



Social Presence in Online Learning: Meta Analysis

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Abstract. This article presents a meta-analysis of the experimental and survey literature that has examined the relationship of social presence to student satisfaction in online learning. The aspects that are considered and carried out in meta-analysis studies in several primary studies on the relationship of social presence to student satisfaction in online learning are in two ways, namely, errors in sampling and errors in measurement. The percentage of variance due to sampling error is small, namely 10% and the variance of measurement error is 1.3%, smaller than the impact of sampling error. This small percentage indicates the possibility of error bias because errors in measurement are very small.

Keywords: meta-analysis · social presence · students satisfaction · online learning

1 Introduction

In distance learning, in the world of higher education, technological advancement has changed the learning delivery and the internet has become one of the emerging technologies (Huan, 1997, Crim S, 2006). The online learning environment is considered capable of helping students get the opportunity to continue their education in various situations, other than that, online learning has also been applied because it is considered a more cost-effective and comfortable learning than traditional educational environments (Oliver, 1999, Crim S, 2006). The integration of computers and the World Wide Web (WWW) has changed the communication and learning process in universities both nationally and internationally, this has been proven in the literature on distance learning (Trentin & Benigno, 1997, Crim S. 2006). Asynchronous student learning becomes very appropriate if it is facilitated by a web-based environment based on the increasing popularity of the internet (Hiltz & Wellman, 1997, Spears L, 2012). In 1990, Harasim foresees the impact of technology on the influx of online education which can provide endless opportunities for educational interactivity (Harasim, 1990, Spears L, 2012).

Student satisfaction can be identified as a student's feelings or interactions with teachers, peers, and of course, college support and flexibility (Yukselturk & Yildirim, 2008, Elham Alsadoon, 2018). The success of the student's educational experience is very important with the existence of a learning experience (Amro, 2014, Elham Alsadoon,

2018). Satisfied students are more tenacious and successful than those who are dissatisfied (Kuo, 2010). Elham Alsadoon, 2018). Student satisfaction is also a key factor in evaluating the success of learning programs (Wiechowski & Washburn, 2014, Elham Alsadoon, 2018). In fact, satisfaction is a factor associated with a high level of student motivation (Kuo, 2010, Elham Alsadoon, 2018).

Factors that contribute to student satisfaction with online learning are direct feedback, social presence, teacher presence, and interaction with content, it was revealed by Seaberry (2008). In addition, several factors such as student involvement, past experiences, other students, students' technical skills and the effectiveness of discussion boards in helping students understand the material which contribute to student satisfaction in e-learning (McFarland and Hamilton, 2005) (Elham Alsadoon, 2018). In their study of the effect of feedback on student satisfaction, Gallien and Oomen (2005) found that feedback from teachers is known to have an effect on student satisfaction as individuals compared to group feedback (Elham Alsadoon, 2018).

The lack of social communication and student involvement compared to traditional learning is a concern expressed by some education experts and students in online learning (Kang, Liew, Kim, & Jung, 2011, Alaulamie, L, 2014). Social presence places more emphasis on feelings from relationships with others, rather than focusing on one's feelings about oneself in a particular academic domain. By Short, Williams, and Christie (1976) social presence was originally defined as "the degree of salience of others in interactions and the consequent salience of interpersonal relationships" (p. 65). Later, it was redefined in the context of learning by Garison and Anderson (2003) as "the ability of learners to project themselves socially and emotionally as 'real' people into a community of learners" (p. 94). (p. 94). (Zehui Zhan., & Hu Mei (2013)).

Social presence was identified as an important factor for improving learning. Students who score high on the social presence scale tend to be intelligent, enthusiastic, imaginative, spontaneous, active, and expressive, it was revealed by Gough (1975). (Gunawardena & McIsaac, 2004, Zehui Zhan & Hu Mei, 2013) other than that, its enhance a sense of active community, promoting student engagement (Hall & Herrington, 2010, Zehui Zhan & Hu Mei, 2013), and facilitate interactions such as requests for help (Leh, 2001, Zehui Zhan, & Hu Mei, 2013). Social presence directly leads to social interaction (Hostetter & Busch 2006, Zehui Zhan., & Hu Mei, 2013).

