

# An Evaluation of Emergency Remote Teaching in Engineering Based on a Community of Inquiry Framework

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**Abstract:** One major effect of the Covid-19 pandemic was the abrupt shift from traditional face-to-face (f2f) teaching and learning to emergency remote teaching (ERT). Student evaluations and reflections by lecturers indicate that the move to the predominantly online environment during the Covid-19 pandemic posed both challenges and opportunities. To capitalize on the opportunities afforded by ERT that can be utilized in another similar event or in movement from f2f to virtual classrooms, it is important to interrogate the challenges and factors that facilitated the transition to online learning. This paper utilizes a community of inquiry framework (CoI) to investigate the components of teaching styles, assessment styles, and student demographics on engineering students' performance during ERT at a top traditional f2f university in the Caribbean. A survey conducted was informed by CoI and student environment during the ERT transition. A quantitative study with regression analysis of survey data was utilized. Qualitative responses were also captured and analysed. The study has found that a teaching presence which demonstrated clear course design, facilitation and communication was a significant contributing factor

to a comfortable online learning transition. Online learning was also impacted by aspects of the home environment like family support, distractions, and quality of living that contributed to a difficult transition.

**Keywords :** community of inquiry; emergency remote teaching; engineering education; online learning; virtual classroom

## I. Introduction

The Covid-19 pandemic resulted in an abrupt shift from traditional face-to-face (f2f) teaching and learning, to what has been termed emergency remote teaching (ERT). In the context of higher education (HE), prior to the pandemic, some students and educators were engaged in various combinations of blended and online learning as part of the traditional f2f environment, in which technology was used to enhance teaching and learning. The sudden restrictions to f2f teaching however required students and educators to shift entirely to emergency remote teaching without much opportunity for appropriate preparation, in some cases. As the pandemic progressed, some HE institutions attempted to adopt a more blended approach, while others continued emergency remote teaching, in the hope of either a return to some level of f2f teaching, or alternatively a more planned, systematic online approach.

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It is evident that online learning in higher education will continue to be a desired mode of delivery as we navigate a post-pandemic world. Moreover, for engineering students in this fourth industrial revolution, traditional forms of education may not provide the right preparation for the 21st century engineer. For engineering students in this context to capitalize on the opportunities afforded by emergency remote teaching, it is important to interrogate the positive and negative factors that facilitated ease of transition to online learning. In the post-pandemic world, some f2f universities have continued using some of the modalities from ERT, taking an approach which does not conform to best practice for online delivery. Adequate care and consideration must be placed in transitioning from f2f to planned online learning, as opposed to ERT. In particular there must be adequate support systems for stakeholders that may include significant information technology infrastructural investments, training and orientation, and adequate physical and human resources.

In the engineering faculty at a top Caribbean university with traditional f2f learning, student evaluations and reflections by lecturers during the pandemic indicated that the move to the predominantly online environment posed both challenges and opportunities. This paper utilizes a Community of Inquiry Framework (CoI) to investigate the effects of teaching styles, assessment styles, and student demographics on engineering students' performance during the transition from f2f learning to ERT. The intention is to find the right mix in teaching delivery and environment to cater to the needs of the 21st century engineer.

## 2. Literature Review

### A. Education in the 21st Century

The need to reform engineering education to prepare the 21st century engineering graduate has been an on-going discussion for decades. There has been recognition that rapid changes in society have resulted in a demand for new skills and requirements in many professions, including engineering. Researchers suggest the need for the “T-shaped” engineer, with “deep knowledge and expertise in their discipline, with a broad breadth of cross-disciplinary knowledge and boundary crossing capabilities” (p.9).

There seems to be a general consensus in the literature that the engineering student of the 21st

century needs to be technically savvy but must also be agile and flexible to adapt to changing scenarios and must be a lifelong learner. In addition, they must be culturally sensitive and be able to work as part of a team. To develop this type of student they suggest that engineering education needs to be learner-centered, constructivist, discovery based, drawing on systems perspective, and involving inquiry-based scientific methods and team-based problem solving (p.11). The impact of Covid-19 has perhaps made the implementation of this type of teaching and learning even more difficult as engineering faculties have been forced to shift to emergency remote teaching (ERT).

### B. Online Learning vs Emergency Remote Teaching

Online learning is defined in many ways in the literature and has had a history of resistance by some faculty. It is generally agreed however that online learning is a systematic, planned approach to deliver teaching and learning, facilitated by the Internet and digital devices. With the onset of Covid 19, HE institutions were forced to deliver all teaching and learning using the Internet and while many referred to this as online learning, an important distinction was made by some researchers. made the point that the shift to online delivery of teaching and learning during the pandemic should be referred to as Emergency Remote Teaching (ERT) since effective online learning is pre-planned and takes account of at least 9 dimensions which they identified as: modality, pacing, student-instructor ratio, pedagogy, instructor role online, student role online, online communication synchrony, role of online assessments, and source of feedback. Online learning also involves the use of coordinated learning management systems to create a learning environment that facilitates these dimensions. Online learning is considered advantageous since it can provide faculty with a chance to be more purposeful in their teaching, it can offer both students and faculty more flexibility, and students can become more self-directed learners. The approach to online learning during the pandemic, which has been labeled ERT, is differentiated from what termed effective online learning by its inability to take account of all the dimensions.

