

Factors Affecting Student Satisfaction, Perceived Learning and Academic Performance in an Emergency Online Science Course

Marissa Fearnley, Christopher Malay, and Jose Noel Fabia

Abstract—The COVID-19 pandemic has caused massive disruptions in the global academic calendar, including the Philippines. To address this, emergency remote teaching was implemented as a viable alternative to face-to-face instruction without contributing to the spread of the disease. This investigation sought to examine the factors that affect student satisfaction, perceived learning and academic performance in an emergency online science course namely, online learning self-efficacy, learner-content interaction, learner-instructor interaction and learner-learner interaction. Data from 104 college students were collected using an online survey and analyses were done by applying correlation and regression methods. In general, college students had favorable views about their online learning experience. Significant and positive associations were found between the dependent and independent variables with academic performance obtaining the weakest correlation. Online learning self-efficacy had a significant influence on perceived learning and academic performance but not student satisfaction. Learner-content and learner-instructor interactions were revealed to be strong predictors of student satisfaction and perceived learning. Learner-learner interaction did not have a meaningful impact on any of the three outcome variables.

Index Terms—Academic performance, emergency remote teaching, learner interactions, online learning self-efficacy, perceived learning, student satisfaction.

I. INTRODUCTION

The COVID-19 pandemic has caused tremendous disruptions in all aspects of human life including health, economy, and education [1], [2]. As a result of this global health crisis, colleges and universities worldwide have reevaluated how they deliver instruction by exploring distance education to facilitate learning [3]. Approximately 28 million Filipino students of varying grade levels were affected when lockdown measures and movement restrictions were enforced to curb the spread of SARS-Cov-2 infections [4]. To optimize learning opportunities during the pandemic, the Commission on Higher Education (CHED) in the Philippines recommended the use of flexible distribution schemes using instructional technologies and other accessible means [5] and offered colleges and universities the option of adopting institution-specific policies on the

resumption of classes [6]. All over the world, online learning has become a common instructional delivery method to enable learners to continue with their education [7].

Online education pertains to learning and teaching that is facilitated by the Internet [8]. It leverages Internet technologies to deliver course content in either synchronous or asynchronous mode, and is not contingent on the physical presence of instructors and students to facilitate the teaching and learning process [9]. Online learning resolves spatial and temporal concerns by allowing students to study from home while teachers work remotely, thereby offering flexible learning and teaching arrangements. During the pandemic, many higher education institutions (HEIs) implemented online learning to carry on with their mission without contributing to the spread of COVID-19 [10].

The sudden shift to online instructional delivery in response to the pandemic, however, resulted in the emergence of the concept called emergency remote teaching, or ERT [11]. It is viewed as a critical measure to ensure that disruptions are minimized, and educational goals are achieved despite the outbreak [3]. Moreover, ERT as a re-engineered form of distance education is an obligation and should be considered as a temporary solution to the current pandemic situation [12]. ERT presupposes that the shift is impermanent, such that instruction will go back to how it was when the critical circumstance abated [13]. Unlike conventional online learning, instructional delivery during ERT had to be planned and facilitated by educators from their domiciles where technical support is not readily available [11].

This investigation examined the factors that affect student satisfaction, perceived learning and academic performance in an emergency online science course namely, online learning self-efficacy, learner-content interaction, learner-instructor interaction and learner-learner interaction. Specifically, the present study sought to answer the following research questions (RQs):

RQ 1a: How do learners describe their learning experience in an emergency online science course in terms of the following:

- 1) online learning self-efficacy,
- 2) learner-content interaction,
- 3) learner-instructor interaction,
- 4) learner-learner interaction,
- 5) student satisfaction, and
- 6) perceived learning?

RQ 1b: How do learners perform academically in their emergency online science course?

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Marissa Fearnley is with De La Salle – College of Saint Benilde in Manila, Philippines (e-mail: marissa.fearnley@benilde.edu.ph).

