education sciences

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Emergency Online Learning in Low-Resource Settings: Effective Student Engagement Strategies

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Abstract: We aim to identify the engagement strategies that higher education students, engaging in emergency online learning in low-resource settings, perceive to be effective. We conducted a sequential mixed-methods study based on Moore's interaction framework for distance education. We administered a questionnaire to 313 students engaging in emergency online learning in low-resource settings to examine their perceptions of different engagement strategies. Our results showed that student–content engagement strategies, e.g., screen sharing, summaries, and class recordings, are perceived as the most effective, closely followed by student–teacher strategies, e.g., Q and A sessions and reminders. Student–student strategies, e.g., group chat and collaborative work, are perceived as the least effective. The perceived effectiveness of engagement strategies varies based on the students' gender and technology access. To support instructors, instructional designers, and researchers, we propose a 10-level guide for engaging students during emergency online classes in low-resource settings.

Keywords: online learning; emergency; low-resource settings; engagement; distance learning; student perception; survey; COVID-19; Moore framework

Citation: Abou-Khalil, V.; Helou, S.; Khalifé, E.; Chen, M.A.; Majumdar, R.; Ogata, H. Emergency Online Learning in Low-Resource Settings: Effective Student Engagement Strategies. *Educ. Sci.* **2021**, *11*, 24. https://doi.org/10.3390/educsci11010024

Received: 26 November 2020
Accepted: 4 January 2021
Published: 8 January 2021

1. Introduction

The COVID-19 pandemic forced teachers and students into a sudden transition to emergency online education without prior preparation or guidelines. Faculties rushed to convert their curricula to an online environment, and online pedagogy had to be overlooked [1]. This transition has been particularly challenging and frustrating for students and teachers in developing countries who have access to limited resources [2–4]. Indeed, low internet connectivity, limited access to technology, low resources, and lack of financial support create major barriers that inhibit synchronous interactions and learners' engagement in online education [1,5–8]. This is important because engaging students is essential to reduce their sense of isolation [9] and maintain their desire to learn [10], their satisfaction [11], and their academic achievement [12]. Student engagement even affects the teacher's motivation to teach [13]. A recent study showed an overall decrease of student engagement during online classes provided during the COVID-19 pandemic [14].

Instructors, instructional designers, and system designers need to know which engagement strategies are the most effective in order to engage students in online classes. Previous studies that aimed to extract successful engagement strategies were conducted mainly in developed countries and in online learning contexts that required extensive planning. This is in contrast to emergency remote learning, which does not allow for much preparation

time [15]. It is still unknown which engagement strategies are perceived by students in low-resource settings to be the most effective during emergency online learning; the results may differ from those found in studies of high-resource settings in non-emergency settings. To fill this knowledge gap, we conducted a survey with higher education students who attended emergency online classes in low-resource settings in order to answer the following research questions:

- RQ1: Which engagement strategies are perceived to be the most effective by students taking emergency online classes in low-resource settings?
- RQ2: Is there any relationship between student characteristics and their perceptions of the effectiveness of different engagement strategies?

2. Literature Review

In this work, we examine the engagement strategies that are perceived to be effective by students participating in emergency online learning in low-resource settings. First of all, it is important to clarify the terms that we will be using throughout this paper. When referring to emergency online learning, we refer to education by emergency remote teaching, which is, according to Hodges et al. [15], a "temporary shift of instructional delivery to an alternate delivery mode due to crisis." Accordingly, the objective of teachers providing emergency online teaching is to temporarily instruct in a quick and reliable way, rather than re-create a robust educational ecosystem. In terms of student engagement, there is no one widely accepted definition [16]. In this paper, we adopt Balwant's [17] definition that concludes his review study by defining engagement as the "highly activated and pleasurable emotional, behavioral and cognitive involvement in academic activities." Finally, the term low-resource contexts refer to contexts where (1) the costs of hardware and infrastructure limit access to, and effective use of, technology [18], and (2) an institution's management, instructors, and students have little or no information technology training or expertise. This can be due to a lack of financial resources, a lack of affiliation with larger organizations that could provide such expertise, a geographic location where such expertise is scarce or absent, or a combination of these factors [19]. In the following section, we will first present the framework used in this paper to examine student engagement and provide the rationale behind this choice in relation to the context of emergency online learning in low-resource settings. We will then present strategies that were shown to be effective in engaging students in online learning classes.

2.1. Framework Used in the Study

To maintain engagement in an emergency online learning context, Hodges et al. [15] recommend a careful planning of how to support the interactions that are important to the learning process. One of the major models that defines interactions in distance education is Moore's interaction model, which proposes three interaction categories: student–student, student–teacher, and student–content [20]. Student–student interaction refers to interaction between individual students or among students working in groups. Student–student interaction is desirable for cognitive purposes and motivational support and is particularly threatened in online education as students might not be aware of the identities of students taking the same course [21]. Student–teacher interaction aims to stimulate or maintain students' interest in the content, motivation to learn, and self-direction. Student–content interaction refers to students' interaction with the content that results in a change in their understanding, perspective, or cognitive structure [20]. Through student–content interactions, learners construct meaning, relate the content to previous knowledge, and apply it to problem solving [21].