The major differences between online learning and ERT are in course design, duration, teacher preparedness, assessment, and student experience. has examined the differences as explained. In ERT, course design is usually less robust where there is a focus on content delivery rather than interactivity or

engagement in the online learning experience. Concerning duration, ERT is typically implemented in response to short-term crises and may last for a limited period compared to the permanency of online learning. In ERT, instructors have varied levels of training and preparation in online pedagogy. ERT may rely more on traditional assessment methods, such as exams and assignments, due to time constraints and limited technological resources whereas online teaching must account for the role of online assessments based on the 9-dimensional requirements. As it relates to student experience, ERT tends to provide a less immersive and engaging student experience due to its inherent emergency nature that limits opportunities for interaction and collaboration. also notes that in online learning, courses are designed to enhance the online student experience by incorporating interactive tools, discussion forums, and collaborative projects to foster a sense of community and engagement.

### C. Challenges to Online Learning and Lessons Learned During the ERT Period

Due to the rapid spread of Covid-19, subsequent ERT was bereft of adequate planning and designs of instructions for online education, thus lacking teaching/learning optimization. affirm the distinction between strategies for fostering community in face-to-face classrooms compared to the online learning environment. Despite this distinction, commented on the remarkable resilience of the students during the ERT period, especially those that actively created bespoke learning experiences. The students also positively responded to the efforts of their educators in helping them through this uncharted period. This is very positive news especially with respect to the observation by who speculate that the longer Covid-19 persists, the more likely online learning will be sustained.

Found that the online learning environment presents challenges for both the academic staff and students. Academic staff need higher levels of technological competency and proficiency. Challenges faced by civic education teachers during the ERT period included optimization of learning within the limited time frame, the indifferent attitude of students to undertaking simple tasks, distractions (such as playing video games) during activities such as group discussions, and online learning disinterest. Recommendations for improvement included providing optimized e-learning platforms, facilitating

smooth and uninterrupted internet access for academic staff and students during the online classes, providing training to academic staff on online class management, and encouraging small class sizes for mathematical computation based courses. The challenges of emergency remote teaching experienced by lecturers during the pandemic are explored in the case of a Language University in China. The case study of a traditional, in-person university (S University), focused on 22 faculty members, whose experiences of emergency remote teaching during the pandemic were analysed using the Technological, Pedagogical and Content Knowledge (TPACK) framework. The challenges identified were psychological challenges such as anxiety about ERT, due to lack of prior online teaching experience and technical competence; frustration due to an uncomfortable work environment attributed to issues such as shared space, babysitting, and noise; stress brought on by increased workload to facilitate digitizing teaching resources, grading online homework, and redesigning course content. Other challenges were lack of technological proficiency, especially at the beginning of ERT; inability to facilitate teaching content with technology effectively; limited ability to stimulate online interactivity and student engagement. Of the challenges for academic staff at S University, however, lack of online pedagogical skills and relevant training was major. Strategies used by University S to mitigate these challenges included institutional support to develop participants' technological knowledge via tutorials and online training and collegial support to address psychological challenges. Collegial support involved colleagues sharing workloads and working together to ensure that those who were more technologically savvy could help those who were technologically challenged.

Students may feel isolated and participation barriers become evident in groupwork activities. In a case study of conservatory students in ERT mode, observed that students seek connections beyond the teacher relationship possibly due to the lack of physical interaction. posited that gamification (employing game-like properties to increase participation/engagement) could offer better online learning experiences. In one study ERT satisfaction increased from sophomore to senior students. This was probably attributable to the maturity of the learners with respect to the number of years of study at the university. Also in the study, proctoring devices

were found to be generally disliked due to privacy, inequality, and mental stress concerns.