Several researchers (Biocca, Harms, & Burgoon, 2003; Heeter, 1992, Zehui Zhan & Hu Mei, 2013) also presented Presence consists of two interrelated phenomena — telepresence and social presence. Telepresence, also known as spatial presence or physical presence, in the sense of "being there", and social presence captures the meaning of "being together with others" (Woo C Park & Kim Dong-gook, 2020).

In the literature, the role of interaction during learning has been studied (Swan, 2001, Woo C Park & Kim Dong Gook, 2020). Learning from the constructivist educator's point of view is participation and interaction with the environment (Jonassen, Davidson, Collins, Campbell, & Haag, 1995). Woo C Park & Kim Dong Gook, 2020). People who interact with the environment and gain knowledge, skills, and competencies from interaction are seen as learners according to Winn (1975). Thus, learning will be more effective if students interact more with the learning environment such as peers, teachers, and learning materials. In online learning, students and teachers interact with each other

via computers, interaction which refers to the use of computer networks to facilitate communication between people who are spatially separated (Jonassen et al., 1995). Therefore, the interactivity of communication technologies may play an important role in students' learning experiences in online learning (Woo C Park & Kim Dong-gook, 2020).

The concept of information system success from the literature states that social presence in online learning is related to student learning success and student satisfaction, achievement, and student learning success, according to Dang, Zhang, Ravindran, and Osmonbekov (2016). (Woo C Park & Kim Dong-gook, 2020). In addition, Mohammadi (2015) defines satisfaction as the extent to which users believe that their needs, goals, and desires have been fully met and result in student satisfaction in e-learning as a dependent variable that can be influenced by various quality factors such as education, services, systems, and information quality. Wu, Tennyson, and Hsia (2010) also tested student satisfaction as the dependent variable and found a significant effect of performance expectations and learning climate on student satisfaction in a mixed learning environment (Woo C Park & Kim Dong-gook, 2020).

The active approach to effective learning emphasizes learning as social interaction. In the era of online learning technology is a necessity, understanding the context of social presence in online learning needs to create a unique type of learning environment. It is known from research on the learning process in traditional face-to-face learning environments that the development of social presence is important to make students feel as a part of the learning community contributing to student motivation, engagement, learning outcomes, and satisfaction (Wegerif, 1998, Crim S, 2006). The active approach to effective learning emphasizes learning as a social process that takes place through communication and interaction with others (Hiltz et al., 2000, Crim S, 2006).

Based on this explanation, the authors apply a meta-analysis as an effort to explain the consistent positive correlation which shows that social presence has a positive relationship with the level of student's satisfaction in online learning.

2 Research Methods

Participants

The characteristics referred to in the applied meta-analysis research are research articles that examines social presence and student satisfaction in online learning with the presence of a regression coefficient or correlation coefficient, *d* value, *t* value, or *f* value. Some of the research articles also includes the reliability value of the measuring instruments for social presence and student satisfaction, but some of them only includes measuring instruments for one of the variables. There are also those who do not display the reliability of the measuring instrument at all.

If based on the selected criteria, it was found that 15 research articles were published starting from 2003 to 2020. The characteristics of the sample were college students and one nursing student. The total number of samples in this study was 2,618.

Procedure

The first step is that the articles related to this meta-analysis study are traced using the EBSCO program which is a computer search program to search for article data through Google Scholar, Academia Edu, and www.elsevier.com/www.sciencedirect.com.

The keywords used are social presence, student satisfaction, and online learning. The findings of the articles that have been obtained are then considered, whether they are included in the criteria for meta-analysis or not.

3 Analysis Technique

Meta Analysis Procedure

According to Hunter and Schmidt (2004), the meta-analysis procedure is based on several stages and these stages are applied in reviewing this meta-analysis, namely:

1. Create an equation to change the value of F to t, d, and r
2. Performing Bare Bones Meta Analysis to correct sample errors by: calculating the mean correlation in the population; calculate the rxy variance (s^2r); calculate the sampling error variance (s^2e); and the impact of sampling.
3. In addition to sampling error artifacts, measurement error correction is also carried out using the following methods: calculating the combined mean; take into account the measurement error correction at x and y, namely, the actual correction of the population; the sum of the squared coefficients of variation (V); variance which refers to the variation of the artifact; true correlation variance; confidence intervals and the impact of variations in reliability.

