehend. In the Document Type column, the letters are (J)ournal article, (D)issertation, and (T)hesis. In the Measure column, AL, PL, and Sat represent actual learning, perceived learning, and satisfaction, respectively.

The instructional context provided in the studies were further analyzed to identify the different presences used in the setting of the study. Table 7 shows the various elements that were used in the study to establish various types of presence.

Table 7
Elements of Presence Described in the Studies

Presence	Elements of Presence
Teaching Presence	<ul style="list-style-type: none"> • Contacting the Teacher or Teaching Assistant directly ($k = 2$) • Instructors facilitated live synchronous lectures and discussions ($k = 1$) • Used LMS to host syllabus, content, assignments, and discussion forums ($k = 2$) • Teachers collaborating with students via email, message boards, announcements, wikis blogs and discussions ($k = 1$) • Establishing curriculum content, learning activities and timelines ($k = 1$) • Monitoring and managing purposeful collaboration and reflection ($k = 1$) • Ensuring that the community reaches the intended learning outcomes by diagnosing ($k = 1$) • Needs and providing timely information and direction ($k = 1$)
Cognitive Presence	<ul style="list-style-type: none"> • Taking Notes ($k = 1$) • Reading/Posting in the Forum ($k = 1$) • Group meets 3 times in a week in virtual space ($k = 1$) • Provided feedback for group members ($k = 1$) • Readings, video resources, and assignment by lecturers ($k = 1$) • Students participated in online discussion ($k = 1$) • Synchronous communication among peers ($k = 1$) • Synchronous communication among instructor and students ($k = 1$) • Students worked collaboratively on course assignments, studying for exams and quizzes, class presentations, and listened to lectures ($k = 1$)

Social Presence	<ul style="list-style-type: none"> • Making Friends in the Forum ($k = 1$) • Joining Social Media Groups ($k = 1$) • Groups of 8 to 10 to foster intimate interaction among members ($k = 1$) • Real-time chat among group members ($k = 1$)
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Note. Not all studies described the elements of presence. This table includes data only from the studies that reported the description of presence elements.

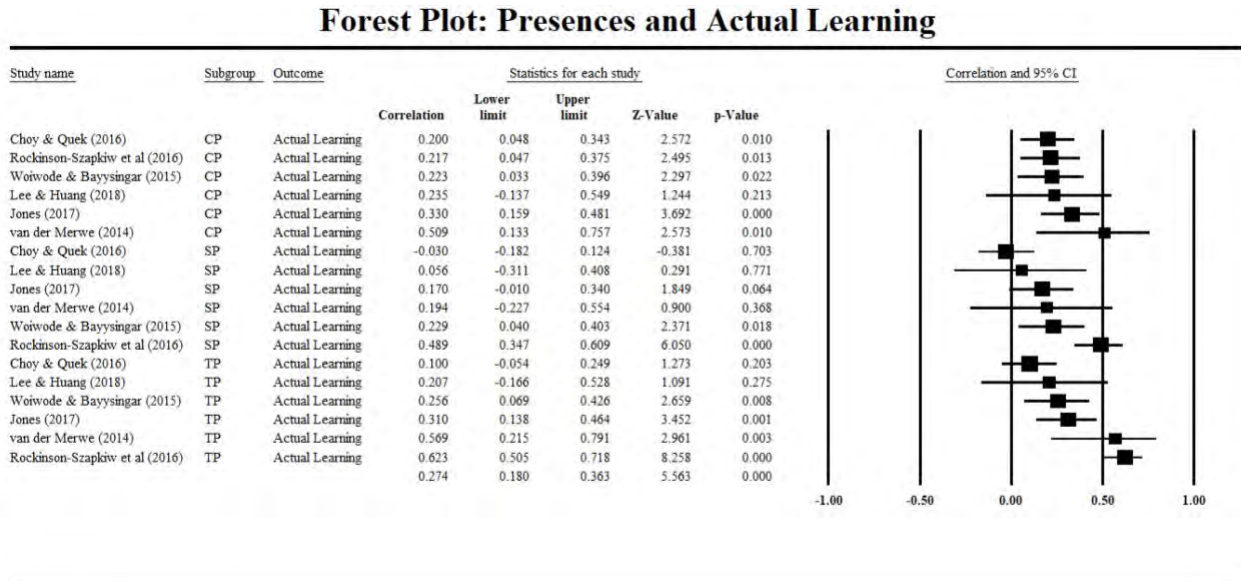
Effect sizes (CP, SP, TP) for Actual Learning

Six studies included in the analysis reported the effect sizes between each of the three presences and actual learning. The forest plots of the effect sizes between teaching, cognitive, social, and teaching presence and actual learning are shown in Figure 4. The effect size estimates were reported in Table 8. Teaching presence and actual learning were found to be moderately positively correlated ($r = .353, p = .001$). Cognitive presence and actual learning had a small correlation ($r = .250, p < .001$). Similarly, it was found that the effect sizes between social presence and actual learning was small ($r = .199, p < .042$). It is worthy to note that there were no statistically significant differences found among the three effect sizes, ($Q = 1.263, p = .532$).

Table 8
Effect Size Estimates for the Correlation Between Presences and Actual Learning

	<i>k</i>	<i>Effect estimate</i> <i>r</i>	<i>95% CI</i>	<i>Z</i>	<i>p</i>	<i>Q-value</i>	<i>df(Q)</i>	<i>p-value</i>
Actual learning								
Cognitive presence	6	.250	[0.171, 0.326]	6.030	<.001	3.549	5	.616
Social presence	6	.199	[0.008, 0.376]	2.038	.042	23.622	5	<.001
Teaching presence	6	.353	[0.144, 0.532]	3.228	.001	31.771	5	<.001
Total between						1.263	2	.532

Figure 4
Forest plot of studies on Actual Learning



Note. CP, SP, and TP refers to cognitive presence, social presence, and teaching presence, respectively.

