A Critical Review of Selected Literature on Learner-centered Interactions in Online Learning

Eirene Katsarou[1] and Paraskevi Chatzipanagiotou[2]
[1]Democritus University of Thrace, Greece
[2]European University Cyprus, Greece
ekatsaro@fmenr.duth.gr
PChatzipanagiotou@euc.ac.cy

Abstract: Interactivity, a fundamental aspect of traditional face-to-face teaching, is a central concern in the design planning and organization of technology mediated instructional settings and online learning, because it is crucial in knowledge acquisition and the development of cognitive skills, and is intrinsic to effective instructional practice and individual discovery. The present paper aims to critically review a set of recent representative empirical studies during the period 2010-2019 focusing on the pedagogical expediency of learner-centered interaction in online learning contexts, to identify which aspects of collaborative learning could successfully be integrated within a structured learning management system environment to safeguard high-quality online learning. Searches for the identification of relevant empirical studies were conducted via Science Direct, EdITLib, IRRODL, SpringerLink, IEEE Xplore Digital Library and Scopus using keywords such as learner interactions, online learning, virtual learning environments, student success, e-learner satisfaction and online education. The search yielded 22 key studies focusing on learner-centered types of online interaction in relation to their contribution to student success and satisfaction in virtual learning environments. Our presentation of relevant research is based on five key types of interactive relationships identified in the field of distance education and culminates in a discussion of potential implications for a successful online learning experience and learner satisfaction.

Keywords: interaction, online learning, distance education, interface, presence

1.   Introduction

Interaction is one of the most documented and disputed aspects of distance education, serving as a foundational component in many seminal and contemporary approaches to understand the phenomenon of learning (Anderson, 2003). A study examining 35 years of publications in *Distance Education* has shown that interaction was among the major themes of the 515 full articles published from 1980 to 2014 (Zawacki-Richter and Naidu, 2016).Interaction has been characterized as a catalyst in the shift from teacher-directed to learner-centered approaches (Hirumi, 2006; Mayes, 2006), and identified as a central component in the development of thriving learning communities in which participants can communicate and respond to each other's learning needs on intrapersonal and interpersonal levels, or interface with technology agents. In this sense, the formation of a learning community in distance learning contexts has often been found to be associated with (i) social reinforcement, which ultimately results in more group cohesion and less attrition; (ii) information exchange, through collaboration and knowledge building (Moller, 1998); and (ii) greater learner satisfaction with academic programs (Rovai and Barnum, 2003). Yet, the design and support of learning interactions that are both genuinely engaging and conceptually stimulating within online learning contexts remains a significant challenge in contemporary distance education. Therefore, more intensive research efforts in this area are needed.

Interaction is at the core of Moore's description of distance education in terms of his transactional distance theory (Moore and Kearsley, 1996; Wallace, 2003). Moore defines interaction as a pedagogical construct that primarily relies on "the interplay among the environment, the individuals and the patterns of behaviors in a situation" (Moore, 2007: 91). The development of a transaction is influenced by three basic factors: (i) the dialogue developed between the teacher and learner, which Moore (1993) considered to be an element associated with the quality rather than the frequency of communication, (ii) the structure, referring to the degree of structural flexibility of the program in terms of the educational goals of the course, the teaching techniques used and the assessment procedures (learner-content interaction) and (iii) the autonomy related to the extent to which the learner exerts control over learning procedures. Thus, three types of learner-centered interaction in distance education have been established:(i) learner-instructor interaction, (ii) learner-content interaction and (iii) learner-learner interaction. Later, Hillman, Willis and Gunawardena (1994) suggested a fourth type, learner–interface interaction. Transactional distance and autonomy are proportional to each other, because increases or decreases in one parameter result in corresponding increases or decreases in the other (McIsaac Gunawardena, 1996; Giossos, Mauroidis and Koutsouba, 2008). By emphasizing structure, dialogue

and autonomy as key elements in the resultant communication equation, Moore has highlighted the relativity of the transactional exchange. Moore's focus on learner autonomy was also central to (1989) early work on distance education by Garrison, who postulated that a triad of control, autonomy and responsibility explains the range of communication possibilities among learners and teachers in distance learning.

More recent efforts toward categorization of online interaction systems have primarily followed Moore's (1989) framework elaborating on the notion of learner-centered online interactions leading to the establishment of new interaction types (see Mutalib, Halim and Yahaya, 2016 for a meta-analysis). In their research on asynchronous patterns of interaction within Web-based learning environments, Jung, Choi, Lim and Leem (2002)have discussed learner online interactions of three types: content-centered academic interactions occurring between learners and instructor or between learners and online resources; collaborative interactions among learners; and social interactions between learners and instructors. In contrast, Hirumi (2002; 2009) has classified interactions into four types: learner–self, learner–human, learner–"non-human" (content, interface and environment) and learner–instruction. Chou, Peng and Chang (2010) have proposed a comprehensive five-type categorization of learner interaction in online learning, consisting of (a) learner-interface, (b) learner-self, (c) learner-content, (d) learner-instructor and (e) learner-learner interaction. Chou, Pengand Chang's (2010) learner interaction classification serves the purposes of our discussion of the relationship between learner-centered interactions and students' perceived success and satisfaction in online learning contexts via relevant empirical studies of the past decade.

This review covers relevant empirical studies on online and distance education focusing on the pedagogical expediency of e-learner interaction patterns, to obtain a fuller understanding of the topic and easy integration of this knowledge in the instructional design and effective implementation online education programs. The need for this paper is even more imperative in the context of the recent COVID-19 pandemic, which has forced a temporary disruption in traditional education and led to a notable rise in e-learning for more than 1.2 billion children and adolescents in 186 countries worldwide, whereby teaching is undertaken remotely and on digital platforms (Adnan, 2020; Dhawan, 2020). In this light, this paper seeks to provide answers to the following questions: What are the research methodologies followed in the investigation of different types of learner interactions in online learning environments? What are the results to date, and what research gaps exist?

2. Methodology of the Study

The review follows the Webster and Watson (2002) method combining keyword searching and examination of leading journals. The keywords used for the identification of relevant empirical studies included learner interactions, online learning, virtual learning environments, student success, e-learner satisfaction and online education. Searches were conducted via Science Direct, EdITLib, IRRODL, SpringerLink, IEEE Xplore Digital Library and Scopus. To enhance reliability, separate searches were performed in key journals, including *Distance Education*, *Online Learning*, *Computers and Education* and the *Journal of Distance Education*. The search yielded 22 key studies deemed suitable for inclusion according to the criteria of studies concerning learner-centered types of online interaction in relation to their contribution to student success and satisfaction in virtual learning environments, which were published in English between 2010 and 2019.

