Measuring Web 2.0 Interaction:

A Meta-Synthesis of Literature on Using Transactional Distance and Social Presence

A research project submitted in partial fulfillment for the degree of

Masters of Education

University of Ontario Institute of Technology

Abstract

In this study, the researcher created an instrument, based on a meta-synthesis of relevant literature, to measure the presence of the variables associated with Transactional Distance and Social Presence when used as a discussion tool in formal post-secondary education. Seven variables were identified (Sense of Community, Affective Connectedness, Open Communication, Mutual Attention and Support, Dialogue, Learner Autonomy, and Structure) and three indicators were used for each variable in the instrument. Twenty empirical research articles were found on Google Scholar and were used as textual data for the newly created instrument. A Transactional "Closeness" score, a Social Presence score and a combined "Effectiveness of Interaction" score was calculated for each application presented in the research articles. The researcher listed the Web 2.0 applications that were found to be most effective for interaction, which included Ning, Adobe Connect, Elgg, Facebook and Twitter. The components common to effective Web 2.0 technologies are presented.

Acknowledgements

This project started many moons ago, when the only people I had to thank were (1) my husband, Kevin Quan, for supporting me on this journey and for his patience in listening to me while I rambled on about RSS technology and instructional interaction as we made, ate and cleaned up dinner. And (2) Dr. François Désjardins for his guidance in helping me edit my proposal, complete my REB and get consent from EVERYONE involved (my students, my principal, my school board).

Fast forward a couple of years; the list of people I need to thank grows as does my family. Apollo and Jovian, I would have much rather spent the time with you, but I thank you both for your patience and your understanding that "Mommy has to do homework."

I need to extend a huge thank you to my mother-in-law and my father-in-law Connie and Henry Quan for taking on those extra hours of Sunday morning baby-sitting while I had a coffee date with my computer. And this project could not have been completed without the extensive support that my parents Dominic Shou, Connie Shou and my sister Hermione Shou provided. Thank you Hermione for keeping me afloat in my massive pool of research articles. A good ¾ of this project was completed while mom watched over my babies and dad burned vacation days at my house.

I would like to thank Judith Amesbury for being my inter-reader extraordinaire but more importantly for re-lighting my fire. You finishing your thesis was THE inspiration for me re-starting my project. Thank you for coming full circle with me on this M.Ed. journey.

I would also like to thank Dr. Maurice DiGiuseppe for his careful editing and thought provoking suggestions.

Finally, I would like to thank Dr. Roland van Oostveen for taking me on, yet again! Your mentorship 10 years ago helped shape me as a teacher (when I thought I knew a lot) and I am grateful for your continued guidance today (when I know I know so very little). This journey of inquiry was truly challenging but I was comforted to know that you were always on the sideline watching me walk three steps forward and two steps back. Thanks again!

Table of Contents

Introduction

Some Web 2.0 technologies such as course management systems (CMS) and social networking sites (SNS) are effective tools for interaction; how can you tell? Web 2.0 technologies inherently invite users to participate in discussions, to contribute their ideas and to create new ideas with others. The availability of Web 2.0 technology has changed the format in which formal and informal education happen and has blurred the line between learning in a "brick-and-mortar" institution and distance education. Now, many face-to-face courses involve a high degree of learning over the Internet. Course materials are frequently distributed through the Internet and Web 2.0 technology is often used to provide learners with opportunities to exchange ideas, to provide feedback, and to collaborate. Because Web 2.0 technologies facilitate learning when individuals are at a distance - regardless of whether the course is primarily a physically co-located course or a distance education course - this paper will evaluate the effectiveness of interaction when using Web 2.0 technology in post-secondary education as if it were distance education and base it on distance education theories.

In order to evaluate the effectiveness of interaction there must be a consensus on the definition of interaction. Wagner (1994) suggested that one of the factors of effective instruction in distance education is interactivity and claims that "interactivity functions as an attribute of contemporary instructional delivery systems" (p. 6). She defined interaction as an experience between learners and their environment and that effective interaction occurs when a response in the environment alters the learner's behavior and helps the learner attain the learning outcome. In her definition, there is a clear distinction between interactivity (the characteristic of technology), and interaction (the interplay between individuals). However some researchers use interaction and interactivity interchangeably (Gilbert & Moore, 1998; Roblyer & Ekhaml, 2000; Vrasidas &

McIsaac, 1999; Su, Bonk, Magjuka, Liu & Lee, 2005). Roblyer and Ekhaml (2000) justify the use of both words because they believe that "interaction and interactivity are linked… [and that] technologies that allow high interactivity seem necessary to allow high person-to-person, person-to-group and person-to-system interaction" (p.2). This research will focus on the characteristics of the technology which afford high interactivity; the effectiveness of interaction is therefore a measure of the level of interaction afforded by the technology.

The independent variables in this research were identified from a study by Vrasidas and McIsaac (1999). Vrasidas and McIsaac (1999) identified four factors as basis for their conceptual framework. The identified factors were learner control, transactional distance, feedback and social presence. In their study, learner control and feedback were the human factors of interaction. Social presence and parts of transactional distance (structure and dialogue) were mainly characteristics involving technology. This study will concentrate on the technological factors of interactivity as identified by Vrasidas and McIsaac (1999). The definitions for Social Presence and Transactional Distance theories are presented in the literature review.

Ideally, objective measurements should be grounded in theories and evaluated using standardized instruments. The theories of Transactional Distance and Social Presence are well established in distance education and will be used as the backbone for the instrument created in this study. Such an instrument to measure interaction in distance education does not currently exist (Roblyer & Ekhaml, 2000; Tello, 2002). In fact, Starr-Glass (2013) claims that the adoption of technology "has been primarily driven by the availability of technology and media, rather than by educational considerations" (p. 117). This research is an attempt at filling this gap.

This research focuses on the following questions:

1) What are the variables of Social Presence and Transactional Distance, and how can they be used to measure the level of interaction afforded by Web 2.0 applications?

2) If a standard tool is to be created to evaluate the interactivity of the Web 2.0 application, what should it look like?

3) How should this the instrument be worded?

4) How do we know whether or not the instrument is transferable amongst most Web 2.0 applications?

More specifically, the two working hypotheses are as follows.

H1: Variables from the theories of Social Presence and Transactional Distance can be used to form an instrument with which to measure the level of interaction afforded by Web 2.0 applications.

H2: The levels of interaction of Web 2.0 applications can be measured by the instrument created.

Literature Review

This section will provide background information used in building the conceptual framework. Definitions and a review of the literature for each concept and theory involved in this research will be presented. The order in which the topics are presented is as follows: Web 2.0 Technologies, Course Management Systems, Social Networking Sites, Social Presence and Transactional Distance.

Web 2.0 Technologies

Web 2.0 technologies have evolved from the definition that O'Reilly (2005) first presented. In his work, Web 2.0 was described as a network of all connected devices and serves as a platform for applications which deliver continually updated and remixed software, data and services to individuals. User participation is inherent in the architecture of Web 2.0 and hence delivers a richer user experience as compared to Web 1.0 (O'Reilly, 2005). A "social-technical" perspective was added to the original definition by Wilson, Lin, Longstreet and Sarker (2011). These authors defined Web 2.0 as the second generation of the Web, "wherein interoperable, user-centered web applications and services promote social connectedness, media and information sharing, user-created content, and collaboration among individuals and organizations" (p. 2). The technologies presented in this study fall into this "social-technical" definition of Web 2.0 technologies. The instrument created in this study will measure the effectiveness of interaction as afforded by tools which promote social connectedness, media and information sharing, user-created content and collaboration.

Collaboration and social connectedness are part of the definition of Web 2.0 technologies, but actual research, with empirical measurements, of whether these applications are beneficial to interaction is scant. Hartshorne & Ajjan (2009) examined student awareness of Web 2.0 benefits. Jung (2001) offered theoretical justifications of Web 2.0 benefits. Hartshorne & Ajjan (2009) created a survey instrument based on the Decomposed Theory of Planned Behavior (Taylor and Todd, 1995) to measure the student use and awareness of Web 2.0 potentialities to supplement classroom learning experiences, and to identify factors that influence the adoption of

these technologies. The authors found that students acknowledged pedagogical benefits of Web 2.0 applications and found blogs most useful in terms of increasing student-faculty interactions and improving student writing. Social networks were most beneficial in increasing peer-to-peer interactions and wikis were the easiest to integrate with class websites. This study concludes that Web 2.0 applications can facilitate "an effective learning environment [which] fosters collaboration among students and faculty" (p.194). Jung (2001) attempted to justify the benefits of instruction using the Web by building a theoretical framework of Web-based instruction using the theory of Transactional Distance. She found that many of these studies supported Moore's theory of Transactional Distance (the psychological and communication gap between individuals) and claimed that the theory was useful as a basis for a conceptual framework. She also found that the studies claimed that Web-based instruction provided for better learning dialogue and learning communities, but only a few of those studies were actual comparative studies that could justify the claims. She found three types of interaction: academic interaction between learners and instructors, collaborative interaction among learners and interpersonal interaction between learners and others. In her review, she voiced the need for more rigorous studies on pedagogical features of Web 2.0 technologies in teaching and learning contexts and asks questions about which features of these Web 2.0 technologies can best provide meaningful dialogue among participants.

This present paper reports on the use of course management systems (CMSs) and social networking sites (SNSs). CMSs and SNSs are common Web 2.0 technologies and have features that support collaboration, sharing, social connectedness and user-content. They attempt to fill the research gap as identified by Jung (2001) and to build upon the research conducted by Hartshorne and Ajjan (2009).

Course Management Systems

Course Management Systems (CMS), sometimes incorrectly called Learning Management Systems (LMSs) are Internet-based applications used to create, organize, present and distribute course content (Morgan, 2003). Some CMSs help manage student enrollment and track student performance. Other CMSs incorporate communication tools, student assessment tools, grade reporting tools and functions to manage class activities (Morgan, 2003). While all of the components in a CMS have effects on student learning, this particular study will focus on the communication tools available in CMSs. The CMSs found in the research articles used as textual data for the instrument created in this study are Moodle and WebCT.

As mentioned in the introduction, many courses in the post-secondary setting have been using CMSs as a means to extend the reach of the classroom, allowing students to have access to classroom resources from home (Malikowski, 2008; Papastergiou, 2006; Flosi & Bandyopadkyay, 2009; Maloney, 2007). Many researchers report on the convenience of CMSs in the distribution of course material and claim improvements in their communication efforts with students (Dutton, Cheong & Park, 2004; Martins & Kellermanns, 2004). However, only a handful of articles really measure whether the use of CMS communication tools actually benefit interaction (Chou, Peng & Chang, 2010).

