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Online mathematics learning experiences of the colleges of education students in Ghana

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ABSTRACT

The dominant mode of instructional delivery in Ghanaian Colleges of Education has been the conventional face-to-face. However, the second semester of the 2019/2020 academic year teaching had to be done via an emergency remote online teaching mode due to the novel covid-19 pandemic. In a cross-sectional survey, the online mathematics learning experienced of 497 students sampled from three Colleges of education in Ghana were explored using the adapted community of inquiry survey instrument. It was observed from the study that students' online mathematics learning experiences were low. Further observation showed that while class cohesion and resolution dimensions were absent, teaching presence, exploration, affective expression, and triggering event dimensions of students' online mathematics learning experiences were present. Additionally, the results showed that the difference in the magnitude of means in gender was partly dependent on the category of internet use before the remote online mathematics teaching was observed in the dimension of lack of class cohesion. Besides, the students were generally indifferent in their learning experiences regarding genders but significantly in terms of their internet use before the remote online mathematics teaching. Based on the results, implications of the state of the college of education (CoE) students' online mathematics learning experiences and suggestions for improvement have been proposed.

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1. INTRODUCTION

Institutionalized online learning among Ghanaian Colleges of Education (CoE) is novel. Unexpected as it might be, in the Ghanaian Colleges of Education, instructional delivery, and learning of all second-semester courses including mathematics (learning, teaching and applying geometry and handling data) for the 2019/2020 academic year was delivered through an online mode tagged "emergency remote online teaching". Unlike the conventional face-to-face mode of instruction that Ghanaian Colleges of Education students are used to, the online mode of instructional delivery presents peculiar challenges such as the absence of physical/human contact [1]. Students must learn to adapt if desired learning outcomes are to be expected. Going through mathematics instruction offered via online, college of education students build a stock of learning experiences.

The level of online learning experiences indicates how well instructional delivery and learning are facilitated [2], [3]. Online learning experience connotes a variety of skills, competencies, knowledge, and opportunities that tempt the transformation of students' perception, conceptual understanding, and emotions irrespective of the online learning platform. The UNESCO-IBE [4] exemplifies these learning experiences to include "ideally challenging, interesting, rich, engaging, meaningful, and appropriate to learner needs". With all intent and purposes, the learning experiences initially planned for Ghanaian Colleges of Education students as they went through the conventional face-to-face instruction in mathematics (learning, teaching and applying geometry and handling data) have not changed even though the learning environment had to change into an online mode due to the COVID-19 pandemic.

Drawing inferences from the government's internet infrastructural development taking place in all colleges of education (CoE) in Ghana, the success of the ongoing online mathematics instructional delivery and learning could, in subsequent semesters, influence college-based instruction and assessment in mathematics. It behaves on mathematics tutors to provide students with the best of online learning experiences in the ongoing emergency remote online teaching. Ironically, CoE students' online mathematics learning experiences following its implementation is yet to be evaluated in the Ghanaian context. Considering the submission that learning experiences could influence learning outcomes even in online instruction [5]–[7], this study sought to examine the online mathematics learning experiences of CoE students.

To gain a better insight into the online mathematics learning experiences of the CoE students, the researchers sought to consider two background factors that may influence students' ability to maximize their learning experiences. These factors are the genders of students and students' prior usage of the internet in learning mathematics. The genders of students were considered because Ghanaian Colleges of Education are being encouraged to enroll more female student-teachers into mathematics-related disciplines. Additionally, these Colleges of Education could be identified in terms of the gender composition of their students. The second background considered was based on the assumption that internet accessibility in Ghana is uneven.

Generally, male and female students have different reactions to using the internet in learning [8], [9]. Particularly, Hamdan [10] observed that significant differences between male and female college students' existed in their online learning experiences relating to the flexibility and interaction in the learning environment and self-discipline and self-motivation. According to Sullivan, female students were the greater beneficiaries. Alongside gender, it is pretty obvious that online learning survives on internet usage. With the internet being an important component for offering new opportunities for students to learn mathematics [11], UNESCO-IBE [4] clarifies that students' previous learning experiences predict further learning. It, therefore, seems to imply that students' usage of the internet in learning mathematics before the emergency remote online learning could influence the online mathematics learning experiences of the CoE student.

