Online learning in Geological Engineering during the Covid-19 pandemic

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Abstract

The undergraduate geoscience program concludes with a field-based capstone course that equips the graduating geologist with basic field-mapping abilities. However, many of the field-based geoscience programs have been temporarily halted or converted to an online version because of the COVID-19 outbreak. The South Dakota Mines created an online course to fulfill the demand for graduating seniors in the vast discipline of geoscience. Considering that this is a new way of delivering this course, it is important to understand the effectiveness of this online course. Thus, the main goal of the present study is to determine students' online learning satisfaction and its relationship with online learning self-efficacy. A total of 33 students participated in the study. Two instruments were used for this study: one for assessing online learning self-efficacy and the other for evaluating online learning satisfaction. Descriptive statistics and Pearson product correlation analysis were conducted to analyze data. The results indicated that students had high levels of self-efficacy beliefs and their learning satisfaction score was high as well. It was also found that self-efficacy to complete an online course was significantly related to learning satisfaction. Discussion of the findings and suggestions for online teaching and learning are given.

Keywords: Online learning; geoscience education; self-efficacy

1. Introduction

Online education has become very popular since it allows anybody to learn at any time, anywhere (Aparicio et al., 2017; Ithriah et al., 2020). With the use of various instructional media and at different times and/or locations, online education is a type of two-way relationship between the instructor and the students. As with any other form of education, online education has its pros and cons. For instance, can you teach geoscience students how to make a geological map during an online class session? Perhaps, no, just like you can't teach medical school students how to do surgery online. In geoscience education, it is mandatory to attend field geology courses for many geoscience departments that require

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students to go outdoors and observe rocks, structures, minerals, and many other geologic features at an outcrop in the field. Therefore, in geological field education, there are some disadvantages of teaching online courses that cannot be incorporated into field courses, but online learning content mixed with hands-on laboratory exercises and/or field trips will likely result in improved learning, especially during a pandemic when no one can participate in person in a geology field camp.

Given the positive learning outcomes of online course-delivery methods, it is surprising that so few centers of higher education offer online courses in geology. The recent Covid-19 pandemic forced many higher education institutes to either cancel or transfer their field geology classes to the online platform. The Black Hills Natural Sciences Field Station of the South Dakota Mines developed a hybrid online field methods course with hands-on activities in the field in 2020. Geoscience students first took three-week-long online field methods in geology course before an opportunity to participate in a field-based mapping course which continued for another three weeks (Rotzien et al., 2021).

Considering that this is a new way of delivering this course, it is important to understand the effectiveness of this online course. Student engagement is the most important portion of the online class experience, yet it frequently gets the least amount of attention. In fact, the slight increase in completion of coursework found in online classes indicates that students in an online class are slightly better at submitting coursework, which may be related to the self-paced nature of learning online and the flexibility it offers students. Recent studies showed that online learning platforms have a greater drop-out rate than traditional education settings (Ali and Leeds, 2009; Shen et al, 2013). According to some experts, a lack of self-efficacy is a contributing factor to the drop-out rate (Lee and Choi, 2011; Shen et al, 2013). Understanding self-efficacy in online learning is essential to improve online education since researchers have stated that due to the self-directed nature of online learning, self-efficacy can be a critical component of academic performance in online education (Hodges, 2008; Shen et al, 2013). Thus, the main goal of this research is to determine students' online learning satisfaction and its relationship with online learning self-efficacy.

2. Literature review

2.1. Self-Efficacy

Social Cognition Theory, which was developed by Bandura (1977), is based on the idea that self-efficacy is fundamental to human cognition. Pituch and Lee (2006) defined self-efficacy as "confidence in one's ability to complete specific learning tasks utilizing an online learning system" in the context of e-learning. According to Li (2012), self-efficacy is the belief that one is capable of accomplishing a given task. It can also be explained as that if a person believes they can complete a task, they are more likely to do so, and vice versa.