In this work, we use Moore's model as a framework to analyze students' perspectives of their own engagement in emergency online learning in low-resource contexts. Our choice is motivated by the fact that Moore's model can be applied to a crisis situation and provides the minimal interactions necessary for effective learning while recognizing learning as both a social and cognitive process [15]. Moreover, Moore's interactions represent one

of the more robust bodies of research in distance education [15], and studying student engagement from this perspective allows a comparison with previous work (e.g., [22]) to examine the specificity of strategies needed in emergency online learning and low-resource contexts.

2.2. Student Engagement Strategies

Student–student interaction is viewed as a major element of student engagement, both online and offline [23]. Several student–student interaction strategies are potentially effective in increasing the students' engagement within distance education. For instance, D'Errico et al. [24] showed that using students group chats can increase their engagement. It has also been shown that a collaborative flipped classroom instructional design increases students' engagement as well as their social presence in the course [25,26]. Martin and Bolliger [22] presented student–student interaction strategies that higher education students perceived as moderately important to important. Those strategies include interacting with classmates through presentations, introductions using icebreaker discussions, completing a profile on the Learning Management System (LMS), peer-reviewing classmates' work [27,28], and moderating class discussions. Moreover, Akcaoglu and Lee [29] showed that placing students in small and permanent discussion groups during online classes can increase student–student engagement.

Student–teacher interaction plays an essential role in online learning and has been perceived by students as the most important type of interaction to keep them engaged [22]. Previous research presented several student–teacher interaction strategies that can increase students' engagement. Chen et al. showed that providing a clear set of due dates was perceived as very important for students [30]. This finding was confirmed by Martin and Bolliger [22] who showed that, on average, students perceived this student–teacher strategy as effective. Chen [31] identified five important types of feedback in distance education and showed that the most valued type of feedback is about their self-regulation. Czerkawski and Lyman [23] proposed a framework to foster student engagement in online learning and indicated the importance of instructional feedback. Martin and Bolliger [22] showed that posting announcements or email reminders, using various synchronous features to interact with students and referring to students by name in discussion forums are perceived as effective strategies by students. Anderson and Garrison [32] indicated the importance of instructors' teaching presence in distance education, while Weil et al. [33] pointed out the importance of instructors' presence in online discussion forums.

Student–content interaction is essential for students' independence and self-regulation. Several strategies allow students to interact more effectively with the content and lead to better engagement in online classes. For example, practice tests in online classes are correlated with students' learning satisfaction [30]. However, Poon et al. [34] suggest that it may not be valid to assume that practice tests would be equally effective in the Global South and in limited computing contexts. Multimedia resources have been shown to provide high-level engagement, learner satisfaction, and learning motivation [35,36]. Previous studies showed the importance of instructor-provided summaries in online learning using different means like videos or infographics [33,37,38]. Weil et al. [33] pointed out the importance of case-based learning. Moreover, students perceived the following as effective engagement methods: presenting a topic using a delivery method of their choice, selecting material based on their interests [22], and using online resources to explore topics in greater depth.

3. Materials and Methods

We used a sequential mixed method research design to create a questionnaire and extract the students' perspectives regarding different engagement strategies. First, we conducted a literature review to extract a list of strategies used to engage students in online learning contexts. Second, we interviewed 10 teachers and 10 students to complete the list of engagement strategies with ones used in the specific context of emergency online

learning and low-resources. The list of strategies constituted the building block of the questionnaire, and each strategy's effectiveness was rated by students.

3.1. Literature Review

To identify existing engagement strategies, we conducted a literature review targeting student engagement in higher education. We extracted, as shown in the background section, engagement strategies that were shown to be successful in previous studies. However, we found that the literature only covers engagement strategies used in online learning in high-resource contexts. Therefore, previous literature may lack some strategies that are successful in emergency online learning in low-resource contexts.

3.2. Interviews

As the literature review only covers engagement strategies used in online learning in high-resource contexts, we interviewed 10 higher education teachers and students engaging in emergency online classes in Lebanon to identify additional strategies specific to low-resource emergency learning contexts. The interviewees were selected to obtain a variation sample in terms of age, gender, institution, and courses. The teachers and students had begun emergency online classes at the start of the confinement due to the COVID-19 pandemic and had been suffering from a slow internet connection, limited tools, no previous training, and limited financial support. The interviews explored (1) the challenges they faced and (2) the engagement strategies they thought were effective in facing those challenges. To analyze the content of the interviews, a thematic analysis was carried out following the guidelines of Braun and Clarke [39] by one researcher and reviewed by a second researcher [40]. Each resulting theme corresponded to a different strategy. Our analysis resulted in the following 12 strategies that were not extracted through the literature review: (1) students work in groups on projects using online tools, (2) students prepare for exams together using online communication tools, (3) students work in groups during class, (4) instructor allocates time for questions and answers during the online class, (5) instructor creates a group chat to answer questions about the course, (6) instructor gives students the chance to give feedback, (7) instructor asks questions during the class to verify the understanding of the students, (8) instructor answers queries through their personal contact information, (9) instructor shows their face during the class, (10) instructor shares the screen during the online class, (11) the online class is uploaded on the learning management system, and (12) students take screenshots or video recordings of parts of the class