Motivational factors for self-directed online learners include curiosity, interest, and intrinsic based self-improvement . Higher attrition rates associated with online learning can possibly be mitigated by offering to the online students the services that the face-to-face student has available such as personal counselling and mental health/career services . also affirm the need to support and counsel students so that they can better meet the learning outcomes in the online environment. Additionally, they found that high-achieving students continued to perform well during the ERT phase. However, low-achieving students were more impacted with dropout rates in fundamental subjects being higher during the ERT period. A case study conducted by " , involving 200 students from a private higher education institution in the Philippines identified the challenges the students experienced, in the ERT environment, and the strategies used to confront these challenges. The participants were Psychology, Physical Education, and Sports Management majors whose ages ranged from 17 to 25. The data were collected using a retrospective self-report questionnaire and a focused group discussion (FGD). According to the researchers, the greatest challenge students experienced was related to the learning environment which included issues such as distractions at home (e.g., noise), difficulties in selecting the learning areas and limitations in learning space. " suggest that these ERT challenges may vary from the typical challenges that students experience in a pre-pandemic online learning environment. Their findings suggest that the lockdown during the pandemic limited students' interaction with peers and teachers, and influenced depression, stress, and anxiety. The lockdowns also depleted the financial resources of those who belong to lower-income groups. The findings from this case study indicate that various strategies were used by students to address the challenges. For example, to address the home learning environment challenges, students talked to their family, moved to quieter places, studied when other family members were asleep, and consulted with their classmates and teachers. The researchers noted that the strategies adopted by the students might be influenced by their specific circumstances for example available resources, or family structure. They also note that challenges could be mitigated by relevant national and institutional policies, protocol and guidelines, technological infrastructure and resources,

instructional delivery, staff development, and collaboration among key stakeholders (i.e., parents, students, teachers, school leaders, industry, government education agencies, and community).

Online learning presents challenges when aspects of the environment are not adequately considered in order to optimize learning. The Community of Inquiry Framework provides principles which can help address some of these challenges.

#### D. The Community of Inquiry Framework

The Community of Inquiry Framework (CoI) is a theoretical framework that was introduced during the emergence of computer conferencing for higher learning . It was formulated to optimally design online learning environments that support critical thinking, critical inquiry and discourse among students and teachers . It claims to measure meaningful engagement and communication in online learning environments with the framework focusing on three interactive elements of presence (teaching, social, and cognitive) and how they enhance teaching and learning . Social presence refers to the ability to identify with a community and to communicate in a trusting environment. Cognitive presence is the ability of learners to construct and confirm meaning through discussion and reflection. Teaching presence refers to the design, facilitation and direction of the cognitive and social presence to achieve learning outcomes.

Initially concerns were raised about its effectiveness with a recommendation for more research into its design . Another CoI review refuted the impact of social presence on cognitive presence, but showed that it was effective when the framework was supported by cognitively focused learning principles .

While the CoI suggests that all three components complement each other, and promote effective online learning, some researchers suggest that teaching presence plays a more significant role by creating and sustaining the context for social presence and cognitive presence to thrive , ' , . and found that teachers' active interest and passion for teaching encouraged student participation. While there seems to be support for the major role of teaching presence in encouraging engagement in online learning, ' suggest that each dimension of teaching presence, for example

design and organization, facilitation, and direct instruction, must be considered as individual predictors of student outcomes in fully online courses.

Since its introduction, and in spite of some critique, the CoI has helped educators with curriculum design, development and sequencing of educational experiences to optimise learning .

### 3. Design And Methodology

A mixed method study was performed, with the use of a survey designed using the Community of Inquiry Framework (CoI). Ordinal regression was used to analyze the survey instrument results for the quantitative investigation. The study sought to determine the extent to which the general transition to ERT during the Covid-19 period was smooth/comfortable or stressful/uncomfortable for engineering students in a traditional face to face (f2f) university and the instructional and personal context that contributed to an easier transition. Four main hypotheses are explored using the survey instrument:

1. Teaching presence that demonstrates clear course design, facilitation and communication is a significant contributing factor to a comfortable/smooth online learning transition;
2. Cognitive presence that supports higher order thinking is a significant contributing factor to a comfortable/smooth online learning transition;
3. Social presence that promotes a community of learners is a significant contributing factor to a comfortable/smooth online learning transition; and
4. Positive student personal context is a significant contributing factor to a successful online learning transition.

#### A. Sample Description

The sample population comprised the levels 1, 2 and 3 undergraduate engineering students completing a 3-year programme, from the school year 2020-2021 in the Engineering Faculty at a top Caribbean university. The total undergraduate engineering student population was part of the emergency remote teaching cohort and transitioned to the online learning environment at the end of second semester in 2020.

Responses were received from five out of seven Departments, which accounts for more than 93% of the student population in the Faculty. The total student population for the 2020-2021 school year was 1047. A total of 244 students attempted the survey. The random student sample in the faculty was obtained through contact emails and text messages submitted through both staff and student representatives for each Department. The responses were analyzed separately by courses which the students determined to have a smooth transition (comfortable courses) and courses students found to have a difficult transition (uncomfortable courses) to the online learning environment.

For comfortable courses, one participant was disallowed for being under 18 years and 34 samples were omitted due to partial omissions in question responses. The final sample population of 209 provided a margin of error of 6.1% for a 95% confidence level for the comfortable courses.