3. Student Success and Satisfaction in Online Learning

Many studies in online learning area have widely expressed the importance of student satisfaction as it is associated with student success in learning (Lear, Ansorge and Steckelberg, 2010; Blasco-Arcas et al., 2013). Among various variables influencing student satisfaction in online learning environments, interaction has been identified as a key determinant affecting student satisfaction in online learning in multiple ways (Muzammil, Sutawjaya, A. and Harsasi, 2020; Turley and Graham, 2019). According to Kauffman (2015), student academic success in online learning environments is a multifaceted term determined by a broad range of factors that fall into five interdependent categories: technology-related, user characteristics, course-related, learning approach and support services (Menchaca and Bekele, 2008; Dziuban, Moskal and Thompson, 2015). According to Dabbagh (2007), the quintessential academically successful online student can be described as self-motivated and self-directed, exhibiting an internal locus of control, with above average executive functioning, communication, interaction and technological skills. Learner or student satisfaction, in contrast, is defined as the student's contentment and fulfillment of the expectations and experiences of the subject and/or course (Hom, 2002), as well as overall satisfaction with the course and its specific components or features (Markham, 1999). Student satisfaction is generally considered the crucial and elemental evaluation level to determine the

overall quality, success and evolution of online learning environments, because "high levels of student satisfaction with online courses, programs and overall learning experiences are now a frequent occurrence, verifying the effectiveness and legitimacy of online learning" (Senerand Humbert, 2002:4). As with student success, the theoretical delimitation of learner satisfaction in online learning remains a complex and challenging process that is equally affected by several factors including course design, learning community, technology support, program policy and degree of interactivity, which is our main focus herein.

Several relevant studies conducted by investigators seeking to identify the dimensionality of student success and satisfaction in online learning environments have emerged in the past few years. For instance, Song, Singleton, Hill and Koh (2004) have examined factors associated with online learning effectiveness from the graduate student perspective by using a survey generated by researchers to assess learner characteristics, perceived difficulties and beneficial components of online learning. The results have indicated that course design and time management are crucial components in successful online learning, whereas a lack of community and technical problems are most challenging for online learners. Similarly, Eom, Wen and Ashill (2006) have examined factors contributing to perceived student success and satisfaction in university online learning contexts, examining both learner and course design characteristics. The authors' model (composed of the six variables listed above) explained 69% of the variance in learner satisfaction and 63% of the variance in learning outcomes. Course content organization and discipline also appear to play roles in student success and satisfaction, as demonstrated by Rogerson-Revell (2015), who has used e-tivities in an online applied linguistics/TESOL master's program to build critical thinking and practice skills. The e-tivities were designed to promote collaboration and formative assessment (portfolio of written assignments and activities) in an asynchronous manner with the use of an e-moderator (student tutor). Students reported increased motivation, reflection and preparedness for their final module assessment. Similarly,in a study by Jones (2015),who made use of synchronous videoconferencing, service learning (for developing clinical skills) and role playing (with asynchronous video recordings) in online foundational courses, social worker students rated both the online and face-to-face courses favorably. Finally, several learner characteristics such as computer technology self-efficacy (DeTure, 2004), cognitive style (Liu, Magjuka and Lee, 2008), lack of time management skills and motivation (Muilenbergand Berge, 2005), and self-regulation (e.g., Park and Choi, 2009; Yukselturk, 2007) have been found to affect e-learning success and satisfaction to a considerable extent.

Below, we consider the two constructs of e-learner success and satisfaction in relation to the five main types of interaction that may occur in a virtual learning environment, to gain further research perspectives and consider useful pedagogical implications in the area of online education and design.

4. The Role of Interaction in Distance Education in Current Research

4.1 Learner-Instructor Interaction

A subset of recent studies using mixed methodology have investigated the significance of learner-instructor interactions as determinants of successful learner participation, academic achievement and satisfaction in online learning contexts. Learner-instructor interactions are defined as student- or instructor-initiated communications occurring before, during and immediately after instruction. Moore (1989) has characterized learner-instructor interactions as attempts to motivate and stimulate learners and allow for the clarification of misunderstanding by learners regarding the content. Although student–student interactivity has been found to play an important role in online student satisfaction (Russo and Benson 2005; Swan 2001), one of the greatest predictors of student satisfaction is the prevalence, quality and timeliness of student–instructor communication. Kang and Im (2013) have investigated learner interactions and perceived learning in an online environment. A total of 654 undergraduate students responded to a survey regarding learners' interactions with their instructor and their perceived performance. Kang and Im's exploratory factor analysis showed that instruction-related interaction factors had greater predictive power for perceived performance than non-instructional interaction factors (e.g., social intimacy or social exchanges in personal information). Thus, instructional content-related interaction appears to have a more significant effect on learner performance than the other types of interactions.

Similarly, in a quantitative survey of 186 online graduate students, Espasa and Menses (2010) have found a statistically significant relationship between instructor feedback to students after assignments and the learning results, as measured by student satisfaction and final grades. These findings further highlight the important role of student–instructor interactions in student achievement and satisfaction in online learning. However, the findings in Kuo et al.'s (2014) study contradict this picture:learner-instructor interaction was found to be a weak

predictor of student satisfaction. The researchers tested a regression model of student satisfaction involving three types of interaction: learner-learner, learner-instructor and learner–content; Internet self-efficacy and self-regulated learning; and class-level predictors in terms of the course category and academic program. Data were elicited via a survey questionnaire from 75 undergraduate and graduate students taking online classes in the College of Education at a US university. Pearson correlation analyses were performed to understand the relationships among three types of interactions: Internet self-efficacy, self-regulation and student satisfaction. The results indicated that learner-instructor interaction had a significant but not particularly strong impact on student satisfaction, as did learner-content interaction; however, this effect became non-significant in the context of class-level–predictors. The authors attributed this finding to student satisfaction being a secondary target of learner-instructor interaction, which may essentially involve criticism, evaluation of student papers, discussion of grades and other instructional activities that may not always be experienced as pleasant.

Learner-instructor interaction has also been researched as a factor contributing to computer-supported collaborative learning. Selles, Munoz-Carriland and Gonzalez-Sanmamed (2019) have conducted a study involving 106 students in the context of five university degree subjects involving work on Computer Supported Collaborative Learning (CSCL) projects. At the end of the projects, the students were requested to fill out a questionnaire including 25 items measuring the five constructs included in the study: student interaction in work groups, intra-group emotional support, teacher-student interaction, use of online collaborative tools and collaborative learning. The results indicated a positive and significant effect of teacher-student interaction in relation to the interaction processes that students developed in their respective groups. Positive and significant relationships were observed for student interaction and the use of online collaborative tools, but with a low and medium effect with respect to team work. These findings clearly indicate the necessity for efficient teacher-student interaction in web-based collaborative learning environments, because the organizational, emotional and educational support provided by the teacher in the early phases of collaboration were deemed key to sustaining group regulation, interaction, communication and individual acquaintance among group members. Teacher presence was also found to significantly affect emerging e-learners' patterns of interaction in online discussion forums, as revealed by qualitative data analysis performed by Park and Choi (2015),on the basis of online discussion transcripts, weekly pre- and post-discussion surveys of student engagement in online discussion and final self-reflective essays in which students described their experiences of the different discussion modes of the class. The study highlights the shifting nature of teacher roles in online learning environments, such that the teacher shares a more symmetrical relationship with students, in contrast to traditional face-to-face instructional contexts. In an earlier study by Suet al.(2005),content-related instructional activities (e.g., summarizing key points, asking/responding to questions and giving feedback) were found to be widely used in asynchronous online programs contributing to the enhancement of interaction among learners, whereas Garrison and Cleveland-Innes (2005) have indicated that qualitative aspects of learner-instructor interaction are important for the promotion of deep approaches to the online learning experience.