4 Research Result

Characteristics of the research sample

The Table 1 is of the characteristics of the research sample in the meta-analysis.

Transform the value of F into the value of t, d and r.

There are 6 studies which are experimental studies that produce an F value, and 9 studies which are survey studies that produce an r value. For this reason, the F value needs to be transformed into the t, d and r values first. The equations of algebraic formulas are presented as follows:

$$\begin{aligned}
 t &= \sqrt{F} \\
 d &= \frac{2t}{\sqrt{N}} \\
 d &= \frac{2r}{\sqrt{1-r^2}} \\
 r &= \frac{d}{\sqrt{4+d^2}}
 \end{aligned}
 \tag{1}$$

Table 1. Characteristics of the Research Sample

year	researcher	study no		sample Characteristics
2006	Susan J. Cream (2006)	1	280	Student
2012	LaJoy Renee Spears (2012)	1	152	Student
2014	Lamees A. Alaulamie (2014)	1	814	Student
2017	Weidlich, J., & Bastiaens, T. (2017)	1	162	Student
2013	Zehui Zhan., & Hu Mei (2013)	1	255	Student
2020	ChongWoo Park., & Dong-gook Kim (2020)	1	67	Student
2018	Elham Alsadoon (2018)	1	73	Student
2003	Jennifer C. Richardson., & Karen Swan (2003)	1	95	Student
2007	Hyo-Jeong So., & Thomas A. Brush (2007)	1	55	Student
2011	Susan C. Cobb (2011)	1	120	Nursing Student
2012	Robert Strong., Travis L. Irby., J. Thomas Wynn., Megan M. McClure (2012)	1	109	Student
2015	Mehmet Baris Horzum (2015)	1	205	Student
2012	Saniye Tugba Bulu (2012)	1	46	Student
2006	Carol Hosteter., & Monique Busch (2006)	1	112	Student
	Total		2618	
	Average		175	
	SD		1727,792	

The values of r_{xy} obtained from survey studies and the transformation of F values from experimental studies are listed in Table 2.

Sampling Error Correction (Bare Bone Meta Analysis)

When population correlations are assumed to be constant across multiple studies, the best estimate of correlation is not a simple average of correlations between studies but a weighted average for each correlation then divided by the number of samples in the study (Hunter & Schmidt, 2004). The best estimate for population correlation is to follow the following equation:

a. Population correlation mean

$$\check{r} = \frac{\sum(N_i r_i)}{\sum N_i} \quad (2)$$

Table 2. Transformation of F values into t, d and r values.

No	Year	Researcher	N	F	t	D	rx _y
1	2006	Susan J. Cream (2006)	280				0.72
2	2012	LaJoy Renee Spears (2012)	152				0.73
3	2014	Lamees A. Alaulamie (2014)	814				0.50
4	2017	Weidlich, J., & Bastiaens, T. (2017)	162				0.32
5	2013	Zehui Zhan., & Hu Mei (2013)	255		2.08	0.26	0.13
6	2020	ChongWoo Park., & Dong- gook Kim (2020)	67		2.92	0.71	0.34
7	2018	Elham Alsadoon (2018)	73				0.63
8	2003	Jennifer C. Richardson., & Karen Swan (2003)	95				0.60
9	2007	Hyo-Jeong So., & Thomas A. Brush (2007)	55				0.22
10	2011	Susan C. COBB (2011)	120				0.63
11	2012	Robert Strong., Travis L. Irby., J. Thomas Wynn., Megan M. McClure (2012)	109	4.57	2.14	0.41	0.20
12	2015	Mehmet Baris Horzum (2015)	205				0.60
13	2012	Saniye Tugba Bulu (2012)	46	3.42	1.85	0.55	0.26
14	2006	Carol Hosteter., & Monique Busch (2006)	112		2.81	0.53	0.26
15	2014	Nasir M. Khalid (2014)	73	62,812	7.93	1.86	0.68

r_i the result of xy correlation in study i and N_i is the number of samples in study i. The next step is to change the value of r_i or r_{xy} in each study to get the mean population correlation, as presented in Table 3.