For uncomfortable courses, one participant was disallowed due to age restrictions and an additional 103 samples were omitted due to partial omissions in question responses. The final sample population of 140 provided a margin of error of 7.7% for a 95% confidence level for the uncomfortable courses.

#### B. Survey

An anonymous, online survey was self-administered to students 18 years and older, on google forms via the Internet, over a seven week period. The survey investigated the extent to which the overall experience of students in the transition to the remote emergency learning environment was smooth or difficult based on application of the CoI according to the three categories: Teaching Presence, Cognitive Presence and Social Presence, as well as the effect of students' personal context. In addition to the CoI, ; ; identified the role of the student's personal context such as motivation, adequate study spaces, and financial and emotional support at home, on student learning. Within the study, these effects were treated as confounding factors and were grouped into 3 categories: personal attributes, socio-economic factors, and student experience.

The questionnaire, which was pre-tested by student representatives from each department, comprised four sections as follows:

**Table1 : Community of Inquiry Framework Criteria for Teaching, Cognitive and Social Presence**

TEACHING PRESENCE	COGNITIVE PRESENCE	SOCIAL PRESENCE
Clear course outline	Students asked to identify goals	Lecturer is visible, using video during course
Clear learning objectives for every class	Students challenged to respond to questions	Lecturer has a profile picture during course
Provided all course material	Discussions allowing students to focus on learning outcomes	Students are visible, using video during the course
Relevant teaching tools utilized for online delivery	Learning activities were challenging and required deep thinking	Students have profile pictures during the course
Minimal external distractions from lecturer	Students were asked to share their thoughts with their peers	Class participants called by name
Clarity of delivery	Students were asked to apply what they know to real world situations	Lecturer introduced themselves to the class and gave a personal background to the class
Lecturer responsiveness	Students were asked to work in groups to solve problems	Students were encouraged to introduce themselves
Provided clear announcements for due dates and other activities		Discussion forum/ chat/ interaction spaces was used in class to facilitate class interaction
Utilized diverse sources for learning		Students felt comfortable to ask questions in class
Summarized discussions		Students actively participated in forums, chats and interaction spaces provided
Assessment schedules were adequately planned/adjusted for the online environment		
Assessments formats were adequately planned/adjusted for the online environment		
Office hours were well utilized		

**Table 2 : CoI and Personal Environment Data Range in SPSS**

SPSS Label	0	1	2	3	4
Teaching Presence Range	<20	20-32	33-45	46-59	>59
Cognitive Presence Range	<11	11-17	18-24	25-32	>32
Social Presence Range	<16	16-25	26-35	36-45	>45
Reduced External Distractions	Extremely distracting	Very distracting	Moderate distractions	Mild distractions	No distractions
Personal Environment	Bad	Mixed	Good		

The introductory section contained a link to a consent form that included identification of the project, confidentiality information, freedom to withdraw statement, risks with support services, and contact information for the research team.

Section two obtained information about the participants and examined the overall ease of transition to online learning measured on a Likert scale (1–5) with opportunity for open ended expression about the reason for their experience.

Section three evaluated courses where students experienced a smooth/comfortable transition only. The evaluation was based on criteria reflecting the three CoI categories derived from the literature . These criteria, identified in Table I, were ranked on a Likert scale from 1 (no courses) to 5 (all courses).

The final section evaluated the courses where students experienced a difficult/uncomfortable transition to online learning based on the CoI as done in section 3.

### C. Methods of Data Analysis

Ordinal regression analysis was used to analyze the survey instrument results. Pre-processing of the raw data was performed in Microsoft Excel prior to input into the SPSS software. Non-response data was omitted from the quantitative analysis while all responses were considered for qualitative investigation. The ratings (1–5) for the CoI criteria were summed for each category and scaled in equal increments of 20% of the maximum points permitted. This process crafted a total range for each CoI from few courses (0) to most courses (4) for each participant as shown in Table II. All variables for analysis were re-labelled from 0 to ensure the 0 value has a known meaning in the ordinal regression. The responses for students' personal environment were pre-analyzed and grouped as shown in Table II. A bad environment contained mostly negative comments or intensely negative descriptions, a good environment contained mostly positive comments or deeply positive descriptions, and a mixed environment contained both positive and negative comments. The

**Table 3 : Significant Odds Ratio for Various Ordinal Regression Models with Easy Transition Course**

	CoI Base Model	Personal Attributes Model	Socio-Economic Model	Experience Model	Complete Model
Teaching Presence	2.38***	2.39***	2.25***	2.47***	2.47***
Access to Technology			1.83***	1.72**	1.68**
Reduced External Distractions			2.29***	2.57***	2.62***
Living Arrangement 1 - Relatives			0.318*	0.325*	0.374
Living Arrangement 2 – One Parent Home			1.55	1.86	1.96*
Personal Envi 1			0.457*	0.405*	0.416*
Level 2				0.262***	0.240***
Test of parallel lines	0.902	0.307	0.698	0.562	0.425
Pseudo R <sup>2</sup> Cox & Snell	0.192	0.197	0.466	0.503	0.498
Pseudo R <sup>2</sup> Nagelkerke	0.201	0.207	0.489	0.528	0.523

\*\*\*p<.001, \*\*p<.01, \*p<.05

ratings for reduced external distractions are also shown in Table II.