Effect sizes (CP, SP, TP) for Perceived Learning

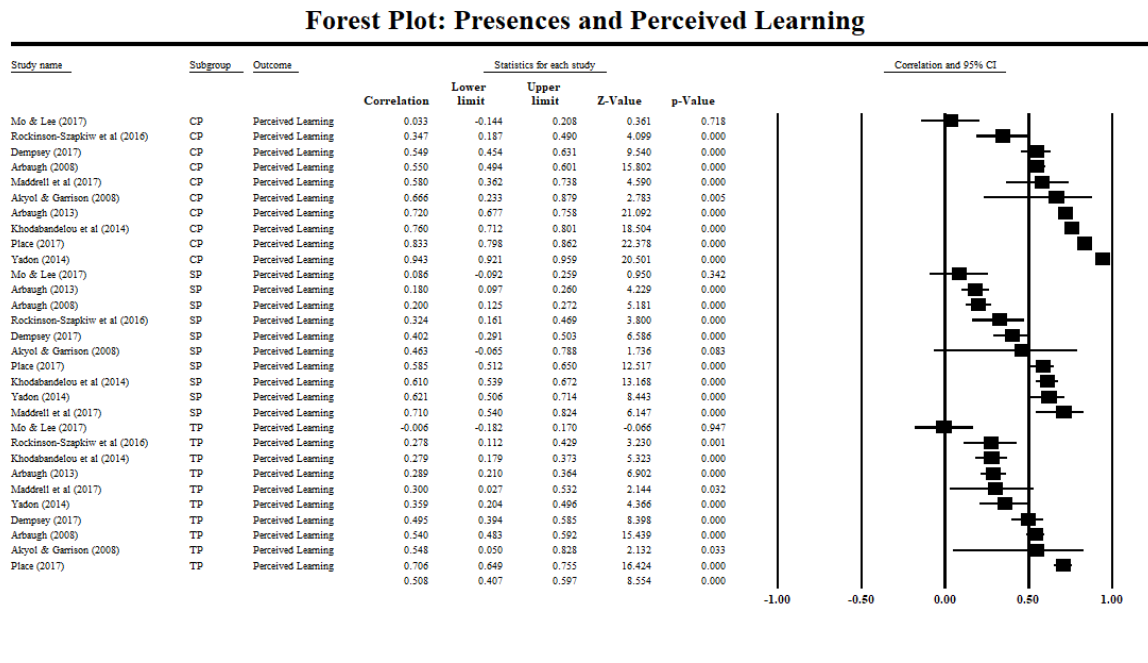
Ten out of the 19 studies reported the effect sizes of the relationship between teaching, cognitive, and/or social presence and perceived learning. The effect sizes of the relationship between each of the three presences and perceived learning are shown in Figure 5. The effect size estimates were reported in Table 9.

It is important to note that the correlation between each of the presences and perceived learning was significant ($p < .001$). The cognitive presence and perceived learning were found to be strongly correlated ($r = .663, p < .001$). Social presence and perceived learning were moderately positively correlated ($r = .432, p < .001$), followed by the correlation between teaching presence and perceived learning ($r = .392, p < .001$). There were significant differences in the three effect sizes ($Q = 6.921, p = .031$). Further analysis showed that the effect size of cognitive presence and perceived learning were significantly larger than the correlation between social presence and perceived learning ($p = .027$) and teaching presence and perceived learning ($p = .010$).

Table 9
Effect Size Estimates for the Correlation Between Presences and Perceived Learning

	<i>k</i>	Effect estimate <i>r</i>	95%CI	Z	<i>p</i>	<i>Q</i> -value	<i>df</i> (<i>Q</i>)	<i>p</i> -value
Perceived learning								
Cognitive presence	10	.663	[0.503, 0.780]	6.359	<.001	324.229	9	<.001
Social presence	10	.432	[0.286, 0.559]	5.367	<.001	147.844	9	<.001
Teaching presence	10	.392	[0.248, 0.520]	5.046	<.001	133.660	9	<.001
Total between						6.921	2	.031

Figure 5
Forest Plot of Studies on Perceived Learning



Note. CP, SP, and TP refers to cognitive presence, social presence, and teaching presence, respectively.

Effect sizes (CP, SP, TP) for Satisfaction

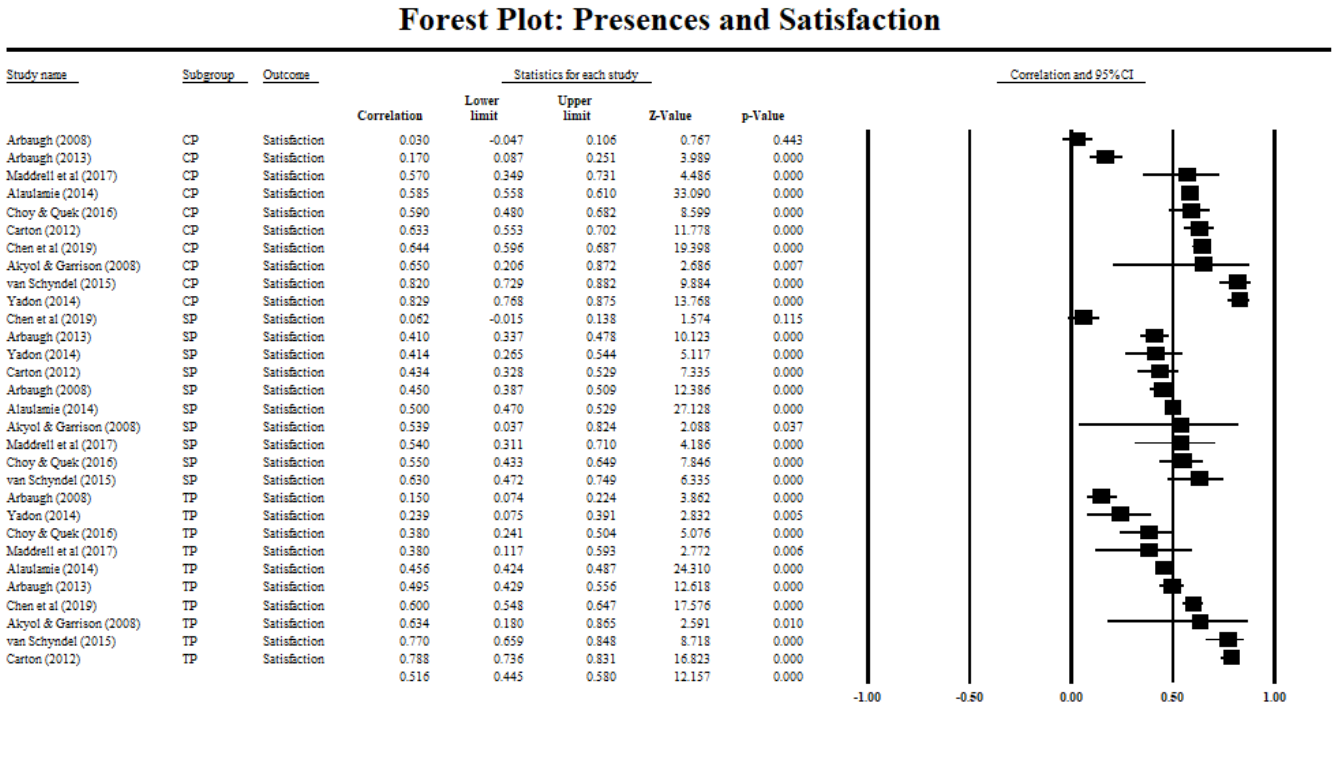
The relationship between each of the three presences and satisfaction were reported in 10 studies. Forest plots that indicate the relationship between teaching, cognitive, or social presence, and perceived learning can be found in Figure 6. Table 10 provided the summary statistics of the relationships.