Christopher Malay is with Kolehiyo ng Lungsod ng Dasmariñas in Cavite, Philippines (email: cmalay@kolehiyonglungsodngdasma.onmicrosoft.com).

Jose Noel Fabia is with De La Salle University Manila, Philippines (e-mail: jose_noel_fabia@dlsu.edu.ph).

RQ 2: To what extent are student satisfaction and perceived learning associated with online learning self-efficacy, and the three types of learner interactions (i.e., with content, the instructor, and other learners) in an ERT setting?

RQ 3: In an ERT setting, what are the measures of influence of online learning self-efficacy and the three types of learner interactions (i.e., with content, the instructor, and other learners) on

- 1) student satisfaction?
- 2) perceived learning?
- 3) academic performance?

This study offers a comparison between convention online learning and ERT with respect to the relationships that exist among the factors affecting student satisfaction, perceived learning, and academic performance. Findings from this work add to the body of knowledge that examines online learning outcomes during an emergency situation like the COVID-19 pandemic.

The succeeding sections of this paper will present a review of related literature, elaborate the methods used, discuss the results, and outline the conclusions derived from this research, including study limitations.

II. LITERATURE REVIEW

This investigation aims to compare important aspects of ERT and online learning by exploring the extent of the relationships among factors that affect learning in an online environment. It augments the work of Alqurashi [14] by including academic performance as another learning outcome linked to online learning self-efficacy and learner interactions.

A. Student Satisfaction, Perceived Learning and Academic Performance

Several ERT-related studies have emerged in the last two years to explore how students perceive this online approach to instruction and examine possible relationships with relevant variables [15]-[20]. One of the most important factors in evaluating online courses is whether students are satisfied with their experiences [14]. Student satisfaction is an essential component of learning since it is linked to academic success and sustained engagement in online programs [15]. The level of satisfaction expressed by students in an online course is a valuable area of investigation because educational technologies have transformed teaching and learning interactions in this setting [21], [22]. Likewise, perceived learning is regarded as a good measure of what students have learned based on their own perceptions. Students who feel they have mastered course topics are more likely to participate actively in online classrooms [14]. Together with students' perceived learning and satisfaction, it can provide a more complete picture of success in an online setting [23]. Academic performance is another index of student success that can inform decisions about the effectiveness of online learning [24]. According to [25], it is a significant cognitive variable that impacts students' learning experiences.

B. Online Learning Self-efficacy

Self-efficacy was also found to be a key factor in achieving academic success while studying online [14], [15]. According to [26], self-efficacy refers to how a person judges his or her own abilities to carry out a set of actions to perform a given task. This means that those with higher self-efficacy are more likely to exert greater effort that will result in favorable outcomes than their counterparts who feel less self-efficacious [27]. Translated to an online environment, individuals who have low online learning self-efficacy tend to give up too soon and fall short of expectations. The investigation conducted by [28] examined how attitude, motivation, self-efficacy, and technology use all contribute significantly to students' cognitive engagement and academic achievement. Data collected from 298 undergraduate and graduate students in the United States showed that following the change in instructional delivery (i.e., from F2F to online learning), motivation, self-efficacy, and cognitive engagement declined, but technology use improved. On the other hand, findings from the survey responses of 1226 university students in Saudi Arabia showed that learners' satisfaction with online learning was positively and significantly correlated with different aspects of online learning self-efficacy [15] during the emergency transition. Similar results were obtained from a mixed-method study that sought to investigate how engineering students in Qatar transitioned to online learning during the pandemic. Students expressed positive self-efficacy views about learning online and indicated confidence in their abilities to manage online tools, obtain material for course needs from Internet sources, and interact successfully with classmates and instructors [1]. It was pointed by [29] that universities should motivate learners to use prior knowledge and skills to help them attain self-efficacy during ERT. In the study of [18], high online learning self-efficacy was found to be positively linked to online self-regulation which is likewise correlated with academic success.