The ordinal regression model conducted in the SPSS program was used to ascertain the presence of a systematic relationship between our explanatory variables (teaching presence, cognitive presence, social presence) and confounding factors (personal context) on the response variable (ease of transition to the overall online emergency learning environment). More specifically, the model is set up to determine if the odds of students having an overall smooth transition to the online emergency learning environment were significantly affected by courses having a more organized teaching presence, cognitive presence, and social presence while controlling the student's personal context. Two groups of courses were examined against the overall student on-line transition experience—the first group (Group 1) considered only courses with smooth transitions while the second group (Group 2) only considered courses with difficult transitions. Within the study, personal context was grouped into 3 categories: personal attributes, socio-economic, and experience.

A base model, with consideration to the CoI only, was first analyzed. The personal attributes model considered the CoI model and controlled the effects of age, gender, health and motivation. The socio-economic model further controlled for living arrangement, personal environment, family support, technology access, reduced external distractions, and financial standing with the University. The experience model included experience as a control and accounted for the effects of level, previous online experience and Department on the CoI. All variables with a non-significant Wald test statistic were removed incrementally and from the final complete model. The pseudo R<sup>2</sup> values for each model was compared against each other.

Variance inflation factors were tested with a faux model utilizing the linear regression option in SPSS to ensure no multicollinearity across variables resulted in inflation of the variance explained or the pseudo R<sup>2</sup> values. Homoscedasticity of the model data was measured in SPSS. Validity of the model was ensured by utilizing attributes of CoI and personal context from the literature.

## 4. Results

### A. Descriptive Statistics

Participants ranged in age from 19 to 36 years with 88% between the ages of 19 to 23 for both the group samples. In the group 1 sample, the male population size was 56.9% followed by female at 42.6% and non-binary at 0.4%, whereas in the group 2 sample the male population maintained the greatest size at 59.3% with female at 40.7%. In both group samples, a normal distribution is observed for the statistically significant ease of transition, total teaching presence range, and external distractions encountered. The student levels were distributed as 30% over level 1, 34% in level 2, and 19% in level 3. A total of 17% of participants were of an unknown level. Over two thirds of the population belonged to two parent homes, with 23% living with a single parent, 7% living with relatives, and 2% living independently. In the group 1 sample, 80% of the sample population rated their access to technology favorably.

### B. Regression Results

#### 1) Group 1 – Smooth transition courses

The results of the odds ratio for group 1 are given in Table III. The CoI base model showed that a unit positive change in the range score for teaching increased the odds of entry to a smoother student

**Table 4: Significant Odds Ratio for Various Ordinal Regression Models with Difficult Transition course**

	CoI Base Model	Personal Attributes Model	Socio-Economic Model	Experience Model	Complete Model
Teaching Presence	1.41	1.35	1.40	1.72*	1.56**
Reduced External Distractions			2.64***	3.21***	3.53***
Living Arrangement 1 - Relatives			0.204*	0.296	0.256*
Level 2				0.412	0.309**
Test of parallel lines	0.582	0.086	0.321	0.142	0.509
Pseudo R-Squared – Cox and Snell	0.087	0.138	0.448	0.458	0.427
Pseudo R-Squared – Nagelkerke	0.091	0.145	0.472	0.482	0.449

\*\*\*p&lt;.001, \*\*p&lt;.01, \*p&lt;.05

**Table 5: Significant Odds Ratio for Various Ordinal Regression Models with Difficult & Smooth Transition Course**

	Complete Model-Easy		Complete Model-Difficult	
	Odds ratio	Percent term (%)	Odds ratio	Percent term (%)
Teaching Presence	2.47***	+147	1.56**	+56
Access to Technology	1.68**	+68		
Reduced External Distractions	2.62***	+162	3.53***	+253
Living Arrangement 1-Relatives	0.374	-63	0.256*	-74
Living Arrangement 2-One Parent Home	1.96*	+96		
Personal Envi 1	0.416*	-58		
Level 2	0.240***	-76	0.309**	-69
Test of parallel lines	0.425		0.509	
Pseudo R <sup>2</sup> Cox & Snell	0.498		0.427	
Pseudo R <sup>2</sup> Nagelkerke	0.523		0.449	