It was identified that there was a statistically significant and strong relationship between cognitive presence and satisfaction ($r = .586, p < .001$). Like cognitive presence, teaching presence was also strongly correlated with satisfaction ($r = .510, p < .001$). Social presence and satisfaction were moderately correlated ($r = .447, p < .001$). The difference in the three effect sizes reported did not differ significantly ($Q = 2.255, p = .324$).

Table 10
Effect Size Estimates for the Correlation Between Presences and Satisfaction

	<i>k</i>	Effect estimate <i>r</i>	95% CI	Z	<i>p</i>	<i>Q</i> -value	<i>df</i> (<i>Q</i>)	<i>p</i> -value
Satisfaction								
Cognitive presence	10	.586	[0.423, 0.712]	5.983	<.001	411.530	9	<.001
Social presence	10	.447	[0.337, 0.544]	7.258	<.001	133.038	9	<.001
Teaching presence	10	.510	[0.381, 0.620]	6.801	<.001	215.719	9	<.001
Total between						2.255	2	.324

Figure 6
Forest plot of studies on Satisfaction



Note. CP, SP, and TP refers to cognitive presence, social presence, and teaching presence, respectively.

Publication Bias

Publication bias, as one of the major threats to the validity of meta-analysis, was examined for studies focusing on the relationship between teaching, cognitive, and social presence and a specific type of learning outcomes through visual inspection of funnel plots, Classic Fail-Safe N test, and Orwin's Fail-Safe N tests. Funnel plots depict effect sizes estimates against the standard error, which represents the study precision (Sterne & Egger, 2001). The funnel plots can be found in Appendix. It seems that there was a lack of symmetric distribution of the point estimates in each of the funnel plot, indicating the presence of the publication bias. The Classic Fail-Safe N and Orwin's Fail-Safe N are reported in Table 11 for further understanding the publication bias of the studies that investigated the correlations between the presence and actual learning, perceived learning, and/or satisfaction. It can be identified that there was a lack of publication bias on perceived learning and satisfaction using the Classic fail-safe N larger than $5k + 10$ (Rosenthal, 1995) as a criterion. However, the publication bias seems to exist in actual learning, as only 52 additional studies on cognitive presence, 26 on social presence, and 95 studies on teaching presence are needed to nullify the effect size. With respect to the results from Orwin's Fail-Safe N test, publication bias also existed in actual learning because 148 additional studies on cognitive presence, 117 studies on social presence, and 203 studies on teaching presence may bring correlation under .01. Publication bias was not of a major concern in perceived learning and satisfaction based on the results from Orwin's Fail-Safe N test.

The three criteria used to examine publication bias for actual learning all indicated the presence of publication bias. For perceived learning and satisfaction, Classic Fail-Safe *N* and Orwin's Fail-Safe *N* showed little evidence of publication bias, though funnel plots indicated that additional studies may change the results.

Table 11
Classic Fail-Safe N and Orwin's Fail-Safe N

Model	Classic Fail-Safe <i>N</i>	Orwin's Fail-Safe <i>N</i>
CP and actual learning	52	148
CP and perceived learning	3717	820
CP and satisfaction	3052	559
SP and actual learning	26	117
SP and perceived learning	1016	384
SP and satisfaction	1832	454
TP and actual learning	95	203
TP and perceived learning	1067	457
TP and satisfaction	2449	496

Discussion

In this meta-analysis, we examined the relationship between cognitive presence, teaching presence and social presence, and actual learning, perceived learning, and satisfaction on online and blended courses. While there has been individual meta-analysis conducted on teaching presence (Caskurlu et al., 2020) and social presence (Richardson et al., 2017), these had included several instruments in addition to the CoI survey and focused only on online courses. There was a need to examine the effects of the presences based on the CoI instrument, in both blended and online courses and also examine the effects of all three presences in a single meta-analysis.

Relationship between Presences and Actual Learning

Actual learning is an important learning outcome to study (Bacon, 2016) and limited research has examined effects of presences on actual learning. Researchers have studied effects of presences on actual learning through measures including academic achievement (Choy & Quek, 2016), online course grade (Jones, 2017), Final Score and portfolio score (Lee & Huang, 2018; van der Merwe, 2014), Course points (Rockinson-Szapkiw et al. (2016), authentic learning, cumulative GPA, and final course grade (Woiwode & Bayysingar, 2015). While cognitive presence and social presence had a small effect on actual learning, teaching presence had a medium effect on actual learning. Based on this meta-analysis only six studies had examined the effect of presences on actual learning. Although there were no significant differences in the effect sizes among the three presences for actual learning, it is important to note that the effect of each of the presences on actual learning was significant with teaching presence having the largest effect in online and blended courses.

Relationship between Presences and Perceived Learning

Social and teaching presence had a medium effect on perceived learning, and cognitive presence had a large effect. Each of the three presences on perceived learning was significant. In addition, there were significant differences in the effect sizes among the three presences on perceived learning. Also, there was a significant difference in the effect sizes between cognitive presence and social presence and cognitive presence and teaching presence. Richardson et al.