The average population correlation after being corrected by the number of samples or \check{r} of 0.479 was rounded up to 0.48.

b. Variance r_{xy} (σ^2r)

The variance of r_{xy} or $2r$ is calculated using the following equation:

$$\sigma^2r = \frac{\sum[(N_i r_i - \check{r})^2]}{\sum N_i} \tag{3}$$

The results of the calculation of the r_{xy} variance are presented below in Table 4.

Based on Table 4, it is known that the variance of r_{xy} or σ^2r is 0.036.

c. Sampling error variance

The r_{xy} variance of 0.036 is a mixture of two things, namely the variation in the population correlation and the variation in the sample correlation resulting from sampling error. The sampling error variance can be calculated using the following equation:

$$\sigma^2e = \frac{(1 - \check{r}^2)^2}{(\check{N} - 1)} \tag{4}$$

Table 3. Sampling Error Correction

No studies	N or ri	rx _y	Nx rx _y
1	280	0.72	201,600
2	152	0.73	110,960
3	814	0.50	407,000
4	162	0.32	51,840
5	255	0.13	33,150
6	67	0.34	22,780
7	73	0.63	45,990
8	95	0.60	57,000
9	55	0.22	12,100
10	120	0.63	75,600
11	109	0.20	21,800
12	205	0.60	123,000
13	46	0.26	11,960
14	112	0.26	29,120
15	73	0.68	49,640
Amount	2618	6.82	1253.540
Average			0.479

Based on the value of obtained and the average number of samples, the variance of sampling error in this meta-analysis study is:

$$\sigma^2 e = \frac{(1 - 0.48^2)^2}{(175 - 1)}$$

$$\sigma^2 e = \frac{0.59228416}{174} = 0.0034$$

The variance of sampling error $\sigma^2 e$ is 0.00342.

- d. Estimated population correlation variance

The population correlation variance, or the true variance, is the corrected variance, i.e. the r_{xy} variance minus the sampling error variance. The population correlation variance can be calculated using the following equation:

$$\sigma^2 p = \sigma^2 r - \sigma^2 e \quad (5)$$

so in this meta-analysis study can be calculated:

$$\sigma^2 p = \sigma^2 r - \sigma^2 e \sigma^2$$

$$\sigma^2 p = 0.036 - 0.00342 = 0.03258$$

$$\text{Standard deviation} = \sqrt{\sigma^2 p} = \sqrt{0.03258} = 0.1804.$$

Table 4. Variance r_{xy}

No Studies	N	r_{xy} or r_i	$(r_{xy} - \bar{r})$	$(r_{xy} - \bar{r})^2$	$N(r_{xy} - \bar{r})^2$
1	280	0.72	0.241	0.058	16,288
2	152	0.73	0.251	0.063	9,590
3	814	0.50	0.021	0.000	0.365
4	162	0.32	-0.159	0.025	4.086
5	255	0.13	-0.349	0.122	31.026
6	67	0.34	-0.139	0.019	1,291
7	73	0.63	0.151	0.023	1,669
8	95	0.60	0.121	0.015	1,395
9	55	0.22	-0.259	0.067	3,684
10	120	0.63	0.151	0.023	2,743
11	109	0.20	-0.279	0.078	8,473
12	205	0.60	0.121	0.015	3,011
13	46	0.26	-0.219	0.048	2,202
14	112	0.26	-0.219	0.048	5,363
15	73	0.68	0.201	0.040	2,955
Total	2618				94.141
Mean	175				0.03596
SD					0.189

e. Confidence interval

\bar{r} of 0.479 compared to the corrected SD, namely:

$$= \frac{0.479}{0.1804} = 2.65$$

The mean correlation shows the result of 2.65 SD above 0, so the correlation between the two variables is positive.

f. Impact of sampling error

The impact of sampling error can be known by using the following equation:

$$\frac{\sigma^2_p}{\sigma^2_r} = \frac{0.03258}{0.036} = 0.905$$

The study correlation reliability was 0.91, so the percentage of variance referring to the sampling error was $1 - 0.9 = 0.1 = 10\%$.