There is also a lot of debate about the benefits of the use of CMSs as compared to SNSs (Morgan, 2003; Koszalka and Ganesan, 2004; Papastergiou, 2006). Dalsgaard (2006) suggested that CMSs should only be used in a minor role in courses and that the use of social networking tools can support learning better. This claim is echoed by Hoffman (2009) who stated that when used appropriately, social networking software has a positive effect on student engagement, motivation, personal interaction and the learning environment. The position of this paper is that

CMSs used in higher education have evolved to include tools that support interaction, social connectedness and information sharing. To that end, CMSs fit the definition of Web 2.0 technologies and hence belong within the parameters of this study and should be evaluated in the same manner as SNS. Articles that evaluate the effects on interaction and learning when CMSs are used are summarized in the two paragraphs below.

Snodin (2012) found that learners were able to achieve a greater level of engagement and develop more learner autonomy when CMS were used. Snodin(2012) reported that CMS usage enabled students to be more aware of the importance of feedback and they felt more independent and confident. She also found that learners developed autonomous behaviours such as contributing to online materials, setting their own learning goals and monitoring and evaluating their own learning progress. Findings from this research are plentiful but it is unclear what activities actually took place through the CMS. Claims gathered by Snodin (2012) can be used as a basis of preliminary understanding of the benefits CMS has onto student interaction but further research was recommended.

Lust, Collazo, Elen & Clarebout (2012) conducted a thorough review of the literature surrounding the pedagogical claims of using CMS. These researchers categorized the literature into 3 different topics: 1) the way students use tools available in; 2) whether different uses of tools affect performance; and 3) variables which influence tool use. In the study, 34 articles were reviewed. The authors reported that there were serious limitations with the articles they used. Most of the studies they reviewed investigated specific tools within a CMS instead of studying the CMS as a whole. They felt that a standard with which to measure the tools was lacking; different tools were investigated in different ways in different studies. They also found that some students were not able to benefit from the affordances of a CMS because they were unable to

choose the appropriate tools within the CMS to enhance their learning. Lust et al. (2012) called for future research into how students use CMS tools from an instructional design perspective.

Researchers agree in that CMS offer a variety of tools for both the instructor and the student. Snodin (2012) found that students experienced a higher degree of learner autonomy when a CMS is used, however Lust et al. (2012), pointed to a lack of standardized methods used in the evaluation of CMS and identified a need to study the CMS as a whole toolset instead of focusing on a specific tool within a CMS. This study attempts to create a standardized instrument in which to measure the effectiveness of using both Web 2.0 technologies (both CMS and SNS) for interaction. It builds on the idea of learner autonomy which Snodin (2012) uses and focuses on the overall experience of using CMS as a whole system with many distinct tools, although it identifies the specific tools which are found in the most effective CMS.

Social Networking Sites

In addition to CMSs, SNSs are another form of Web 2.0 technology that is being used in formal education. Very often they are used in the same manner as a CMS, as a means to distribute course materials and to communicate.

Boyd and Ellison (2007) defined SNS as follows:

> Web-based services that allow individuals to (1) construct a public or semi-public profile within a bounded system, (2) articulate a list of other users with whom they share a connection, and (3) view and traverse their list of connections and those made by others within the system. (p. 211)

In an education setting, SNS have been found to be a place where students share ideas, provide peer feedback and engage in critical thinking (Selwyn, 2007). SNSs that are included as part of the textual data for the instrument are: Facebook, Ning and Twitter.

The benefits of using SNSs in formal education have been debated. In some instances the use of SNS was banned from the educational institution (Bosch, 2008). Waycott, Bennett, Kennedy, Dalgarno and Gray (2010) questioned the use of SNSs in formal learning and claimed that they interfered with students' daily lives. Salaway, Caruso and Nelson (2007) found that some students were apprehensive about the use of online learning environments with their instructors. Research has also shown that the adoption of SNSs by faculty and their decision to use SNS for formal education purposes still lag behind the usage of SNSs by the general student population (Roblyer, McDaniel, Webb, Herman & Witty, 2010). On the other hand, there have been reports of the use of SNS improving communication and establishing of a sense of community in an education setting (Klein, 2008).

Lockyer and Patterson (2008) gave a very basic overview of the issues which resulted from the usage of SNS in formal education. These researchers used Gunawardena, Lowe and Anderson's (1997) online social interaction model to code the types of interaction found in an online activity and found evidence of social interaction, sharing, comparing and negotiation and co-construction of knowledge.

McCarthy (2010) used Facebook as a means to enhance first year social and academic interaction between peers. In the article, McCarthy (2010) claimed that Facebook was the perfect host site because its interface is user friendly and easy to use. However, he also stated that there

is an existing conflict of attitudes and assumptions regarding the use of SNSs to support teaching and learning in higher education.

Thoms & Eryilmaz (2014) measured student perceptions of their learning, interaction and their Sense of Community. The researchers found that the frequency of interactions were significantly higher in the SNS as compared to the CMS. They found that students using the SNS had a higher course average and that the learners' satisfaction with the application was higher for the SNS group. Unfortunately, the study really only measured the usage of Elgg vs. Angel on groups of individuals in a non-controlled environment and hence one cannot apply the findings to all SNSs and CMSs.

While using SNS in formal education continues to be a contentious issue, there is research which finds SNS usage was beneficial to interaction. Findings from Thoms & Eryilmaz (2014) support the SNS claim but are interactions resulting from the use of SNS significantly better than those resulting from the use of CMS? The instrument created in this study will serve as an objective tool based on theories to measure the effectiveness of Web 2.0 technology as tools for interaction.

Social Presence

Social Presence theory is a theory originally described by Short, Williams & Christie (1976) to explain the effects of media on communications. It was identified as the "degree of salience between two communicators using a communication medium" (p.65) or the degree to which a particular medium affords individuals to be perceived as a "real person." Accordingly, technology determines the perception of Social Presence; the capacity of the medium to transmit information including all verbal communication and nonverbal cues such as facial expression,

gaze, posture and dress contributing to the degree of Social Presence of a communications medium. This theory of Social Presence pertains to intimacy and immediacy, qualities that are present when social interaction is mediated through media high in Social Presence (Biocca, Harms & Burgoon, 2003). Intimacy is based on a concept by Argyle & Dean (1965) and depends on factors such as physical distance, eye contact and smiling. Immediacy is a concept suggested by Mehrabian (1967) and is a measure of the "degree of directness and intensity of interaction" (p. 414) between the communicator and the object being referred to.

Many researchers have since expanded on the original conception of Social Presence. Newer definitions of Social Presence include factors other than the medium being used. According to Rourke, Anderson & Garrison (1999), Social Presence is the ability for individuals to "project themselves socially and affectively" (p. 50) and is "the degree to which a person is perceived as a 'real person'" (Gunawardena & Zittle, 1997, p. 9). Garrison, Anderson and Archer (1999) claim that Social Presence is directly influenced by the communication context created by one's familiarity, skills, motivation organizational commitment, activities and length of time using the media.

Social Presence can offer a sense of being in and belonging in a community (Hall & Davison, 2007; Richardson & Swan, 2003; Picciano, 2002; Cui, Lockee & Meng, 2013; Lowenthal , 2009). Individuals with a high degree of Social Presence are more confident in their dialogue and along with cognitive presence (the extent to which learners are able to construct and confirm meaning though sustained reflection and discourse in a critical community of inquiry), allows for deep meaningful learning (Anderson, 2008). Garrison et al. (1999) indicate that Social Presence enables individuals to instigate, sustain and support critical thinking and helps to make group interactions more appealing, engaging and intrinsically rewarding, leading

to increases in "academic, social, and institutional integration and results in increase[d] persistence and course completion" (p. 4). Social Presence, according to Fabro and Garrison (1998), is necessary for creating a "critical community of learners," with a collaborative process of critical reflection and discourse (Schrage, 1995). Social Presence, according to Garrison et al. (1999) enhances quality of the interchange, from the process of downloading information into a "collaborative community of inquiry" (p.96).

A number of studies have reported a strong positive correlation between Social Presence and effective learning. Kearney, Plax and Wendt-Wasco (1985) found that immediacy was a good predictor of student learning. Christophel (1990) found that a high Social Presence from instructors translated to a feeling of higher instructional effectiveness. Furthermore, Liu, Gomez and Yen (2009), concluded that Social Presence can be a "significant predictor of course retention and final grade" (p. 165).

Various instruments to measure Social Presence have been created and have been used to measure media before the evolution of Web 2.0 technology. Short et al. (1976) used bi-polar scales to measure students' perceptions of a tool to afford Social Presence. The scale measures were personal/impersonal, immediate/non-immediate, interactive/non-interactive, sensitive/insensitive, social/unsociable and colourful/colourless. Gunawardena and Zittle (1997) used the intimacy and immediacy described earlier as two variables of Social Presence. They designed a study to measure the immediacy aspect of Social Presence and then adopted 6 bi-polar items originally used by Short et al. (1976) to measure the intimacy of the medium. Tu (2002) studied Social Presence using 3 main variables affecting Social Presence: social context (users' perceptions), online communication (attributes of the media) and interactivity (the activities in which users are engaged). Tu (2002) concluded that "because the different forms of

CMC may affect the level of Social Presences, it is highly recommended that one must select the most appropriate online communication forms to increase online interaction" (p. 43).

The instrument created in this study looks at Social Presence through four variables as described by Kim (2011). Kim (2011) stated that Social Presence is the "specific awareness of relations among the members in a mediated communication environment and the degree of proximity and affiliation formed through it" (p. 766). Four factors were identified in which Social Presence can be constructed. These four factors are Affective Connectedness, Open Communication, Sense of Community and Mutual Attention and Support. Kim (2011) defined Affective Connectedness as a feeling of psychological and social connectedness; the degree in which participants expresses intimacy and warmth. A Sense of Community is established when users perceive the usefulness of community support and cooperation. According to Kim (2011), Open Communication can be conceived of interactions where participants pursue knowledge through critical discourses and is achieved by participants sharing, recognizing and showing interest in others' messages. Finally, Mutual Attention and Support encompasses the mutual attentiveness, empathy and interdependent support. The instrument developed in this study includes these four factors as a means of determining the extent to which the development of Social Presence is supported.

