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ORIGINAL RESEARCH ARTICLE

A causal loop approach to uncover interrelationship of student online interaction and engagement and their contributing factors

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Advances in technology reinforce the imperative to obtain further insight into the factors that impact online interaction in online environments. Even though past researchers have extracted factors impacting student online interaction and engagement, there is a lack of research that uncovers the dynamics of these relationships and investigates the impact of a comprehensive set of factors on student online interaction at the same time. Thus, this paper seeks to fill this gap by employing a causal loop approach to uncover the interrelationships of these factors that contribute to a positive impact on students' learning outcomes, and to evaluate satisfaction and engagement in online courses by focussing on students' online interaction. To this end, a rich qualitative data set was obtained from an online focus group consisting of students from a large online course, and a thematic analysis was conducted resulting in identifying different factors that played a role in the topic under study. More importantly, causal loop modelling was used to model these factors and their causal interrelationships.

Keywords: Causal loop approach; online learning; online interaction; online engagement; qualitative approach; thematic analysis

Introduction

Online education is an educational medium that has enabled communities of learners and their teachers to interact with one another even while located in different geographical locations. An essential aspect of online learning environments is active engagement with learners, course contents and instructors (Tung; Nor, Hamat, and Embi 2012; Kuo, Walker, and Schroder 2010a; Kyei-Blankson, Ntuli, and Donnelly 2016). Different methods employed to foster learners' interactions include sharing opinions with others, asking questions and debating about different subjects. Various technologies are also used to address this fundamental need. Web-based learning provides students and instructors with the ability to interact with each other through different technologies such as email, discussion boards, synchronous chat areas, etc. Social media and other Web 2.0 technologies have also been widely adopted for educational purposes. In fact, the success of many online courses relies on effective online interactions (Ellison, Steinfield, and Lampe 2006;

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Kang and Im 2013; Lenhart *et al*. 2010; Mayer 2002; Reed 2014; Stutzman 2006; Yoo, Jeong Kim, and Young Kwon 2014).

Past studies have shown the importance of online interaction in student learning outcomes and satisfaction (Chen and Chen 2007; Kurucay and Inan 2017; Richardson, Tunwall, and Carnevale 2000; Wilson 2007). In addition to technologies and administrative features, there are different drivers and factors that significantly influence students' online interaction and engagement. Different studies have been conducted on these factors, including students' self-efficacy, (Kuo *et al*. 2014a, 2014b), levels of readiness and computer literacy (Kaymak and Horzum 2013), interaction behaviours (Daradoumis, Xhafa, and Marques 2003), age and ethnicity (Ke and Kwak 2013), learning styles (Hao 2006), cultural diversity (Bing and Ping 2008) and attitude towards distance and online learning (Hao 2004); however, there is a lack of research that uncovers the dynamics of these relationships and analyses relatively comprehensive set of factors that play a role in student online interaction and engagement at the same time.

This study focusses on generating a comprehensive picture of the different contributing factors and their causal relationships, which is an important gap in the literature. To address this gap, a qualitative research design has been employed to investigate factors that contribute to a positive impact on students' learning outcomes, and to evaluate satisfaction and engagement in online courses by focussing on students' online interaction with learners, course content and instructors. It has been conducted by posing open-ended questions to students of an undergraduate e-commerce online course, which were then thematically analysed to extract the fundamental factors and their internal relationships. Then a series of causal loop diagrams (CLD) has been generated to clearly indicate the result.

Research background

The percentage of students who are not successful in completing their online courses varies from 10% to 50% (Bawa 2016; Carr 2000; Jun 2005). These attrition rates result in increased costs and expenses for institutions and universities, and are likely to decrease student satisfaction and outcomes. Investigating the factors that can cause dropouts in online courses is an essential task and thus deserves special attention from educational organisation management and course designers (Cheawjindakarn, Suwannatthachote, and Theeraroungchaisri 2013; Kuo *et al*. 2013; Prougestaporn, Visansakon, and Saowapakpongchai 2015; Wu *et al*. 2014).