Table 5. Measurement Error Estimation Worksheet

No Studies	N	r xy or ri	r xx	r yy	(a)	(b)	N xr xy
1	280	0.72	0.88	0.87	0.9381	0.9327	201,600
2	152	0.73	-	-			110,960
3	814	0.50	-	-			407,000
4	162	0.32	0.91	0.77	0.9539	0.8775	51,840
5	255	0.13	0.849	0.932	0.9214	0.9654	33,150
6	67	0.34	0.872	0.952	0.9338	0.9757	22,780
7	73	0.63	0.81	0.905	0.9000	0.9513	45,990
8	95	0.60	-	-			57,000
9	55	0.22	-	-			12,100
10	120	0.63	-	-			75,600
11	109	0.20	0.94	0.89	0.9695	0.9434	21,800
12	205	0.60	0.95	0.95	0.9747	0.9747	123,000
13	46	0.26	0.81	0.85	0.9000	0.9220	11,960
14	112	0.26	0.87	-	0.9327		29,120
15	73	0.68	0.86	0.93	0.9274	0.9220	49,640
Total	2618	6.82	8.751	8.049	9.3516	8.4646	1253.540
Mean	174,533	0.455	0.875	1.006	0.935	0.941	0.479
SD	1727,79185	0.213	0.048	0.058	0.025	0.031	102.969

Measurement Error Correction

After correcting the sampling error, the next step is to correct the measurement error. The measurement error correction analysis was first carried out based on the score of the reliability value of the measuring instrument for each variable x and y from 15 studies, although not all studies included the reliability value of the measuring instrument. From the results found, it is known that there are 10 research articles that include measuring instruments for the social presence variable, while for measuring student satisfaction variables in online learning, there are 9 research articles. The following is the data on the reliability scores of each measuring instrument in the form of a worksheet to find the estimated measurement error in Table 5.

Evaluation of assessment errors can use the methods below:

a. Finding the Combined Average

The combined mean is calculated using Eq. 6 below.

$$\tilde{A} = \text{Ave (a) Ave (b)} \quad (6)$$

Explanation:

\check{A} = combined mean

(a) = square root of reliability coefficient rxx (b) = square root of reliability coefficient ryy Ave (a) = mean (a)

Ave (b) = mean (b)

\check{A} = Ave (a) × Ave (b)

= 0.935 × 0.941

= 0.8795

Based on the formula above, the combined mean is 0.88.

- b. Finding for population correlation after being corrected by measurement error
The calculation of the actual population correlation after being evaluated using measurement error is calculated using the following equation.

$$P = Ave(\rho_i) = \frac{Ave \check{r}}{\check{A}} \tag{7}$$

Information:

Ave \check{r} = true mean of rxy correlation

\check{A} = combined mean

$\rho = Ave(\rho_i) = 0.479/0.88 = 0,5444$

The actual population correlation after being evaluated by measurement error in both the dependent and independent variables is 0.544.

- c. Finding the sum of the coefficients of the squares of variance (V)
V = SD²(a) + SD²(b)

$$Ave^2(a) + Ave^2(b) \tag{8}$$

$$\begin{aligned} &= \frac{(0.025)^2 + (0.031)^2}{(0.935)^2 + (0.941)^2} \\ &= \frac{0.000625 + 0.000961}{0.874 + 0.885} \\ &= 0.000715 + 0.00108 \end{aligned}$$

