Synchronous or Asynchronous? Investigating the Impact of Online Learning Overload on Student Outcomes

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ABSTRACT

The shift to online learning (i.e., classes conducted remotely through platforms such as Zoom and Blackboard) due to the COVID-19 pandemic has resulted in students experiencing online learning overload, leading to adverse impacts on their experiential and learning outcomes, and calling into question the sustainability of online learning. Drawing on the media synchronicity theory, this study aims to investigate how a mismatch between the modes of a communication application (i.e., synchronous, or asynchronous) and the type of communication process (i.e., conveyance or convergence) can result in students experiencing online learning overload. We conceptualize online learning overload as composed of technology related overload, information overload and extraneous cognitive load. We investigate how the three overloads negatively affect student performance and student satisfaction. The study contributes to improving the online learning process by emphasizing the importance of fitting the capabilities of the communication application to the communication process.

Keywords: technology related overload; online learning; information overload; media synchronicity; cognitive load

INTRODUCTION

COVID-19 led to schools shutting across the world, causing the largest disruption of education in living memory, and affecting learners and teachers from all kinds of educational establishments including universities (United Nations, 2020). Preventing the learning crisis that ensued from becoming a generational catastrophe, has been identified as a top priority by the United Nations, not only for the education community, but also for society at large (United Nations, 2020). The defining change in education has been the distinctive and dramatic rise of online learning, whereby teaching is undertaken remotely and solely through digital platforms (Li & Lalani, 2020). Development and use of sustainable online learning applications is an important step toward helping students and educators dealing with this change.

While some worry that the hasty nature of the transition may have hindered the goal of an effective method for educating students, others plan to make online learning part of their 'new normal' after experiencing the benefits (Li & Lalani, 2020). A key barrier to the latter is the exposure of

students to overload relating to the use of communication applications used in online learning (ex. Zoom, Moodle, Blackboard), and its potential non-beneficial impacts on key student outcomes (Chen, Pedersen, & Murphy, 2012), (Wang, Fang, & Gu, 2020), an area that current literature does not tackle. The objective of this paper is thus to investigate the impact of the three types of overloads, namely, technology related overload, information overload and cognitive load, on students' learning experience and outcomes. We investigate how a mismatch or poor fit between the mode of the communication application used for online learning and the communication processes involved in learning could be a source of online learning overload that can result in an inferior learning experience.

LITERATURE REVIEW AND THEORY

Media Synchronicity Theory

Using the fit appropriation model, the **Media Synchronicity Theory (MST)** posits that the fit of media capabilities to the communication needs of the task influence the appropriation and use of media, which in turn influence communication performance (Dennis, Fuller, & Valacich, September 2008). As per the theory, media synchronicity is the extent to which the capabilities of a communication medium enable individuals working together to achieve synchronicity and a common focus.

There are two type of communication media, synchronous and asynchronous. Application features such as video conferencing and instant messaging support synchronous communication whereas email and discussion boards support asynchronous communication. An increasing number of communication applications have features supporting both synchronous and asynchronous communication. Conveyance and convergence are the two primary processes of communication. Conveyance processes include the transmission of a diversity of new information to enable the receiver to create and/or revise a mental model of the situation (Dennis, Fuller, & Valacich, September 2008). In convergence, the objective is to agree on the meaning of the information, which requires individuals to reach a common understanding and to mutually agree that they have achieved this understanding.

When the needs of conveyance and convergence processes are matched to appropriate modes of the communication application better communication performance is achieved. We apply MST to show how the learning task performance is affected by the communication applications used in

online learning. Here, conveyance refers to the way information is disseminated to and gathered by the students. Convergence refers to how well the interpretation and meaning of the discussion material is mutually agreed upon by the instructor and other students in the class.

Online Learning Overload

We define online learning overload as the distress resulting from the perception that the demands of the online course are excess and overwhelming to the extent that they interfere with learning the content. From existing literature, we find that communication applications may induce three types of overloads, namely techno-overload (Tarafdar, Tu, & Ragu-Nathan, 2010), information overload (Williamson & Eaker, 2012) and extraneous cognitive load (Klepsch, Schmitz, & Seufert, 2017), (Chen & Wu, 2015). Any experience of overload can lead to confusion, poor knowledge construction (Chen, Pedersen, & Murphy, 2012), distractibility, infobesity, attention deficit and even stress (Bawden & Robinson, 2009).

In this study we refer to techno-overload as *technology related overload* (adapted from Tarafdar, Tu, & Ragu-Nathan, 2010) where the communication application forces students to learn faster and for longer periods of time than in traditional face-to-face learning. *Information overload* refers to the distress associated with the perception that there is too much information (Williamson & Eaker, 2012). *Extraneous cognitive load* is explained by Cognitive Load Theory (Sweller, van Merrienboer, & Paas, 1998). It refers to the mental effort imposed by instructional activities, design, and presentation, on the learner. As deduced from (Klepsch, Schmitz, & Seufert, 2017) and (Chen & Wu, 2015) extraneous cognitive load can be triggered by the technology used for instruction.