One of the key elements of effective teaching and high-quality online learning is providing ways for students to exchange their ideas with instructors and among themselves (Kuo *et al*. 2014b). Interaction has been identified as an essential component of online learning and a major key to increasing student learning outcomes, satisfaction and engagement (Kang and Im 2013; Yoo, Jeong Kim, and Young Kwon 2014). It has been demonstrated that higher level of interaction between teachers and learners leads to more satisfaction, greater engagement with course content and better outcomes (Veletsianos 2010).

Different solutions have been developed to improve online interaction and engagement, and a vast number of technologies have been employed to cater to the need for interaction and engagement in online learning classes. For instance, Torun (2013) applied Adobe Connect Pro, an online collaboration and virtual classroom system,

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to investigate its effect on the synchronous interaction of students in online courses (Girard, Willoughby, and Berg; Ghanbarzadeh and Ghapanchi 2018). Authors (Bubas, Coric, and Orehovački 2010; Reed and Watmough 2015) have also investigated the potential uses of the online community tool 'Ning' in a hybrid university course for part-time students. There are also researches implemented on social media such as Twitter for improved student engagement (Reed 2013). Apart from different technologies and interventions, there are different drivers and factors that have a significant direct impact on students' online interaction and engagement. Identifying and improving these factors can highly influence online interaction among learners, and consequently, their learning outcomes.

Some researchers also investigated different characteristics of learners that can impact on their online interaction and engagement. These include student expectation, self-expression, leadership, self-efficacy, creative thinking, confidence, learning flexibility and knowledge sharing (Hao 2006; Ke and Kwak 2013; Kuo *et al*. 2014a). The factors that are assessed in the literature with regard to course and technology design are course clarity, task design, academic integrity (Bubas, Coric, and Orehovački 2010; Lamy and Hassan 2003; Swan 2002; Torun 2013), active discussion, feedback, technical support and academic support (Mohamad, Yusof, and Aris 2014; Nor, Hamat, and Embi 2012; Swanson 2010).

Many researchers have investigated online interaction and its effectiveness in online learning; they have applied various research methods, including quantitative (Chen and Chen 2007; Kuo *et al*. 2014b; Sher 2009; Tatar, Gray, and Fusco 2002), qualitative (Fredrickson 2018; Hammer 2002; Wang 2005; York and Richardson 2012) and mixed methods (Ellis and Romano 2008; Madland and Richards 2016; Su *et al*. 2005; Wilson 2007). Different elements of online learning and interactions have been described in the literature. Generally, these studies can be described as investigations of personal and psychological factors, studies of course-related and technology design factors that impact online interaction and studies of engagement in online education systems.

Despite the attempts of course instructors and researchers to increase and cultivate students' online interaction and engagement through different elements, this issue still remains a major concern. Many students complain about a lack of interaction and engagement in their feedback and online educational systems. It is thus essential for e-learning course instructors, university faculties and researchers to investigate and explore factors that influence student online interaction and engagement in online learning systems and generating a comprehensive picture of different contributing factors and their causal relationships.

Methodology

One of the areas in philosophy that elaborate the creation of knowledge is epistemology (Neuman 2013). There are three main epistemologies in the field of information systems (IS): positivism, interpretivism and design science (Orlikowski and Baroudi 1991). Positivism refers to epistemology that describes 'an organised method for combining deductive logic with precise empirical observations of individual behaviour in order to discover and confirm a set of probabilistic causal laws that can be used to predict general patterns of human activity' (Neuman 2013). The interpretivist epistemology application is to determine social life, to construct meaning in natural settings and to

describe how people develop and employ IS in society (Willcocks 2006). The design science approach is applied when creating or developing new approaches or methods for coping with current problems (von Alan *et al*. 2004).

This study adopts an interpretivist approach. Researchers in this approach typically aim to discover causal relationships between online interaction and engagement through careful empirical observations, identically quantifying the concepts and analysing the measures. This approach is consistent with interpretivist epistemology, where the objective is to describe causal connections between concepts and objects (Neuman 2006). Employing this epistemology is based on previous studies with regard to online interaction and engagement in higher education online courses, which are mentioned in the literature review section.