Learning necessitates experience [12]. How these experiences generate, learning is explained in Kolb's experiential learning theory [13] as "the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience." The theory identifies these experiences to include students' cognition and emotions, as well as environmental factors. Through experiential learning (that is, learning from experiences), students are helped to explore and strengthen their learning needs and abilities. Deducing from the submissions of Theobald [14], a learning process that facilitates mathematics learning through experiences should, among other things, ensure the following: that students are personally and actively engaged not only in terms of their intellect but also their senses, feelings, and personalities in reflective thought learning processes that allow learners to apply mathematics to real-life situations. Likewise, prior mathematics learning experiences of students should be brought into the learning process. Similarly, mathematics tutors need to establish a sense of trust, respect, openness, concern, and support for their well-being and progress.

A community of inquiry framework was adopted in this study to appreciate the composition of students' cognition, emotions, and environmental factors in their online mathematics learning experiences [15]. Lee [15] identified teaching presences, cognitive presences, and social presences whose interdependence, according to Almasi, Zhu, and Machumu [16], provides a building block defining the educational experiences of online learners. Consequently, these three presences were renamed respectively as a teaching-learning experience, cognitive learning experience, and social learning experience. The operational definition of the three interrelated components of students' online mathematics learning experiences are presented as: i) Social learning experience: the experiences acquired by students who project their social, emotional, and communication abilities are needed for cognitive activation; ii) Cognitive learning experience: the experiences acquired by students which equips them to support, reject, and construct mathematical meaning resulting from reflective discourses during online mathematics learning; and iii) Teaching learning experience: these are experiences that enable students to appreciate the design and organization, facilitation, and direct instruction administered by mathematics tutors.

To verify the online mathematics learning experiences of the college of education students, the following three research questions guided the study: i) What are the colleges of education students' online mathematics learning experiences in the emergency remote teaching and learning period?; ii) To what extent do college of education students differ in their online learning experiences concerning their gender and previous use of the internet to learn mathematics?; and iii) To what extent does the previous use of the internet in learning mathematics by colleges of education students influence their online learning experiences due to their gender?

2. RESEARCH METHOD

2.1. Research design

A cross-sectional survey design [17], [18] in which quantitative data was collected through the administration of closed-ended questionnaires was adopted in this study. Jackson [18] described a cross-sectional design as a developmental design in which a study of research participants drawn from different backgrounds could be studied simultaneously. In this regard, an exploration of CoE students' online mathematics learning experiences in Ghana was carried at the same time. This design was necessary because the emergency online mathematics teaching was an intervention program rolled out to ensure the completion of the academic year's teaching and learning activities in Ghanaian Colleges of Education.

2.2. Instrumentation

The community of inquiry survey instrument [19] was slightly adapted for this study. The questionnaire is a 34-four Likert scale with responses ranging from 1 (strongly disagree) to 4 (strongly agree). It has been validated in previous studies and found to be a reliable and suitable measure of the educational experiences in online teaching and learning [19]–[21]. The modifications were carried out to apply terminologies used in the Ghanaian college system. For example, 'instructor' alternated with 'tutor', and 'participants' alternated with 'course mates'. Besides the slight modifications, the 34 items were shuffled alphabetically. In this line, the items did not exactly follow consecutively in the measure of the original constructs. Thereby, a monotony of responses as indicated by Cleveland-Innes and Campbell [22] might have been avoided.

2.3. Participants

There were 519 students from three colleges of education in Ghana who voluntarily participated in the survey. These three colleges of education were purposively sampled from a host of 14 colleges whose students took the mathematics course of 'learning, teaching and applying geometry and handling data'. In selecting the participating colleges in this study, gender consideration was prioritized. To this end, the 14 colleges were categorized into three clusters: that is cluster A (one all-male college), cluster B (two all-female colleges), and cluster C (11 mixed-sex colleges). From cluster A, the only male college was purposively sampled. However, simple random sampling was used to sample one college from cluster B and cluster C. consequently, individual student participation from these colleges was also conveniently identified. The respondent rate for this study was a little below 40% (39.95%). However, 22 responses were dropped because they were found to be non-engaging. Hence, 497 responses were subsequently used in all analyses.

2.4. Data collection procedure

Students' responses to the community of inquiry survey were collected from the seventh to the eleventh week into the online mode of instructional delivery. It was expected that students would have gained sufficient online learning experiences to answer the questionnaire adequately. The questionnaire was administered via the internet (Google Forms). The URL to the questionnaire was sent to the students through their mathematics tutors.