RESEARCH MODEL AND HYPOTHESES

Figure 1 shows the research model with five constructs and six of eight hypotheses. The paper examines asynchronous, and synchronous features of communication applications for two different communication processes: conveyance and convergence. Based on MST, factors that have implications on communication performance are a student's familiarity with the instructor, other students in the class, with the study topic and with the communication application.
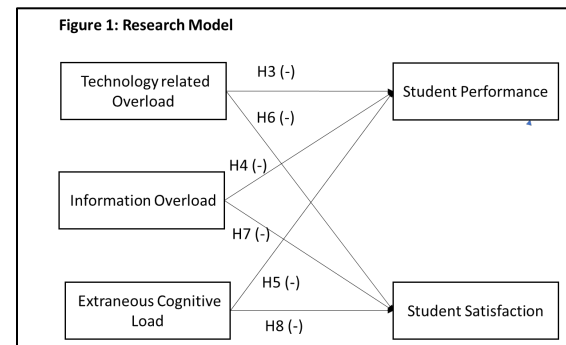
Conveyance processes and online learning overload
The conveyance process in the online learning context may involve transfer of information about a new subject by the instructor to the students. Asynchronous communication applications such as recorded Zoom videos are better to use for conveyance of information because to process the information students require slow retrospective examination. Zoom recorded videos have features such as rewind, pause, and repeat that facilitate conveyance of information and generate less online learning overload while synchronous communication applications such as live Zoom sessions may not be suitable for conveying new information because they provide low support for the

student to deliberate. This can induce more online learning overload. We therefore hypothesize as below.

Hypothesis 1a, b, c: For **transfer of new information or learning content** by the instructor to the student (which is a conveyance process), use of **recorded Zoom videos** (an asynchronous communication feature) is negatively associated with (a) technology related overload; (b) information overload; and (c) extraneous cognitive load.

Hypothesis 1d, e, f: For **transfer of new information or learning content** by the instructor to the student (which is a conveyance process), use of **live Zoom sessions** (a synchronous communication feature) is positively associated with (a) technology related overload; (b) information overload; and (c) extraneous cognitive load.

Figure 1: Research Model

Convergence processes and online learning overload
In online learning, the convergence process refers to discussions between students and instructor so that they understand and agree to the interpretation of learning material. Synchronous communication applications such as live Zoom live sessions promote speedy transmission of perspectives and discussion for matching and agreement of differing views. Therefore, it is expected that they generate less of all three overloads. On the other hand, asynchronous communication applications such as Blackboard discussion boards may not be suitable for discussions and resolution of conflicting interpretations of the case material. We therefore hypothesize.

Hypothesis 2a, 2b, 2c: For **case discussions** among the students coordinated by the instructor (which is a convergence process), use of **live Zoom sessions** (a synchronous communication feature) is negatively associated with (a) technology related overload; (b) information overload; and (c) extraneous cognitive load.

Hypothesis 2d, 2e, 2f: For **case discussions** among the students coordinated by the instructor (which is a convergence process), use of **asynchronous Blackboard discussion boards** (an asynchronous communication feature) is positively associated with (a) technology related overload; (b) information overload; and (c) extraneous cognitive load.

Online Learning Overload and Student Performance
Student performance is a measure of learning effectiveness and academic achievement. Technology related overload is identified as a stress creator and affects task performance (Tarafdar, Tu, & Ragu-Nathan, 2010). Information overload leads to infobesity, distractibility and even

negative health outcomes that affect task efficiency (Bawden & Robinson, 2009). Extraneous cognitive load results into confusion and negatively impacts knowledge assimilation (Chen, Pedersen, & Murphy, 2012). We therefore hypothesize the following.

Hypothesis 3, 4, 5: Student performance is negatively associated with (a) technology related overload; (b) information overload; and (c) extraneous cognitive load.

Online Learning Overload and Student Satisfaction

Student satisfaction, an outcome of the student's evaluation of the course reflects how well the course met the student's expectations and how satisfied the student is after attending a given course. Excess overload may deter the student's learning expectations. We therefore hypothesize as below.

Hypothesis 6, 7, 8: Student satisfaction is negatively associated with (a) technology related overload; (b) information overload; and (c) extraneous cognitive load.

Table 1: Experimental Conditions
1. Conveyance process & Synchronous mode: Participants will be required to attend Zoom sessions and information will be disseminated by the instructor talking to class of students live.
2. Conveyance process & Asynchronous mode: Participants will be required to listen to recorded Zoom videos with features such as rewind, pause, replay. Information will be disseminated in the form of voiceover presentation by the instructor.
3. Convergence process & Synchronous mode: Participants will be required to attend live Zoom sessions in which the case discussion will be conducted by the instructor and student talking to each other with the aim to reach an agreement among students.
4. Convergence process & Asynchronous mode: Participants and instructor will discuss the case using Blackboard forum. The instructor will pose questions and initiate the discussion and students participate in it by posting responses to each other and the instructor to reach an agreement.

METHODOLOGY

Experimental Process and Analysis

At the time of submission, the study is at the stage of experiment planning. To test the research model, four experimental conditions will be set up as shown in Table 1. We plan to use Amazon MTurk to recruit students in the age group of 18 to 25 through a pre-screen survey to ensure that they are not familiar with the topic of study, and the communication application. To measure performance, all participants will be tested using post-experimental quiz.

POTENTIAL CONTRIBUTION

The study aims to contribute to the understanding of how online learning environments can be better designed to avoid the pitfalls of online learning overload that negatively impacts the learning experience. We intend to make three potential contributions. First, we provide a delineation of the three different kinds of overloads i.e.,

technology related overload, information overload, and extraneous cognitive load that have not been studied in IS literature in the online learning context. Second, we show that student outcomes can be lowered by a failure to address these types of overloads. Third, we expect to show that use of a platform that supports both types of communication media is the best for online learning.

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