The goal of our research is to gain an in-depth understanding of the factors and drivers that contribute to student online interaction, participation and involvement with an online course and their causal relationships. To achieve this goal, a qualitative research approach is designed to investigate factors that contribute to a positive impact on students' learning outcomes, and to evaluate satisfaction and engagement to determine different factors impacting on the online interaction, participation and engagement of students in higher education online learning entities.

In this research, the underlying factors and parameters that have positive and negative impacts on learners' interactions and connectedness to the course contents and other learners in online education are investigated by addressing research questions regarding what factors contribute to student online interaction, participation and engagement? What is their causal and interrelationships with students' involvement, satisfaction and learning outcomes? An exploratory study approach is suitable for this purpose because it asks 'what' and 'how' questions and is based on a key assumption that the phenomena are inherent in the context in which they exist.

Data collection and participants

To achieve an in-depth insight and investigate the research problem, qualitative data have been collected from undergraduate students enrolled in an e-commerce online course offered by an Australian university. The course contained more than 100 students and an online group discussion was conducted at the end of the semester, in May 2015, where the qualitative data were collected. An online focus group approach was adopted and populated with open-ended questions that provided opportunities for students to express their points of view regarding their online interaction in their online course, as well as their opinions about the pros and cons of their experience with the course and its impact on their academic prospects (Gaiser 2008). This approach of collecting text data from online forums in the form of online focus groups is a practical method for online courses because their students are mostly off campus and distant students.

Students have been asked to answer and discuss open-ended questions about the online interaction they had in the course. Potential participants were asked to sign a consent form, indicating their voluntary participation, and their participatory status will not be revealed to the teaching team until after the grades for a semester have been issued. They were also assured that participating in the study would not affect their course grade in any way.

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From a demographical perspective, the total participation rate of students was 43%, of which 86% were males and 14% were females. The age of the participants varied significantly: 11 (16%) participants were aged under 20 years, 25 (37%) were aged between 21 and 30 years, 18 (27%) were aged between 31 and 40 years and 13 (20%) were aged over 40 years.

Data analysis

Thematic analysis is prevalent among researchers in qualitative research approach studies (Boyatzis 1998; Braun and Clarke 2006). Analytic themes in this concept involve identifying the patterns in data sets, which are most important to explaining, and describing particular events or areas associated with a specific research objective. It is therefore a very effective method for compiling and analysing focus group data. There are six main steps to conduct a thematic analysis (Braun and Clarke 2006): familiarising the analyst with the data, coding data, searching for themes, reviewing themes, defining and naming extracted themes, and presenting the results. The entire data set was read carefully several times to gain familiarity with it (Braun and Clarke 2006). Themes in this concept involve patterns in data sets that are more important and critical in order to explain and describe particular events or areas associated with a specific research objective.

Then, with the help of NVivo software (Gibbs 2002), the data were coded and themes were extracted, reviewed, named, and the results presented through a CLD. Traditionally, causal modelling results in a developed network of variables and the explicit delineation of their internal relationships. The main purpose of CLD is to display causal hypotheses in order to present the structure of the system in an aggregate illustration. This structure helps the user discuss the feedback structure and the underlying presumption (Sushil 1993). It contains parameters or variables connected by arrows, indicating the causal relationship or influences among them. A positive mark on the link indicates a positive relation, which means that the two variables change in the same direction. When one increases the other also starts to increase; similarly, if the node in which the link starts decreases the other node decreases as well. A negative mark shows a negative influence and means the two nodes change in opposite directions (Richardson 1986).