3.3. Questionnaire Design

The purpose of the questionnaire was to examine the students' perceptions regarding the effectiveness of different engagement strategies, and to identify the individual characteristics that are associated with these perceptions. An initial version of the questionnaire was created, reviewed, and modified by four experts in the field of education, educational technologies, and social informatics. A refined version was pre-tested with two students and further refined. The final version of the questionnaire included 43 questions. It included 11 demographics questions about the student's age, gender, grade, device used to access online classes, experience in taking online classes, major, classes taken online, country of residence, country of the institution, internet speed, and data plan. The questionnaire also included two open-ended questions about (a) the main challenges faced during the emergency online classes and (b) the most effective engagement strategies the student encountered. Finally, the questionnaire included 30 five-point Likert-type items ranging from "1—very ineffective" to "5—very effective" and examining the effectiveness of engagement strategies in terms of student–student interaction, student–teacher interaction, and student–content interaction. The Cronbach's alpha value of the student–student, student–teacher, and student–content subscales are respectively 0.85, 0.89, and 0.87, and exhibited internal consistency.

3.4. Data Collection

The questionnaire was administered online as a Google Form in English and took approximately 15 min to complete. The target study population for the questionnaire was higher education students residing in Lebanon or India or enrolled in institutions in Lebanon or India. The respondents were recruited through faculty members of four universities in Lebanon and one university in India, who forwarded the invitation to participate in the study via email to students engaging in emergency remote learning in their programs. The invitation included information about the study and a link to the online survey. Participation was voluntary and all responses were anonymous. The responses were collected from 26 May 2020 to 31 July 2020.

3.5. Data Analysis

We collected a total number of 320 responses. Seven questionnaires contained missing data and were deleted. In total, 313 valid responses were considered for the data analysis. The respondents' characteristics are shown in Table 1. To understand student perceptions of engagement strategies during emergency online learning, we analyzed the collected data using descriptive statistics. To identify the individual characteristics that are associated with those perceptions, we analyzed the data using parametric inferential statistics, namely a one-way analysis of variance (ANOVA) and Pearson's correlation coefficient. To reveal the gaps of knowledge in the engagement strategies, we analyzed the responses to the open-ended questions using a quantitative content analysis [41,42]. We chose the strategies as a sampling unit and coded the answers to the open-ended question, "What strategies used by the teacher were the most useful?"

Table 1. Summary of respondent characteristics.

	Frequency	Percent
Age		
18–20	162	51.7
21–22	71	22.6
23–25	38	12.1
26–30	28	8.9
>30	14	4.4
Gender		
Female	168	53.7
Male	143	45.7
Prefer not to say	2	0.6
Country of residence		
Lebanon	267	85.3
India	36	11.5
Ivory Coast	6	1.9
Algeria	2	0.6
Democratic Republic of Congo	1	0.3
Canada	1	0.3
Country of the institution		
Lebanon	261	83.4
India	36	11.5
France	16	5.1
Current Education		
Bachelor	205	65.5
Master	83	26.5
MBA	3	1.0
PhD	22	7.0
Major		
Business	165	52.7
Engineering	69	22
Science	35	11.2

Table 1. *Cont.*

	Frequency	Percent
Medicine	26	8.3
Health Sciences	8	2.6
Letters	2	0.6
Social Sciences	2	0.6
Economy	2	0.6
Agriculture	2	0.6
Others	2	0.6
Using Smartphone		
Yes	234	74.8
No	79	25.2
Using PC		
Yes	228	72.8
No	85	27.2
Using tablet		
Yes	106	33.9
No	2017	66.1
Type of connection		
Wifi	188	60.1
3G	53	16.9
Wifi and 3G	72	23
Internet Data per day		
Less than 200 MB	21	6.7
Between 200 MB to 500 MB	47	15.0
Between 500 MB to 1 GB	32	10.2
Between 1 GB and 1.5 GB	55	17.6
Between 1.5 GB and 2 GB	26	8.3
More than 2 GB	47	15.0
N/A	85	27.2

4. Results

4.1. Effectiveness of Student Engagement Strategies

We conducted a one-way ANOVA to compare the differences in means of the perceived effectiveness of different engagement strategies categories as shown in Table 2. The results show a significant difference in the perceived effectiveness of the three categories $F(3, 309) = 71.52$, $p < 0.001$. We also conducted post hoc tests using Tukey HSD and showed that the mean of perceived effectiveness of student–content strategies and student instructor strategies is significantly higher than the mean of perceived effectiveness of student–student engagement strategies.

Table 2. Perceived effectiveness of student engagement strategies.

Engagement Strategy	M	SD	F	Post-Hoc
(a) Student–content engagement strategies	4.04	0.67		a > c
(b) Student–teacher engagement strategies	3.99	0.64	71.52 **	b > c
(c) Student–student engagement strategies	3.45	0.75		

Note. ** $p < 0.001$, Scale ranging from 1 (very ineffective) to 5 (very effective).