(2017) found a medium effect to indicate social presence predicts perceived learning in their meta-analysis. Our findings are consistent with Richardson et al.'s (2017) findings on social presence having a medium effect for perceived learning. This shows that the effect sizes stayed the same in both online and blended courses in our study, while Richardson study used only online courses. Caskurlu et al. (2020) found moderately strong correlation between teaching presence and perceived learning while we found medium effects between teaching presence and perceived learning. While we examined both online and blended courses, Caskurlu and colleagues examined only online courses.

Relationship between Presences and Satisfaction

While social presence had a medium effect, cognitive presence and teaching presence had a large effect on satisfaction. Though there were no significant differences in the effect sizes among the three presences, each of the three presences on satisfaction was significant. Similar to Richardson et al. (2017) study which found a medium effect to indicate social presence predicts satisfaction the findings of our study are consistent with the Richardson et al. (2017) study on social presence having medium effect on satisfaction. Caskurlu et al. (2020) found moderately strong correlation between teaching presence and satisfaction; this is consistent with our finding of it having a large effect. This shows when studying effects of presences on satisfaction, the effects remained the same in online and blended courses and only in online courses studied by Richardson and Caskurlu.

Lack of studies for Moderating Effects

We found that there were only few studies that examined actual learning. Also, though we coded for several moderating variables, due to the low frequencies we were unable to run moderator analysis. We hope with the increase in studies using the CoI instrument and examining the relationship between actual learning, perceived learning, and certification, moderating effects can be studied. Also, while coding for articles, we found that the authors of the primary studies did not include several of the details that we were interested in coding as moderators such as course duration, types of learners, course discipline, etc.

Elements of Cognitive, Teaching, and Social Presence

The second research question coded for the different elements of presences described in the articles. This finding has implications for instructors who design online and blended courses. Instructors can include the elements of presences as shown in Table 7 to enhance presences in their courses. For example, for teaching presence providing the opportunity to contact the teacher, for cognitive presence the opportunity for reading/posting in the forum and for social presence including real-time chat opportunities among group members. There were fewer elements of social presence described compared to cognitive and teaching presence reported in these research studies. Also, only two cognitive presence elements were reported in two studies, and the rest of the elements were included only once in each study. These design elements from online blended instruction used in the various research studies has implications to support learners' achievement. This overlaps with some of the design and facilitation recommendations from Fiock (2020) for including various presences in online courses.

Limitations

Only 19 studies that met the inclusion and exclusion criterion were included this meta-analysis. The numbers were insufficient, especially considering the fact that we conducted analysis with nine different models separately. There were only six studies that focused on actual learning. Therefore, the differences between subgroups, (e.g., the difference between teaching presence and actual learning and cognitive presence and actual learning), should be interpreted

cautiously. Another limitation of this study is the problem of publication bias on the studies related to actual learning, which might prevent us from generating accurate effect size estimates or developing a more comprehensive understanding of the relationship between the presences and actual learning. Also, though we coded several variables to run moderator analysis, we were unable to because of the low frequencies which is a limitation of this study.

Implications and Future Directions

The findings from our meta-analysis shows it is important for online and blended learning to include teaching, cognitive and social presence. The CoI survey indicates to be stable measure for studying presence in online learning and blended learning environments in multiple contexts. In summary, cognitive presence had a small effect on actual learning, and large effect on perceived learning and satisfaction. Teaching presence had a medium effect on actual and perceived learning and a large effect on satisfaction. Social presence had a small effect on actual learning but medium effect on perceived learning and satisfaction. Cohen’s (1988) effect size conventions for Pearson correlation coefficient was used for interpretation, .1 as small effect, .3 as medium effect and .5 as large effect. The findings show the importance of building in the different presences in online and blended learning environments though their effect sizes may vary (see Table 12). The large effect size estimates identified in the correlations indicated that if a specific type of presences increases, the corresponding learning outcome tends to increase. Hattie et al. (2014) argued that interpreting effect sizes only based on the descriptors, such as “small,” “medium,” and “large” seems to be too simple. When practical factors and the context are taken into consideration, even the small effect have important implications. Based on the results from our study, although effect sizes from small to large were found, it is still important for instructors to increase all the presences such that all learning outcomes are likely to achieve improvement.

Table 12
Summary of Effects of Cognitive, Teaching, and Social Presence

	Actual Learning	Perceived Learning	Satisfaction
Cognitive Presence	Small	Large	Large
Teaching Presence	Medium	Medium	Large
Social Presence	Small	Medium	Medium

There were only 19 studies that we were able to identify to use in this meta-analysis that had used the CoI instrument and had examined relationship to learning outcomes. This shows the need for more studies to examine the relationship of presences with the learning outcomes especially with actual learning. Another challenge we faced while coding variables for moderator analysis was the lack of detail reported by authors in primary studies. This demonstrates a need for future studies to describe the instructional setting thoroughly when presences are examined.

Declarations

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*Indicates studies that were included in the meta-analysis