After analysing the data and creating the output of the thematic analysis, the findings are used to generate a list of potentially important variables associated with online interaction and engagement in an online course. These variables were then used to develop descriptive CLDs using the Vensim Software (6.3D 2013). Coding is an explicit and iterative process in which the researchers will alter and modify the analysis as reflected by the data and as ideas emerge. To ensure the integrity of the codes, they are developed and reviewed by all people in the research team. The researchers read and re-read the data and double-checked the codes for consistency and validation. Assessment of course, communication skills, course engagement, learning improvement, assignment and quizzes, knowledge sharing, discussion, feedback, learning skills, personal characteristics, motivation, medium features and course administration are some of the nodes created. Then, themes and sub-themes are identified, finalised and named from the coded data in the result part. Figure 1 is an example of the word tree created by NVivo to visualise some nodes existing in the data.

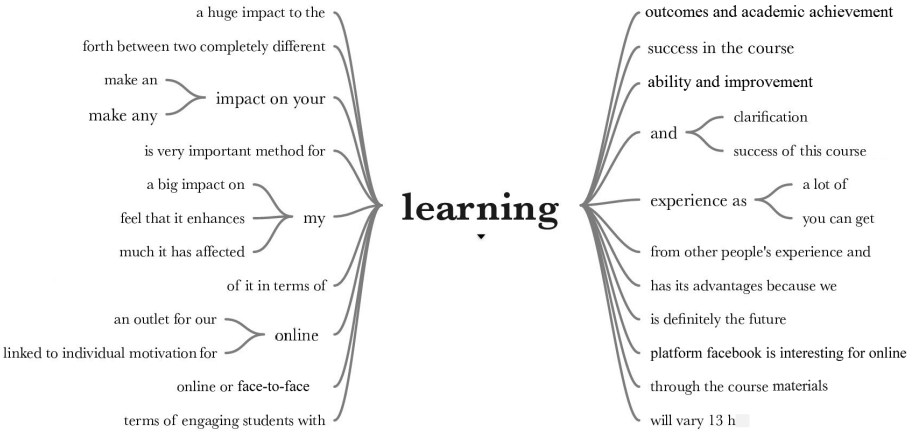

Figure 1. Word tree for node 'learning'.

Results

When coding the entire data set was completed, reviewed and labelled, themes were extracted, finalised and labelled by researchers. Table 1 indicates the final result of thematic analysis. There are seven main themes – participation, adoption, involvement, interaction, learning outcome, engagement and satisfaction. Each theme has been labelled based on coding the data. For instance, in the learning outcome theme, there are six sub-themes including post-lectures links and videos, self-paced learning, knowledge acquisition, interact with other students, give directions for assignments and improve learning and giving feedback.

After analysing the data and creating the thematic analysis, the findings were used to generate a list of potentially important variables associated with online interaction and engagement in an online course, and used to develop descriptive CLDs. At the first level, all variables and potential relations and causes have been extracted. At each stage, separated causal diagrams were generated to document different factors and their influences on students' positive outcome features such as learning outcome, satisfaction and engagement in an online course. An example of such a causal model can be found in Figure 2.

Figure 2 indicates that factors including accessibility, organising information, functionality, group discussion, individual motivation, polls and quizzes, communicationality and technology aptitude have a positive impact on participation. These factors also generate positive feedback on students' learning outcome, satisfaction and engagement. The term technology aptitude in this study means the ability to use and navigate technology as intended by the designers (Olaniran and Rodriguez). These can include a wide range of tools such as discussion board, email, blog, Facebook, Twitter, Google Plus, 3D virtual worlds, etc., that are adopted as tools to enhance learning and education (Bowman and Akcaoglu 2014; Merchant *et al*. 2013).

Past research has shown that online interaction has a strong impact on various positive student outcomes, such as student satisfaction and motivation (Kuo *et al*. 2010b, 2014a; Moallem, Pastore, and Martin 2013; Shank and Doughty 2002), learning outcomes, prospects and performance (Beatty 2002; Daradoumis, Xhafa, and Marques 2003; Heinemann 2007; Kang and Im 2013; Kuo *et al*. 2010b; Okonta 2010; Tatar, Gray, and Fusco 2002). Figure 3 illustrates the same relationship among

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Table 1. Thematic analysis themes and sub-themes.