3. RESULTS

An exploratory factor analysis (EFA) was conducted to extract students' online mathematics learning experiences. A Kaiser-Meyer-Olkin (KMO) of 0.911 gave an assurance that the sample size was adequate. Also, at 465 degrees of freedom, a Chi-square of 16151.676 was significant [$p<.001$]. Commonalities extracted were all above 0.4, indicating a stronger possibility of each item loading defining a factor. Using a principal component extraction (PCE) analysis based on an Eigenvalue greater than one, six factors were extracted with a total variance extracted at approximately 72.3%. Besides, three items were deleted to achieve high and reliable factor loadings. Thus, CP_31 was deleted because it cross-loaded on two factors. Additionally, items CP_30 and CP_24 were deleted because they loaded below 0.6 on their respective factors [23]. The six extracted factors are herein operationalized as teaching presence (ability to sense the mathematics teacher in managing instruction, building understanding, and direct instruction) [24]; Lack of class cohesion (absence of interaction and group discussion among students), Affective expression (able to appreciate how individuals express their feelings about mathematics learning) [25]; Exploration (generating relevant mathematical knowledge from reflective learning activities); Lack of resolution (not confident in the immediate and future application of mathematics knowledge directly or vicariously); and Triggering event (positive learning challenge which has the potential to annihilate distracting learning events to promote the attainment of the intended mathematics learning outcome) [24].

The factor loadings for each of the six factors are presented in Table 1 (see Appendix). From Table 1, the remaining 31 items loaded strongly (above 0.6) to their respective factors (hereafter, dimensions of emergency remote online learning experiences), internal reliability was thus achieved [23]. Convergent reliabilities (alpha>0.7) were achieved for five dimensions except for the dimension of the triggering event.

Regarding the normality index for the data, the critical ratio (between ±1.96) of skewness and kurtosis for each of the dimensions concerning the genders of the students, and the frequency with which students learned mathematics via the internet before the emergency remote teaching and learning showed that the online learning experiences data was generally not normal. Equally, the Shapiro-Wilk test indices [$p<0.05$] showed non-normal data for all six dimensions [26]. However, a visual inspection of the histograms, normal Q-Q plots, and box plots showed that the online learning experiences data were approximately normally distributed for a few of the six dimensions. That notwithstanding, with a relatively large sample (greater than 200), [23] believes that the normality of data could be compensated with the sample size.

The average variance extracted (AVE) for each of the six factors was at least 0.5. Table 2 illustrates the discriminant validity among the six dimensions. Arguably, the discriminant validity for all six constructs was achieved because the diagonal values (the square root of AVE) were higher than the correlation values (row and column entries) between the respective constructs.

Table 2. Discriminant validity summary for the dimensions of students' learning experiences

	1	2	3	4	5	6
1. Teaching presence	0.742					
2. Lack of class cohesion	0.197	0.903				
3. Exploration	0.301	0.162	0.975			
4. Affective expression	0.326	0.182	0.321	0.726		
5. Lack of resolution	0.115	0.676	0.089	0.084	0.883	
6. Triggering event	0.209	0.214	0.356	0.280	0.171	0.781

An indication of a very low relationship among the dimensions. Even though the discriminant validity assured a multivariate analysis, the low level of correlations among the dimensions, as seen in Table 2, did not support a multivariate analysis. Indeed, 10 out of the fifteen correlation indices were below the minimum limit of 0.3. In this regard, individual univariate analysis was conducted concerning the possibility of determining significant differences among the students' learning experiences.

Analysis of students' average perception of their online mathematics learning experiences dimensionally summarized in Table 3 shows that their overall learning experience was generally weak [M=2.473, SD=0.396] with the least mean perception and spread in lack of resolution [M=2.497, SD=0.721] and highest mean perception and spread in teaching presence [2.528, .562]. Further analysis of the mean and standard deviation indicators showed that in terms of cognitive, social, and teaching-learning experiences, students' cognitive learning experience [M=2.367, SD=0.425] was the lowest. This was followed by social learning experience [M=2.386, SD=0.518], whilst the strongest learning experience was recorded for teaching-learning experience [M=2.528, SD=0.562].