C. Learner Interactions

Interaction is a crucial part of online learning as well. According to [30], how learners interact with the course content, the teacher, and their classmates must be understood when it comes to delivering education remotely (i.e., distance education). Likewise, these three forms of interaction were identified by [31] to be meaningful contributors to an effective online learning experience. Findings from the investigation of [32] among 205 university students in Jakarta revealed that learner interaction with content, the instructor, and other learners positively affected satisfaction towards online learning during the COVID-19 pandemic. In Malaysia, 322 pre-university students were surveyed to examine how the three types of interaction are associated with student satisfaction. Results indicate that learner-content interaction is the strongest predictor of satisfaction in online learning, while learner-instructor interaction is the weakest [33]. Related studies reported a positive relationship between student satisfaction and interaction among Chinese [34], and Sri Lankan students [35]. The effects of variables related to content and interaction were also investigated among students of an online Master of Business Administration

(MBA) program. This study found that the interaction variables had no significant effect on perceived learning, and only learner-instructor interaction was found to affect course satisfaction significantly and positively [36].

III. METHODOLOGY

This section will characterize the respondents, describe the research instrument, and discuss data analysis methods.

A. Participants

A total of 115 college students pursuing different degree programs at a private HEI in Manila, Philippines voluntarily responded to an online survey that asked about their online learning experience during the first term (i.e., September to December) of the academic year 2020-2021. All learners were enrolled in Science, Technology and Society (STS), a general education science course that was facilitated fully online due to the pandemic. During the 14-week academic term, synchronous and asynchronous sessions were equally facilitated. Attendance to the synchronous meetings was optional and video recordings of these sessions were made available to all students through Brightspace, the learning management system (LMS) of the institution. Brightspace is a proprietary cloud-based LMS developed by the Desire2Learn Corporation [37], [38].

An electronic link to the online survey was sent to the respondents through the LMS. Respondents were informed of the content of the survey and informed consent was sought. Compliance to data privacy guidelines were observed and respondents' identity remained anonymous all throughout the investigation. After removing duplications and omitting erroneous entries, only 104 responses were included in the investigation.

From the 104 respondents, 68 (65.38%) were females, 35 (33.65%) were males, while 1 (0.96%) respondent preferred not to say (Table I). With respect to year level, there were 79 (75.96%) first year, 20 (19.23%) second year and 5 (4.81%) third year students. More than half of the respondents were enrolled in 10-12 course units (55.77%) while others were enrolled in 7-9 (23.08%), 4-6 (14.42%), and 1-3 (6.73%) course units during the conduct of the study, respectively. Based on degree program, majority (74, 71.15%) of students were from the design and arts (DAA), while 28 (26.92%) from management and information technology (MIT), and 1 (0.96%) each from the culinary, hospitality and tourism (CHT) and the diplomacy and governance (DAG) clusters. More than 75% of these students reported having no previous online learning experience.

B. Data Collection

The research instrument consisted of three parts namely, consent agreement, demographic profile, and survey items. The first part obtained respondents' agreement to voluntarily participate or withdraw from the study after a sufficient explanation of the research objectives. The demographic profile asked about respondents' gender, year level, academic program, the number of units enrolled in, and previous online learning experience. The third part consisted of items related to online learning self-efficacy, types of

interaction in an online learning environment (i.e., learner-content interaction, learner-instructor interaction, and learner-learner interaction), course satisfaction, and perceived learning.

This study adopted with permission the questionnaire developed by [14]. The same instrument was reviewed and validated by the research officer of the college prior to dissemination. Reported internal reliability using Cronbach's alpha ranged from 0.79–0.95 [24] while computed internal reliability ranged from 0.83–0.95.

The instrument consists of 29 items from six predictors. The first predictor is online learning self-efficacy (OLSE) which consists of 8 items that measure learners' level of confidence in performing their online tasks, activities, and other responsibilities related to the subject matter. The next three predictors pertain to learner interactions in an online environment namely, learner-content interaction (LCI with 4 items) which refers to the interaction between the learner and the subject matter, learner-instructor interaction (LII with 6 items) which involves the two-way communication between the learner and teacher of the subject matter, and learner-learner interaction (LLI with 8 items) which notes reciprocal communication among learners during the collaboration related to the subject matter. Student satisfaction (SS) is a two-item predictor that indicates students' perceptions on the quality of their online learning experience [14]. Lastly, perceived learning (PL) has to do with students' estimates of how much they learned in the course. An additional item was added to this predictor which asks how well students, in their perception, achieved the learning outcomes of the course. All in all, there were 30 items in this part of the instrument.