In a series of related quantitative studies, learner-teacher interaction has been the subject of further empirical investigation in relation to more affective aspects of the learning process, i.e., e-learners' self-reported autonomy and degree of self-regulation in virtual learning environments. In the Greek educational context of distance education, Fotiadou and associates (2017) have used data gathered at the Hellenic Open University via a four-section questionnaire designed to measure learner autonomy, and student-student and student-tutor interactions, which was completed by 100 postgraduate students. The study used a correlational research design to examine the relationships among the three variables described above and demographic variables (e.g., age, gender, total number of the course module successfully attended and the total number of face-to-face counseling group sessions that the students had attended at the time the study was conducted. Analysis of the results indicated positive but weak correlations between learner autonomy and (i) learner-instructor interaction as well as (ii) one of the three subscales of autonomy examined in this study, i.e., self-awareness, thus indicating an urgent need for a redefinition of the tutor's role in distance learning courses. Although the students in the study had high levels of autonomy in relation to the sub-scale of self-awareness, they still expressed their need to interact with the tutor, because effective tutor-student interaction appears to be perceived by students as a means of continuous academic, emotional and psychological support throughout their studies.

Self-regulation in interactions with others (peers and tutors) as a component of learner autonomy in online learning environments was the focus of Cho and Kim's (2013) study at a Midwestern US university. This notion arose from various views of learning; according to the researchers, SR for interaction with others "involves proactive management of motivation and cognition with others" (Cho and Jonassen, 2009). A total of 407

students participated in the study, and data were elicited from 69 online courses representing 11 departments via a two-part survey questionnaire. The first part focused on students' demographic information, the types of learning tasks in which they participated in the online course they attended and the perceived importance of mastering the content through interaction with an instructor and peers. The second part of the survey asked about online instructors' scaffolding strategies for interaction and their own SR for interaction with others. Hierarchical model regression analysis revealed that all variables significantly contributed to the explanation of students' SR for interaction with others, but instructor scaffolding for the interaction explained the most variance, followed by the importance of mastering content in the course, the importance of interaction with other students and the grade. Most importantly, the study extended self-regulation research in online learning environments to study interaction patterns between learners and between learners and tutors, thus providing a groundwork for further online research in this area.

Finally, in an exploratory study within the Uses and Gratifications Theory framework, which posits that individuals use mass media and other forms of communication to fulfill needs and wants, Sarapin and Morris (2015) have examined learner-instructor interaction patterns via Facebook and the extent to which this type of "digital socialization" (Siemens and Weller, 2011) meaningfully affects learners' academic achievement through the creation of an online community of inquiry. A total of 308 US college faculty members with Facebook profiles were surveyed regarding their expectations of students' perceptions of their credibility, professionalism and approachability in the classroom as well as mutual connectedness with their instructors as a result of out-of-classroom socializing and teacher self-disclosure on Facebook. The instructors who interacted with students on Facebook were more frequently those who had expected to enhance their credibility and relatability in the classroom through the use of a less conventional, out-of-class method of communication—Facebook. However, the study did not analyze or discuss how informal talk between learners and teachers through social media enhances the learning experience. An indication of students' types of online interaction via Facebook has been provided by Jumaat and Tasir (2013), who have noted that students prefer to share their opinions with classmates and convey their judgments in academic-related discussions in terms of responses to instructors' comments and questions rather than moving to a higher level of knowledge construction, such as providing their own examples of their ideas and elaborating on certain topics in learning. Proper scaffolding strategies are deemed necessary to further stimulate meaningful Facebook interactions with students, reflecting their learning process (see for example, Hew and Cheung, 2008; Donmez, 2010; Bosch, 2009).

4.2 Learner-Learner Interaction

Learner-learner interactions occur "between one learner and another learner, alone or in group settings, with or without the real-time presence of an instructor" (Moore, 1989, p. 4). Typically, such interactions ask learners to work together to analyze and interpret data, solve problems, and share information, opinions and insights. The interactions are designed to help groups and individuals construct and apply targeted skills and knowledge. The considerations for effective learner-learner interactions are similar between traditional classroom environments and e-learning environments (e.g., group size, group goals, individual roles and responsibilities, group and individual accountability, contact information and communications and grading). The challenge lies in planning and coordinating such interactions during e-learning (Hirumi, 2009).

In a recent study by Huang et al.(2019), students' interaction patterns in online discussions were quantitatively examined through both content and lag sequential analysis of the learning sentiments of e-learners performing seven types of learning tasks in an asynchronous discussion platform. The research participants were 38 postgraduate students enrolled in a fundamental educational technology theory course in a university in China. All seven learning tasks (four individual-oriented and three group-oriented) were designed to promote thinking and reflection through interactions in online discussions. After the tasks were launched on the learning platform, participants were asked to actively exchange ideas without any form of intervention by the instructor. In general, students participating in group-oriented learning tasks tended to exhibit intense and diverse learning sentiments and to experience more diverse and in-depth interactions (negotiation, testing and modification) that could facilitate meaningful learning. Using a mixed-method analysis, the study considered learners' feelings and disposition as central components in the online learning experience that can either promote or undermine quality interaction and successful cognitive engagement. These findings have various practical implications for online learning educators and designers.

Primarily on the basis of qualitative methodology in the form of social network analysis and thematic analysis, Shuand Gu (2018) have also attempted to investigate differences in student-group interactions between online

and face-to-face sessions in a blended learning course. A total of 5090 online posts, 18 thematic groups and 604 classroom conversations were gathered, coded and analyzed to enable further examination of group interaction characteristics on the basis of the relationships among group members. A strong "group-controlling" pattern was found in the online learning component, thus indicating that teachers and students spontaneously produce many interactive behaviors, and the interaction initiative is usually under the control of students when they are learning in the online context. The depth of student interaction increased with the teaching progress and reached a relatively stable state during the middle and later periods in both the online and the face-to-face teaching and learning modes, whereas no significant correlation was found between the depth of the interaction and the number of posts. Compared with the informal environment of online learning, classroom dialogues were more open and required deep thinking, thus echoing the relevant findings in Miyazoe and Anderson's (2010) study.

The quality of online interaction among learners for knowledge construction purposes within a blended learning program was also addressed in another recent study conducted by Diep et al.(2017) in centers of adult education in Belgium. Focusing on adult learners' characteristics, the authors sought to investigate the effect of core self-evaluation when explaining learning performance and online interaction quality on adults' learning performance and also to determine the extent to which online interaction quality and learning performance affect their bonding and bridging social capital. The study used a quantitative approach to data collection, and the data were elicited via a questionnaire using validated scales for the measurement of each of the variables investigated. Path analyses showed that only core self-evaluation significantly predicted adults' learning performance, but,interestingly, online quality interaction quality significantly affected only learners' bonding and bridging capital (cf.e.g., Bernard et al., 2014; Wang, Hsuand Hwang, 2014). Heo, Lim and Kim(2010) have confirmed this result, finding that quality interaction affects communication, mutual support and cohesion among team members in project-based learning, but not the online learners' academic achievement. On the basis of these results, the researchers have concluded that the quality of online interaction accompanied by the support of technologies can foster and bolster social networks that facilitate the collaborative knowledge construction in blended online courses. Moreover, the relationship between online interaction and adults' learning performance appears to be mediated by adults' learning styles and preferences but requires further research. According to Lee, Carter-Wells and Glaeser, (2006), positive teacher-learner and learner-learner interactions contribute to community development but do not correlate with academic achievement. Students' responses to open-ended survey questions have indicated that the instructor's presence in the discussion boards is critical to building community, whereas positive interactions with peers contribute to students' sense of community and meaningful learning. In fact, negative peer-to-peer interactions have detrimental effects on community coalescence.