Subsequently, the researchers conducted a two-way analysis of variance to explore the impact of students' gender (gender) and students' use of the internet in learning mathematics before implementing the emergency remote teaching (internet use) on the six deduced dimensions of online learning experiences. In the gender category, students were grouped into either males or females. For Internet use, the students were categorized per the frequency with which they resorted to the use of the internet-never, sometimes, and most of the time. Out of the 497 students, 226 were males, and 271 were females. Again, of the total 497 participating students, 96, 244, and 157 students never, sometimes, and most of the time used the internet to learn mathematics, respectively.

Table 3. Number of students, mean and standard deviation indices for the dimensions of students' learning experiences

Groups	Group	N	Teaching presence M	Teaching presence SD	Lack of class cohesion M	Lack of class cohesion SD	Exploration M	Exploration SD	Affective expression M	Affective expression SD	Lack of resolution M	Lack of resolution SD	Triggering event M	Triggering event SD
Gender	Male	226	2.513	0.577	2.429	0.705	2.311	0.632	2.391	0.499	2.460	0.747	2.281	0.547
	Female	271	2.540	0.550	2.571	0.626	2.331	0.682	2.381	0.533	2.528	0.698	2.352	0.548
Internet use	Never	96	2.346	0.592	2.491	0.683	2.153	0.654	2.358	0.528	2.477	0.756	2.182	0.558
	Some times	244	2.507	0.544	2.503	0.685	2.300	0.610	2.346	0.498	2.493	0.736	2.324	0.521
	Most of the times	157	2.671	0.537	2.521	0.630	2.465	0.709	2.465	0.535	2.516	0.678	2.398	0.871
Total		497	2.528	0.562	2.507	0.666	2.322	0.659	2.386	0.518	2.497	0.721	2.320	0.548

For each of the six dimensions of the emergency remote online learning experiences, Table 4 and Table 5 summarize the interaction effect and main effect. For the interaction effect (gender*internet use), Table 4 and Table 5 paint the picture of whether students statistically differed significantly in their internet use due to their gender. The main effects for gender, as displayed in Table 4 and Table 5, provide information about whether there is a statistically significant difference in the students in terms of gender independent of the data on internet use. Equally, as displayed in Table 4 and Table 5, the main effects of Internet use provide information about whether there is a statistically significant difference in the students in terms of internet use whilst collapsing data on gender. Where significant difference was detected, the effect size was determined using [27] benchmarks of 0.1, 0.3, and 0.5 as small, medium, and large, respectively, for classifying correlational studies.

Table 4. Interaction and main effect differences in students concerning dimensions of learning experiences

Effect source	*df*	Teaching presence F	Sig.	η^2	Lack of class cohesion F	Sig.	η^2	Exploration F	Sig.	η^2
Gender	1	0.066	0.798	0.000	10.242	0.001*	0.020	0.072	0.789	0.000
Internet use	2	8.828	0.000*	0.035	0.070	0.933	0.000	6.384	0.002**	0.025
Gender * Internet use	2	2.779	0.063	0.011	3.940	0.020*	0.016	0.682	0.506	0.003
Error	491									

* Significance at alpha=0.05
* * Significance at alpha=0.01

Table 5. Interaction and main effect differences in students concerning dimensions of learning experiences contd.

Effect source	*df*	Lack of resolution F	Sig.	η^2	Affective expression F	Sig.	η^2	Triggering event F	Sig.	η^2
Gender	1	2.026	0.121	0.005	0.044	0.834	0.000	3.886	0.115	0.005
Internet use	2	0.111	0.859	0.001	2.250	0.107	0.009	4.420	0.009*	0.019
Gender * Internet use	2	2.240	0.130	0.008	0.842	0.431	0.003	1.379	0.397	0.004
Error	491									

* Significance at alpha=.05

Within the dimension of teaching presence, and at 0.05 alpha level of significance as shown in Table 4, the interaction effect between gender and internet use was not significant statistically, F[2,491]=2.779, p=0.063. There was a statistically significant main effect for Internet Use, F[2,491]=8.828, p<0.001; and the effect size was small (partial eta squared=0.04). Post-hoc comparisons using the Scheffe test, because of the uneven distribution of students among the three categories of Internet Use though Levene's test of homogeneity of variance was not significant, indicated that the mean score for the never group [M=2.346, SD=.592] was significantly different from the sometimes group [M=2.507, SD=0.544] and the Most of the Times Group [M=2.671, SD=0.537]. Equally, the Sometimes Group [M=2.507, SD=0.544] was significantly different from the Most of the Times Group [M=2.671, SD=0.537]. The main effect for Gender, F[1,491]=0.066, p=0.798, did not reach statistical significance.