All dimensions are presented in a 5-point Likert-type scale. For OLSE, a score of 1 denotes low self-efficacy while 5 indicates high confidence in doing tasks. For SS, LCI, LII, and LLI, a mark of 1 indicates strong disagreement while 5 means strong agreement. For PL, a mark of 1 implies "not well" and 5 means "extremely well". Means were interpreted as "very low" (1.00–1.80), "low" (1.81–2.60), "moderate" (2.61–3.40), "high" (3.41–4.20), and "very high" (4.21–5.00) [39].

To measure academic performance (AP), students' final grades in the course were requested from the chairperson of the science department. To maintain confidentiality, only the student identification numbers (i.e., a unique 8-digit identifier obtained from the survey) corresponding to the 104 respondents were furnished to the department. Consequently, students' final grades in STS were retrieved by the chairperson and electronically relayed to the research team.

C. Data Analysis

Descriptive statistics (e.g., mean, standard deviation, etc.) were used to describe respondents' online learning experience and course grades. Data from the study showed non-normality based on the results of skewness and kurtosis (i.e., -2.34–2.39). In such a case, Spearman's rho was employed to measure correlation among the relevant study variables. The interpretation of Spearman's rho was based on the categories of [40] as follows: weak (0.1 – 0.3), moderate (0.4 – 0.6) and strong (0.7 – 0.9). Multiple regression was

carried out to assess the predictive relationships between the independent variables (i.e., OLSE, LCI, LII, and LLI) and dependent variables (i.e., SS, PL, and AP). All statistical analyses were performed using SPSS version 23.

IV. RESULTS AND DISCUSSION

This study sought to describe learner’s experience in an emergency online science course and examine the relationships among variables that have been found to significantly impact online learning.

A. Descriptive Analyses of Variables

1) Online learning self-efficacy

Self-efficacy plays a vital role in online learning [41]. Table I shows the mean scores obtained when learners were asked about their confidence in performing related tasks while learning online. Means for the OLSE items ranged from 3.66–4.31, with the statement “*Successfully complete ALL required online activities*” ranked highest ($M = 4.31, SD = 0.86$) and the statement “*Understand complex concepts*” rated lowest ($M = 3.66, SD = 0.94$). An overall mean score of 4.03 suggests students’ high online learning self-efficacy. According to [42], students who exhibit high levels of self-efficacy for online learning are more likely to perform well in future courses where online components are included.

TABLE I: DESCRIPTIVE STATISTICS FOR ONLINE LEARNING SELF-EFFICACY

Statement	Mean (SD)	Interpretation
1. Complete an online course with a good grade	3.91 (0.90)	High
2. Understand complex concepts	3.66 (0.94)	High
3. Willing to face challenges	3.98 (0.82)	High
4. Successfully complete all required online activities	4.31 (0.86)	Very high
5. Keep up with course schedule	4.02 (0.93)	High
6. Create a plan to complete the given assignments	4.12 (0.90)	High
7. Willingly adapt my learning styles to meet course expectations	4.11 (0.80)	High
8. Evaluate assignments according to the criteria provided by the instructor	4.13 (0.81)	High
Overall	4.03 (0.67)	High

2) Learner-content interaction

The presentation, organization and accessibility of the online course are important aspects of interaction [36]. Course content must be designed in a way that learners will be able to navigate the course by themselves when the teacher is not available to give directions, address concerns, or clarify instructions. For LCI, the highest mean ($M = 4.07, SD = 1.06$) was obtained for the statement “*It was easy for me to access the course materials*” and lowest ($M = 3.61, SD = 0.07$) for the statement “*The online materials stimulated my interest for the course*” (Table II). Mean scores in this dimension show high agreement to all four statements under the scale.