Knowledge building, student interactions and participation, and the relations among them, have also been investigated in a similar study by Yucel and Usluel (2016) in the context of an online collaborative learning environment with 145 prospective teachers at a private university in Ankara, Turkey. The data were collected from multiple sources, including the log records and the content analysis of Knowledge Forum postings. Interaction development was observed in terms of the use of opinion building and expressing forms and note creation and the students' knowledge building processes in the online collaborative learning environment. Using a convergent parallel design method based on a cross-comparison of separate quantitative and qualitative data analysis, in contrast to Diep et al.'s (2017) study, the authors found an increasing improvement in the quality of student participation and interaction, thus reinforcing learners' knowledge building process throughout the course. Collaboration among students encouraged students to create notes and follow their friends' note creation processes. Students with no information about the course were observed to conduct research and attempt to match their friends' speed after being influenced by those students. To the researchers, such increases in academically related content and quality were considered a function of a dense network of learner-learner interactional patterns and participation in an online collaborative course, thus causing a memorable impact on their learning experiences.

Finally, the relationship between learner-learner interactions and their effect on e-learners' achievement has also recently been re-addressed empirically by Kurucay and Inan (2017) in an online undergraduate course at a southwestern university in the United States. The study also sought to determine the extent to which interactions between online learners affected their perceived learning and satisfaction. A quasi-experimental research design was used: students in the control group were asked to complete their course assignments individually, and students in the treatment group were asked to complete the same assignment collaboratively

in groups of three. Data were collected via pre- and post-survey electronic questionnaires and analyzed quantitatively. Overall, the results revealed a significant effect of learner-learner interaction with students' achievement, but no significance in terms of perceived learning and satisfaction. This finding contradicts those from prior relevant studies indicating that learner-learner interaction is a key predictor of student satisfaction (e.g. Chang and Smith, 2008; Sher, 2009; So and Brush, 2008; Young and Norgard, 2006), and it has been attributed to the assumed difficulties encountered in online collaboration or learners' incapability of effectively using the online tools, or to the different natures of collaborative learning in an online learning environment compared with a face-to-face environment. Nevertheless, the frequency of interaction and peer evaluation scores in online group activities were positively associated with students' perceived learning, achievement and satisfaction, whereas students' perceptions of online collaboration (e.g., interest, experience and capability)positively improved after students were involved in online group activities.

4.3 Learner-Content Interaction

Learner-content interactions in online and blended learning (BL) environments have been the subject of two recent empirical studies aiming to fill in the gaps in scientific knowledge by surveying this type of interaction as a determinant of student success and student satisfaction in online courses. The inclusion of studies on BL in this analysis was justified because this teaching method maintains not only the benefits in face-to-face interactions among learners or between instructors and learners, but also the inherent advantages of online teaching methods (Osguthorpeand Graham, 2003). Within the framework of Transactional Distance Theory, Ekwunife-Orakwue and Teng (2014) have investigated the extent to which student interactions in online and blended learning environments affect student learning outcomes, as measured by student satisfaction and their grades. The participants comprised 342 graduate, undergraduate, certificate, non-degree and alumni students enrolled in part time or full time synchronous and asynchronous online or blended courses in the academic areas of Professional Development, Technology and Society, Management and Electrical Engineering at a large US university. Student satisfaction was measured via a survey questionnaire, and the final summative assessment score received in the course reflected the students' academic achievement in the course.

Quantitative data analysis using standard multiple regression indicated that student-content interaction substantially affected student learning outcomes (satisfaction and academic achievement) as opposed to learner-teacher, learner–learner and learner-technology interactions. Sixty percent of the variability in student satisfaction was attributed to the interactions among learners, the content and the technology, whereas the contribution of learner-content interaction (38%) to student grades was almost twice those of other forms of interaction. Females reported slightly higher levels of learner-content interaction than males, and age had a neutral influence on all types of interaction, and did not contribute to online student satisfaction, because the sample included only a higher education population, and its size was limited. This finding appears to be consistent with Rhode's (2009) results from an exploratory study examining the experiences and preferences of adult learners the in terms of various interactions encountered in a self-paced professional development certificate program offered by a private higher education US institution. The authors also found that learner-quality course content and learner-instructor interaction were considered the most important aspects of the program. Participants indicated that quality interaction with the content is indispensable in the self-paced learning environment and cannot be replaced, but that interaction with the instructor could potentially be decreased and compensated for through increased quality interactions with content or learners. Learner-content interaction was found to be the most important predictor of student satisfaction in a study by Kuoet al.(2009) investigating students' perceptions of interaction and course satisfaction in a blended learning postgraduate course via synchronous and asynchronous weekly sessions.

In the same educational context as that of the previous studies discussed above, Zimmerman's (2012) study investigated the relationship between the learner-content interaction and course grades of 185 students in an asynchronous online course at a university in the southwestern United States. Using Blackboard CMS, the students relied completely on materials posted online to complete the requirements. Students were required to complete both a discussion assignment and a five-question quiz each week within a 7-day period, and no make-ups were allowed for either of the two tasks. Data associated with student interaction with course content, including the time spent reviewing online course materials, such as module Power Point presentations and course videos, and the time spent completing weekly quizzes, were collected in three sections of the online course. The results indicated a statistically significant relationship between the amount of time that the learners spent with the content and weekly quiz grades, thus confirming Ekwunife-Orakwue and Teng's (2014) findings concerning the contribution of learner-content interaction to academic achievement. Nevertheless, the generalizability of this

study is again compromised by the small sample size as well as the use of strictly quantitative measures that did not capture or enable determination of the full relationship between the heavily under-researched learner-content interaction and course success in online learning contexts. Future research on the topic is imperative, given the implications for online educators and designers in terms of explicit strategy instruction regarding the importance of content interaction in course success as well as the development of course designs that are easily accessible, engaging and motivating for learners to use and learn.

4.4 Learner-interface Interaction

Learner to interface interaction was introduced by Hillman, Willis and Gunawardena (1994) as an additional fourth dimension to the construct of interaction in distance education. The authors have suggested that in online courses, learners must interact with some form of a technology medium as part of the course requirements. According to Hirumi (2002: 147), "learners must possess the skills necessary to operate the delivery system before they can be expected to successfully interact with human and non-human resources," and, if they do not possess such skills, the instructor or supporting staff should provide technological assistance to learners to facilitate learner-interface interaction (Prammanee, 2003). Although the effects of interface and interface design on online student learning have been a focus of growing research, several empirical studies have examined the ways in which e-learners interact and negotiate learning with the technological means of successfully completing their online learning.

To determine the extent to which learner satisfaction in an online graduate higher education course is associated with different types of interaction, Cho (2011) conducted one of the first research projects in learner-interface interaction. The participants were 342 students enrolled in 24 different online courses within a Master of Science degree-accredited online program, who were asked to complete an online learner satisfaction survey questionnaire sent by email after completion of the online course program. The data were analyzed via simple regression analysis to identify each relationship between different types of interaction and learner satisfaction. The results indicated that: (i) Significant positive linear relationships were found between learner-content (.739), learner-instructor (.540) and learner-learner (.770) interactions with learner satisfaction. However, the learner-interface interaction and learner satisfaction were not statistically significant. (ii) Learner-interface interaction also had the least impact on overall learner satisfaction. In contrast, learner-content satisfaction heavily influenced student satisfaction, followed by learner-instructor and learner-learner interaction. Finally, (iii) although significant relationships were observed among learner-content, learner-instructor and learner-learner interactions, learner-interface interaction was correlated with only learner-learner interaction (.206). Given the pivotal role of technology in online courses, Cho attributed the absence of any statistically valid relationships between learner-interface interaction and learner satisfaction to methodological flaws in the study, including (a) the use of general and abstract questionnaire items unable to elicit precise information on the effects of learner-interface interaction on learner satisfaction, (b) response bias, (c) environmental distractions and (d) the use of a single quantitative research method that prevented gathering of more in-depth knowledge data, as are usually afforded in qualitative research paradigms.