\*\*\*p&lt;.001, \*\*p&lt;.01, \*p&lt;.05

transition, while cognitive and social presence demonstrated no significance in the model. The pseudo R<sup>2</sup> values were below 20% for the base model. The addition of personal attributes (gender, age, health and motivation) to the base model provided no significant Wald test statistic for any confounding variables and a similar pseudo R<sup>2</sup> value as the base model. The addition of socio-economic variables contributed significantly to the model and more than doubled the pseudo R<sup>2</sup> values. Access to technology, reduced external distractions, living arrangements, and personal environment were the significant confounding factors contributing to the model within the socio-economic group. The addition of the experience parameters contributed to an improvement of 8% to the socio-economic model's pseudo R<sup>2</sup> values with only student level demonstrating a significant Wald test statistic for the experience parameters investigated. With all non-contributing factors removed for the complete model, the living arrangement 2 (one parent home) became significant and the living arrangement 1 (living with relatives) became less significant with p value of 0.06. The test of parallel lines demonstrate that the complete ordinal proportional fit model has better fit than a general model.

In the group 1 sample courses, a level 3 student living with both parents and in a good personal

environment would be considered our reference group. The odds of entry for the reference group to obtaining an overall smooth transition to the online learning environment increased by 147% for each unit positive increase in the range of teaching presence—even after controlling for other variables modelled. Based on the range calculation for teaching presence, each unit range change constitutes an additional 13 points from the Likert scale. More specifically, in comfortable courses, for every 13 points on the Likert scale gained with teaching presence, students were 2.5 times more likely to experience an increased odds in smooth transition in the emergency remote teaching environment. Within the CoI criteria, teaching presence demonstrated significant Wald test statistics with p<0.001 for group 1.

Students in level 2 of the programme and with reduced external distractions showed significance (p<0.001) for having a smoother transition to the online learning environment after controlling for other variables modelled. Compared to the reference group 1, level 2 students had 0.24 times (76% less) as likely odds to be entered into a higher tier of smoother transition. Courses in level 3 tend to be more project based in various Departments and students may have a more manageable workload at level 3 than level 2.

Moreover, as the level of distractions decreased, students had 2.62 times (162% increasingly) more likely odds to enter an easier transition when compared to the reference group 1.

Students with greater access to technology demonstrated less significance than teaching presence, level and external distractions, with  $p < 0.01$  but resulted in 1.68 times more (68% increase in) likely odds of smoother online transition. Personal environment and living arrangements provided the least significance of  $p < 0.05$ .

Compared to the reference group, students in a mixed personal environment experienced a 58% decrease in ease of transition odds and students in a single parent home were 96% more likely to experience smoother transition odds than the reference group of two parents' home.

## 2) Group 2 – Difficult transition courses

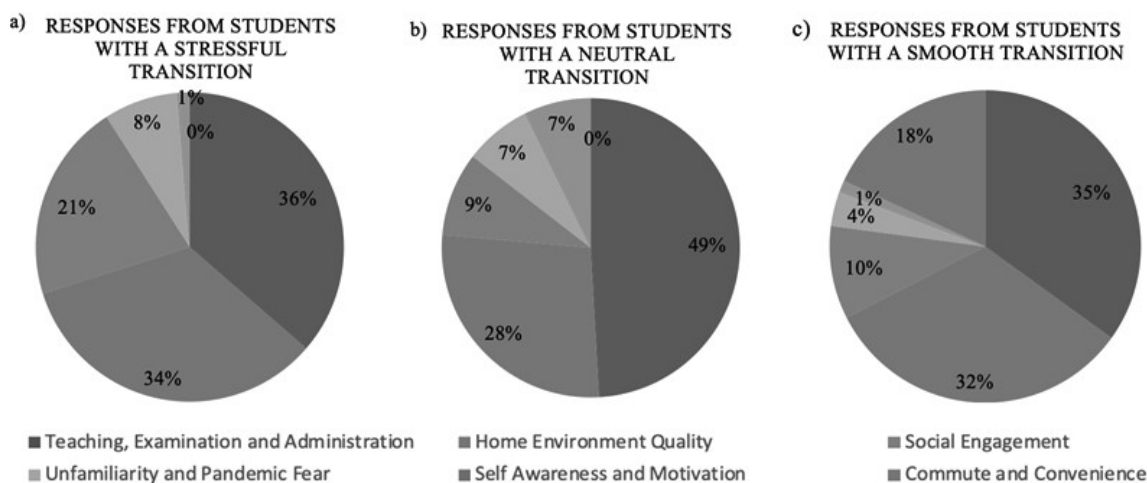
Similarly, Table IV provides a comparison of odds ratio and pseudo  $R^2$  values for specific courses with

the group 2 sample. The CoI base model demonstrated no significance having pseudo  $R^2$  values less than 10%. The addition of the personal attributes model generated no significant factors and maintained a low pseudo  $R^2$  of below 15%. Both reduced external distractions and living arrangements demonstrated significant effects on having an easier transition to the online learning environment in the socio-economic model with more than tripling the pseudo  $R^2$  values to 45% and 48% respectively for Cox and Snell and Nagelkerke. No significance was observed for teaching presence until the addition of the experience model confounding factors, and no significance was observed for both social and cognitive presence. The removal of all non-significant factors resulted in the complete model with acceptance of the proportional odds assumption.