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Appendix

Funnel Plots of Standard Errors for Variables in this Study

Figure A.1

Funnel plot for the correlation between cognitive presence and actual learning

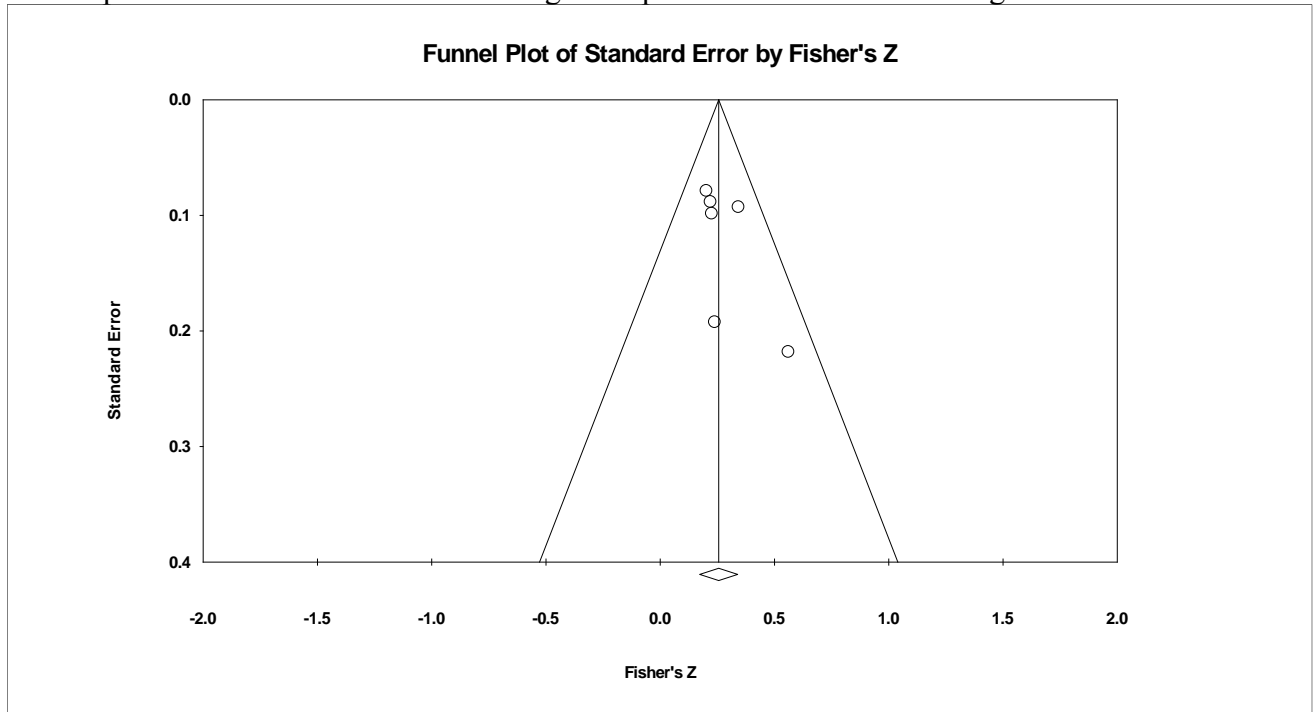


Figure A.2

Funnel plot for the correlation between social presence and actual learning

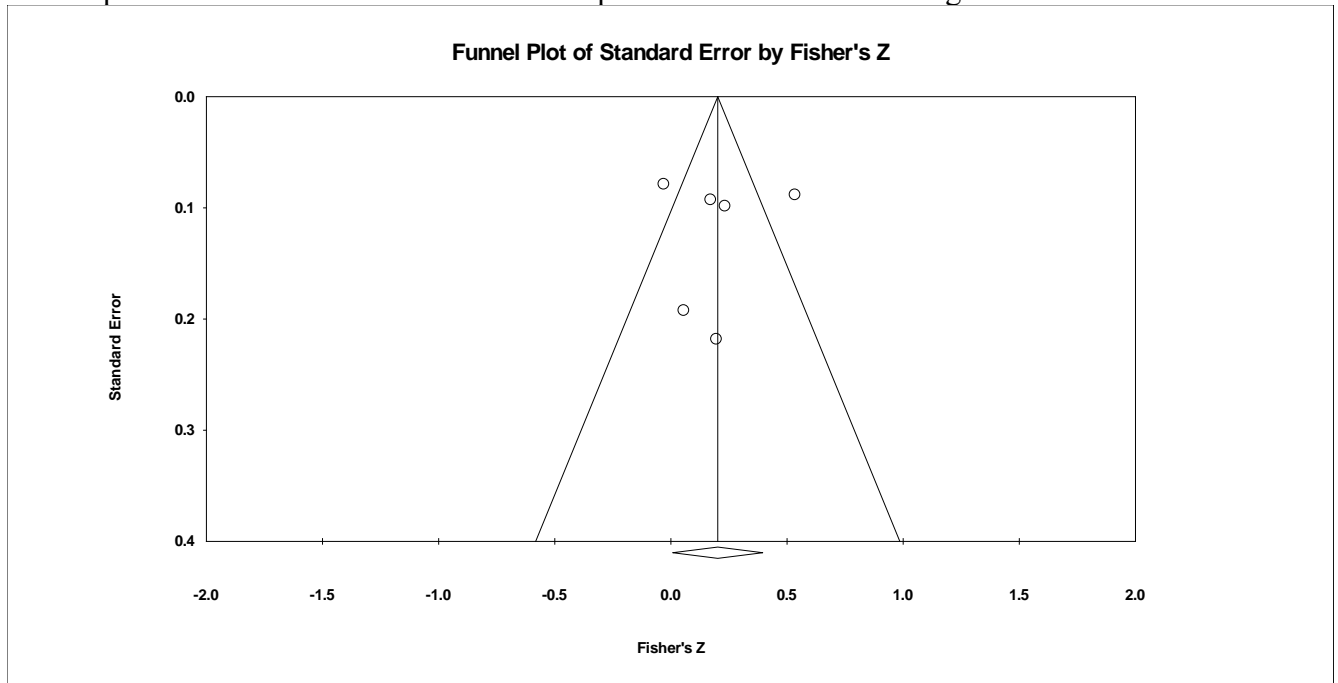