In a similar study, Jung and colleagues (2002) have investigated the effects of three types of interaction, i.e., academic (including learner-online resources and task-oriented interaction between learners and instructor), collaborative (or learner-learner interaction) and social (learner-instructor interaction to promote interpersonal encouragement or social integration), on learner satisfaction, participation and attitudes towards online learning in a Web-based instruction (WBI) environment. The participants were 120 undergraduate students from three courses at a university in Seoul, Korea, allocated to three interaction groups. Data were collected via pre- and post-tests measuring learners' prior experience with WBI, their attitudes toward online learning and their motivation levels before and after completing the course. As in Cho's (2011) study, learner satisfaction was measured via a survey questionnaire, and students' learning achievement was calculated in terms of the scores on the five assignments that learners were required to complete during their online course. Overall, social interaction was related more to learning outcomes than to learner satisfaction, whereas collaboration among learners was related more to learner satisfaction than to learning outcomes in WBI. Although learner-interface interaction was not directly addressed as a separate variable in this study but instead was considered part of what the researchers call "academic interaction"—which appears to refer more to learners' access and use of the course content than to the online course design and usefulness of the learning management system in the course—the study concluded that regardless of the type of interaction, WBI experiences result in a more positive view of online learning. However, more extensive qualitative research is necessary to determine the extent to which social and collaborative interactions affect e-learners' achievement, satisfaction and motivation.

Additional focus should be placed on the effect of learner-interface interaction per se and determination of its roles and effects on online learning courses via more sophisticated mixed-method approaches and more sensitive data-gathering instruments in future research (e.g.,Zydney, deNoyelles and Ju-Seo, 2012).

Interaction with technology, an integral part of distance education, has also been addressed in a more recent study by Danesh, Bailey and Whisenand (2015), in relation to instructors. The data were based on 91 graduate and undergraduate college online learners' perceptions of the effects of various interaction methods on the success of the educational outcome of the course. All courses used a mixed-mode, blended learning format combining face-to-face and online classroom discussion, and making use of both asynchronous and synchronous communication technology. Students were encouraged in each course to use both traditional and computer-mediated communication to interact with the teacher and other students, and feedback was routinely provided by the teachers. At the end of the course, the instructors administered a survey questionnaire consisting of a Likert scale, and open ended and agree/disagree questions. According to the questionnaire results, 62% of learners agreed that scheduled synchronous sessions positively influenced their interaction with the instructor, and 56% believed that the scheduled synchronous sessions positively influenced how they interacted with their fellow students, whereas 71% believed that asynchronous technology was the best means of communication with all participants in the course and the instructor. With respect to instructor-interface interaction, 64% of the students agreed that the professor's knowledge and technology use during the synchronous online sessions was critical to the overall success of the class, and they further commented that instructors with highly advanced technological knowledge and skills contributed more effectively to the online course. Although this study has provided further insights into e-learners' perceptions of the instructor-interface relationship in terms of technological expertise and competence while organizing and conducting online learning courses, the nature and characteristics of the interaction with technology, an essential and indispensable pedagogical means of e-learning, remain largely opaque. Therefore, extensive, detailed and interdisciplinary research efforts are needed in the areas of educational technology, distance education and online learning alike.

In a recent study on learner-interface interaction in online environments, Song, Rice and Oh (2019) have investigated learners' participation in online courses, focusing on synchronous learner interaction with a conversational virtual agent. Study data were collected from four graduate asynchronous online courses in an instructional technology program at a mid-sized university in the southern United States, organized into 15 weekly themes and topic modules. Participants were required to complete 13 weeks of asynchronous discussion activity throughout the course term and were also asked to complete seven interaction sessions with a conversational virtual agent throughout the semester regarding instructional topics, through reflection prompts such as "Why do we need to use educational multimedia?" and "Are mobile apps good for teaching?" The conversational agent used was designed and developed to demonstrate the feasibility of the agent in better supporting synchronous interaction in online courses. The agent was an independent online application, rather than being embedded in the course LMS, and was directly accessed by students using a web browser, without logging into the LMS. Learners interacted with the agent through text-based chat, and the virtual agent analyzed their input and replied to their questions and answers. Factor analysis of the results concerning learners' interaction/participation in online courses indicated two factors tied to e-learners achievement: (i)interaction quality, including the quality of discussion forum posts and conversation with the agent and (ii) LMS-oriented interaction, including the frequency and length of course access and the quantity of discussion forum posts. Participants successfully had meaningful interactions with the virtual agent about course topics and materials, and consequently were motivated to further express their opinions and were encouraged to complete tasks throughout the course.

4.5 Learner-self Interaction

Learner-self interaction encompasses the intrapersonal and meta-cognitive skills needed for students to be self-directed distance learners(Northrup, 2002) and is defined as the "learner's reflections on the content, learning process and his new understanding" (Soo and Bonk, 1998). This type of interaction examines learners' reactions to the content and asserts that their reflections and inner-dialogue (called "self-talk") are associated with the learning process. Self-regulation and reflection are critical to online learning, because, according to Northrup (2001), learning ultimately occurs as learners retreat from interaction and focus on individual and internal reflection. Self-regulated learners may have a substantially greater potential for success in distance education than learners with relatively poor self-regulatory skills, because the former may not need as much prompting from an instructor or help from other learners in monitoring, regulating and otherwise facilitating their learning (Hirumi, 2002; Hirumi, 2009).

Notably, this type of interaction has been examined in one recorded empirical study to date by Chou (2010) and associates. The study focused on exploring the interactivity of course-management systems (CMSs). Six commonly used CMSs in colleges and universities in Taiwan were selected for evaluation (Blackboard, e-Campus III, iCAN XP, Moodle, TopLearn and Wisdom Master), and data from 391 online learners in the form of self-reported perceptions of several CMS interactive functions were collected via a survey questionnaire distributed via these platforms. Within the learner-self interaction dimension, students in two of the six groups reported grade status tracking as the most-known function and materials-viewed tracking as the most-frequently used functions, as the top three. Among the most useful functions of the learner-self interaction type were the individualized learning record, assignment-completion tracking, software downloading, system announcements, user guidance for the system and FAQs about the system. Calendar and schedule reminders, a diary and reflection journal, and a report transformer were among the least used functions with respect to the learner-self interaction type. The researchers concluded that although the design of the six investigated CMSs favored most human interactions (learner-learner and learner-instructor), the approximately 50% adoption rates of functions in the learner-interface and learner-self interaction types indicated the existence of substantial room for system improvement and ample research opportunities for qualitative assessment of these interactive functions in computer-mediated learning environments.