4.2. Student–Student Engagement Strategies

Table 3 and Figure 1 show the reported effectiveness of student–student engagement strategies. We conducted a one-way ANOVA to compare the differences in the perceived effectiveness of student–student engagement strategies as shown in Table 3. The results show a significant difference in the perceived effectiveness of the different strategies with $F(9, 303) = 21.72$, $p < 0.001$. We also conducted post hoc tests using Tukey HSD that showed that the perceived effectiveness of using a group chat (Item S1) and collaborating on projects using online tools (Item S2) is significantly higher than the perceived effectiveness of class

groupwork, peer review, icebreaker discussions, and completion of profiles on the LMS. Strategies S1 and S2 were rated either effective or very effective by 61.9% and 62.2% of students respectively. Moreover, students agree that the least effective strategy within all categories is the completion of a student profile on the LMS (Item S10), with only 25.5% of students reporting that the strategy is effective or very effective.

Table 3. Perceived effectiveness of student–student engagement strategies.

Item	M	SD	F	Post-Hoc
S1. Students use group chat to discuss class matters or common interests	3.80	1.11		S1 > S7, S8, S9, S10
S2. Students work in groups on projects using online tools	3.73	1.04		S2 > S7, S8, S9, S10
S3. Students interact with their classmates through presentations in class	3.65	1.12		S3 > S8, S9, S10
S4. Students moderate discussions in class	3.59	1.04		S4 > S8, S9, S10
S5. Students prepare and present lectures together based on their interests	3.57	1.15		S5 > S9, S10
S6. Students prepare for exams together using online communication tools	3.51	1.18	21.72 **	S6 > S9, S10
S7. Students work in groups during class	3.41	1.24		S7 > S9, S10
S8. Students peer-review classmates' work	3.30	1.15		S8 > S10
S9. Students introduce themselves in class using an icebreaker discussion	3.02	1.17		
S10. Students complete a profile accessible to their peers on the LMS	2.88	1.10		
Total	3.45	1.17		

Note. ** $p < 0.001$, Scale ranging from 1 (very ineffective) to 5 (very effective).

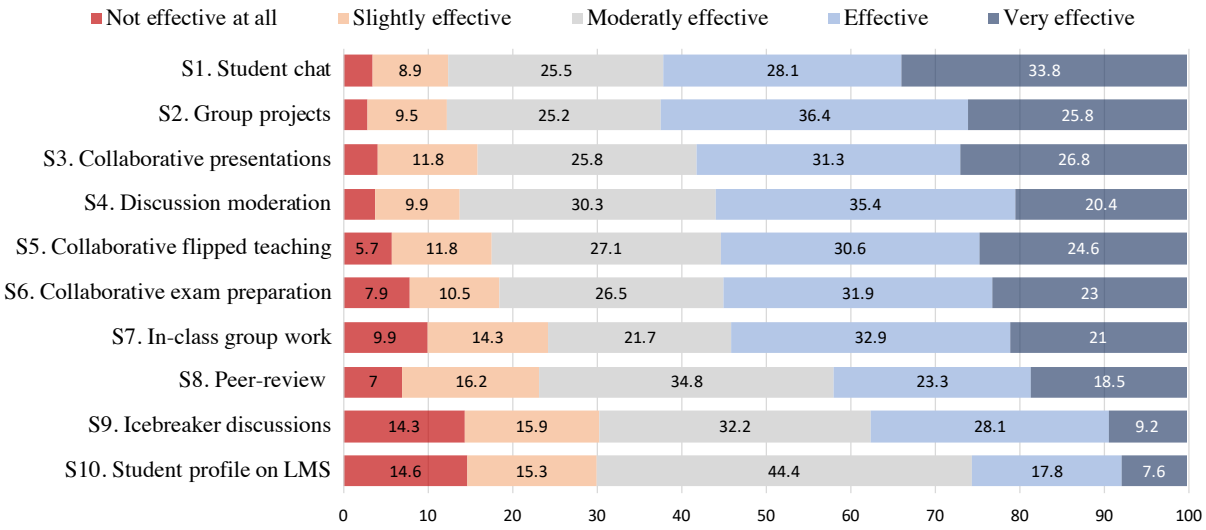

Figure 1. Distribution of respondents' answers for the student–student category.

4.3. Student–Teacher Engagement Strategies

Table 4 and Figure 2 show the reported effectiveness of the student–teacher engagement strategies. We conducted a one-way ANOVA to compare the differences in the perceived effectiveness of student–teacher engagement strategies as shown in Table 4. The results show a significant difference in the perceived effectiveness of the different strategies with $F(9, 303) = 7.31$, $p < 0.001$. We also conducted post hoc tests using Tukey HSD that showed that the perceived effectiveness of allocating time for questions and answers during the online class is perceived significantly more effective than other strategies, with 78.5% of students describing that strategy as effective or very effective. Moreover, posting regular announcements (Item S12), using various features to interact with the students (Item S13), creating a forum/group chat (Item S14), and providing feedback using various modalities (Item S15) are highly rated with more than 70% of respondents describing them as effective or very effective. The least effective student–teacher strategy is showing the instructors' face during the class (M = 3.73, SD = 1.23).

Table 4. Comparison of means of student–teacher engagement strategies.