TABLE II: DESCRIPTIVE STATISTICS FOR LEARNER-CONTENT INTERACTION

Statement	Mean (SD)	Interpretation
1. The online course materials helped me better understand the course content.	3.85 (0.97)	High
2. The online course materials stimulated my interest for this course.	3.61 (0.07)	High
3. The online course materials helped relate my personal experience to new concepts or new knowledge.	3.84 (0.93)	High
4. It was easy for me to access the course materials.	4.07 (1.06)	High
Overall	3.84 (0.84)	High

3) Learner-instructor interaction

Even though interaction between professors and online learners is considerably good, it is not as optimal as face-to-face [43]. One of the challenges of remote learning is that both professors and students are used to direct interaction [44]. In Table III, statement 1 ranked lowest in terms of mean score ($M = 3.79, SD = 1.09$) suggesting that learners felt that they did not have as many interactions with their instructors. On the other hand, learners reported that teachers were highly reliable when it comes to responding to their questions in a timely manner (statement 4). Among the three types of learner interaction, however, LCI recorded the highest overall mean ($M = 4.13, SD = 0.74$). This could be since teachers are the main drivers of interaction when learning and teaching are facilitated remotely, especially for students who are new to the online setup.

TABLE III: DESCRIPTIVE STATISTICS FOR LEARNER-INSTRUCTOR INTERACTION

Statement	Mean (SD)	Interpretation
1. I had numerous interactions with the instructor during the class.	3.79 (1.09)	High
2. I asked the instructor my questions through different electronic means, such as email, discussion forum, instant messaging tools, etc.	4.24 (0.95)	Very high
3. The instructor regularly posted some questions for students to discuss on the discussion forum.	4.03 (1.05)	High
4. The instructor replied to my questions in a timely fashion.	4.36 (0.88)	Very high
5. I replied to messages from the instructor.	4.30 (0.86)	Very high
6. I received enough feedback from my instructor when I needed it.	4.06 (1.07)	High
Overall	4.13 (0.74)	High

4) Learner-learner interaction

The means for LLI are shown in Table IV. Students reported moderate agreement to statement 5 which suggests that they did not have enough opportunities to comment on other students’ thoughts and ideas ($M = 3.72, SD = 1.07$). The same moderate agreement was also observed in statements 1, 4, and 6. Meanwhile, statement 3 showed that learners were able to answer questions from their classmates through different electronic means such as email, discussion forum, instant messaging tools, etc. ($M = 3.81, SD = 1.09$). High agreement was also reported for statements 2, 7, and 8.

Overall, the respondents expressed moderate agreement to the items in LLI ($M = 3.42$, $SD = 1.03$). While frequent communication among learners is very desirable, [45] argue that collaborative interactions when it comes to course completion will produce more favorable achievement results.

TABLE IV: DESCRIPTIVE STATISTICS FOR LEARNER-LEARNER INTERACTION

Statement	Mean (SD)	Interpretation
1. I got lots of feedback from my classmates.	3.11 (1.28)	Moderate
2. I communicated with my classmates about the course content through different electronic means such as email, discussion forum, instant messaging tools, etc.	3.71 (1.23)	High
3. I answered questions of my classmates through different electronic means such as email, discussion forum, instant messaging tools, etc.	3.81 (1.09)	High
4. I shared my thoughts or ideas about the lectures and its application with other students during this class.	3.33 (1.17)	Moderate
5. I comment on other students' thoughts and ideas.	3.02 (1.37)	Moderate
6. Group activities during class gave me chances to interact with my classmates.	3.30 (1.34)	Moderate
7. Class projects led to interactions with my classmates.	3.49 (1.31)	High
8. Overall, I had numerous interactions related to the course content with my fellow students.	3.62 (1.14)	High
Overall	3.42 (1.03)	Moderate

5) Student satisfaction

Student satisfaction represents learners' emotions and attitudes of their educational experience [46]. It is among the five elements defined by the Online Learning Consortium as essential for evaluating the quality of online learning along with learning efficacy, faculty satisfaction, scalability, and access [14], [30]. When students were asked to assess their satisfaction with their online STS class, overall SS mean was found to be high. The results support strong agreement by learners that the course met their needs and that the online course was highly satisfying (Table V).