Figure A.3

Funnel plot for the correlation between teaching presence and actual learning

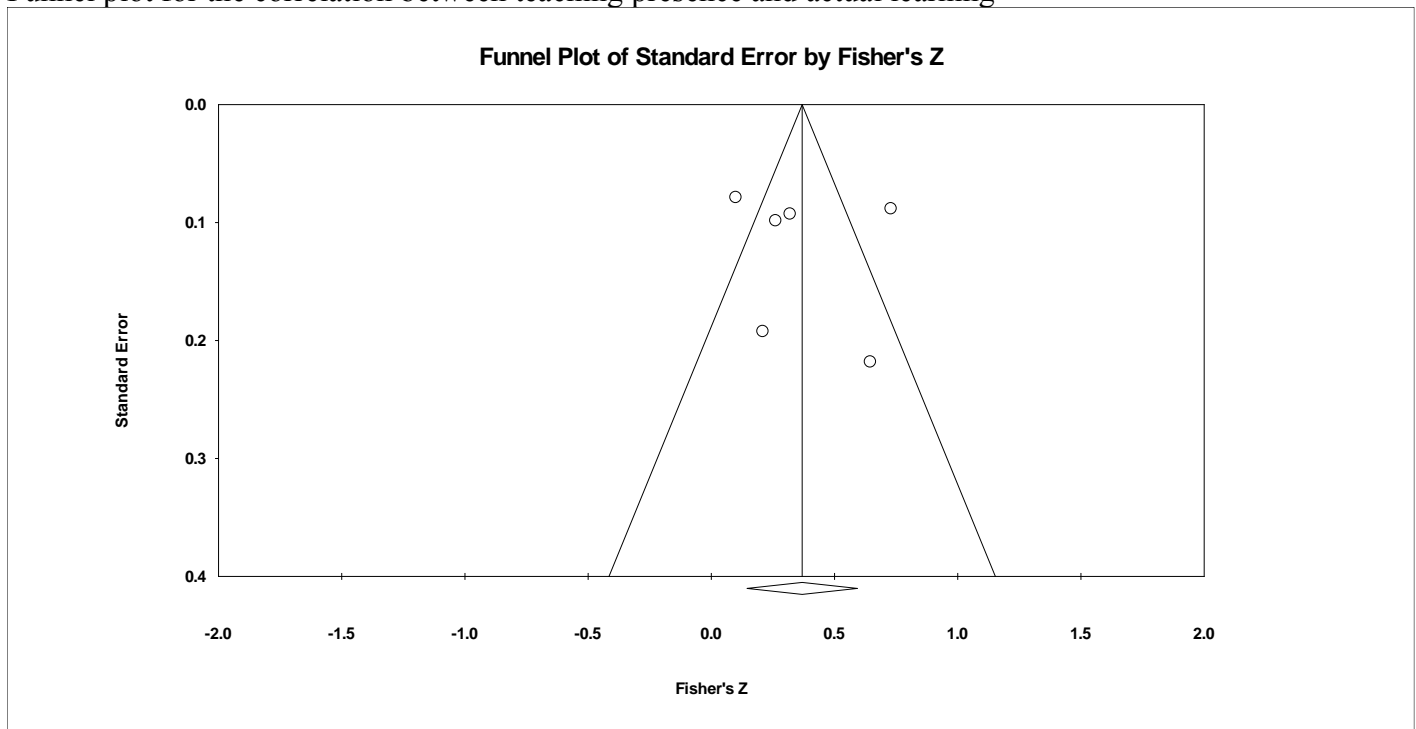


Figure A.4

Funnel plot for the correlation between cognitive presence and perceived learning

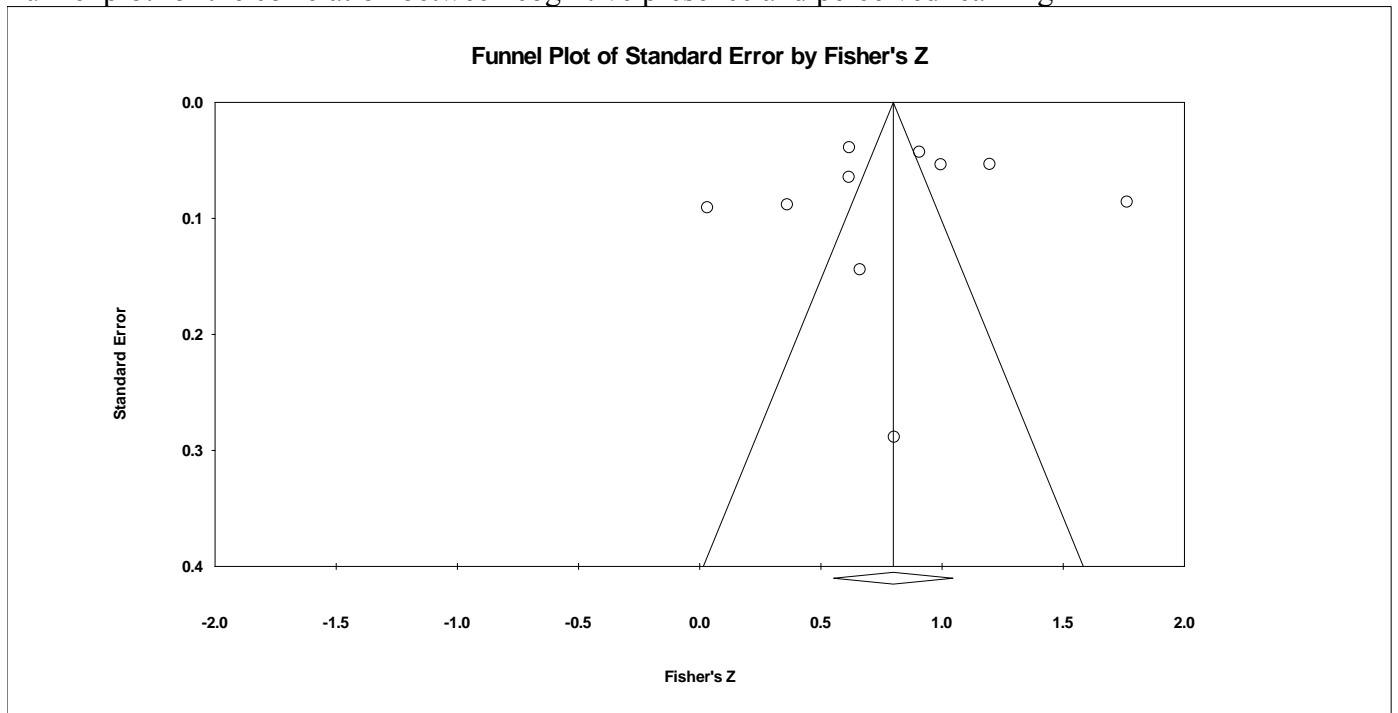


Figure A.5

Funnel plot for the correlation between social presence and perceived learning.