Computer self-efficacy is a strong indicator of Web-based distance education courses (Lim , 2001). Few studies have been conducted on self-efficacy with online learning before the COVID-19 pandemic, and the majority of previous studies in this field have been more focused on self-efficacy related to technology (computers, learning management systems, and the internet). According to Shen et al. (2013) there are at least two factors to take into account when talking about online self-efficacy: technology and learning, however most researchers simply take the technological side of online learning into account. Self-efficacy in online learning has therefore been disregarded. Several tools have been developed that measure various aspects of self-efficacy regarding virtual, online, and distance learning. The Online Learning Self-Efficacy Scale (OLSES), introduced in 2016 by Zimmerman and Vulakovich, is one of these scales (Ahmadipour, 2021). According to Cicha et al. (2021) the two factors that have the biggest emotional effects on students and influence their decision to use an online learning approach are satisfaction and self-efficacy. According to Alqurashi (2019), students won't try to take the necessary actions to attain if they think they can't get the results they want. High self-efficacy students, on the other hand, view challenging activities as opportunities to build their talents rather than obstacles to be avoided, which could improve learning and performance and increase satisfaction with the achievements. Shen et al. (2013) described how student satisfaction is impacted by and linked to self-efficacy for online learning. Furthermore, Alqurashi (2019), showed that the most reliable predictor and important contributor to perceived learning in online contexts is online learning self-efficacy.

2.2. Online learning satisfaction

Self-efficacy has been identified as an accurate indicator of students' learning satisfaction in online learning environments (Shen et al, 2013). Among 440 government agency employees who were enrolled in training courses, Womble (2008) examined the relationship between e-learning self-efficacy and e-learner satisfaction and found a significant and beneficial relationship between them. Lim (2001) examined the relationships between the computer self-efficacy, academic self-concept, satisfaction, and future participation of adult distance learners. According to the findings of numerous research, computer self-efficacy was a significant predictor of both online learners' satisfaction and their intention to sign up for additional online courses in the future. Lin et al. (2008) investigated students' task value, self-efficacy, social skills, and learning satisfaction. According to their findings, self-efficacy, task value, and social ability all had a significant impact on online learning satisfaction among participants in 11 online courses in a distance learning program. The success of online learning programs is reportedly influenced by a number of student-related aspects, including time management skills, satisfaction and commitment with online education systems, an online classroom setting, and student self-efficacy. Online learning self-efficacy is one of these variables that helps students adjust to the online learning environment and plays a significant role in academic

achievement (Ahmadipour, 2021; Cole et al., 2014; Yavuzalp and Bahcivan, 2020). According to Shen et al. (2013), demographic factors such the number of online courses taken, gender, and academic standing were found to predict students' online learning self-efficacy, which in turn predicted their online learning satisfaction with the course. According to Simsek et al. (2021), students prefer in-person education and that they are only somewhat satisfied with online learning because they struggle with factors such as individual learning, time management, motivation, and socializing. The attitude and satisfaction of the students are positively impacted by providing enjoyment and self-efficacy in the online learning process. According to studies, the lack of interaction during the online education process is what leads to dissatisfaction(Simsek et al., 2021).

Considering the pros and cons of the online learning, as fairly a new way of delivering a course, it is important to understand the effectiveness of the online course. Thus, the main goal of the present study is to determine students' online learning satisfaction and its relationship with online learning self-efficacy.

To this end, the following research questions were specified as in the following:

1-What are the levels of geoscience students' online learning satisfaction and online learning self-efficacy?

2-To what extent is self-efficacy related to geoscience students' online learning satisfaction?

3. Methods

3.1. Research Design

The main goal of the study is to ascertain how satisfied students are with their online education and how that correlates with self-efficacy. Quantitative research methods were used for this objective. The collection and analysis of quantitative data were done. Quantitative methods are said to be unbiased and trustworthy by Taylor & Trumbull (2005). Quantitative research is used to define a particular phenomenon and show how it can be managed using various interventions. In quantitative research, the researcher is impartial and the data is gathered using impartial tests. The descriptive correlational design was used as a quantitative research technique in this study. The primary objective is to present static images of situations and establish the relationship between various variables (McBurney & White, 2009). Correlational research examines two variables to determine their relationship. The current situation can be depicted using descriptive correlation design.

The data was obtained from the South Dakota Mines' online geoscience course using the information provided above. Faculty use online platforms such as D2L and Zoom to deliver

live online content as well as pre-recorded lectures and tutorials. Sharing files with students is a common strategy. One of the study's authors taught alongside five other instructors, and permission was obtained to conduct the research in the online course. The enrollment letter and the link to the online survey were then posted on a message board by the researcher. In addition, the instructor encouraged students to participate in the research. After completing the online consent form, students were directed to the website to complete the online survey.