The results of the difficult courses (group 2 sample) demonstrated significance of  $p < 0.01$  for teaching presence. With the reference group as a level 3 student in a 2 parent home, the odds of entry for the reference group to obtaining an overall smooth transition to the online learning environment

**Table 6 : Categories Based on Student Qualitative Response**

CATEGORY	CONCEPT
Teaching, Examination and Administration	Responses based on quality of teaching with all supporting documents, examination procedures and time to complete examination, lecturers' response time, number of assignments, strategy, engagement, teaching tools, scheduling, pastoral care, flexibility, availability of resources, online tools, etc.
Home Environment Quality	Responses based on distractions in the home, quality living, family support, technology, health, internet access, computer access
Social Engagement	Interaction with lecturer and other students
Unfamiliarity and Pandemic Fear	Fear of the transition to the online learning and fear of the pandemic
Self-Awareness and Motivation	Personal responsibility
Commute and Convenience	Traffic, cost of commuting, time for commuting



**Fig. 1 : Qualitative response to online emergency remote learning for a) stressful transitions b) neutral transitions c) smooth transitions**

increased by 56% (1.56 times) for each unit positive increase in the total range of teaching presence, even after controlling for other variables modelled. This value is about 100% less than the odds experienced for the group 1 sample. A higher significance ( $p < 0.001$ ) was experienced for external distractions with an increase by 3.53 (253%) on overall odds of being in a higher tier of smooth transition for each unit increase in reduced external distractions. Living arrangements and student level showed a lower and moderate significance of  $p < 0.05$  and  $p < 0.01$  respectively. Students demonstrated a 75% and 70% decrease in odds to having an easier transition when living with relatives and when in level 2 respectively, compared to the reference group.

### 3) Groups 1 and 2 Compared

The finalized complete models for the group 1 and group 2 samples (courses with easy and difficult transitions respectively) are given in Table V. Direct comparison of the odds ratio for the smooth courses (group 1 sample) and the difficult courses (group 2 sample) demonstrates that the positive effect of teaching presence resulted in an amplified ease of transition odds for group 1 whereas the positive effect of reduced external distractions resulted in an amplified ease of transition odds for group 2. More specifically the positive effect of teaching presence is 2.6 times more on easy courses than the negative courses and the positive effect of reduced external distractions is 1.6 times more for the negative courses than the positive courses. The negative effect of living with relatives on ease of transition was 1.2 times more for the difficult courses. The negative effect of being a level 2 student was 1.1 times more for the easy courses than the difficult courses.

In summary, the following 2 hypotheses can be accepted: Teaching presence that demonstrates clear course design, facilitation and communication is a significant contributing factor to a comfortable online learning transition; Positive student personal context is a significant contributing factor to a successful online learning transition. However, based on the findings, the following 2 hypotheses are rejected: Cognitive presence that supports higher order thinking is not a significant contributing factor to a comfortable online learning transition; Social presence that promotes a community of learners is not a significant contributing factor to a comfortable online learning transition.

### C. Qualitative Analysis

In addition to the predetermined quantitative scale measurement for the student's level of comfort or discomfort in transitioning to the online environment, qualitative responses were captured on the survey. Students' responses were documented based on stressful, neutral, and smooth transitions and their responses examined. Based on student responses, all student replies were grouped into 6 categories (see Table VI) and the distribution of results are given in Fig. 1. The top two categories were 1) teaching, examination and administration and 2) home environment quality for all student experiences. These results were aligned to the quantitative results obtained for teaching presence and student's personal context on the effect of a more smooth or difficult transition to ERT.

Students with a stressful transition described only negative experiences like family stress, lack of technology, long work hours, inconsiderate lecturers, difficult examinations and long screen time. However, students with a smooth transition expressed more positive views like conducive learning environment, great/good technology, pre-recorded and self-paced learning, and understanding lecturers. Students with an easy transition did express difficulty with exam times and assignment scheduling. Students with neutral experiences also provided more positive responses than the students who had a stressful transition, even while they upheld the difficulty of their experience. Students with positive and neutral experiences generally maintained a more optimistic and encouraging assessment.