6) Perceived learning

Perceived learning is an acceptable determinant of learning [47], as well as a strong predictor of final grades in a course [48]. Like SS, learners' responses in PL showed very positive results (Table VI). In this study, the respondents estimate that they learned well from the course materials and achieved the learning outcomes of the course to a great extent.

TABLE V: DESCRIPTIVE STATISTICS FOR STUDENT SATISFACTION

Statement	Mean (SD)	Interpretation
1. Overall, I was satisfied with my online learning experience.	3.73 (1.10)	High
2. This online course met my needs as a learner.	3.62 (1.14)	High
Overall	3.67 (1.09)	High

TABLE VI: DESCRIPTIVE STATISTICS FOR PERCEIVED LEARNING

Statement	Mean (SD)	Interpretation
1. In your estimation, how well did you learn the material presented in this course?	3.80 (0.95)	High
2. In your estimation, how well did you achieve the learning outcomes of this course?	3.77 (0.96)	High
Overall	3.78 (0.92)	High

7) Academic performance

The academic performance ($M = 91.21$, $SD = 7.89$) of students (Table VII) suggests high achievement in the emergency online science course. It is worthy to note that enrollment during the pandemic was voluntary and learners with access to the Internet comprised the study respondents. According to [49], online students with more reliable access to the Internet perform better in their academics. Perceived learning has also been found to be predictive of course final grades, such that learners who feel positively about their learning gains are more likely to exhibit greater achievement [50]. All these could explain the overall satisfactory performance of students in the online science course.

TABLE VII: DESCRIPTIVE STATISTICS FOR ACADEMIC PERFORMANCE

N	Minimum	Maximum	Mean	SD
104	41.00	99.00	91.21	7.89

B. Correlation Analysis

Table VIII presents the Spearman's rho coefficients obtained from the study data. Data shows that OLSE has moderate positive correlations with student satisfaction ($r_s = 0.59$, $p < 0.01$) and perceived learning ($r_s = 0.62$, $p < 0.01$). Prior studies pointed out that OLSE is positively linked to SS in an online learning environment [48]. These results attest to the favorable association between online learning self-efficacy and student satisfaction as indicated in the investigations conducted by [14] and [51].

The interaction variables namely, LCI, LII and LLI were all found to be significantly and positively associated with both SS and PL, with the strongest correlation observed between SS and LCI ($r_s = 0.75$). This means that more frequent opportunities to interact with content increase learners' satisfaction about the online course. This finding supports the work of [52] which investigated satisfaction of Vietnamese university students enrolled in an online language course. Next, LII was significantly and positively associated with SS at a moderate level ($r_s = 0.68$). This means that student satisfaction is enhanced when the teacher gives clear instructions, provides timely feedback, and offers individualized comments [53]. Like the study of [14], the weakest associations between variables were observed between SS and LLI ($r_s = 0.46$, $p < 0.01$) PL and LLI ($r_s = 0.37$, $p < 0.01$).

TABLE VIII: CORRELATION ANALYSIS AMONG VARIABLES

Variables	Variables/Correlation coefficients			
	OLSE	LCI	LII	LLI
Student satisfaction	0.59**	0.75**	0.68**	0.46**
Perceived learning	0.62**	0.68**	0.66**	0.37**

Academic performance	0.39**	0.24*	0.26**	0.23*
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**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

C. Regression Analysis

The correlation analysis showed significant relationship among the study variables thus, regression analyses for student satisfaction, perceived learning and academic performance were performed. The degree of influence of the independent variables can be estimated by the beta coefficient (β).