In Table 4, for the lack of class cohesion dimension, and at 0.05 alpha level of significance, the interaction effect between gender and internet use was significant statistically, F[2,491]=3.940, p=.016; the effect size was small (partial eta squared=0.02) though. Using a Bonferroni adjusted alpha level of 0.008, a follow-up posthoc comparison along the three groups of internet use indicated that the significant differences occurred at the never group [N=96] where male students [M=2.241, SD=0.681] was different from female students [M=2.712, SD=0.609]. The difference in the mean score of the gender at the Sometimes group and most of the times group of internet user did not statistically reach a significance point. The profile plot for this interaction in Figure 1 illustrates a possibility of a spreading interaction as the differences in means of the gender graphically seems to be much wider at the never group than observed at the Sometimes group and most of the times Group.

The main effect for Internet use, F[2,491]=0.070, p=0.933 did not reach statistical significance. However, the main effect for gender, F[1,491]=10.242, p=0.001 was statistically significant; the effect size was small (partial eta squared=0.02). Which thus suggest that the mean scores of male students [M=2.429, SD=0.705] significantly differed from the female students [M = 2.571, SD = 0.626].

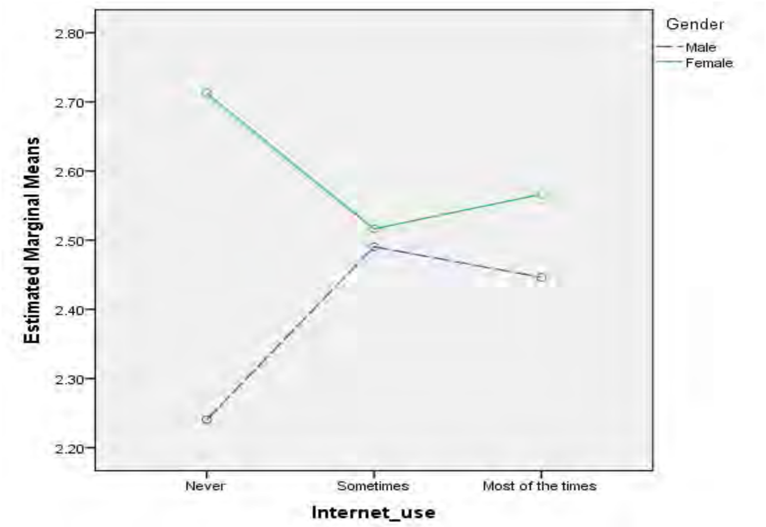

Figure 1. Profile plot for estimated marginal means for lack of class cohesion

Within the dimension of Exploration, the uneven distribution of students coupled with a significant Levene's homogeneity test compelled the testing of a statistically significant difference at 0.01 alpha level of significance, as seen in Table 4 [28]. The interaction effect between gender and internet use was not significant statistically, F[2,491]=0.682, p=0.506. There was a statistically significant main effect for internet use, F [2,491]=6.384, p=0.002; and the effect size was small (partial eta squared=0.03). Post-hoc comparisons using the Scheffe test indicated that the mean score for the never group [M=2.153, SD=.654] was significantly different from most of the times group [M=2.465, SD=0.709] but not statistically significant with the sometimes group. Additionally, the sometimes group [M=2.296, SD=0.610] was neither significantly different from either of the two groups. The main effect for gender, F[1,491]=0.072, p=0.789, did not reach statistical significance.

Within the dimension of lack of resolution, and at 0.05 alpha level of significance (Table 5), the interaction effect between gender and internet use was not significant statistically, F[2,491]=2.050, p=.130. Equally, the main effect of gender F[1,491]=2.418, p=0.121 and the main effect of internet use F[2,491]=0.151, p=0.859, were all not significantly different statistically. Besides, in Table 5, at 0.05 alpha level of significance for the dimension of affective expression, the interaction effect between gender and internet use was not significant statistically, F[2,491]=.842, p=0.431. Equally, the main effect of Gender F[1,491]=2.250, p=0.107 and the main effect of internet use F[2,491]=.044, p=0.834, were all not significantly different statistically.