3.2. Research Sample

Students taking an online course at the time of the research participated. Thirty-three distance learning college students agreed to take part. There were a total of 29 students, 18 (54.5%) of whom were female and 15 (45.5%) of whom were male. The participants' ages ranged from 20 to 31, with the largest single grouping (20-25) indicating a relatively young cohort of students. Everyone involved was in college with the intention of earning a bachelor's degree. For specific demographic data, please refer to Table 1.

Table 1. Age, Gender and Online Classes Taken of the Participants

		N	%
Age	20-22	16	48.5
	23-25	12	36.4
	26-28	4	12.1
	29-31	1	3.0
Gender	Male	15	45.5
	Female	18	54.5
Online classes taken	1-2	10	30.3
	3-5	19	57.6
	6+	4	12.1

3.3. Research Instrument and Procedures

This study employed two instruments to assess online learning self-efficacy and online learning satisfaction, respectively. All participants were asked to fill out a self-reported survey about their demographics, including their gender, educational level, and number of

online courses they've taken. The number of online courses taken by participants as of the survey's release was requested.

3.3.1. Online learning self-efficacy scale

Shen's et al.'s (2013) online learning self-efficacy scale was adopted for this study. The eight-item self-efficacy scale to complete an online course scale was utilized because it provides a summative approach to self-efficacy in online learning environments. Online course's students were polled on their level of self-assurance while performing a variety of tasks. They gave their answers on a scale from 0 to 10, with 0 meaning "cannot do at all" and 10 meaning "highly confident can do." Results showing greater confidence in one's ability to learn online were given higher scores.

3.3.2. Learning satisfaction scale

21 items were used to gauge how satisfied people were with their online education on a scale of 1 to 5, where 1 represented "strongly disagree" and 5 represented "strongly agree." They were modified based on Lin's (2005) study.

3.4. Data Analysis and Process

The SPSS (Statistical Package for the Social Sciences) was initially used to compute descriptive statistics like medians, mode, and ranges (SPSS). Correlation coefficients based on Pearson's method were calculated after the primary statistical analysis was performed (e.g. control of normality and linearity).

4. Results

4.1. Findings about the First Research Question

For the first research question, geoscience students' online learning self-efficacy and online learning satisfaction levels were investigated.

To share their perceptions of their self-efficacy for online learning, online course's students were polled on their level of self-assurance while performing a variety of tasks. They gave their answers on a scale from 0 to 10, with 0 meaning "cannot do at all" and 10 meaning "highly confident can do." Results showing greater confidence in one's ability to learn online were given higher scores. The table below contains descriptive statistics, such as mean and standard deviations, that were obtained. The mean value of all the self-

efficacy factors was above 7.85 out of 10, and students typically had high levels of self-efficacy beliefs.

Table 2. Online Learning Self-efficacy Levels

How confident are you that you could do the following tasks in the Online Course?	Mean	SD
Complete an online course with a good grade	7.90	1.94
Understand complex concepts	7.48	1.76
Willing to face challenges	8.18	1.94
Successfully complete all of the required online activities	7.78	1.72
Keep up with course schedule	7.75	2.07
Create a plan to complete the given assignments	7.96	1.72
Willingly adapt my learning styles to meet course expectations	7.84	2.13
Evaluate assignments according to the criteria provided by the instructor	7.93	1.56
Total	7.85	1.46

By means of online learning satisfaction survey, learning satisfaction score of the participants was calculated (Table 3). The results indicated that learners were highly satisfied with their online geoscience course as well, with a mean value of 4.32.

Overall, the students had a favorable impression of the online format. The highest mean score (mean=5.30) was given to item 11 (I developed knowledge and competencies in this course), followed by item 19 (The mentors assisted me in solving problems and meeting my needs for assistance) with a mean score of 4.96, and item 14 (The knowledge and competencies taught through the course activities are meaningful and important to me) with a mean score of 4.93. For that reason, these elements were chosen as the most important parts of this geosciences-related online course.