Contrary to the findings of [14], OLSE had no significant influence on SS (Table IX), suggesting that high online learning self-efficacy does not directly translate to student satisfaction in an ERT setting. This may be explained by the novelty of the online experience for students, as well as the abruptness of their transition to the virtual learning

environment. The pandemic has been reported to increase anxiety and stress among learners, which negatively affect their satisfaction in an online course [18]. Among the independent variables, LCI had the strongest influence on SS ($\beta = 0.469, p < 0.01$). The squared semi-partial correlation (r_{sp}^2) indicates that LCI and LII contributed 11% and 3.3% of the total variation on student satisfaction, respectively. According to [32], student satisfaction is rated more favorably by learners who can readily access course content online. The study findings partially agree with [53] noting that learner interactions with content and their instructors were significant predictors of student satisfaction. While LII and LLI have been observed to positively affect engagement which in turn, significantly impact student satisfaction [54], this investigation found LLI to have no significant predictive relation with SS.

TABLE IX: MULTIPLE REGRESSION OF STUDENT SATISFACTION

Independent variables	B	SE B	β	t	Sig.	Correlations		Rank order
						Part	(r_{sp}^2)	
(Constant)	-1.477	0.432		-3.421	0.001			
OLSE	0.220	0.126	0.135	1.739	0.085	0.103	0.011	3
LCI	0.608	0.108	0.469	5.637	0.000**	0.335	0.112	1
LII	0.377	0.122	0.256	3.079	0.003**	0.183	0.033	2
LLI	0.109	0.073	0.103	1.492	0.139	0.089	0.008	4

**Significant at the 0.01 level (2-tailed)

In Table X, LCI, LII, and OLSE showed significant positive predictive relations with PL. Among the three variables, LCI recorded the strongest influence on PL ($\beta = 0.343, p < 0.01$) with a 6% contribution to the total PL variance ($r_{sp}^2 = 0.060$). This is best explained by the accessibility of course materials for students to peruse in their own time, whether they attend the synchronous online sessions. The significant effect of LII on PL ($\beta = 0.291, p < 0.01$) lends support to the work of [55] that highlights the importance of LII as a factor in determining online learning outcomes. According to [45], contact between the instructor and students positively impacts how learners view their academic progress by enabling socialization, exchange of ideas, and participation in group activities. The effect of OLSE on PL ($\beta = 0.276, p < 0.01$) is likewise noteworthy although it did not conform with the finding of [14] that online learning self-efficacy is the strongest predictor of

perceived learning. Learners who feel self-efficacious when performing online tasks and who persist despite challenges are more likely to report that they learn better. On the other hand, a negative relation was found between PL and LLI ($\beta = -0.012$) thereby suggesting a decrease in perceived learning when there is a change in learner-learner interaction.

Although perceived learning is used as an indicator of academic performance, no congruence was observed between the two outcome variables. Table XI reveals that none of the learner interaction variables pose a significant influence on academic performance. Only OLSE was found to be a significant determinant of the outcome variable ($\beta = 0.343, p < 0.01$) with a 6.9% contribution to the total AP variance ($r_{sp}^2 = 0.069$). This is compatible with the assertion of [41] and [56] that learners with high self-efficacy show greater achievement results.

TABLE X: MULTIPLE REGRESSION OF PERCEIVED LEARNING

Independent Variables	B	SE B	β	t	Sig.	Correlations		Rank order
						Part	(r_{sp}^2)	
(Constant)	-0.645	0.395		-1.632	0.106			
OLSE	0.379	0.116	0.276	3.278	0.001**	0.211	0.045	2
LCI	0.376	0.099	0.343	3.813	0.000**	0.245	0.060	1
LII	0.362	0.112	0.291	3.229	0.002**	0.208	0.043	3
LLI	-0.011	0.067	-0.012	-0.159	0.874	-0.010	0.000	4