As seen in the literature review above, claims that a high level of Social Presence allows for deep meaningful learning and higher instructional effectiveness are strong. Social Presence has been studied thoroughly on different forms of CMC, in the past. Adopting ideas from Kim's (2011) article, this study uses the broader definition of Social Presence and measures the levels of Social Presence in Web 2.0 applications.

Transactional Distance

Transactional Distance is the psychological and communication gap resulting from the separation (physical, hierarchical, socio-economical, etc) between learners (Moore, 1993; Vrasidas & McIsaac, 1999). It may be described by three variables; dialogue, structure and learner autonomy (Moore, 1993; Kearsley & Moore, 1996; Woods & Baker, 2004). Chen (2001) describes Transactional Distance as the "distance of understandings and perceptions that might lead to a communication gap or a psychological space of potential misunderstandings between people" (p. 459).

According to Moore (1993) Dialogue is a series of purposeful positive interactions constructed and valued by both parties involved. Each party in a dialogue must listen, contribute and be respectful. Moore (1993) explained that Structure is the elements in the design of the course and includes the flexibility of a program's objectives, teaching strategies and evaluation methods. Finally, Learner Autonomy is described as the extent to which a learner is able to determine his or her own goals, learning experiences and evaluation decisions (Moore, 1993).

The theory of Transactional Distance does have its critics. Gorsky & Caspi (2005) claimed that the theory can be reduced simply to the correlation as discussion increases, Transactional Distance decreases. However, the general consensus is that a decrease in Transactional Distance provides for better interaction for the learner (Moore & Kearsley, 2005; Vrasidas & McIsaac, 1999). Teacher personality, learner personality and content affect the flow of dialogue (Moore, 1993). Moore (1993) explained that aside from these variables that alter Transactional Distance in any setting, Transactional Distance still varies when different communication media are used.

There is also contention as to how structure, specifically, affects Transactional Distance. Vrasidas and McIsaac (1999) claimed that more structure in a course reduces Transactional Distance because “requiring students to engage in discussions and to collaborate on projects increased interaction in the course” (p.32). Whereas Moore (1993) claimed the opposite because he believed a highly structured course hinders teacher-learner dialogue and therefore increases Transactional Distance. He claims that highly structured media such as print and recorded video offer no opportunity for accommodations, which increases Transactional Distance. Moore (1993) described situations where programs with little structure, such as those based on teleconferences where the instructor loosely structures the dialogue and is not overanxious about its flow, enable learners to make their own judgments and consequently decrease Transactional Distance. Others have found that a loosely structured course enables students to become complacent in the learning process and thereby increases Transactional Distance (Vrasidas & McIssac, 1999; Stein, Wanstreet, Overtoom & Wheaton, 2005). In the ideal scenario, Moore (1993) may be correct in that loosely structured programs will allow for the learner to take on a larger interest and more responsibility in their own learning and thereby decreasing Transactional Distance. In practice, the likelihood of students becoming complacent in programs that are more loosely structured may be highly possible. However, too much structure, as suggested by Vrasidas & McIssac (1999) may be too restrictive as well. A chart which represents the researcher’s believe of how Transactional Distance varies with structure is presented in Appendix C and illustrate that Transactional Distance is very high if there was exceptionally low structure (e.g. if the learner as no direction) however a reasonably low structure (e. g. flexibility in the flow of dialogue) enables a lower Transactional Distance otherwise.

In a study which measured Transactional Distance perceived by students in a Web-based environment Chen (2001) concluded that Transactional Distance was not impacted by learners' previous experience or by in-class learner support when taking distance education courses. Her study was based on the measurement of the impact 4 variables (learner's skill level with the Internet, previous experience in taking distance education courses, extent of interaction and types of learner support) on learners' perceived Transactional Distance. The study was conducted with 82 students taking part in an online course and measured using a questionnaire developed by the researcher. This questionnaire was clearly presented in the article and supported in a well structured model and framework. Many of the indicators written in this study are based loosely on the questionnaire.

Despite some contention in the definition and the implication of Transactional Distance, Moore's (1993) theory is generally accepted in the distance education field (Vrasidas & McIsaac, 1999; Kearsley & Moore, 1996; Woods & Baker, 2004; Chen, 2001). The research being reported in this paper measures the level of Transactional Distance found in Web 2.0 applications in hopes to build on the knowledge gained by previous research in this area.

Conceptual Framework

In the current study, seven variables associated with Social Presence and Transactional Distance, as found in the literature, were identified to measure the level of interaction afforded by Web 2.0 applications. The first four variables were identified using the framework created by Kim (2011) for Social Presence, namely, Affective Connectedness, Open Communication, Mutual Attention and Support, and Sense of Community. Transactional Distance was considered

as three variables according to Moore's (1993) original definition: Learner Autonomy, Dialogue and Structure.

An initial set of indicators for the Social Presence variables (a priori codes for the template analysis as described in the Methodology section) were written based on Kim's (2011) article. Another set of indicators for Transactional Distance were written based on the conceptual from work from Chen (2001) and Moore (1993). Both the Social Presence indicators and the Transactional Distance indicators are used in a positive sense, thus a greater Social Presence score translates to more effective interaction. Transactional Distance indicators are also written in a positive sense and therefore, in essence, "Transactional Closeness" is actually measured. Since a smaller Transactional Distance is more desirable for interaction, a larger Transactional "Closeness" score is better for the interaction. Figure 1 illustrates the variables affecting Social Presence and Figure 2 describes the variables affecting Transactional "Closeness."

Graphs which demonstrate the interaction of the dependent and independent variables are found in Appendix C. The graphs were created based on the researcher's understanding of the literature reviewed previously. Social Presence varies directly with each of the 4 independent variables: Sense of Community, Affective Connectedness, Open Communication and Mutual Attention and Support. Transactional Distance varies inversely with Learner Autonomy and with Dialogue. Lastly, Transactional Distance, for the most part, varies inversely with Structure, but when little or no structure exists, the Transactional Distance is very high. This high transactional distance is a result of individuals potentially becoming complacent with communicating (Moore, 1993).

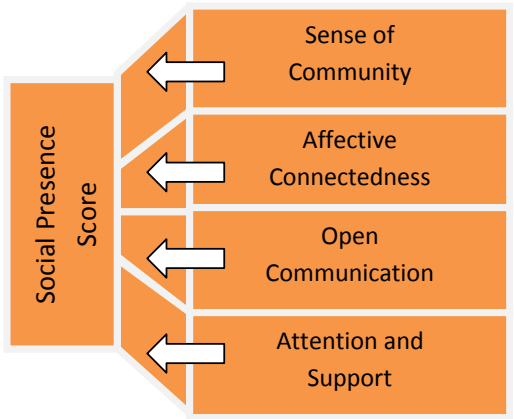

*Figure 1.*Map showing Social Presence comprised of four independent variables.

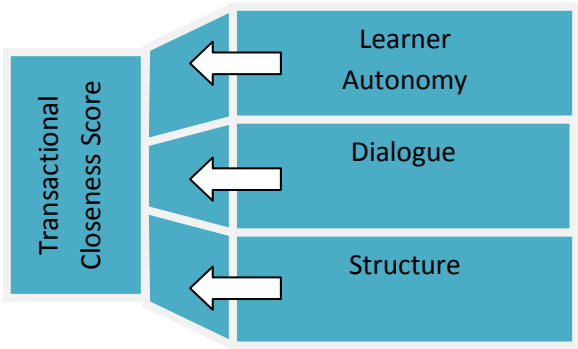

*Figure 2.*Map showing Social Presence comprised of four independent variables.

Methodology

This particular study is a meta-synthesis which is a method that involves the generation of new insights and understandings from existing qualitative research (Noblit & Hare, 1988; Thorne, Jensen, Kearney, Noblit & Sandelowski, 2004; Walsh & Downe, 2005). The specific type of meta-synthesis used in this study is called template analysis (King, Cassell & Symon, 2004). As described by the University of Huddersfield, "template analysis involves the development of a coding 'template', which summarizes themes identified by the researcher(s) as important in the data set and organizes them in a meaningful and useful manner" (2014). The initial template can be derived from pervious theory or research evidence (Reynolds, 2003) and the process commonly starts with "a priori" codes or "themes strongly expected to be relevant to the analysis" (University of Huddersfield, 2014). The second state of this form of qualitative meta-synthesis is developed based on themes that arise from the textual data (Au, 2007). This second stage is where the researcher works systematically through the full set of textual data,

marking them on the codes from the initial template and revising the template as necessary (King et al., 2004).

In this current study, the initial template was derived after conducting a thorough literature review of Social Presence and Transactional Distance. A second set of data, based on the use of Web 2.0 applications in formal education settings, was found. In this paper, this second set of data is referred to as textual data. An explanation of the process of obtaining these studies, using specific inclusion and exclusion criteria, is explained in the Qualitative Studies as Data section of the methodology. In the second state of this meta-synthesis, the researcher worked through some of the textual data and revised the template, adding codes that were evident in the data and deleting codes that were not supported. For instance, the code *the quality of responses-meaningful or not* was deleted because none of the textual data was able to demonstrate that the quality of responses played a part in any of the studies. An example of a code that was added was *response more frequent than prescribed or encouraged by the tool* since that theme occurred in more than one of the textual data analyzed. The codes which remained on the final template were rephrased and organized into a chart which became the instrument. The final set of codes (referred to as indictors on the instrument) is presented in figure 3 and 4. To complete the meta-synthesis, the full set of textual data was applied to the instrument and the findings from the analysis were reported.

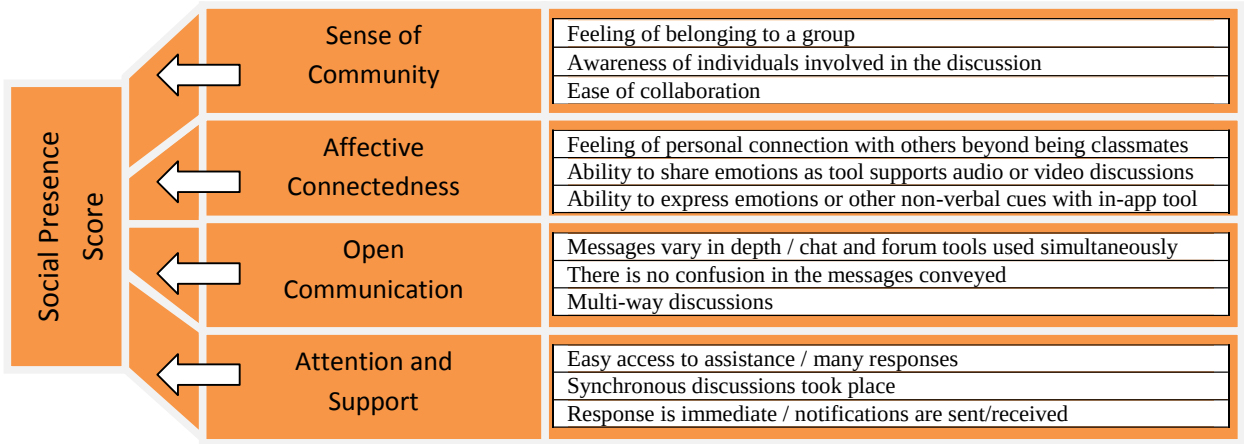

*Figure 3.*Map showing Social Presence comprised of four variables and codes (indicators) from the final template.