5. Summary of Key Findings

On the basis of the review of the most recent empirical studies presented in this paper, the most important findings concerning interaction in online learning environments can be summarized as follows:

- Learner-instruction interactions significantly correlate with learners' academic performance (Kang and Im, 2012) and student satisfaction (Kuo et al., 2014), and significantly affect emerging e-learners' patterns of interaction in online discussion forums (Park et al. 2015). Positive and significant effects of teacher-student interaction have also been found in relation to the interaction processes in which e-students engage in online courses (Selles, Munoz and Gonzalez-Sanmamed, 2019), and to e-learners' level of autonomy in the learning process, although these effects are weak (Foteiadou, Angelaki and Mavroudis, 2012). However, instructor scaffolding strategies strongly affect the self-regulation capacity for interactions with others (learners and/or teacher) in online courses (Cho Kim, 2013). Finally, the development of learner-instructor interactions via social media is a useful out-of-class method for university teachers to enhance their credibility and accessibility in conventional classrooms.

- Quality and in-depth learner-learner interactions in online and blended collaborative learning environments are affected by learners' sentiments and dispositions (Huang, 2019) and have a significant effect only on learners' bonding and bridging capital (Diep et al., 2017; Shu and Gu, 2018) and knowledge building processes in online courses (Yucel and Usluel, 2016). However, no significant effect on perceived learning and satisfaction has been found (Kurucay and Inan, 2017; Rovai and Barnum, 2003).

- Interactions with course content are among the most valued types of interaction by learners in self-paced and blended online learning environments. These interactions have been statistically correlated with learner satisfaction and success in course completion (Ekwunife-Orakwue and Teng, 2014; Zimmerman, 2012; Rhode, 2009; Kuo et al., 2009)

- Learner-interface interaction does not statistically correlate with learner satisfaction (Cho, 2011), bearing in fact the least impact on it (Jung et al., 2002). Its effect on learning outcomes in web-based instruction environments is largely superseded by social and collaborative interaction types. However, e-learners believe that online instructors' expertise and knowledge of technology in synchronous online courses is a critical factor facilitating effective online learning (Danesh, Bailey and Whisenand, 2015).

- With respect to learner-self interaction type, the limited research on the topic suggests that e-learners appear to favor certain aspects associated with the individualized learning record, assignment-completion tracking, software downloading, system announcements, user guidance for the system and FAQs about the system (Chou, Peng and Chang, 2010). Because this type of interaction is determined by affective personality traits involving e-learners' self-regulatory behavior, self-efficacy, agency and degree of autonomy displayed during the online learning process, more targeted research is needed to understand and explain the role of this type of interaction in the distance education field.

6.   Discussion and Implications for Future Research

As university-level courses are increasingly being developed for online delivery, the pressure to identify the components of online learning environments that contribute to or support learning is increasing. Notably, the issue of the quality and effectiveness of interaction in online learning contexts has also emerged as a major pedagogical challenge in emergency remote teaching, which has been globally enforced as a mandatory educational paradigm as a result of the COVID-19 pandemic (Ferri et al., 2020; Meulenbroeks, 2020). Although much of the research in online education has focused on technical characteristics, technology by itself does not operate independently to create a learning environment. As demonstrated above, student interaction online appears to be a critical component in online learning environments that improves the quality of learning outcomes and facilitates successful course completion. Clearly, a fundamental shift in the culture of research practices is necessary to enable distance educators' and researchers' alike to reach broader and more comprehensive conclusions regarding the processes and conditions that best support learning and interaction in online distance education course design (Abramiet al., 2011). This research agenda should include: (a) further study of the interaction patterns used by learners in a variety of distance education online learning environments, including emergency remote learning contexts, and their effects on learning outcomes and motivational processes; (b) sophisticated research designs and better-quality measures of student learning, higher order thinking and engagement in online learning courses; and (c) more studies in a wide variety of educational contexts, particularly across the grade levels (K-12) and in higher education settings of all types.

References

Abrami, P.C., Bernard, R.M., Bures, E.M. and Tamim, R. 2011. Interaction in distance education and online learning: Using evidence and theory to improve practice. *Journal of Computing in Higher Education,* 23(2-3), pp.82-103.

Adnan, M. and Anwar, K. 2020. Online learning amid the COVID-19 pandemic: Students' perspectives. *Journal of Pedagogical Sociology and Psychology,* 2(1), pp.45-51.

Anderson, T. 2003. Getting the mix right again: An updated and theoretical rationale for interaction. *International Review of Research in Open and Distance Learning,* 4(2), pp. 1-14

Available at: http://www.irrodl.org/index.php/irrodl/article/view/149/230, Accessed Date: 23.01.2021

Bernard, R.M., Borokhovski, E., Schmid, R.F., Tamim, R.M. and Abrami, P.C. 2014. A meta-analysis of blended learning and technology use in higher education: From the general to the applied. *Journal of Computing in Higher Education,* 26(1), pp.87-122.

Blasco-Arcas, L., Buil, I., Hernandez-Ortega, B., and Sese, F.J. 2013. Using clickers in class. The role of interactivity, active collaborative learning and engagement in learning performance. *Computers & Education*, 62, pp. 102-110

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

Chang, S.-H.H. and Smith, R.A. 2008. Effectiveness of personal interaction in a learner-centered paradigm distance education class based on student satisfaction. *Journal of Research on Technology in Education,* 40(4),pp.407-426.

Cho, M.-H. and Kim, B.J. 2013. Students' self-regulation for interaction with others in online learning environments. *Internet and Higher Education,* 17(1), pp. 69-75.

Cho, M.-H. and Jonassen, D. 2009. Development of the human interaction dimension of the self-regulated learning questionnaire in asynchronous online learning environments. *Educational Psychology,* 29(1), pp. 117-138.

Cho, T. 2011. The impact of types of interaction on student satisfaction in online courses. *International Journal on E-Learning*, 10(2), pp. 109–125.

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

Dabbagh, N. 2007. The online learner: characteristics and pedagogical implications. *Contemporary Issues in Technology and Teacher Education, 7*(3),pp.217-226.

Danesh, A., Bailey, A. and Whisenand, T. 2015. Technology and instructor-interface interaction in distance education. *International Journal of Business and Social Science,* 6(2), pp.39-47.

Dhawan, S. 2020. Online Learning: A Panacea in the Time of COVID-19 Crisis. *Journal of Educational Technology Systems,* 49(1), pp. 5-22.

Diep, N.A., Cocquyt, C., Zhu, C., Vanwing, T. and de Greef, M. 2017. Effects of core self-evaluation and online interaction quality on adults' learning performance and bonding and bridging social capital. *The Internet and Higher Education,* 34, pp. 41-55.

DeTure, M. 2004. Cognitive style and self-efficacy: predicting student success in online distance education. *American Journal of Distance Education,* 18(1), pp. 21-38.

Donmez, O., Simsek, O. and Arikan, Y.D. 2010. How can we make use of learner interaction in online learning environments? *Procedia Social and Behavioral Sciences,* 9, pp. 783-787.

Dziuban, C., Moskal, P.D. and Thompson, J. 2015.Student satisfaction with online learning: Is it a psychological contract? *Journal of Asynchronous Learning Network,*19(2), pp. 1-15.

Ekwunife-Orakwue, K.C.V. and Teng, T.-L. 2014. The impact of transactional distance dialogic interactions on student learning outcomes in online and blended environments. *Computers & Education,* 78, pp. 414-427.

Eom, S., Wen, H. and Ashill, N. 2006. The determinants of students' perceived learning outcomes and satisfaction in university online education: An empirical investigation. *Decision Sciences Journal of Innovative Education,* 4(2), pp. 215-235.