Table 3. Online Learning Satisfaction Levels

Online Learning Satisfaction Items	Mean	SD
1- If I had a chance to take another course similar to the one I am taking now, I would be happy if it used D2L.	4.21	1.38
2- If I had a chance to take another course similar to the one I am taking now I would be happy if was being taught in the Zoom.	3.48	1.60
3- If I had a chance to take another course similar to the one I am taking now and it used D2L I would be confident that I could do well.	4.12	1.21
4- If I had a chance to take another course similar to the one I am taking now and it was taught in the Zoom I would be confident that I could do well.	3.78	1.59
5- If I had the chance to teach a course I would like to use software similar to D2L.	3.90	1.50
6- If I had the chance to teach a course I would like an environment similar to the Zoom.	3.36	1.83
7- Course learning objectives were clear.	4.81	1.15
8- I usually have a clear idea of where I am going and what is expected of me in this course.	4.42	1.14
9- The teaching materials for this course are extremely good at explaining things.	4.63	1.11
10- The course really tries to get the best out of all the students.	4.84	.97
11- I developed knowledge and competencies in this course.	5.30	.95
12- The course activities were a good fit for the way I like to learn.	4.03	1.51
13- The course activities met my expectations for what I had hoped to learn.	4.78	1.08
14- The knowledge and competencies taught through the course activities are personally meaningful and important to me.	4.93	.93
15- D2L effectively helped me know what to do and easily access course materials.	4.39	1.22
16- Zoom effectively helped me communicate with others in the course.	3.81	1.59
17- D2L effectively helped me present my work to others in the course and complete assignments.	4.09	1.25
18- I am satisfied with using D2L in this course.	4.48	1.22
19- The mentors helped me solve problems and met my needs for assistance.	4.96	.91
20- I am satisfied with the physical space of the D2L.	4.21	1.26
21- I am satisfied with the web-based supports from the D2L.	4.12	1.21
Total	4.32	1.26

4.2. Findings about the Second Research Question

4.2.1. The Nature of the Relationship Between Students' Online Learning Satisfaction and Online Learning Self-Efficacy

   After conducting some basic statistical tests (such as ensuring that the data is normally distributed and linear), we calculated Pearson correlation coefficients and found a positive, statistically significant relationship between the two variables.

   A significant correlation (r(33) =.481, p.01) was also discovered between students' online learning satisfaction and online learning self-efficacy (Table 4). This relationship also suggests that learners' online learning self-efficacy level would have a great effect on their online learning satisfaction.

Table 4. Relationship Between Students' Online Learning Satisfaction and Online Learning Self-Efficacy

	1	2	3	4
Online learning satisfaction	1			
Online learning self-efficacy	.481**	1		

**. Correlation is significant at the 0.01 level (2-tailed).

5. Discussion and Conclusion

   In this study, it was discovered that students scored highly on both learning satisfaction and self-efficacy beliefs. Additionally, it was discovered that learning satisfaction and self-efficacy were significantly related.

   This study's findings corroborate those of previous research showing that students who take an active role in their own education have a higher chance of succeeding in online courses (Whipp & Chiarelli, 2004; Yukselturk & Bulut, 2007; Zimmerman, 2002). Increasing students' self-assurance in their capacity to succeed at academic work provided to them online might be a good first step in that direction. Fostering a sense of confidence in students' abilities to succeed in the course can improve their overall performance in an online course. The foundation for a long-lasting sense of mastery will be laid by constructive criticism and specific recommendations for how a student can improve their performance in light of that criticism, which has significant implications for online teachers (Bandura, 1997; Yukselturk & Bulut, 2007).

   Teachers who are invested in their students' academic success must be able to recognize the symptoms of low self-efficacy and help their students develop coping mechanisms. Without first being given the confidence in their own abilities to regulate their own behavior, students may not retain the skills they have learned. In addition, instructors of

fully online courses need to be aware of the many ways in which their students' experiences differ from those in a traditional classroom and modify their teaching strategies accordingly. When compared to their face-to-face counterparts, online educators have an even greater responsibility to address students' lack of confidence in their own abilities.

Whether or not a student believes they have the skills necessary to complete an online course is the most important factor in how satisfied they will be with their online education. Online instructors can aid their students in completing courses by providing coregulation opportunities, such as monitoring students' course participation and encouraging them to finish the course on a regular basis (Shea, Li, & Pickett, 2006). Particularly for less seasoned online students, routine monitoring can reveal a student's lack of participation or assignment submissions. Then, as students engage in activities or complete assignments, online teachers can provide instant feedback and guidance.

Acknowledgements

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