Many students with a smooth transition mentioned the benefit of not having to commute to school, whereas this was not mentioned for learners with neutral and difficult transitions. All groups did mention disappointment with limited social interaction, but a few students with an easy transition preferred working and being alone. Pandemic fear and unfamiliarity affected all groups negatively and there was mention of personal responsibility and motivation amongst all groups. Students with a stressful transition discussed how demotivated they were learning in the online environment compared to students with a neutral transition that additionally mentioned their personal responsibility in the situation and their required self-motivation to succeed. Overall, the students' experience reflected their general perspective in each category. Students

with a smooth transition maintained a very positive outlook, and those with a difficult transition were generally pessimistic.

## 5. Discussion

The CoI suggests that online learning benefits from the mindful combination of teaching presence, social presence and cognitive presence in ways that complement each other. In the case of ERT however, it is apparent that teaching presence plays a significant role in the level of comfort of students transitioning from face to face to ERT, regardless of whether a course is perceived as easy or difficult by students. This supports the view by some researchers that teaching presence may have a more significant role than the other presences. also noted the importance of maintaining a strong teaching presence in the transition to ERT during the pandemic. However, as noted by , there is no “one-size fits all” when interpreting what constitutes teaching presence and effective online teaching and learning is dependent on a complex combination of factors.

In difficult courses, the results demonstrated a great need for reduction of external distractions for an easier transition when compared to the easy courses. In easier courses, the results showed a more organized teaching presence better aided the odds of a greater ease of transition when compared to the difficult courses. However, reducing the external distractions and creating a more organized teaching presence both demonstrated benefit for overall ease of transition for both groups.

Unpredictability or uncertainty negatively affected students' experience of ERT and this could perhaps provide one explanation for the importance of teaching presence, which serves as a source of structure for the student. As the qualitative data indicated, pandemic fear and unfamiliarity affected all groups negatively. Although all groups expressed disappointment with limited social interaction, students who were able to accept personal responsibility for their learning seemed to have a more positive experience, as well as those students who seemed to be more independent learners. This suggests therefore that while the data indicates the significance of teaching presence, for a more effective online teaching and learning environment, social presence may have a more important role for those students who require motivation and social interaction.

Researchers have made a link between the environment and learning . The results of this study suggest that factors beyond the classroom such as family stress, lack of access to technology, and distractions in the home negatively affect the online experience. One finding of note is the more positive effect of single-parent homes on the ease of transition to ERT during the pandemic than living with relatives or even two-parent homes. Further investigation would need to be conducted to determine the aspects of a single parent home living during the pandemic that may have contributed to an easier course transition. Nevertheless, this study revealed that a living environment with less distractions was beneficial.

Additionally, even with positive teaching presence, it was noted that during the ERT some of the learning outcomes of students were negatively affected. The loss of certain acquired skills-sets that were in the psychomotor domain posed a challenge. For instance, existing laboratory or project-based courses had learning outcomes that were focused on the cognitive domain specifically, data acquisition, analysis, problem solving and reporting. Participation in face-to-face lab setting would indirectly build on students' reflexive movements, perceptual abilities, some skilled movements (as with formulating liquid mixtures, chemical titrations, materials handling, etc.) and non-discursive communication. The online modality would have allowed for certain learning outcomes to be met, but at the expense of these skills that may not be specifically stated in the course outlines' learning outcomes.

Based on the findings of the study, the confounding factors had a significant effect on the CoI framework. The CoI framework can be optimized with inclusion of personal attributes and environment of students being considered in addition to the aspects that are teacher driven like learning, cognitive, and social presence.

## 6. Conclusion

An ordinal regression was conducted to determine the effects of the CoI of teaching presence, cognitive presence, and social presence and students' personal context on the ease of transition to the emergency remote teaching environment for easy courses and difficult courses. The odds of students having an overall smooth transition to the online learning environment were significantly impacted by the CoI

for courses having a more organized teaching presence, and students' personal context but there was no significance determined toward an increased odds for smooth transition to the online learning environment by the CoI social and cognitive components. These results led to the acceptance of the two hypotheses: 1) Teaching presence that demonstrates clear course design, facilitation and communication is a significant contributing factor to a comfortable/smooth online learning transition; and 4) Positive student personal context is a significant contributing factor to a successful online learning transition. A more organized teaching presence also created a magnified odds for an easier transition in smooth courses compared to difficult courses. Reduction of external distractions resulted in a magnified odds for ease of transition for the difficult courses compared to the smooth courses. Students living with relatives demonstrated a similar decrease in odds in ease of transition for both easy and difficult courses. Students in one parent homes demonstrated an increase in odds for ease of transition for easy courses while no significance was observed for difficult courses. Students who accept more personal responsibility for their learning maintained a greater ease of transition for both easy and difficult courses.

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