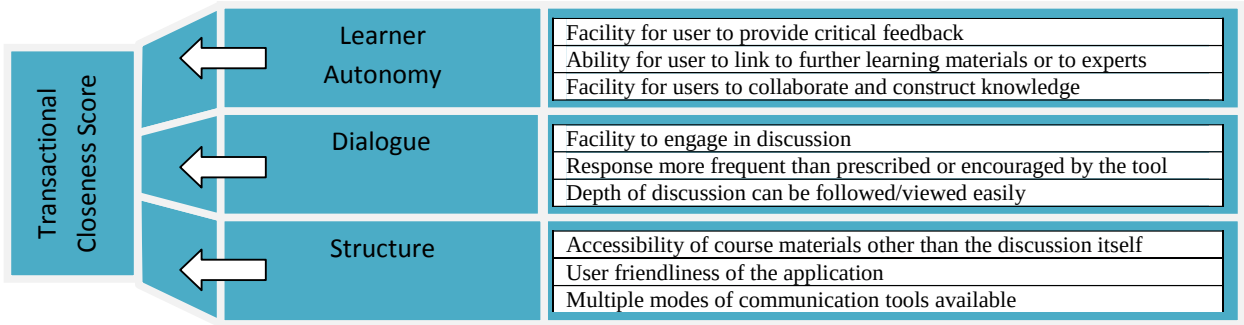

*Figure 4.*Map showing Transactional "Closeness" comprised of three variables and codes (indicators) from the final template.

The instrument is based on the final template resulting from the template analysis and the conceptual framework presented in the section above. It was designed to serve as an analytic device to assess the extent of which a Web 2.0 application affords interaction as per one's perception and one's description of the activities that were conducted on it. It is arranged into seven sections, one representing each independent variable. Three indicators were written for each of the seven independent variables.

Initially, the instrument created required the researcher to report the degree, from 0 (for absent) to 5 (strongly present) of each indicator found in the data. However it was quickly

apparent that the strength of presence of each indicator depended highly on the wording of the article. Therefore, the instrument was adjusted to require the researcher to report simply the presence, absence or non-report of the indicator.

All of the data was coded using the instrument by analyzing the findings section of each primary literature, line-by-line. Each descriptive indicator was searched for in the findings of each primary study and marked as “reported present” (+1), “reported absent” (-1) and “not reported” (0). For instance, if the research reported indicated that “students were happy with the group work situation” then a (+1) would be coded for the “Ease of collaboration” indicator. If the research reported that “students felt isolated” then a (-1) would be coded for the “Feeling of personal connection with others beyond being classmates” indicator. If there was no mention of “student’s ability to share how they feel” then a (0) was coded in the “Ability to express emotions or other non-verbal cues with in-app tool” indicator.

The findings sections of the research from the literature were read multiple times. If the indicator was present in the findings section, a +1 was marked in the corresponding box. The researcher then went back through the findings section and identified any indicators that were reportedly absent from the original research. Finally the researcher filled the rest of the chart with 0 to indicate that neither a reported presence nor a reported absence was found in the findings section of the article. The scores for each of the variables were added and an overall score out of 3 was reported.

Table 1 is an example of the instrument with scores filled in. It is a copy of the worksheet used to measure the Social Presence and Transactional Distance score of a CMS called Ning. The original research was done by Arnold and Paulus (2010).

Table 1: Example Instrument Worksheet

		Ning, Arnold and Paulus, 2010			
	Indicators	Presence (+1) Absence (-1) Non-Report (0)			
Sense of Community	Feeling of belonging to a group	+1			
	Awareness of individuals involved in the discussion	+1			
	Ease of collaboration	+1			
	OVERALL Sense of Community		+3		
Affective Connectedness	Feeling of personal connection with others beyond being classmates	0			
	Ability to share emotions as tool supports audio or video	-1			
	Ability to express emotions or other non-verbal cues with in-app	0			
	OVERALL Affective Connectedness		-1		
Open Communication	Messages vary in depth / chat and forum tools used	+1			
	There is no confusion in the messages conveyed	+1			
	Multi-way discussions	+1			
	OVERALL Open Communication		+3		
Mutual Attention and Support	Easy access to assistance / many responses	+1			
	Synchronous discussions took place	+1			
	Response is immediate / notifications are sent/received	0			
	OVERALL Mutual Attention and Support		+2		
	Social Presence Score			+7	
Learner Autonomy`	Facility for user to provide critical feedback	+1			
	Ability for user to link to further learning materials or to experts	-1			
	Facility for users to collaborate and construct knowledge	+1			
	OVERALL Learner Autonomy		+1		
Dialogue`	Facility to engage in discussion	+1			
	Response more frequent than prescribed or encouraged by the tool	0			
	Depth of discussion can be followed/viewed easily	+1			
	OVERALL Dialogue		+2		
Structure	Accessibility of course materials other than the discussion itself	+1			
	User friendliness of the application	+1			
	Multiple modes of communication tools available	+1			
	OVERALL Structure		+3		
	Total Transactional Closeness			+6	
	TOTAL of Social Presence and Transactional Closeness				+13

Indicators

The independent variables for Social Presence are taken from Kim's (2011) Social Presence model. The independent variables for Transactional Distance are loosely based on the

questionnaire that Chen (2001) created to measure Transactional Distance. Although her focus was on the various types of interaction (learner-instructor, learner-learner, learner-content and leaner-interface, her ideas can be mapped loosely onto the 3 original variables of Transactional Distance. The wording for each of the indicators is explained in this section. Each indicator is italicized for the ease of readability.

Sense of Community.

Kim (2011) claims that a Sense of Community is established when users perceive the usefulness of community support and cooperation. The researcher felt that this Sense of Community was present if the learners in her study expressed a *feeling of belonging to a group*. A Sense of Community is also strengthened when the learners are aware of who their classmates and instructors are, and who is present during discussions. Therefore, the second indicator for Sense of Community is: *awareness of individuals involved in the discussion.* Lastly, if the application allows users to collaborate easily (*ease of collaboration*), then the Sense of Community is also stronger.

Affective Connectedness.

Affective Connectedness was defined by Kim (2011) as a feeling of psychological and social connectedness. It is the degree to which participants expresses intimacy and warmth. The researcher felt that Affective Connectedness is exemplified when learners report that they are able to build a personal connection with others in their course, or if learners become "actual friends" with others, through the use of the Web 2.0 application. This act of becoming friends does not refer to the act of adding individuals as "friends" in their social profile; rather it is where one has more intimate conversations with others, shares laughs and has discussions outside of school work. The indicator is described as: *Feeling of personal connection with others*

beyond being classmates. When a Web 2.0 application supports the *ability to share emotions as the tool supports audio or video discussions,* Affective Connectedness is increased since learners are then able to share emotions through verbal cues such as tone of voice and non-verbal cues such as facial gestures. The last indicator, *ability to express emotions or other non-verbal cues with in-app tool,* refers to the ability to use in-app functions such as status updates and emoticons ("meta-communicative pictorial representation of facial expression") (Wikipedia, 2015) to express their emotions.

Open Communication.

Kim's (2011) definition of Open Communication is where "participants pursue knowledge through critical discourses" (p. 773). Kim (2011) described Open Communication as the ability to recognize and show interest in others' messages while having quality discussions and critical inquiry. He also described the need for learners to feel open and free in the environment to make critical comments. An indicator that an application provides for Open Communication includes having the ability to have discussions amongst multiple people at once. These *Multi-way discussions* (as opposed to one-on-one discussions) help make the discussion environment appear to invite freedom and invite all participants to comment. For quality discussions, the meaning of individual messages must be conveyed easily. Therefore, the indicator is described as: *There is no confusion in the messages conveyed.* Delays in message delivery/reception, frequent communication failure or restrictions on messages (e.g. by number of characters) hinders Open Communication. For Open Communication to occur, users need to have the flexibility to chat as well as offer detailed posts since the researcher feels that individuals become reluctant to provide feedback if it takes too long. The last indicator for Open Communication is: *Messages vary in depth / chat and forum tools used simultaneously*.

Mutual Attention and Support.

Mutual Attention and Support encompasses the mutual attentiveness, empathy, and interdependent support. The indicators chosen for this variable are: (1) *Easy access to assistance / many responses,* (2) *Synchronous discussions took place*, and (3) *Response is immediate / notifications are sent / received.* Web 2.0 applications that can provide easy access to assistance and permit many responses enable learners to feel mutual attentiveness. Kim (2011) explains that the feeling of Mutual Attention and support can reflect the feeling of others "'being there' even though they are not physically there" (p. 774). If the Web 2.0 application enables for synchronous discussions, then this feeling of mutual attentiveness may be achievable. This feeling of "being there" can also be imitated if the application has a system in place to provide for instant notification when messages are sent and/or received.

Learner Autonomy.

Learner Autonomy refers to learners' ability to contribute to online materials (Snodin, 2012) and to set, monitor and evaluate their own learning progress and goals (Moore, 1993). An autonomous learner takes initiative to engage in learning processes and to further the learning of everyone involved. If a Web application can offer the *facility for user to provide critical feedback* then Learner Autonomy can be achieved. The *ability for user[s] to link to further learning materials or to experts* provides users with opportunities to take initiatives seamlessly to acquire knowledge and help. Finally when Web applications make it easy for students to engage in collaborative discussions and construct knowledge, Learner Autonomy is also increased. The last indicator for this variable is: *Facility for users to collaborate and construct knowledge.*

Dialogue.