Item	M	SD	F	Post-Hoc
S11. Instructor allocates time for questions and answers during the online class	4.21	0.94	7.31 **	S11 > S16, S17, S18, S19, S20
S12. Instructor posts regular announcements or email reminders	4.13	0.95		S12 > S18, S19, S20
S13. Instructor uses various features during class to interact with students	4.11	0.94		S13 > S19, S20
S14. Instructor creates a group chat to answer questions about the course	4.11	0.95		S14 > S20
S15. Instructor provides various types of feedback	4.03	0.90		S15 > S20
S16. Instructor gives students the chance to give feedback	3.96	1.04		
S17. Instructor posts a "due date checklist" at the end of each online class	3.90	1.01		
S18. Instructor refers to students by name in discussion forums and during class	3.86	1.01		
S19. Instructor answers queries through their personal contact information	3.86	1.04		
S20. Instructor shows their face during the class	3.73	1.23		
Total	3.99	1.02		

Note. ** $p < 0.001$, Scale ranging from 1 (very ineffective) to 5 (very effective).

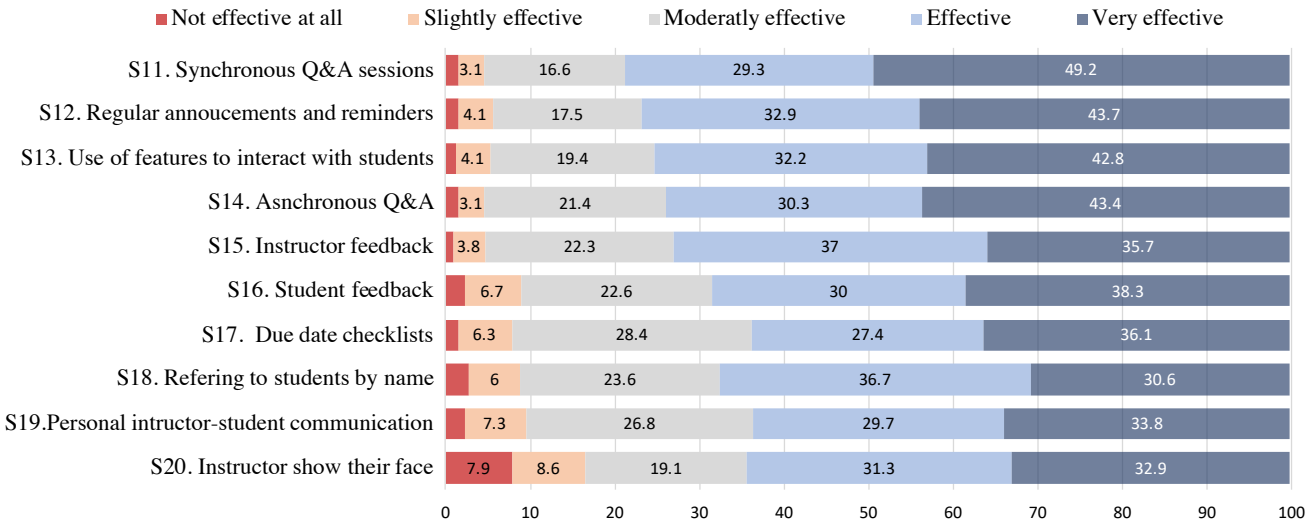

Figure 2. Distribution of respondents' answers for the student–teacher category.

4.4. Student–Content Engagement Strategies

Table 5 and Figure 3 show the reported effectiveness of the student–content engagement strategies. This category is assessed by respondents as the most effective (M = 4.04, SD = 0.67). We conducted a one-way ANOVA to compare the differences in the perceived effectiveness of student–content engagement strategies as shown in Table 4. The results show a significant difference in the perceived effectiveness of the different strategies with $F(9, 303) = 22.39$, $p < 0.001$. We also conducted post hoc tests using Tukey HSD that showed that the perceived effectiveness of screen-sharing during the online class (Item S21) is significantly higher than all other strategies. Moreover, providing summaries (Item S22), uploading the online class on the LMS (Item S23), allowing students to take screenshots and video recordings during class (Item S24), presenting the content in several formats (Item S25), and using tests to check understanding (Item S26), are highly rated by students, with more than 70% reporting those strategies being effective or very effective.

Table 5. Perceived effectiveness of student–content engagement strategies.

Item	M	SD	F	Post-Hoc
S21. The instructor shares the screen during the online class	4.56	0.79	22.39 **	S21 > S22, S23, S24, S25, S26, S27, S28, S29, S30
S22. Summaries are provided at the end of each online class	4.27	0.97		S22 > S26, S27, S28, S29, S30
S23. The online class is uploaded on the learning management system	4.19	1.07		S23 > S26, S27, S28, S29, S30
S24. Students take screenshots or video recordings of parts of the class	4.18	1.01		S24 > S27, S28, S29, S30
S25. The content is presented in several multimedia formats	4.10	1.03		S25 > S29, S30
S26. Instructors provide practice tests to students	3.93	1.02		S26 > S30
S27. Students use online resources to explore topics in more depth	3.92	0.99		
S28. Case-based learning is conducted during class	3.87	0.99		
S29. Students present a topic in a delivery method of their choice	3.74	1.03		
S30. Students select materials based on their interests	3.67	1.01		
Total	4.04	1.02		

Note. ** $p < 0.001$, Scale ranging from 1 (very ineffective) to 5 (very effective).