V = 0,001795

- d. Finding the variance that refers to the variation of the artifact (error variance)

$$\sigma^2_2 = \rho^2 \check{A}^2 V \tag{9}$$

$$\sigma^2_2 = (0.544)^2 \times (0.88)^2 \times (0.001795)$$

$$\sigma^2_2 = 0.000424949$$

e. Finding true correlation variance;

$$\begin{aligned} \text{Var}(\rho) &= \frac{\text{Var}(\rho_{xy} - \rho^2 \tilde{A}^2 V)}{\tilde{A}^2} & (10) \\ &= (0.03258 - 0.0004249) / 0.88 \\ &= 0.0321551 / 0.88 \\ &= 0.03209 \\ \text{SD} &= \sqrt{0.03209} \\ &= \mathbf{0.566} \end{aligned}$$

A true population (ρ) is considered to be 0.5444 and the standard deviation (SD) is 0.566.

f. Finding Confidence Intervals:

$$0.5444 / 0.566 = 2.046$$

g. The impact of reliability variation is:

$$\begin{aligned} \frac{\rho^2 \tilde{A}^2 V}{\sigma^2(\rho_{xy})} \times 100\% & & (11) \\ = 1.304\% \end{aligned}$$

5 Discussion

The purpose of this meta-analysis study is to analyze facts regarding research related to social presence and student satisfaction variables in online learning. The results of these reviews are used as a basis for agreeing or disagreeing while providing direction for future research. From the results of the data study, it is shown that the hypothesis which states that there is a relationship between social presence and student satisfaction in online learning is accepted. It can be seen from the value of 0.48 and the mean correlation shows the results of 2.65 SD above 0, so the correlation between the two variables is positive.

The value of the variance of the sampling error is small, namely 10%. This proves that the chance of bias inaccuracies when determining the sample is minimal. Then the value of the variance of the assessment error in the assessment of the independent variable or the dependent variable is worth 0.000424949 and the value of the variables in the population reaches 0.03258. However, the variance of the assessment error is at least 1.3%, very minimal compared to the result of sample collection errors. Poor presentation indicates that the chance of error bias due to deviations at the time of assessment is minimal.

Social presence is not the only factor to consider when designing or evaluating online learning, but this meta-analysis has revealed its very important function in predicting student learning success, namely student satisfaction in perceived learning. Student satisfaction in online learning is reflected in the concept of social presence that emphasizes social interaction as the basis for critical thinking and high-level learning for students (Garrison & Akyol, 2013; Richardson, Jennifer C, 2017).

In addition, when considering the importance of social presence in online learning, we can return to the previous study that social presence has a relationship with student participation and motivation in the learning process, student satisfaction, perceived learning, academic outcomes such as grades, and that has implications for learning and retention methods (Boston et al., 2009; Cobb, 2009; Gunawardena & Zittle, 1997; Hostetter & Busch, 2013; Jorge, 2010; Swan & Shih, 2005; Swan et al., 2012; Tu & McIsaac, 2002; Weaver & Albion, 2005; in Richardson, Jennifer C, 2017).

Social presence theory according to Tu and McIssac (2002), explains that social presence has the greatest influence on student satisfaction in eLearning learning. Tu and McIssac say interactivity, social context and online communication are part of social presence. Students prefer to participate in an active learning process with an online format (Tu & McIssac, 2002). Research by Walther (1992) in it further explains that social presence enhances students in building a sense of identity. The interactivity dimension reveals the interaction and collaboration that students prefer and teacher support (Tu & McIssac, 2002). This confirms the results of this meta-analysis which shows that there is a correlation between the variables of social presence and student satisfaction in online learning.

6 Conclusion

From the meta-analysis study that has been carried out, it is found that there is a good relationship with social presence and student satisfaction in online learning. After an evaluation of sample collection or evaluation of assessment errors, it can be shown that someone is able to compare social presence with student satisfaction in online learning. The presentation of the result of calculation errors is 1.3%, this shows the measurement error in this meta-analysis research article is small, so it can be used by future researchers.

Limitations and Suggestions

The number of journals in the study can be increased so that the number of samples in the study is larger, thus the error in sampling can be even smaller. In online learning, social presence has a positive relationship with student satisfaction, but in the learning process in addition to social presence, learning process also required the presence of teachers, student motivation and other variables, this can be studied further on how these two variables increase student satisfaction in online learning.

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