Chen's (2001) ideas of one's perceived understanding of concepts, fluidity of comments and overall quality of interaction influenced the creation of the indicators for the Dialogue variable in the current study. The researcher believes that a Web 2.0 application that provides *facility to engage in discussion* and promotes frequent responses shows fluidity of comments. The Dialogue indicator is described as: *response more frequent than prescribed or encouraged by the tool.* And, finally, for one to more easily understand concepts, especially when comments are fluid and of high quality, one must be able to follow the discussion. *Depth of discussion can be followed/viewed easily* is the last indicator for the Dialogue variable.

Structure.

Structure refers primarily to instructors' choice of course content and their flexibility for change, but it can also apply to media (Moore, 1993). Chen's (2001) concepts of accessibility of course materials other than the discussion itself and the degree of user friendliness of the medium serve as the foundation for the indicators used for Structure. The responsiveness of the application to the learner's needs and preferences and having multiple modes of communication tools available, also helps with Structure, and is beneficial to decreasing Transactional Distance (increasing Transactional Closeness). The three indicators for Structure are: (1) *Accessibility of course materials other than the discussion itself,* (2) *User friendliness of the application,* and (3) *Multiple modes of communication tools available*.

The Variables and Equations

Equation 1, 2 and 3 below show that the scores obtained from the instrument are simple arithmetic summations of the presence or absence of each of the indicators. Theoretically, this

instrument could tally scores ranging from -21 points to +21 points where the application allowing for effective interactions could receive a score of +21 points, and the application allowing for the least effective interactions could receive a score of -21 points.

Effectiveness of Interaction = Social Presence Score + Transactional Closeness Score (1)

Social Presence Score = Sense of Community Score+ Affective Connectedness Score + Open Communication Score + Mutual Attention and Support Score (2)

Transactional Closeness Score = Learner Autonomy Score + Dialogue Score + Structure Score (3)

As seen in the equations above, Effectiveness of Interaction is found by adding the Social Presence score with the Transactional Closeness score. The Social Presence score is dependent on the Sense of Community score, the Affective Connectedness score, the Open Communication score, and the Mutual Attention and Support score. The Transactional Closeness score is dependent on the Learner Autonomy score, the Dialogue score and the Structure score. This research makes an assumption that each of the independent variables contributes equally (a maximum of +3 points for each variable) to the Social Presence and Transactional Closeness scores, so that a quantitative measurement can be obtained, however in actuality, the weight of each independent variable would vary depending on the situation. The literature neither supports nor contradicts this assumption. This generalization will be readdressed in the limitations section of the paper.

Qualitative Studies as Data

Twenty empirical research articles on the use of Web 2.0 applications in a formal education setting were found and used as the textual data to be analyzed using the instrument.

The articles were first downloaded in Google Scholar and relevant data was isolated. Searches included phrases made up by combining the following keywords: Web 2.0, education, discussion, online, empirical, learning, distance education, computer mediated learning, twitter, blogging, RSS, Social Presence, Transactional Distance, interaction, CMS, Ning, Blackboard and Facebook. For example, a search was conducted using the keywords "Discussion online empirical, education" and 26 articles were downloaded for further review.

Articles were excluded if the research was not empirical (experimentation and data gathered by the way of surveys, interviews), or if the research was not situated in a formal education setting (university or college). Exploratory research and constructive researcher were excluded because coding the indicators on the instrument requires descriptions of Web 2.0 activities and/or user perceptions when using the application. The articles were also screened such that they fit within the conceptual framework. The technology used in the research articles must fall under the definition of Web 2.0 as described in the literature review section of this paper and the information gathered must have included discussion of the impact of the Web 2.0 technology on interaction. Some of the studies excluded from the data set included studies of researcher-created software, studies which presented conclusions without presenting detailed findings as well as studies which use Web 2.0 technologies not specifically used as discussion tools. The quality of the research was also taken into account, and studies which were judged to employ poor methodologies (in the opinion of this author) were also excluded from the data set.

Inter-rater Reliability

The researcher and a Masters of Arts graduate research assistant (RA) coded the findings of 5 different articles independently. The inter-rater reliability correlation Cohen's Kappa was

calculated to be 0.662, or “good” level of agreement (Landis & Koch, 1977). The table showing the Cohen’s Kappa calculations is found in Appendix A.

After the initial Cohen’s Kappa calculation, six indicators were identified to be the weakest matches. The researcher and the RA discussed and modified the wording in those six indicators and then re-evaluated the six new indicators on one more article and found that both (the researcher and RA) coded the indicators the same way. Such exact matches increased the researcher’s and RA’s confidence in the clarity of the wording of the indicators.

Limitations of the Study

The findings from this study are well supported; it uses an instrument developed after substantial review of the literature. The articles used as data were all published in peer reviewed journals. However, limitations are still present.

The search was conducted using the combinations of keywords listed in the previous section. The study was conducted over a period of four months, and although the search was detailed it was not exhaustive. The article search was only conducted in Google Scholar. Journals not listed under that database were missed. Some existing research which study interaction with the use of Web 2.0 technology may have also been missed because the articles were not available for downloading or different key words may have been used by the original researchers when publishing their article.

The research articles used in this study were all published within the last ten years, about when Web 2.0 applications were first released. However, true to the definition of Web 2.0, applications are constantly updated and improved. The researcher was only able to analyze each application as it was presented in the article, even though there were instances in which the

application being measured had undergone significant updates since the date of publication. Likewise, this study was also limited in that new research is constantly being published and yet the researcher was only able to analyze the research found during the four months of searching. Articles published since the data searches were conducted would have been missed.

This research is also limited by the subjectivity inherent in the original research articles. While the use of many articles may lessen the impact of this limitation, objectivity is difficult to attain when using others' research as data. The way in which each application was used and the structure of each course differed in each article. The researcher believes that the Effectiveness of Interaction scores evaluated in each instance would be higher had the Web 2.0 application been used in its optimal manner while the original researcher was conducting their research. After all, the definition of Web 2.0 technologies inherently calls its services to foster social connectedness, share information and collaborate (Wilson et al., 2001), all of which are indications of interaction.

Although the instrument was subjected to interrater reliability analyses and was based heavily on definitions of Transactional Distance and Social Presence found after an extensive literature review, the choice of words and the design of the instrument still depended heavily on the researcher's understanding and interpretation of these theories and definitions. This study shows that the instrument that was generated is needed and works well in measuring the flexibility of applications; however adjustments to the instrument may be warranted for future research.

One possible adjustment to the instrument may be the weighting of the values for each indicator. As it stands in this study, the equal weighting for each indicator may be a significant

limitation. The researcher chose to not to introduce coefficients to multiple the value of each score generated by the independent variables, not because each of the independent variables contribute equally to Social Presence and Transactional Distance, but rather, there has not been research to show one way or another which variables of these theories matter more than others. This research was an attempt to quantify the effectiveness of Web 2.0 applications to afford interaction. If further research shows that some variables contribute more to interaction than others, than the equations used to generate the Effectiveness of Interaction score will need to be altered. Future research may also show that effectiveness of interaction may only be described qualitatively.

Findings

Twenty articles were chosen using the inclusion and exclusion criteria described in the methodology section above. They were then reviewed and measured using the developed instrument. Appendix B shows the raw data generated using the instrument for the data set. Table 3 summarizes the scores for each of the variables for each of the applications found in the articles. The chart is organized alphabetically according to the original study's author. The columns reporting the total Social Presence score and the total Transactional Closeness score are shaded for quick reference.

The results were then grouped and the highest scoring Web 2.0 technologies for Interaction are found to be Ning, Adobe Connect, Elgg, Facebook and Twitter. See Table 2 for the total Effectiveness for Interaction score for those applications.

Table 2

Top 5 Web 2.0 Applications with the Highest Effective of Interaction Score

Web 2.0	**Total Effectiveness of Interaction Score**
Ning	+16
Adobe Connect	+15
Elgg	+15
Facebook	+14
Twitter	+11

Table 3

Tabulated Results of Textual Data Applied to the Instrument

#	Identification	Web 2.0	Sense of Community	Affective Connectedness	Open Communication	Mutual Attention and Support	Total Social Presence Score	Learner Autonomy	Dialogue	Structure	Total Transactional Closeness Score	Total Score
1	Arnold & Paulus,	Ning	+3	-1	+3	+2	+7	+1	+2	+3	+6	+13
2	Baran, 2010	Facebook	+2	+2	-1	+1	+4	0	0	0	0	+4
3	Balcikanli, 2012	Ning	+3	0	+2	+2	+7	+3	+1	+3	+7	+14
4	Brady et al., 2010	Ning	+1	+2	+2	-1	+4	+3	+1	+1	+5	+9
5	Ching, 2013	VoiceThread	+2	+3	+1	-3	+3	+3	-1	+2	+4	+7
6	Choi, 2013	Facebook	+2	0	+1	+2	+5	+3	+1	+1	+5	+10
7	Churchill, 2009	Blogs	+1	0	0	-3	-2	+2	0	+1	+3	+1
8	Clarke & Nelson,	Twitter	0	+1	0	0	+1	+1	+2	0	+3	+4
9a	Davi et al., 2007	Blogs	+2	-1	+3	+1	+5	+2	+1	+1	+4	+9
9b	Deng & Tavares, 2013	Moodle	0	-1	+3	-3	-1	+1	+1	0	+2	+1
10	Deng & Tavares, 2013	Facebook	+3	+1	+3	+1	+8	+3	+1	0	+4	+12
11	Ebner et al., 2010	Twitter	+1	+1	+3	+1	+6	+3	+1	0	+4	+10
12	Esteves, 2012	Facebook	+2	+1	+3	+3	+9	+3	+1	+1	+5	+14
13	Falloon, 2011	Adobe	+3	+3	+3	+3	+12	+2	+1	0	+3	+15
14	Feliz et al. 2013	Twitter	+1	0	+3	+1	+5	+3	+2	+1	+6	+11
15	Hsu & Ching, 2012	Twitter	+1	+1	+3	+1	+6	+3	+2	0	+5	+11
16	Hung & Yuen, 2010	Ning	+3	+2	+2	+1	+8	+3	+2	+3	+8	+16
17	McCarthy, 2010	Facebook	+2	+1	+2	+1	+6	+2	+1	+1	+4	+10
18	Stodel et al., 2006	WebCT	-1	-1	+1	-1	-2	0	+1	+1	+2	0
19	Veletsianos et al.,	Elgg	+3	+1	+3	+2	+9	+2	+3	+1	+6	+15
20	Wang et al., 2012	Facebook	+3	0	+1	+1	+5	+1	0	+3	+4	+9

Component Analysis

Each of the top Web 2.0 applications allow for rich discussions between one user and the rest of the class. Further analyses of the common properties that are present in the Web 2.0 technologies which scored the highest total score reveal that the ability to personalize ones' profile page, chat, and share media are amongst the most reported characteristics of the application. These applications afford users the ability to engage in both synchronous and asynchronous discussions, and the flexibility to share files easily. The ability to notify users of updates made by their peers is also important. A summary of the characteristics found in the "top 5" Web 2.0 application is found in Table 4.