**Significant at the 0.01 level (2-tailed)

TABLE XI: MULTIPLE REGRESSION OF ACADEMIC PERFORMANCE

Independent variables	B	SE B	β	t	Sig.	Correlations		Rank order
						Part	(r_{sp}^2)	
(Constant)	-2.463	0.613		-4.015	0.000			
OLSE	0.508	0.179	0.343	2.831	0.006**	0.262	0.069	1
LCI	-0.007	0.153	-0.006	-0.045	0.964	-0.004	0.000	4

LII	0.061	0.174	0.046	0.352	0.725	0.033	0.001	3
LLI	0.056	0.104	0.057	0.535	0.594	0.050	0.003	2

**Significant at the 0.01 level (2-tailed)

V. CONCLUSION

The results of this study revealed that college students have favorable perceptions about their ERT learning experience with respect to online learning self-efficacy and the three interaction variables. Overall, students' academic performance in the emergency online science course was high. While significant positive correlations were noted among all study variables, differences were observed when individual predictive relationships were examined. Online learning self-efficacy had a significant effect on only two outcome variables namely, perceived learning and academic performance. Learner-content and learner-instructor interactions were both found to significantly influence student satisfaction and perceived learning but not academic performance. In addition to having the weakest correlation, learner-learner interaction posed no significant effect on any learning outcome.

These findings support the viability of ERT as an alternative form of instructional delivery to mitigate the effects of a disrupted education during the pandemic [35], [57].

In addition, this research affirms that examining student satisfaction, perceived learning and academic performance collectively provides a more complete picture of how successful online education can be [23].

Careful consideration of pre-pandemic teaching practices and modifying them to adapt to the challenges brought forth by COVID-19 is necessary [19]. To promote positive online learning outcomes in terms of student satisfaction, perceived learning and academic performance [14], [34], [50], instructors should strengthen the integration of activities that will help students enhance their online learning self-efficacy, as well as provide adequate opportunities for worthwhile interactions within the online course. Orientation sessions that aim to familiarize students with the institutional online learning platform and offer tips for online success will be valuable [35]. Online course design that optimizes interactions with content, the instructor, and other learners will be instrumental toward learners' academic success. While the effects of learner-content and learner-instructor interactions on learning outcomes have been consistently noted in prior studies, the influence of learner-learner interaction merits further investigation.

The online nature of the survey confined the reach of data collection to students who can access the Internet. Noting the small sample size, the findings of this investigation are likely to benefit HEIs who implemented online learning in a similar manner and whose students are comparable to the study respondents in terms of demographic profile. In this vein, context with respect to institutional and student characteristics is an important consideration before generalizing results. A qualitative study is another useful direction for delving deeper into the views of learners regarding their overall remote learning experience.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

First A. Author was responsible for study design, literature review and data collection. Second B. Author analyzed data and interpreted results, while Third C. Author assisted in data analysis and formatted the manuscript. All three authors were responsible for writing the discussion and conclusion sections of the manuscript.

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Marissa Fearnley is a faculty of the Natural Science Area-School of Multidisciplinary Studies of De La Salle-College of Saint Benilde in Manila, Philippines. She earned her degrees in BS biology and master of public health from University of the Philippines Manila. She also holds a degree in master of learning and teaching from De La Salle University Manila, where she is presently pursuing her PhD in science education major in biology. Her research interests focus on online learning, technology-enhanced instruction and faculty development.



Christopher Malay is a faculty of Kolehiyo ng Lungsod ng Dasmariñas in Cavite, Philippines. He completed his BS and MS biology degrees from Cavite State University. He is a licensed professional teacher with PhD units in science education major in biology from De La Salle University Manila. His research interests include microbial analysis and identification, antibacterial potential of natural products, and educational research.



Jose Noel Fabia is a PhD student of science education major in biology at De La Salle University Manila. He is also a part-time faculty of the Natural Science Area-School of Multidisciplinary Studies of De La Salle-College of Saint Benilde in Manila, Philippines. He is currently writing his dissertation which emphasizes teaching presence in an online learning environment. His research interests include applying mixed methods research and rasch analysis in educational research.