Major theme	Categories of sub-theme	
Participation	• Organising information • Lack of participation • 1-to-1 and group discussion	• Individual motivation • Polls and quizzes • Easy to use, up to date and fast to access medium
Adoption	• Picture display ability • Get into it everyday	• Organising information • Time-consuming to read all comments
Involvement	• Good commenting and alert system • Live update • Easy to access and notify	• Keep connected via frequent notification • Distracted by other notifications
Interaction	• Easy to use, discuss and focus • Group discussion and live chat	• More interaction with visual representation • Involve with course content
Learning outcome	• Post-lectures link and videos • Self-pace learning • Knowledge acquisition	• Interact with other students • Give directions for assignments • Improve learning and giving feedback
Engagement	• Increase sense of presence • Easy to follow comments • Allow every student to involve	• Keep connected to other students and course content • Increase individual motivation
Satisfaction	• Allow students to participate • Share ideas and other experiences • Increase sense of presence	• Easy to get involved and connect with course

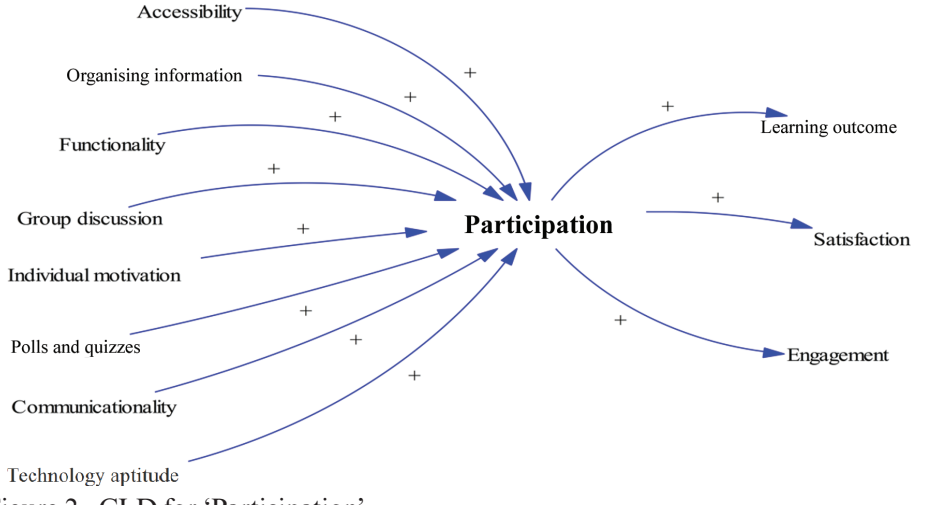

Figure 2. CLD for 'Participation'.

communicationality, technology aptitude, sociability and live updates in that they have a positive effect on involvement. In the same way, involvement has a direct positive relationship with students' learning outcomes, satisfaction and engagement. However, in Figure 4, the factor 'time consumption' has been connected to an adoption feature

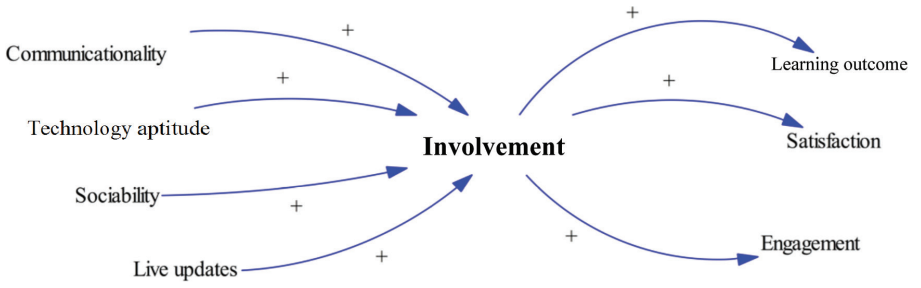

Figure 3. CLD for 'Involvement'.