Table 4

Characteristics (Tools) Found in the Top 5 Web 2.0 Applications

Web 2.0 Application	Tool
Ning	Personal Profile Page, Sub Groups, Forums, Blogs, Wall Posts, Chat, Activity Update Notifications, Text Searching, File Sharing (video, audio, docs), Comments, Customizable Site, Private Groups
Adobe Connect Pro	Audio, Video, Chat, File Sharing (video, audio, docs), Presentation Tools, Desktop Sharing, Whiteboard, Closed Group
Elgg	Blogs, Social Bookmarking, Collaborative Document Authoring, Wall Posts, Microblogs, File Sharing (docs), Personal Profile Page, Status Updates, Activity Stream, Subscription to Others
Facebook	Group, File Sharing (video, docs), Discussions, Wall Posts, Comments, Status Updates, Third-party Quiz Tools, Chat
Twitter	Microblogging, Retweet, Subscription to Others

Discussions

The findings from this research show that variables from Social Presence and Transactional Distance can be used to form an instrument to measure the level of interaction afforded by Web 2.0 applications. The applications found to maximize Social Presence and to minimize Transactional Distance (increase Transactional Closeness) offers an abundance of tools. These applications afford users the ability to engage in both synchronous and asynchronous discussions, and provide the flexibility to share files easily. The ability to notify users of updates made by their peers also seems important. For the most part, the instructor needs to be able to create a safe environment where students can clearly identify the individuals they are learning with. Most of the applications are able to do this by allowing users to create private groups, although in the case of Twitter, appropriate hashtags can be used to replicate the attempt to create a closed community. Personal profile pages are also common in successful sites, and serve as a means to identify users to their peers and to allow users to instill a sense of identity in the learning environment. It is also found that most of these sites use some way to notify the user of updates made by their peers.

In analyzing a number of existing articles which report on interaction when Web 2.0 technology is used, this research found that the best applications have both synchronous and asynchronous tools that can be used simultaneously in the learning process. Each tool (chat, video conferencing, discussion forum, blog) offers different benefits. The chat tool is synchronous and informal, enabling users to brainstorm information and to volunteer opinions without the fear of having to provide responses that are “set in stone”. The chat tool has also been shown to be exceptionally useful in maintaining a Sense of Community, Affective Connectedness, Open Communication and Mutual Attention and Support. Video conferencing

allows users to receive nonverbal cues and allow for instantaneous discussions. While synchronous tools are important, evidence from this research suggests that asynchronous tools are just as important in affording interaction. Asynchronous tools found to be the best in this research include discussion forums and blogs where users are able to provide thoughtful, thorough and well composed contributions to their class.

The findings of the current research highlight the need for Web 2.0 applications used for education purposes to be flexible. The flexibility of these systems should be measured using instruments grounded in established theories, much like the instrument created in this study. However, the instrument in this current study is an introductory tool. As Web 2.0 applications evolve and are updated, improvements must be made to the tools. Individuals evaluating Web 2.0 applications cannot simply assess the applications' effectiveness based on the presence or absence of particular tools (e.g. presence of a file sharing tool). One must begin to evaluate whether there is flexibility in "how" the tools are used (e.g. file sharing tool to share multiple file types). And further still, whether there is flexibility within the implementation of certain settings within each tool (e.g. file sharing tool to share with whole group, one person or selected few). Further research in this area is definitely necessary.

This study attempts to identify the ability for certain Web 2.0 technologies to provide for effective interaction, as measured through the lens of Transactional Distance and Social Presence. Both Transactional Distance and Social Presence are prominent theories in distance education and therefore findings should hold some weight; however, the researcher also acknowledges that just because the affordances of Web 2.0 technologies allow for interaction, it does not mean interaction actually takes place. This criticism is made by Kreijns, Kirschner and Jochems (2003), who identified two pitfalls in the analysis of social interaction in computer-

mediated environments. They caution researchers to not neglect the social (psychological) dimension of interaction, but more pertinently to not take for "granted that social interaction automatically takes place just because an environment makes it technologically possible" (p. 336). The researcher argues that although students may not experience interaction whilst using flexible Web 2.0 technology, interaction is sufficiently more difficult to attain if the Web 2.0 technology was not flexible. The pedagogical choices of the instructor, the structure of the class, and the attitudes of the learners are critical in the whole learning journey. The choice of technology is merely one of the starting places, albeit a very important one.

Conclusion

This study was a form of meta-synthesis called template analysis. Variables of Social Presence and Transactional Distance that can be used to measure the level of interaction afforded by Web 2.0 applications were identified and presented in Figures 1 and 2. The template analysis resulted in a list of codes which were re-written as indicators for the instrument that was created. Twenty empirical studies involving Web 2.0 technologies in the formal education setting were used as textual data for the instrument.

This research found that the top 5 Web 2.0 applications for the purpose of effective interaction were: Ning, Adobe Connect, Elgg, Facebook and Twitter. It also identified the tools found in these applications which were most useful in maximizing Social Presence and minimizing Transactional Distance (maximizing Transactional Closeness).

The current study also involved a discussion of whether the use of CMSs is better than SNSs or vice versa. This research argued that the difference between traditional CMSs and SNSs is merely in name and not in function. Both CMSs and SNSs fit under the definition of Web 2.0

technologies and the instrument created showed that some CMSs afforded effective interaction. Likewise, some SNSs were able to afford effective interaction as well.

Course developers will continue choosing new classroom media regularly as technology continues to evolve. The findings of this research indicate that individuals choosing to use Web 2.0 technologies in their courses should consider all of the perspectives available (organizational, financial, pedagogical, etc.) and base decisions on sound research. The chosen application should allow for synchronous and asynchronous discussions to take place. As well, the application should have the flexibility of integrating a variety of other components, such as media sharing and activity notifications. The instrument presented in this research study, or a variation of it which is equally grounded in established education theories, should be used to help with the decision making process.

All in all, however, the choice Web 2.0 application should only be secondary to good instruction and a sound course structure. The levels of interaction afforded by each application depend highly on the way in which the course and activities are structured. Facilitators can "make or break" the success of a course. Regardless of its importance, the choice of medium should only be a secondary consideration.

References

Anderson, T. (2008). Social software to support distance education learners. *The Theory and Practice of Online Learning (2nd ed)* (pp.221 – 244). Edmonton, AB, Athabasca University Press.

Argyle, M., & Dean, J. (1965). Eye-contact, distance and affiliation. *Sociometry*, 289-304.

Arnold, N., & Paulus, T. (2010). Using a social networking site for experiential learning: Appropriating, lurking, modeling and community building. *The Internet and Higher Education*, 13(4), 188-196.

Au, W. (2007). High-stakes testing and curricular control: A qualitative metasynthesis. *Educational Researcher*, *36*(5), 258-267.

Balcikanli, G. S. (2012). Social networking in physical education: Undergraduate students' views on Ning. *Turkish Online Journal of Distance Education*, 13(2), 277- 290.

Baran, B. (2010). Facebook as a formal instructional environment. *British Journal of Educational Technology*, 41(6), E146-E149.

Biocca, F., Harms, C., & Burgoon, J. K. (2003). Toward a more robust theory and measure of Social Presence: Review and suggested criteria. *Presence*, 12(5), 456-480.

Bischoff, W. R., Bisconer, S. W., Kooker, B. M., & Woods, L. C. (1996). Transactional Distance and interactive television in the distance education of health professionals. *American Journal of Distance Education*, 10(3), 4-19.

Bosch, T. E. (2009). Using online social networking for teaching and learning: Facebook use at the University of Cape Town. *Communicatio: South African Journal for Communication Theory and Research*, *35*(2), 185-200.

boyd, d. m. and Ellison, N. B. (2007), Social Network Sites: Definition, History, and Scholarship. *Journal of Computer-Mediated Communication*, 13: 210–230.

Brady, K. P., Holcomb, L. B., & Smith, B. V. (2010). The use of alternative social networking sites in higher educational settings: A case study of the e-learning benefits of Ning in education. *Journal of Interactive Online Learning*, *9*(2), 151-170.

Chen, Y. J. (2001). Dimensions of Transactional Distance in the world wide web learning environment: a factor analysis. *British Journal of Educational Technology*, 32(4), 459-470.

Ching, Y. H., & Hsu, Y. C. (2013). Collaborative learning using VoiceThread in an online graduate course. *Knowledge Management & E-Learning: An International Journal (KM&EL)*, 5(3), 298-314.

Choi, A. (2013). Use of Facebook group feature to promote student collaboration. In 2013 ASEE Southeast Section Conference. *American Society for Engineering Education.* Retrieved from http://www.asee-se.org/proceedings/ASEE2013/Papers2013/112.PDF

Chou, C., Peng, H., & Chang, C. Y. (2010). The technical framework of interactive functions for course-management systems: Students' perceptions, uses, and evaluations. *Computers & Education*, *55*(3), 1004-1017.

Christophel, D. M. (1990). The relationships among teacher immediacy behaviors, student motivation, and learning. *Communication Education*, *39*(4), 323-340.

Churchill, D. (2009). Educational applications of Web 2.0: Using blogs to support teaching and learning. *British Journal of Educational Technology*, 40(1), 179-183.

Clarke, T., & Nelson, C. (2012). Classroom Community, Pedagogical Effectiveness, and Learning Outcomes Associated with Twitter Use in Undergraduate Marketing Courses. *Journal for Advancement of Marketing Education*, 20(2), 29-38.

Cotterall, S. (1995). Readiness for autonomy: Investigating learner beliefs. *System*, *23*(2), 195-205.

Cui, G., Lockee, B., & Meng, C. (2013). Building modern online Social Presence: A review of Social Presence theory and its instructional design implications for future trends. *Education and Information Technologies*, 18(4), 661-685.

Dalsgaard, C. (2006). Social software: E-learning beyond learning management systems. *European Journal of Open, Distance and E-Learning*, *2006*(2). Retrieved from http://www.eurodl.org/materials/contrib/2006/Christian_Dalsgaard.htm

Davi, A., Frydenberg, M., & Gulati, G. J. (2007). Blogging across the disciplines: Integrating technology to enhance liberal learning. *MERLOT Journal of Online Learning and Teaching*, 3(3), 222-233.