Espasa, A., and Meneses, J. 2010. Analyzing feedback processes in an online teaching and learning environment: An exploratory study. *Higher Education*, 59(3), pp. 277-292.

Ferri, F., Grifoni, P. and Guzzo, T. 2020. Online learning and emergency remote teaching: Opportunities and challenges in emergency situations. *Societies,* 10(4), pp. 1-18

Available at: https//:www.mdpi.com/2075-4698/10/4/86, Accessed Date: 10.02.2021

Fotiadou, A., Angelaki, C. and Mavroudis, I. 2017. Learner autonomy as a factor of the learning process in distance education. *European Journal of Open, Distance and e-Learning,* 20(1), pp. 97-111.

Garrison, D. R. and Cleveland-Innes, M., 2005. Facilitating cognitive presence in online learning: Interaction is not enough. *The American Journal of Distance Education,* 19(3), pp. 133-148.

Garrison, D. R. 1989. *Understanding distance education: A framework for the future*. London, UK: Routledge.

Giossos, Y. Mauroidis, H. and Koutsouba, M. 2008. Research in distance education: review and perspectives. *Open Education - The Journal for Open and Distance Education and Educational Technology* 4(1)Available at:

https://ejournals.epublishing.ekt.gr/index.php/openjournal/article/view/9724/0/TurabianCitationPlugin, Accessed Date: 23.02.2021

Heo, H., Lim, K.Y. and Kim, Y. 2010. Exploratory study on the patterns of online interaction and knowledge co-construction in project-based learning. *Computers & Education,* 55, pp. 1383-1392.

Hew, K.F. and Cheung, W.S. 2008. Attracting student participation in asynchronous online discussions: A case study of peer facilitation. *Computers & Education,* 51(3), pp. 1111-1124.

Hillman, D. C., Willis, D. J., and Gunawardena, C. N. 1994. Learner-interface interaction in distance education: An extension of contemporary models and strategies for practitioners. *The American Journal of Distance Education,* 8(2), pp. 30-43.

Hirumi, A. 2009. A framework for analyzing, designing and sequencing planned e-learning interactions. In: A. Orellana, T. L. Hudgins, and M. Simonson (Eds.).*The perfect online course: Best practices for designing and teaching.* Charlotte, NC: Information Age Publishing. pp.201–228.

Hirumi, A. 2006. A framework for analyzing and designing e-learning interactions. In C. Juwah (Ed.). *Interactivity and Interactions in Distance and Online Education*. London, UK. Kogan Page. pp. 46-72

Hirumi, A. 2002. A framework for analyzing, designing, and sequencing planned e-learning interactions. *Quarterly Review of Distance Education,* 3(2), pp. 141-160.

Hom, W. C. 2002. Applying customer satisfaction theory to community college planning of counselling services. *i-Journal,* 2, pp. 3-15

Available at:http://www.ijournal.us/issue_02/ij_issue02_WillardHom_01.htm., Accessed Date: 23.01.2021

Huang, C.-Q., Han, Z.-M., Li, M.-X., Jong, M.S. and Tsai, C.-C. 2019. Investigating students' interaction patterns and dynamic learning sentiments in online discussions. *Computers & Education,* 140, pp.1-18.

Jones, S. H. 2015. Benefits and challenges of online education for clinical social work: three examples. *Clinical Social Work Journal,* 43, pp. 225-235.

Jumaat, N.F. and Tasir, Z. 2013. Students' types of online interaction through Facebook discussion. *Procedia – Social and Behavioral Sciences,* 97, pp. 353-360.

Jung, I., Choi, S., Lim, C., and Leem, J. 2002. Effects of different types of interaction on learning achievement, satisfaction and participation in Web-based instruction. *Innovations in Education and Teaching International,* 39(2) pp. 153–162.

Kang, M., and Im, T. 2013. Factors of learner-instructor interaction which predict perceived learning outcomes in online learning environment. *Journal of Computer Assisted Learning,* 29(3), pp. 292-301.

Kuo, Y.C., Walker, A.E, Schroder, K.E.E. and Belland, B. R. 2014. Interaction, Internet self-efficacy and self-regulated learning as predictors of students' satisfaction in online education courses. *Internet & Higher Education,* 20, pp. 35-50.

Kuo, Y.C., ,Eastmond, J.N., Bennett, L.J. and Schroder, K.E.E. 2009. Student perceptions of interactions and course satisfaction in a blended learning environment. In: G. Siemens and C. Fulford (Eds.), *Proceedings of ED-MEDIA 2009--World Conference on Educational Multimedia, Hypermedia &Telecommunications.* pp. 4372-4380. Honolulu, HI, USA: Association for the Advancement of Computing in Education (AACE).

Kauffman, H. 2015. A review of predictive factors of student success and satisfaction with online learning. *Research in Learning Technology,* 23, pp. 1-13

Kurucay, M. and Inan, F.A. 2017. Examining the effects of learner-learner interactions on satisfaction and learning in an online undergraduate course. *Computers & Education,* 115, pp. 20-37.

Lear, J. L., Ansorge, C., and Steckelberg, A. 2010. Interactivity/community process model for the online education environment. *Journal of Online Learning and Teaching,* 6(1), pp. 71–77.

Lee, J., Carter-Wells, J. and Glaeser, B.2006. Facilitating the development of a learning community in an online graduate program. *The Quarterly Review of Distance Education,*7(1), pp. 13-33.

Liu, X., Magjuka, R. J. and Lee, S. 2008. The effects of cognitive thinking styles, trust, conflict management on online students' learning and virtual team performance. *British Journal of Educational Technology,* 39(5), pp. 829-846.

Markham, S., and Hagan, D. 1999. Student satisfaction – CSSE1202. *CERG Technical Report* 3/99.

Mayes, T. 2006. Theoretical perspectives on interactivity in e-learning. In: C. Juwah (Ed.). *Interactivity and Interactions in Distance and Online Education*. London, UK. Kogan Page. pp. 9-26.

McIsaac, M.S. and Gunawardena, C.N. 1996. Distance Education. In: D.H. Jonassen, (Ed.).*Handbook of research for educational communications and technology: a project of the Association for Educational Communications and Technology*. pp. 403-437. New York: Simon & Schuster Macmillan.

Menchaca, M.P. and Bekele, T.A. 2008. Learner and instructor identified success factors in distance education. *Distance Education,* 29(3), pp. 231-252.

Meulenbroeks, R. 2020. Suddenly fully online: A case study of a blended university course moving online during the Covid-19 pandemic. *Heliyon,* 6, pp. 1-7.

Miyazoe, T. and Anderson, T. 2010. The Interaction Equivalency Theorem. *Journal of Interactive Online Learning,* 9(2) ,pp. 94-104.

Moller, L. 1998. Designing communities of learners for asynchronous distance education. *Educational Technology Research and Development,* 46(4), pp. 115-122.

Moore, M. G. 2007. The theory of transactional distance. In: M. G. Moore (Ed.), *Handbook of distance education* (2nd Ed.). Mahwah, NJ: Erlbaum. pp. 32-46.

Moore, M. G., and Kearsley, G. 1996. *Distance Education: A systems view.* Belmont, CA.: Wadsworth.

Moore, M. G. 1993. Theory of transactional distance. In: D. Keegan (Ed.), *Theoretical principles of distance education.* New York: Routledge. pp. 22-38.