Within the dimension of triggering event, the incidence of an uneven distribution of students among the groups despite a non-significant Levene's homogeneity test occasioned the Scheffe test at a significance level of 0.05, as revealed in Table 5. In this regard, the interaction effect between gender and internet use was not significant statistically, F[2,491]=0.926, p=0.397. Besides, there was a statistically significant main effect for internet use, F[2,491]=4.795, p=0.009; and the effect size was small [partial eta squared=.02]. Post-hoc comparisons using the Scheffe indicated that the mean score for the never group [M=2.182, SD=0.558] was significantly different from only most of the times group [M=2.398, SD=.571]. Above and beyond this effect in internet use, there was no statistically significant main effect for gender, F[1,491]=2.492, p=0.115.

4. DISCUSSION

The community of inquiry framework was successfully used to describe the online mathematics learning experience of CoE students from three broad perspectives-teaching presence, cognitive presence, and social presence [15]. Following exploratory factor analysis, six sub-scales emerged. For the teaching presence scale, all three sub-scales were collapsed into a unidimensional scale. The social presence scale birthed affective expression [25] and lack of class cohesion, a merger of [25] open communication and group cohesion. Similarly, for cognitive presence, exploration, and triggering were extracted [21]. Conversely, integration was lost from factors extracted whilst the resolution sub-scale was negatively factored. Negative factor loadings adduced for the two factors resulted in naming them oppositely to their original description [29], [30] as a lack of class cohesion and lack of resolution.

By extension, the data indicated that the emergency remote teaching did not engineer interaction and group discussion among the CoE students. The deficiency in interaction and group discussion among the students is obvious with undergraduates [31]. Additionally, students were not adequately prepared for the immediate and future application of mathematics knowledge directly or vicariously. As noted by [21], a resolution experience would rather point to opportunities where students could apply knowledge created from a learning encounter. The absence of this opportunity might imply that students were paddled through the various learning milestones without considering whether or not the students had acquired useful knowledge. Ironically, the mathematics course under study was the 'learning, teaching and applying geometry and handling data course', which is supposed to promote the application of geometry and statistics. It is not amazing as resolution usually entails consensus building. However, consensus building is heightened in a learning community where socio-emotional communication practices are well established [19], [21]. In this online mathematics learning environment, two important elements of social presence - open communication and group cohesion [25] were absent. It may be conjectured that weak social-emotional experiences akin to online learning due to the absence of physical contact might have culminated in the absence of resolution and integration. Generally, students' online mathematics learning experience was low. A low social learning experience coupled with a moderate teaching-learning experience was not sufficient to raise students' cognitive learning experience.

Dimensional analysis of each of the six online learning experiences-teaching presence, lack of class cohesion, exploration, affective expression, lack of resolution, and triggering event concerning students' gender and internet use points to the following observations. Primarily, across all six dimensions, the difference in the magnitude of means in gender being partly dependent on the category of internet use was observed in the dimension of lack of class cohesion. Thus, differences between males and females in the lack of class cohesion depended on the internet use category at the level where students never used the internet to study mathematics before the emergency remote online teaching. In this dimension also, female students exhibited a higher perception of a lack of class cohesion than their male counterparts. Generally, male and female students had similar perceptions about learning experiences except for the lack of class cohesion. The findings indicate no gender difference in teaching presence, exploration, affective expression, lack of resolution, and triggering event among students implying that gender identity has no bearing on student online mathematics learning experiences. This makes it partly difficult to agree with researchers [10], [32], [33] who concluded that female students have a better online learning experience than their male counterparts. Perhaps, as Thanuskodi [34] conjectured, internet access, usage, and exposure among gender have levelled up differences that might have existed.

Besides, students' use of the internet in learning mathematics before the emergency remote teaching created differences among CoE students concerning their perceived learning experiences in teaching presence, exploration, and triggering events. Though the internet has become an inseparable component of learning [34], students' desire to voluntarily learn mathematics through this medium is inconclusive [35]–[37]. Perhaps, the uneven spread of internet accessibility within Ghana [38]–[40] might explain why CoE students across the country feel reluctant in its use in learning. In this study, students who used to learn mathematics somehow (sometimes and most of the time) had a better average perceived learning experience in teaching presence, exploration, and triggering events. Thus, the college of education students who had used the internet to study mathematics was better positioned to experience opportunities that enhance online learning.