Deng, L., & Tavares, N. J. (2013). From Moodle to Facebook: Exploring students' motivation and experiences in online communities. *Computers & Education*, 68, 167-176.

Dutton, W. H., Cheong, P. H., & Park, N. (2004). The social shaping of a virtual learning environment: The case of a university-wide course management system. *Electronic Journal of e-Learning*, *2*(1), 69-80.

Ebner, M., Lienhardt, C., Rohs, M., & Meyer, I. (2010). Microblogs in Higher Education–A chance to facilitate informal and process-oriented learning? *Computers & Education*, 55(1), 92-100.

Esteves, K. K. (2012). Exploring Facebook to enhance learning and student engagement: a case from the University of Philippines (UP) Open University. *Malaysian Journal of Distance Education*, 14(1), 1-15.

Fabro, K. G., & Garrison, D. R. (1998). Computer Conferencing and Higher-Order Learning. *Indian Journal of Open Learning*, *7*(1), 41-53.

Falloon, G. (2011). Making the connection: Moore's theory of Transactional Distance and its relevance to the use of a virtual classroom in postgraduate online teacher education. *Journal of Research on Technology in Education*,*43*(3), 187-209.

Feliz, T., Ricoy, C., &Feliz, S. (2013). Analysis of the use of Twitter as a learning strategy in master's studies. *Open Learning: The Journal of Open, Distance and e-Learning*, 28(3), 201-215.

Flosi, A., & Bandyopadhyay, K. (2009). An empirical investigation into factors relating to the use of course management software by post-secondary faculty. *International Journal of Business Information Systems*, *4*(6), 597-621.

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2), 87-105.

Gilbert, L., & Moore, D. R. (1998). Building Interactivity into Web Courses: Tools for Social and Instructional Interaction. *Educational Technology*, *38*(3), 29-35.

Gorsky, P., & Caspi, A. (2005). A critical analysis of Transactional Distance theory. *The Quarterly Review of Distance Education*, 6(1), 1-11.

Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of Educational Computing Research*, 17(4), 395-429.

Gunawardena, C. N., & Zittle, F. J. (1997). Social Presence as a predictor of satisfaction within a computer-mediated conferencing environment. *American Journal of Distance Education*, 11(3), 8-26.

Hall, H., & Davison, B. (2007). Social software as support in hybrid learning environments: The value of the blog as a tool for reflective learning and peer support. *Library & Information Science Research*, 29(2), 163-187.

Hartshorne, R., & Ajjan, H. (2009). Examining student decisions to adopt Web 2.0 technologies: theory and empirical tests. *Journal of Computing in Higher Education*, *21*(3), 183-198.

Hoffman, E. (2009). Evaluating social networking tools for distance learning. In *TCC Worldwide Online Conference*, Retrieved from http://etec.hawaii.edu/proceedings/2009/hoffman.pdf

Hsu, Y. C., &Ching, Y. H. (2012). Mobile microblogging: Using Twitter and mobile devices in an online course to promote learning in authentic contexts. *The International Review of Research in Open and Distributed Learning*, 13(4), 211-227.

Hung, H. T., & Yuen, S. C. Y. (2010). Educational use of social networking technology in higher education. *Teaching in Higher Education*, 15(6), 703-714.

Johnson, G. M. (2006). Synchronous and asynchronous text-based CMC in educational contexts: A review of recent research. *TechTrends*, *50*(4), 46-53.

Jung, I. (2001). Building a theoretical framework of web-based instruction in the context of distance education. *British Journal of Educational Technology*, 32(5), 525-534.

Kearney, P., Plax, T. G., & Wendt-Wasco, N. J. (1985). Teacher immediacy for affective learning in divergent college classes. *Communication Quarterly*, *33*(1), 61-74.

Kearsley, G., & Moore, M. (1996). Distance education: A systems view. Belmont. *Wadsworth*

Keegan, D. (1996). *Foundations of distance education (3rd ed)*. New York, NY, Routledge.

Kim, J. (2011). Developing an instrument to measure Social Presence in distance higher education. *British Journal of Educational Technology*, 42(5), 763-777.

King, N., Cassell, C., & Symon, G. (2004). Using templates in the thematic analysis of texts. *Essential guide to qualitative methods in organizational research*, 256-270.

Koszalka, T., & Ganesan, R. (2004). Designing online courses: A taxonomy to guide strategic use of features available in course management systems (CMS) in distance education. *Distance Education*, *25*(2), 243-256.

Kreijns, K., Kirschner, P. A., & Jochems, W. (2003). Identifying the pitfalls for social interaction in computer-supported collaborative learning environments: a review of the research. *Computers in Human Behavior*, *19*(3), 335-353.

Landis, J. R., & Koch, G. G. (1977). The measurement of observer agreement for categorical data. *Biometrics*, 159-174.

Liu, S. Y., Gomez, J., & Yen, C. J. (2009). Community college online course retention and final grade: Predictability of Social Presence. *Journal of Interactive Online Learning*, *8*(2), 165-182.

Lockyer, L., & Patterson, J. (2008, July). Integrating social networking technologies in education: a case study of a formal learning environment. In *Advanced Learning Technologies, 2008. ICALT'08. Eighth IEEE International Conference on* (pp. 529-533). IEEE.

Lowenthal, P. R. (2009). The Evolution and Influence of Social Presence Theory on Online Learning. Social Computing: Concepts, Methodologies, Tools, and Applications: *Concepts, Methodologies, Tools, and Applications*, 113.

Lust, G., Collazo, N. A. J., Elen, J., & Clarebout, G. (2012). Content Management Systems: Enriched learning opportunities for all?. *Computers in Human Behavior*, *28*(3), 795-808.

Malikowski, S. R. (2008). Factors relted to breadth of use in course management systems. *The Internet and Higher Education*, *11*(2), 81-86.

Maloney, E. (2007). What Web 2.0 can teach us about learning. *Chronicle of Higher Education*, *53*(18), B26.

Martins, L. L., & Kellermanns, F. W. (2004). A model of business school students' acceptance of a web-based course management system. *Academy of Management Learning & Education*, *3*(1), 7-26.

McCarthy, J. (2010). Blended learning environments: Using social networking sites to enhance the first year experience. *Australasian Journal of Educational Technology*, 26(6), 729-740.

Mehrabian, A. (1967). Orientation behaviors and nonverbal attitude communication. *Journal of Communication*. 17(4), 324 -332.

Moore, M. G. (1993). 2 Theory of Transactional Distance. *Theoretical principles of distance education*, 22.

Morgan, G. (2003). *Faculty use of course management systems* (Vol. 2). Boulder, CO, EDUCAUSE Center for Applied Research.

Noblit, G. W., & Hare, R. D. (1988). *Meta-ethnography: Synthesizing qualitative studies* (Vol. 11). Newbury Park: CA, Sage.

Offir, B., Lev, Y., & Bezalel, R. (2008). Surface and deep learning processes in distance education: Synchronous versus asynchronous systems. *Computers & Education*, *51*(3), 1172-1183.

O'Reilly, T. (2005). Web 2.0: compact definition. Retrieved from *http://radar.oreilly.com/ archives/2005/10/web_20_compact_definition.html*.

Papastergiou, M. (2006). Course management systems as tools for the creation of online learning environments: Evaluation from a social constructivist perspective and implications for their design. *International Journal on E-learning*, *5*(4), 593-622.

Picciano, A. G. (2002). Beyond student perceptions: Issues of interaction, presence, and performance in an online course. *Journal of Asynchronous Learning Networks*, *6*(1), 21-40.

Reynolds, F. (2003). Exploring the meanings of artistic occupation for women living with chronic illness: a comparison of template and interpretative phenomenological approaches to analysis. *The British Journal of Occupational Therapy*, *66*(12), 551-558

Richardson, J. C., & Swan, K. (2003). Examing Social Presence in online courses in relation to students' perceived learning and satisfaction. Retrieved from http://www.itecideas.pbworks.com/f/v7n1_richardson.pdf

Roblyer, M. D., & Ekhaml, L. (2000). How interactive are your distance courses? A rubric for assessing interaction in distance learning. *Online Journal of Distance Learning Administration*, *3*(2).

Roblyer, M., McDaniel, M., Webb, M., Herman, J., & Witty, J. V. (2010). Findings on Facebook in higher education: A comparison of college faculty and student uses and perceptions of social networking sites. *The Internet and Higher Education*, *13*(3), 134-140.

Rourke, L., Anderson, T., Garrison, D. R., & Archer, W. (2007). Assessing Social Presence in asynchronous text-based computer conferencing. *International Journal of E-Learning & Distance Education*, 14(2), 50-71.

Salaway, G., Caruso, J. B., and Nelson, M. R. (2008) The ECAR Study of Undergraduate Students and Information Technology, 2008 (no.8). Boulder, CO.: EDUCAUSE Center for Applied Research.

Schrage, M. (1995). *No more teams!: Mastering the dynamics of creative collaboration*. New York, NY, Doubleday.

Selwyn, N. (2007). Web 2.0 applications as alternative environments for informal learning-a critical review. Retrieved from http://www.oecd.org/edu/ceri/39458556.pdf

Short, J., Williams, E., &s Christie, B. (1976). The social psychology of telecommunications. London, John Wiley & Sons.

Simonson, M., Schlosser, C., & Hanson, D. (1999). Theory and distance education: A new discussion. *American Journal of Distance Education*, *13*(1), 60-75.

Snodin, N. S. (2013). The effects of blended learning with a CMS on the development of autonomous learning: A case study of different degrees of autonomy achieved by individual learners. *Computers & Education*, *61*, 209-216.

Starr-Glass, D. (2013). From connectivity to connected learners: Transactional Distance and Social Presence. *Cutting-edge Technologies in Higher Education*, 6, 113-143.

Stein, D. S., Wanstreet, C. E., Calvin, J., Overtoom, C., & Wheaton, J. E. (2005). Bridging the Transactional Distance gap in online learning environments.*The American Journal of Distance Education*, 19(2), 105-118.

Stodel, E. J., Thompson, T. L., & MacDonald, C. J. (2006). Learners' perspectives on what is missing from online learning: Interpretations through the community of inquiry

framework. *The International Review of Research in Open and Distributed Learning*, 7(3).

Su, B., Bonk, C. J., Magjuka, R. J., Liu, X., & Lee, S. H. (2005). The importance of interaction in web-based education: A program-level case study of online MBA courses. *Journal of Interactive Online Learning*, 4(1), 1-19.