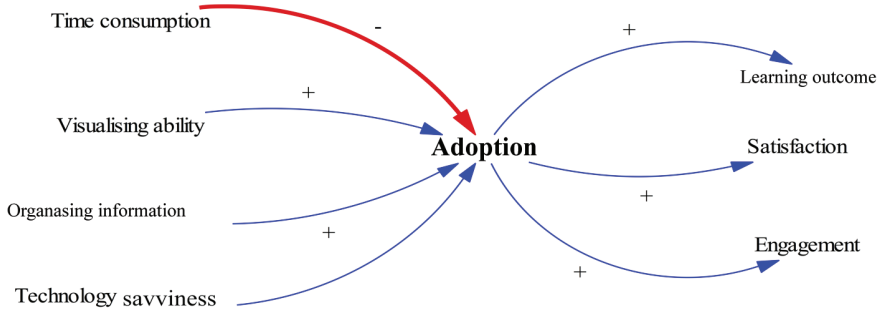

Figure 4. CLD for Adoption.

with a negative sign, meaning this factor has a reverse effect on social media adoption. Some students noted that it takes time to read all the comments and messages to keep up to date with the discussion.

Figure 5 is the final CLD generated from the qualitative data analysis and includes all of the extracted and contributing factors in students' online interaction. It depicts all elements and their causal relationships simultaneously. There are different loops, negative and positive relationships, to interpret this diagram. It can easily convey important information and help the reader understand the impact and correlation of different factors affecting students' online interaction and engagement in an online learning environment.

Discussion

Given the importance of online interaction and engagement in online courses and their role in student's satisfaction and learning outcomes, in this research, data from an online forum have been collected in online courses and the results of this data analysis, displayed in the form of a CLD, reveal the causal relationships of different factors influencing online interaction in online courses. In this study, a thorough thematic analysis has been conducted to extract different elements and features of online learning which have a direct impact on students' online interaction and engagement from a rich set of qualitative data. The contributing factors of the findings of this study can be divided into two main categories: *individual and behavioural characteristics* and *course-related and technology design factors*. This grouping indicates that different aspects of educational drivers influence online interaction and involvement

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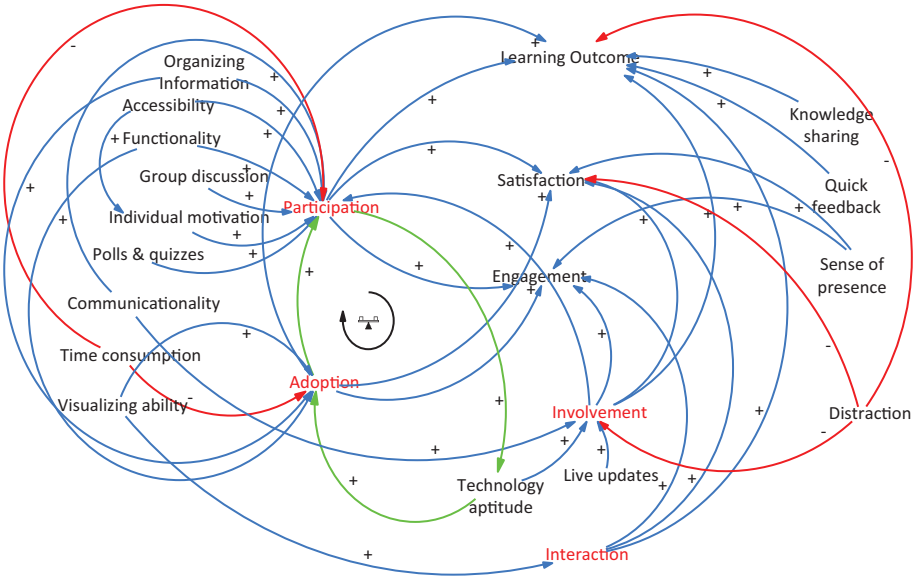

Figure 5. CLD for other factors.

in an online course. Only applying an interesting medium or technology in the course does not guarantee a high level of interaction among students. There are also some personal and psychological elements that influence student interaction online.