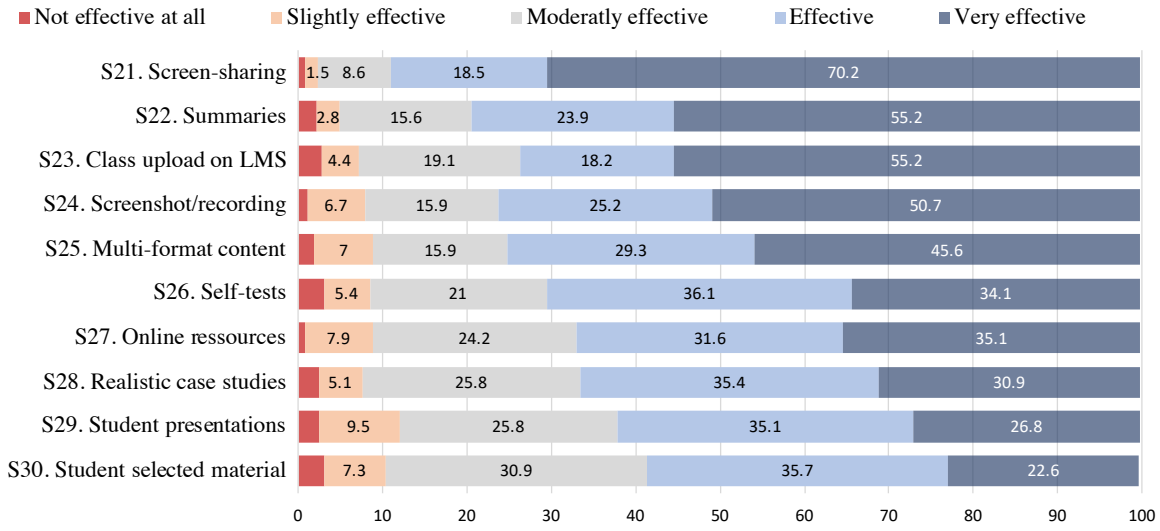

Figure 3. Distribution of respondents' answers for the student–content category.

4.5. Individual Differences

4.5.1. Gender

We conducted a one-way multivariate analysis of variance (MANOVA) to evaluate the differences in gender and perceptions of student engagement categories. The results show a significant difference of means in the perceptions of student engagement strategies with F (6, 616) = 2.12, $p < 0.005$; Wilk's $\Lambda = 0.96$, partial $\eta 2 = 0.02$. We conducted tests of between-subjects effects that showed that gender has a statistically significant effect on the perceptions of student–teacher engagement strategies (F (2, 310) = 4.99; $p < 0.001$; partial $\eta 2 = 0.03$). We conducted Tukey HSD post-hoc tests that showed that mean scores for student–teacher engagement strategies were statistically significantly different between female students and male students ($p < 0.05$), with female students finding student–teacher engagement strategies (M = 4.07, SD = 0.63) more effective compared to male students (M = 3.88, SD = 0.63).

We conducted a series of one-way ANOVA tests to evaluate the differences in gender and perceptions of different student–teacher engagement strategies. The analysis results show that the use of features to interact with students in class (Item S13) was found to be more effective by female students than by male students, F(2, 310) = 3.06, $p = 0.04$. In addition, the creation of a group chat to answer questions (item S14) (M = 3.96, SD = 0.95), F(2, 310) = 4.00, $p = 0.01$; the allocation of time for questions and answers (Item S11)

F(2, 310) = 3.35, p = 0.03; the provision of feedback using various modalities (Item S15) F(2, 310) = 4.04, p = 0.01; and the provision of students with an opportunity to give feedback (Item S16) F(2, 310) = 3.89, p = 0.02 were all perceived as more effective by female than male students.

We also found significant differences between genders regarding two student–content interaction strategies. In fact, female students perceived the presentation of the class content in multiple formats (Item S25) F(2, 310) = 3.59, p = 0.02 more effective than male students. Female students also judged the presentation of content using the delivery method of their choice (Item S29), F(2, 310) = 3.38, p = 0.03 better than male students.

4.5.2. Technology used

We studied the correlations between the technology used (computer, smartphone, or tablet) to attend online classes and the student perceptions of different engagement strategies. We found a weak correlation between the usage of a computer to take online classes and the perception of student–teacher and student–content engagement strategies. The students who were using a computer found more effective student–teacher engagement strategies r(312) = 0.15, p = 0.005, and student–content strategies r(312) = 0.17, p = 0.002, compared to the students who were not. There was no correlation between the use of a smartphone or tablet and student perceptions of different engagement strategies. Consequently, we conducted a one-way MANOVA to evaluate how the use of a computer relates to the perceptions of student engagement categories. The results show a significant difference of means in the perceptions of student engagement strategies with F (3, 309) = 3.59, $p < 0.005$; Wilk's Λ = 0.96, partial $\eta 2$ = 0.03. We conducted tests of between-subjects effects that showed that technology used has a statistically significant effect on the perceptions of student–teacher engagement strategies (F (1, 311) = 3.21; $p < 0.005$; partial $\eta 2$ = 0.02) and student–content engagement strategies (F (1, 311) = 4.44; $p < 0.005$; partial $\eta 2$ = 0.03). Students who were using a computer found more effective student–content engagement strategies (M = 4.11, SD = 0.59) and student–teacher engagement strategies (M = 4.05, SD = 0.57).