5. CONCLUSION

Even though social learning experiences could be fostered in an online learning environment, it is not automatic to realize all social-emotional elements. Mathematics tutors should frantically create opportunities for students to develop their socio-emotional tenants, culminating in high cognitive learning experiences. Similarly, students should be encouraged to interact with their tutors and colleagues to enhance their learning experiences right from the beginning of online teaching. Students' low level of online mathematics learning experience might jeopardize their critical inquiry skills and learning outcomes in learning, teaching, and applying geometry and handling data course. It is herein suggested that a face-to-face session be held to augment this novel remote online teaching practice.

Gender might no longer predict online learning experience, particularly among CoE students in mathematics learning. Equal online learning opportunities could be created for both genders. However, there is a need for mathematics tutors to create online learning opportunities for students to as much as possible access some mathematical knowledge through the internet. In this way, CoE students would be better equipped to harness the learning opportunities afforded on the internet.

Since this study adopted a survey approach within a cross-sectional design, the data collected were quantitative. Future research may also include qualitative analysis to unravel teaching and learning activities that take place on various online learning platforms. It is likely to understand students' appraisal of their perception of online learning experiences. Additionally, future research into how the online learning experiences of CoE students could impact their end-of-semester exams is recommended.

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APPENDIX

Table 1. Internal consistency reliability and the average variance extracted for the dimensions of students' learning experiences

Dimension	Item code	Item statement	Factor loadings	Cronbach alpha (AVE)
Teaching presence	TP_10	Instructor actions reinforced the development of a sense of community among course participants.	0.821	0.934 (.550)
	TP_4	The instructor communicated important due dates/time frames for learning activities	0.813	
	TP_2	The instructor communicated important course goals.	0.811	
	TP_1	The instructor communicated important course topics.	0.808	
	TP_7	The instructor helped to keep course participants engaged and participating in productive dialogue.	0.747	
	TP_6	The instructor helped guide the class towards understanding course topics in a way that helped me clarify my thinking.	0.747	
	TP_13	The instructor provided feedback in a timely fashion	0.744	
	TP_8	The instructor helped keep the course participants on the task in a way that helped me to learn.	0.727	
	TP_5	The instructor helped identify areas of agreement and disagreement on course topics that helped me to learn.	0.687	
	TP_12	The instructor provided feedback that helped me understand my strengths and weaknesses relative to the course's goals and objectives.	0.684	
	TP_3	The instructor provided clear instructions on how to participate in course learning activities.	0.681	
	TP_9	The instructor encouraged course participants to explore new concepts in this course.	0.679	
	TP_11	The instructor helped to focus the discussion on relevant issues in a way that helped me to learn.	0.666	
Lack of class cohesion	SP_21	I felt that other course participants acknowledged my point of view.	-.0940	0.976 [.815]
	SP_17	I felt comfortable conversing through the online medium.	-0.920	
	SP_20	I felt comfortable disagreeing with other course participants while still maintaining a sense of trust.	-0.902	
	SP_22	Online discussions help me to develop a sense of collaboration.	-0.900	
	SP_18	I felt comfortable participating in the course discussions	-0.883	
	SP_19	I felt comfortable interacting with other course participants.	-0.873	
Exploration	CP_26	I utilized a variety of information sources to explore the problems posed in this course.	0.978	0.989 [.951]
	CP_27	Brainstorming and finding relevant information helped me resolve content-related questions.	0.974	
	CP_28	Online discussions were valuable in helping me appreciate different perspectives.	0.973	
Affective expression	SP_16	Online or web-based communication is an excellent medium for social interaction.	0.771	0.619 [.527]
	SP_14	Getting to know other course participants gave me a sense of belonging in the course.	0.747	
	SP_15	I was able to form distinct impressions of some course participants.	0.654	
Lack of resolution	CP_32	I can describe ways to test and apply the knowledge created in this course.	-0.903	0.955 [.779]
	CP_34	I can apply the knowledge created in this course to my work or other non-class related activities.	-0.883	
	CP_33	I have developed solutions to course problems that can be applied in practice.	-0.879	
	CP_29	Combining new information helped me answer questions raised in course activities.	-0.865	
Triggering event	CP_23	The problems posed increased my interest in course issues.	0.833	0.551 [.611]
	CP_25	I felt motivated to explore content-related questions.	0.726	
Deleted items				
CP_24	Course activities piqued my curiosity.			
CP_30	Learning activities helped me construct explanations/solutions.			
CP_31	Reflection on course content and discussions helped me understand fundamental concepts in this class.			