Moore, M.G. 1989. Three types of interaction. *The American Journal of Distance Education*, 3(2), pp. 1-6.

Muilenburg, L. Y. and Berge, Z. L. 2005. Student barriers to online learning: a factor analytic study. *Distance Education,* 26(1), pp. 29-48.

Mutalib, M.A., Halim, N.D.A. and Yahaya, N. 2016. *Meta-analysis of Interaction in Online Learning*. Conference Proceedings Universiti Teknologi Malaysia.

Muzammil, M., Sutawjaya, A. and Harsasi, M. 2020. Investigating student satisfaction in online learning: The role of student interaction and engagement in distance learning university. *Turkish Online Journal of Distance Education,* 21, pp. 88-96.

Northrup, P.T. 2002. Online learner's preferences for interaction. *The Quarterly Review of Distance Education,* 3(2), pp. 219-226.

Northrup, P. 2001. A framework for designing interactivity into web-based instruction. *Educational Technology,* 41(2), pp. 31–39.

Osguthorpe, R. T., and Graham, C. R. 2003. Blended learning environments: Definitions and directions. *The Quarterly Review of Distance Education,* 4(3), pp. 227-233.

Park, J.H., Schallert, D.L., Sanders, A.J.Z., Williams, K.M., Seo, E., Yu, L.-T., Vogler, J.S., Song, K., Williamson, Z.H. and Knox, M.C. 2015. Does it matter if the teacher is there? A teacher's contribution to emerging patterns of interactions in online classroom discussions. *Computers & Education,* 82, pp. 315-328.

Park, J. and Choi, H. J. 2009. Factors influencing adult learners' decision to drop out or persist in online learning. *Journal of Educational Technology & Society* 12(4), pp. 207-217.

Prammanee, N. 2003. Understanding participation in online courses: A case study of perceptions of online interaction. *Instructional Technology Forum,* 29
 Available at: http://it.coe.uga.edu/itforum/paper68/paper68.html, Accessed Date: 09.02.2021

Rhode, J. F. 2009. Interaction equivalency in self-paced online learning environments. An exploration of learner preferences. *International Review of Research in Open and Distance Learning,* 10(1), pp. 1-23.
Available at: http://www.irrodl.org/index.php/irrodl/article/view/603/1179, Accessed Date: 23.01.2021

Rogerson-Revell, P. 2015. Constructively aligning technologies with learning and assessment in a distance education master's programme. *Distance Education,* 36(1), pp. 129-147.

Rovai, A. F. and Barnum, K. T. 2003. Online course effectiveness: An analysis of student interactions and perceptions of learning. *Journal of Distance Education,* 18(1), pp. 57-73.

Russo, T. and Benson, S. 2005. Learning with invisible others: Perceptions of online presence and their relationship to cognitive and affective learning. *Educational Technology and Society*, 8(1), pp. 54-62.

Sarapin, S.H. and Morris, P.L. 2015. Faculty and Facebook friending: Instructor-student online social communication from the professor's perspective. *Internet and Higher Education* 27, pp. 14-23.

Selles, N.H., Munoz-Carril, P.-C. and Gonzalez-Sanmamed, M. 2019. Computer-supported collaborative learning: An analysis of the relationship between interaction, emotional support and online collaborative tools. *Computers& Education,* 138, pp. 1-12.

Sener, J., and Humbert, J. 2003. Student satisfaction with online learning: An expanding universe. In J. C. Moore (Ed.).*Elements of Quality Online Education: Practice and Direction, Volume 4 in the Sloan-C Series.* Needham, MA: Sloan-C.

Sher, A. 2009. Assessing the relationship of student-instructor and student-student interaction to student learning and satisfaction in web-based online learning environment. *Journal of Interactive Online Learning,* 8(2), pp. 102-120.

Shu, H. and Gu, X. 2018. Determining the differences between online and face-to-face student-group interactions in a blended learning group. *The Internet and Higher Education,* 39, pp. 13-21

Siemens, G. and Weller, M. 2011. Higher education and the promises and perils of social network. *Revista de Universidad y Sociedad del Conocimiento,* 8(1), pp. 164-170.

So, H.-J. and Brush, T.A. 2008. Student perceptions of collaborative learning, social presence and satisfaction in a blended learning environment. Relationships and critical factors. *Computers & Education,* 51(1), pp. 318-336.

Song, L., Singleton, E.S., Hill, J.R .and Koh, M.H. 2004. Improving online learning: student perceptions of useful and challenging characteristics. *Internet and Higher Education*,7(1), pp. 59-70.

Song, D., Rice, M. and Oh, E.Y. 2019. Participation in online courses and interaction with a virtual agent. *International Review of Research in Open and Distributed Learning.*

Available at: http://www.irrodl.org/index.php/irrodl/article/view/3998, Accessed Date: 23.01.2021

Soo, K.S. and Bonk, C.J. 1998. Interaction: What does it mean in online distance education? Paper presented at the *98 World Conference on Educational Multimedia and Hypermedia & World Conference on Educational Telecommunications*, Freiburg, Germany, pp. 20-25.

Su, B., Bonk, C. J., Magjuka, R., Liu, X. and Lee, S.-H. 2005. The importance of interaction in Web-based Education: A program-level cases Study of online MBA courses. *Journal of Interactive Online Learning*, 4(1),pp.1-19.

Available at :http://www.ncolr.org/jiol/issues/pdf/4.1.1.pdf, Accessed Date: 23.01.2021

Swan, K. 2001. Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses. *Distance Education,* 22(2), pp. 306-331.

Turley, C. and Graham, C. 2019. Interaction, student satisfaction, and teacher time investment in online high school courses. *Journal of Online Learning Research,* 5(2), pp. 169-198.

Wallace, R.M. 2003. Online learning in higher education: A Review of research on interactions among teachers and students. *Education, Communication and Information,* 3(2), pp. 241-280.

Wang, S.L., Hsu, H.Y., Lin, S.S. and Hwang, G.J. 2014. The role of group of interaction in collective efficacy and CSCL performance. *Educational Technology & Society,* 17(4), pp. 242-254.

Webster, J., and Watson, R., 2002. Analyzing the past to prepare for the future: writing a literature review. *MIS Quarterly,* 26(2), pp. 13-23.

Young, A. and Norgard, C. 2006. Assessing the quality of online courses from the students' perspectives. *Internet and Higher Education,* 9(2), pp. 106-115.

Yucel, U.A. and Usluel, Y.K.2016. Knowledge building and the quantity, content and quality of the interaction and participation of students in an online collaborative learning environment. *Computers & Education,* 97, pp. 31-48.

Yukselturk, E. and Bulut, S. 2007. Predictors for student success in an online course. *Journal of Educational Technology & Society,* 10(2), pp. 71-83.

Zawacki-Richter, O. and Naidu, S.,2016. Mapping research trends from 35 years of publications in Distance Education. *Distance Education,* 37(3), pp. 245–269.

Zimmerman, T. D. 2012. Exploring learner to content interaction as a success factor in online courses. *The International Review of Research in Open and Distributed Learning,* 13(4), pp. 152–165

Zydney, J.M., deNoyelles, A. and Ju-Seo, K.K.,2012. Creating a community of inquiry in online environments: An exploratory study on the effect of a protocol on interactions within asynchronous discussions. *Computers & Education,* 58, pp.77-87.