We conducted a series of one-way analysis of variance (ANOVA) tests to evaluate how the use of a computer relates to the perception of engagement strategies. Within the student–teacher strategies, students using a computer perceived the following items as more effective than students not using a computer: the use of various features to interact with students (Item S13), F(1, 311) = 4.38, p = 0.03; the use of group chats to answer questions (Item S14), F(1, 311) = 10.73, p = 0.00; the allocation of time for questions and answers during class (Item S11), F(1, 311) = 10.08, p = 0.00; and the provision of students with an opportunity to give feedback (Item S16), F(1, 311) = 7.57, p = 0.00.

Finally, students using a computer judged the following items as more effective: the instructor sharing their screen (Item S21), F(1, 311) = 30.95, p = 0.00; taking screenshots or screen recordings during the online class (Item S24), F(1, 311) = 4.57, p = 0.03; presenting the content using multiple formats (Item S25) F(1, 311) = 5.22, p = 0.02; working on realistic scenarios to apply content (Item S28) F(1, 311) = 8.95, p = 0.00; and using tests to check their understanding (Item S26), F(1, 311) = 7.39, p = 0.00.

4.5.3. Major

We conducted a one-way MANOVA to evaluate the differences in student major and perceptions of student engagement categories. The major was not significantly related to the perceived effectiveness at $p < 0.05$ with F (27, 879) = 1.07, $p > 0.005$; Wilk's Λ = 0.91, partial $\eta 2$ = 0.031.

4.5.4. Education level

The education level was not significantly related to perceived effectiveness of different interaction strategies at the $p < 0.05$ level (with student–student strategy F(4, 309) = 0.30,

$p = 0.82$, with student–teacher strategy $F(4, 309) = 0.23$, $p = 0.87$, and with student–content strategy $F(4, 309) = 0.17$, $p = 0.91$).

4.6. Challenges of Emergency Online Learning in Low-Resource Contexts

When answering the question "What are the challenges you faced during the online classes?", the participants reported the challenges shown in Table 6. The most encountered challenges were slow internet connection and frequent disconnections (68%), lack of comprehension and focus (14.6%), and electricity cuts (13.7%). One respondent reported, "The internet connection wasn't fast enough: the teacher's connection is often poor, and we would struggle to understand the course. Connection and electricity cuts were a nuisance on both sides and a waste of time." The main challenges involving student–teacher interaction were a lack of clear schedules, breaks, and explanations. Another student wrote, "Not all teachers respected the pre-established time frames of the courses. They assumed that since we were in quarantine our time was free and set courses in the morning, whereas most of us were still working from home and trying to stick to our usual schedules." Finally, the main problems related to student–content interaction were that STEM classes were difficult to understand (3.5%) and the sessions were not uploaded on the LMS (3.5%).

Table 6. Challenges faced by the participants.

	Frequency	Percent
Student–student interaction challenges		2.5
Difficulty working in groups	4	1.2
Other students are noisy	4	1.2
Student–teacher interaction challenges		
Instructors do not set clear schedules and breaks	13	4.1
Instructors read the material without providing explanations	13	4.1
Instructors are difficult to reach outside of class time	9	2.8
Student–content interaction challenges		
Difficulty understanding STEM classes	11	3.5
The sessions are not uploaded on the LMS	11	3.5
Instructors are difficult to reach outside of class time	9	2.8
Other challenges		
Slow internet connection/disconnections	231	68.0
Lack of comprehension/focus	46	14.6
Electricity cuts	43	13.7
Lack of instructor's IT knowledge	17	5.4
Very long sessions	15	4.7
Boredom/low motivation/anxiety	15	4.7
Audio quality is very low	11	3.5
Technical problems	9	2.8
Lack of required hardware or software	7	2.2
Technical problems while taking exams online	5	1.5

4.7. Most Effective Engagement Strategy for the Students

When answering the question "Which strategy encountered during the online classes was the most useful to keep you engaged?", the participants presented the strategies shown in Table 7. The strategies included four student–student strategies mentioned 23 times, 15 student–teacher strategies mentioned 88 times, eight student–content strategies mentioned 88 times, and four strategies not belonging to the former categories mentioned 24 times. Moreover, 52 respondents reported not experiencing any successful strategy.

Table 7. Effective engagement strategies according to the participants.