Taylor, S., & Todd, P. (1995). Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions. *International Journal of Research in Marketing*, *12*(2), 137-155.

Tello, S. F. (2002). *An analysis of the relationship between instructional interaction and student persistence in online education* (Doctoral dissertation). University of Massachusetts , Massachusetts.

Thoms, B., & Eryilmaz, E. (2014). How media choice affects learner interactions in distance learning classes. *Computers & Education*, 75, 112-126.

Thorne, S., Jensen, L., Kearney, M. H., Noblit, G., & Sandelowski, M. (2004). Qualitative metasynthesis: reflections on methodological orientation and ideological agenda. *Qualitative health research*, *14*(10), 1342-1365.

Tu, C. H. (2002). The measurement of Social Presence in an online learning environment. *International Journal on E-learning*, 1(2), 34-45.

University of Huddersfield (2014) What is Template Analysis? Retrieved from http://www.hud.ac.uk/hhs/research/template-analysis/what-is-template-analysis/

Veletsianos, G., & Navarrete, C. (2012). Online social networks as formal learning environments: Learner experiences and activities. *The International Review of Research in Open and Distributed Learning*, 13(1), 144-166.

Vrasidas, C., &McIsaac, M. S. (1999). Factors influencing interaction in an online course. *American Journal of Distance Education*, 13(3), 22-36.

Wagner, E. D. (1994). In support of a functional definition of interaction. *American Journal of Distance Education*, 8(2), 6-29.

Walsh, D., & Downe, S. (2005). Meta-synthesis method for qualitative research: a literature review. *Journal of advanced nursing*, *50*(2), 204-211.

Wang, Q., Woo, H. L., Quek, C. L., Yang, Y., & Liu, M. (2012). Using the Facebook group as a learning management system: An exploratory study. *British Journal of Educational Technology*, 43(3), 428-438.

Waycott, J., Bennett, S., Kennedy, G., Dalgarno, B., & Gray, K. (2010). Digital divides? Student and staff perceptions of information and communication technologies. *Computers & education*, 54(4), 1202-1211.

Wilson, D. W., Lin, X., Longstreet, P., & Sarker, S. (2011). Web 2.0: A Definition, Literature Review, and Directions for Future Research. Retrieved from http://www.geekebook.com/file/yZYz1M/web-20-a-definition-literature-review-and-directions.pdf

Woods, R. H., & Baker, J. D. (2004). Interaction and immediacy in online learning. *The International Review of Research in Open and Distributed Learning*, *5*(2).

Zaina, L. A., Ameida, T. A., & Torres, G. M. (2014). Can the online social networks be used as a learning tool? a case study in twitter. *Learning Technology for Education in Cloud.* 114.

Appendix A

Calculation of Cohen's Kappa -This chart shows the process of attaining Cohen's Kappa, the measure of the agreement between the researcher and the interrater. A Cohen's kappa of 0.662 is a "good" level of agreement (Landis & Koch, 1977).

		Reader 1			
		Presence	**Absence**	**Non-report**	**Total**
Reader 2	**Presence**	34	0	16	50
	Absence	0	7	1	8
	Non-report	3	0	43	46
	Total	37	7	60	104
	Agreement	34	7	43	84
	By Chance	17.78846154	0.538461538	26.53846154	44.86538462
	Kappa	**0.661788618**			

Appendix B

Raw data generated by measuring each Web 2.0 application found in the data set, using the instrument.

	Ning	Facebook	Ning	Ning	Voicethread	Facebook	Blogs with V	Twitter	Blogs
	Arnold & Pa	Baran 2010	Balcikanli 20	Brady 2010	Ching 2013	Choi 2013	Churchill 20	Clarke 2012	Davi 2007
Feeling of belonging to a group	1	1	1	0	0	0	1	1	1
Awareness of individuals involved in the discussion	1	0	1	0	1	1	0	-1	0
Ease of collaboration	1	1	1	1	1	1	0	0	1
OVERALL Sense of Community	3	2	3	1	2	2	1	0	2
Feeling of personal connection with others beyond being classmates	0	1	0	0	1	0	0	1	-1
Ability to share emotions as tool supports audio or video discussions	-1	1	0	1	1	0	0	0	0
Ability to express emotions or other non-verbal cues with in-app tool	0	0	0	1	1	0	0	0	0
OVERALL Affective Connectedness	-1	2	0	2	3	0	0	1	-1
Messages vary in depth / chat and forum tools used simultaneously	1	0	0	0	1	0	0	0	1
There is no confusion in the messages conveyed	1	-1	1	1	1	0	0	0	1
Multi-way discussions	1	0	1	1	-1	1	0	0	1
OVERALL Open Communication	3	-1	2	2	1	1	0	0	3
Easy access to assistance / many responses	1	1	1	1	-1	1	-1	0	1
Synchronous discussions took place	1	0	0	-1	-1	0	-1	0	0
Response is immediate / notifications are sent/received	0	0	1	-1	-1	1	-1	0	0
OVERALL Mutual Attention and Support	2	1	2	-1	-3	2	-3	0	1
Facility for user to provide critical feedback	1	-1	1	1	1	1	1	0	1
Ability for user to link to further learning materials or to experts	-1	1	1	1	1	1	1	1	0
Facility for users to collaborate and construct knowledge	1	0	1	1	1	1	0	0	1
OVERALL Learner Autonomy	1	0	3	3	3	3	2	1	2
Facility to engage in discussion	1	1	1	1	1	1	0	1	1
Response more frequent than prescribed or encouraged by the tool	0	0	0	0	-1	0	-1	1	-1
Depth of discussion can be followed/viewed easily	1	-1	0	0	-1	0	1	0	1
OVERALL Dialogue	2	0	1	1	-1	1	0	2	1
Accessibility of course materials other than the discussion itself	1	-1	1	1	0	0	1	0	0
User friendliness of the application	1	0	1	0	1	0	0	0	1
Multiple modes of communication tools available	1	1	1	0	1	1	0	0	0
OVERALL Structure	3	0	3	1	2	1	1	0	1
TOTAL of Social Presence and Transactional Closeness	13	4	14	9	7	10	1	4	9

	Moodle	Facebook	Twitter	Facebook	Adobe Con	Twitter	Twitter with	Ning	Facebook
	Deng-a 201	Deng-b 201	Ebner 2010	Esteves 201	Falloon 201	Feliz 2013	Hsu 2012	Hung 2010	McCarthy 2
Feeling of belonging to a group	0	1	0	0	1	0	0	1	1
Awareness of individuals involved in the discussion	1	1	0	1	1	1	0	1	0
Ease of collaboration	-1	1	1	1	1	0	1	1	1
OVERALL Sense of Community	0	3	1	2	3	1	1	3	2
Feeling of personal connection with others beyond being classmates	-1	1	1	1	1	0	1	1	1
Ability to share emotions as tool supports audio or video discussions	0	0	0	0	1	0	0	1	0
Ability to express emotions or other non-verbal cues with in-app tool	0	0	0	0	1	0	0	0	0
OVERALL Affective Connectedness	-1	1	1	1	3	0	1	2	1
Messages vary in depth / chat and forum tools used simultaneously	1	1	1	1	1	1	1	1	0
There is no confusion in the messages conveyed	1	1	1	1	1	1	1	0	1
Multi-way discussions	1	1	1	1	1	1	1	1	1
OVERALL Open Communication	3	3	3	3	3	3	3	2	2
Easy access to assistance / many responses	-1	1	0	1	1	1	1	1	1
Synchronous discussions took place	-1	-1	0	1	1	0	-1	0	0
Response is immediate / notifications are sent/received	-1	1	1	1	1	0	1	0	0
OVERALL Mutual Attention and Support	-3	1	1	3	3	1	1	1	1
Facility for user to provide critical feedback	1	1	1	1	1	1	1	1	1
Ability for user to link to further learning materials or to experts	1	1	1	1	0	1	1	1	0
Facility for users to collaborate and construct knowledge	-1	1	1	1	1	1	1	1	1
OVERALL Learner Autonomy	1	3	3	3	2	3	3	3	2
Facility to engage in discussion	1	1	1	1	1	1	1	1	1
Response more frequent than prescribed or encouraged by the tool	-1	1	1	1	1	1	1	1	0
Depth of discussion can be followed/viewed easily	1	-1	-1	-1	-1	0	0	0	0
OVERALL Dialogue	1	1	1	1	1	2	2	2	1
Accessibility of course materials other than the discussion itself	1	-1	0	-1	0	0	0	1	0
User friendliness of the application	-1	1	0	1	-1	1	0	1	1
Multiple modes of communication tools available	0	0	0	1	1	0	0	1	0
OVERALL Structure	0	0	0	1	0	1	0	3	1
TOTAL of Social Presence and Transactional Closeness	1	12	10	14	15	11	11	16	10

	WebCT	Elgg	Facebook
	Stodel 2006	Veletsianos	Wang 2012
Feeling of belonging to a group	-1	1	1
Awareness of individuals involved in the discussion	1	1	1
Ease of collaboration	-1	1	1
OVERALL Sense of Community	-1	3	3
Feeling of personal connection with others beyond being classmates	1	1	1
Ability to share emotions as tool supports audio or video discussions	-1	0	0
Ability to express emotions or other non-verbal cues with in-app tool	-1	0	-1
OVERALL Affective Connectedness	-1	1	0
Messages vary in depth / chat and forum tools used simultaneously	1	1	-1
There is no confusion in the messages conveyed	-1	1	1
Multi-way discussions	1	1	1
OVERALL Open Communication	1	3	1
Easy access to assistance / many responses	-1	1	1
Synchronous discussions took place	1	0	0
Response is immediate / notifications are sent/received	-1	1	0
OVERALL Mutual Attention and Support	-1	2	1
Facility for user to provide critical feedback	-1	1	-1
Ability for user to link to further learning materials or to experts	0	0	1
Facility for users to collaborate and construct knowledge	1	1	1
OVERALL Learner Autonomy	0	2	1
Facility to engage in discussion	1	1	1
Response more frequent than prescribed or encouraged by the tool	0	1	0
Depth of discussion can be followed/viewed easily	0	1	-1
OVERALL Dialogue	1	3	0
Accessibility of course materials other than the discussion itself	0	0	1
User friendliness of the application	0	1	1
Multiple modes of communication tools available	1	0	1
OVERALL Structure	1	1	3
TOTAL of Social Presence and Transactional Closeness	0	15	9

Appendix C

Composite Graphs of Social Presence variables and Transactional Distance variables