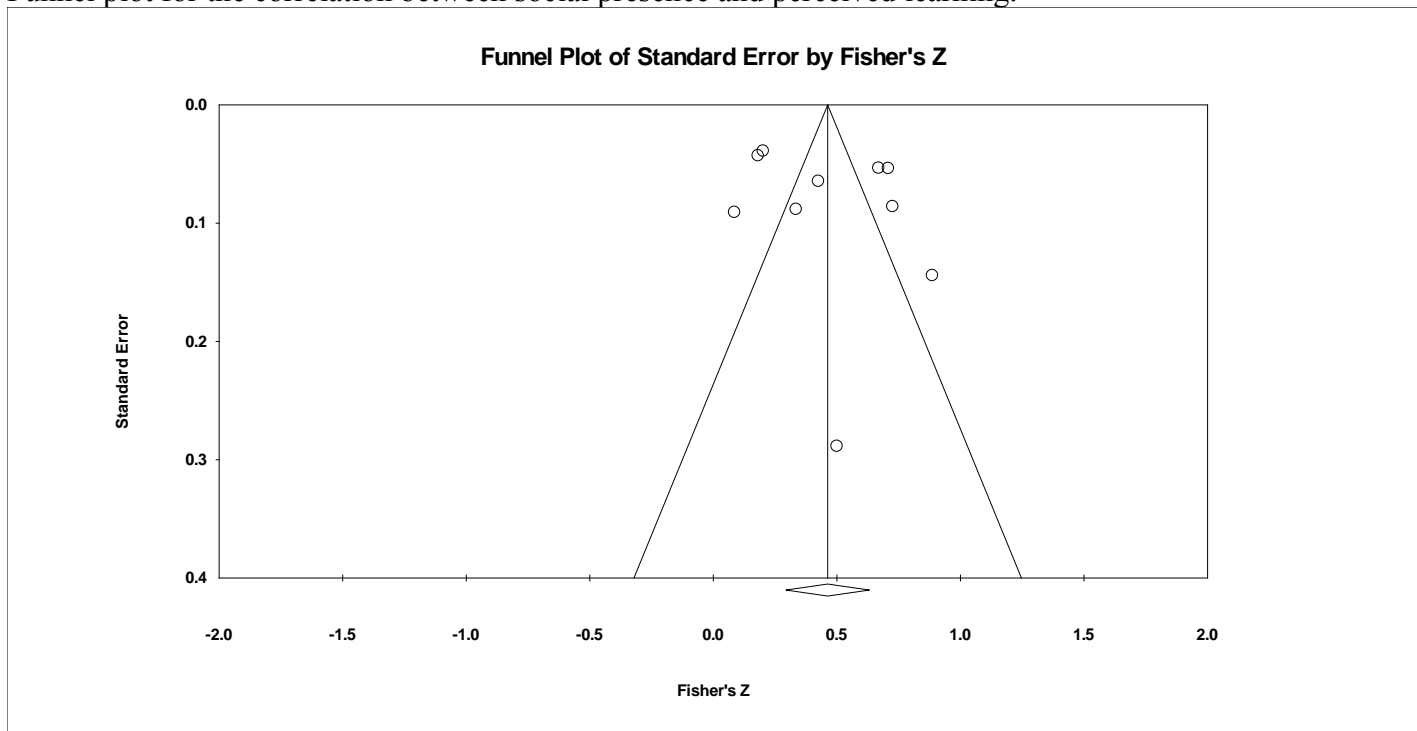


Figure A.6

Funnel plot for the correlation between teaching presence and perceived learning

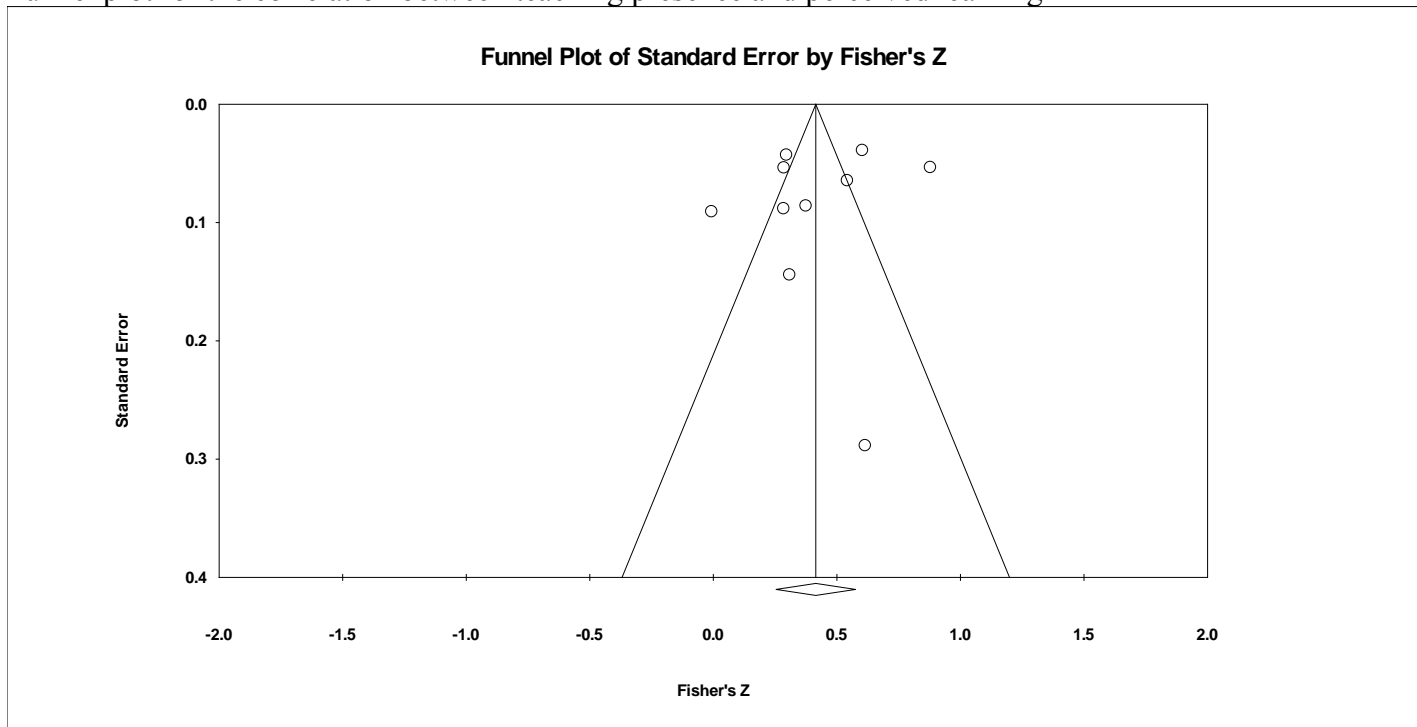


Figure A.7

Funnel plot for the correlation between cognitive presence and satisfaction