For instance, one of the issues seemingly impacting online interaction is quick feedback. Students believed that the lack of immediate feedback was a discouraging driver and contributed to their limited engagement and participation in online discussion. They argue that when there is no real-time feedback, they are less motivated to continue posting comments and they feel they are posting to a non-responsive network. Therefore, providing timely feedback could have improved student participation in all aspects of the course.

As mentioned in the literature review, there are some characteristics of students that impact their online interaction and engagement such as course clarity, task design, academic integrity, active discussion, feedback, technical support and academic support. This study examined a sense of presence, technology aptitude, individual motivation and communicationality for the individual and behavioural characteristics category. Also included were organising information, accessibility, functionality, polls and quizzes, visualising ability, live updates and quick feedback for course-related and technology design factors. For better understanding, the results of this research and findings are depicted through CLDs.

Implication for researchers and practitioners

This research results in significant findings for theory and practice. There are a number of implications for this research:

(1) The potential implication of CLD representations for instructors, university faculties, students and learners, course designers and conveners is that they provide an overall picture of the various factors influencing online interaction

and engagement in online learning. This allows educators to take into account these factors when designing an online course in order to promote and cultivate online interaction and engagement, thus facilitating better student academic performance and satisfaction.

(2) In addition to having several practical implications, these results could also assist researchers, particularly new researchers, understand these factors in a very convenient way. More importantly, CLD representation can depict the causes and effects of all important parameters of online learning as well as their internal relations and interplay, the knowledge of which is essential for conducting comprehensive research, and which enables instructors and researchers to select the factors most relevant to their work.

(3) By gaining knowledge of these factors, practitioners are better positioned to improve students' online interaction and engagement by effectively manipulating and controlling these traits. For instance, if a learner's communicational ability is a factor which has a positive impact on online interaction, instructors using this educational expertise will be able to increase online interaction in their courses by working in this specification or try to improve the functionality and visual ability of the medium they use.

(4) In addition, the students can be made aware of those features which depend on their own characteristics and encouraged to try to improve on them. Investigating the aspects of online education that have not been considered in past research will enrich the literature and enhance the impact of existing works. This contribution will further assist researchers, provide a better understanding of these fields and give direction to their future, as well as to identify gaps in the body of knowledge in this area

Research limitation

There were some limitations to our study, such as the data were collected from one online course on the subject of e-commerce. Drivers that influence online interaction may differ from other students' perspectives because they are students seeking to learn electronic commerce and business and are more familiar with the technology, and it could be a future work to investigate on students of a different area of study. Moreover, we conducted research in a course in which social media was used as a tool for promoting interactions and engagement; this context may limit their students' opinions regarding online interaction.

Conclusion

In addition to various interactive opportunities available in the online environment, opportunities for improvements in online education, particularly in the area of interaction, are possible and necessary given that high levels of interaction have positive effects on the learning experience. Failure to adequately consider the relational dynamics in online learning environment (OLE) may incur feelings of isolation in online courses, decrease student satisfaction, cause deficient learning outcomes and performance, and result in high attrition rates. Therefore, exploring and elaborating the different parameters and factors contributing to higher and more effective interaction in online courses was the main subject of this discussion. The objective of this

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research is to extract different elements and features of online learning which have a direct impact on students' online interaction and engagement from a rich set of qualitative data. The contributing factors of the findings of this study can be divided into two main categories: *individual and behavioural characteristics* and *course-related and technology design factors*. This grouping indicates that different aspects of educational drivers influence online interaction and involvement in an online course.

In this study, rich qualitative data have been collected and thematic analysis was conducted to identify factors that contribute to learners' online interaction. The results illustrated by CLD diagrams indicate that various factors have direct positive impacts on students' engagement and satisfaction, including:

- Accessibility
- Functionality
- Group discussion
- Students' communicationality
- Technology aptitude, etc.

The results also show that there are factors that have negative influences such as time consumption and distraction. The comprehensive CLD (Figure 5) illustrates all the factors and features with their causal relationships. This illustration can help researchers, course conveners and students improve online interaction and engagement in online learning educational systems.

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