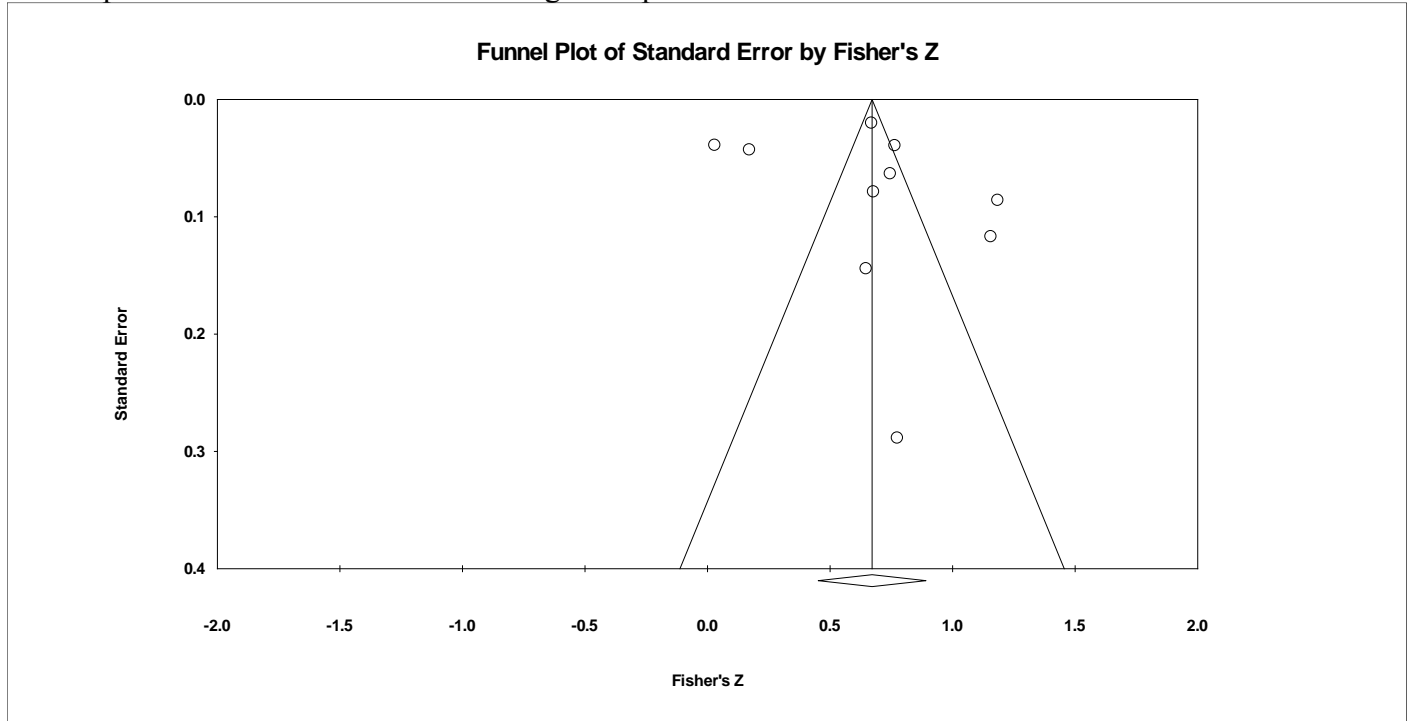


Figure A.8

Funnel plot for the correlation between social presence and satisfaction

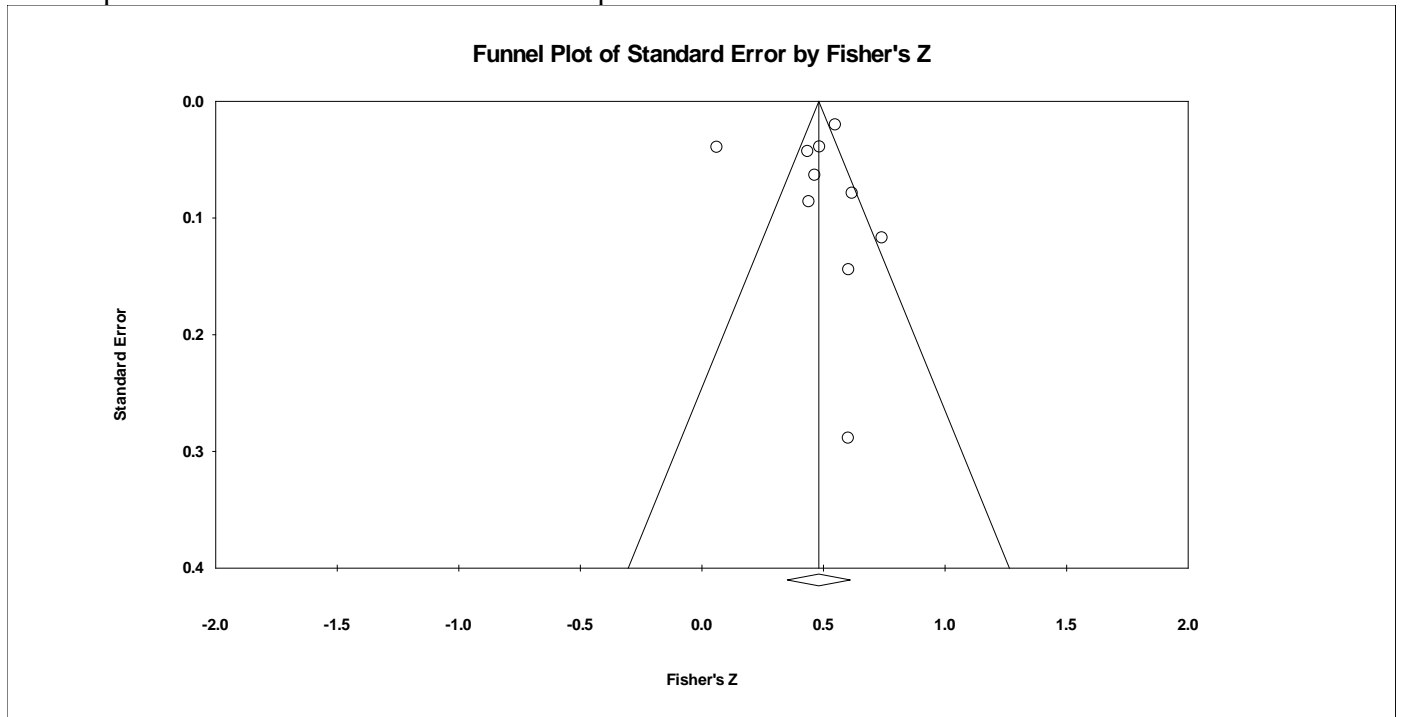


Figure A.9

Funnel plot for the correlation between teaching presence and satisfaction