	Frequency	Percent
Student–student strategies		
Students keep their cameras off	12	3.8
Students collaborate on projects	5	1.5
Students are muted	3	0.9
Students discuss the content in groups	3	0.9
Total	*23*	*7.3*
Student–teacher strategies		
Instructor interacts with students during the class	21	6.7
Instructor often repeats main ideas during the class	14	4.4
Instructor responds to students' emails/calls/messages	13	4.1
Instructor allocates time for Q&A during online class	6	1.9
Instructor checks students understanding after disconnection	6	1.9
Instructor calls students by name and asks them to participate	5	1.5
Instructor uses white board feature during online class	4	1.2
Instructor answers questions/sends material over group chat	3	0.9
Instructor uses multimedia when explaining	3	0.9
Instructor summarizes important notions in online class	3	0.9
Instructor answers questions asked through the chat feature	3	0.9
Instructor provides online office hours	2	0.6
Instructor communicates with students through one platform	2	0.6
Instructor shows their face during class	2	0.6
Instructor divides student into smaller groups for Q&A	1	0.3
Total	88	28.1
Student–content strategies		
The lecture is recorded and uploaded on the LMS	43	13.7
The instructor shares their slides during the online class	18	5.7
Explanatory videos explain homework and case studies	7	2.3
Corrections of the exercises are posted on the LMS	6	1.9
Video/slides summaries of the class are provided	6	1.9
Case studies are provided	4	1.2
Self-tests and homework are constantly provided	3	0.9
Exercises are provided during the synchronous class	1	0.3
Total	88	28.1
Other strategies		
Classes are shorter/contain breaks	12	3.8
The instructor uses their mobile data to give the course	7	2.3
The classes are given outside of internet rush hours	3	0.9
Students choose between multiple sessions of the same class	2	0.6
Total	24	7.6
No successful strategies	52	14.3
N/A	45	14.3

The most mentioned strategy belongs to the student–content interaction category: the lecture is recorded and uploaded on the LMS (13.7%). One respondent explained, "Uploading the class on Moodle makes it easier to follow. We don't have to ask the teacher to repeat themselves many times because of the connection issues. We are also able to re-watch the course as many times as needed, the process results in calmer and clearer sessions (better video and audio quality, no disturbances) and we can follow up with our teachers via email or text as we've been doing for any questions we might have."

The student–teacher interaction category contained several strategies that were frequently mentioned. The most frequently mentioned strategy was the instructors' interaction with the students during the synchronous class (6.7%). One student wrote, "Teachers that were very interactive during class and addressed each student were very helpful. Jokes, Q&A sessions, and lots of communication helped me stay motivated." The second most frequently mentioned strategy was the repetition of main ideas during class (4.4%). "It

is useful to repeat the main points during class as some of us might have missed them whenever there's an electricity problem," one student noted.

5. Discussion

We conducted a survey of higher education students taking emergency online classes in low-resource contexts to examine their perceived effectiveness of different engagement strategies. We also examined how different individual characteristics relate to the student perceptions of different engagement strategies. In the following sections, we will discuss our results in relation to the previous literature; based on the results, we will provide a guide to instructors, instructional designers, and instructional design researchers.

5.1. Effective Engagement Strategies

The students perceived student–content engagement strategies as significantly more effective than student–teacher and student–student strategies. Those results differ from previous findings by Martin and Bolliger [22] that showed that higher education students in the United States perceived student–teacher engagement strategies to be the most important of the three categories in non-emergency online learning. This difference could be attributed to the nature of emergency versus non-emergency online learning and/or the resources available to students and teachers in low- versus high-resource contexts. Students in low-resource contexts may have different needs, as total access of the course content can be hindered by a slow internet connection and a lack of required technologies. Content access is placed in the first level of needs of Maslow's hierarchical model adapted to online learning [43,44]. Level two of this model contains pre-course preparation and achievement of a level of comfort with the assigned formats, the online platform, and the instructors' expectations. Only after these needs have been met can the student advance to level three, which is comprised of interactions with students and instructors. Trust and Whalen [45] noted that it is difficult for students in both low- and high-resource contexts to achieve level two in an emergency online learning situation, as instructors and institutions do not have the required level of readiness to provide its criteria.

Students perceived sharing the instructors' screen as the most effective strategy within all categories. This strategy was also mentioned 18 times in answer to an open-ended question regarding the students' preferred strategy. This finding resonates with a recent study showing that during the COVID-19 pandemic, students judged screen sharing as an important feature [46]. Other effective student–content strategies were receiving summaries at the end of the class, accessing the online class on the LMS, and taking screenshots and recordings of the class. These strategies are similar to that of uploading the lecture on the LMS, which was the students' most frequent answer to the open-ended question. The results imply that the students want basic interactions with the content that ensure its effective delivery and availability.

Student–teacher engagement strategies were just behind student–content strategies in terms of perceived effectiveness. According to students, the most effective student–teacher engagement strategies are allocating time for questions and answers during the online class, posting regular announcements, and emailing reminders. The latter strategy was also found to be the most important in online learning by students [22] and teachers [47]. The students' desire for regular announcements and emails could reflect their need for structure and clear requirements, which aligns with the second level of Maslow's hierarchical model applied to online learning [43,44].

Gender and technology used were shown to relate to the perceived effectiveness of different engagement strategies. Female students perceived more effective student–instructor engagement strategies, while science students rated highly student–content engagement strategies. Students using a computer perceived the three categories of engagement strategies as more effective compared to students using phones or smartphones. This may be due to the lack of adaptability of some LMS to mobile devices or the lower cognitive access to video content resulting from mobile-sized screens [48].

5.2. Less Effective Engagement Strategies

Even though the student–content strategies were perceived as the most effective on average, two of those strategies were rated significantly lower than average: (i) students select the material based on the students' interests and (ii) students conduct presentations using the delivery method of their choice. Interestingly, these two strategies are the only student–content strategies that require a mandatory action from the students; they are also the only two strategies in this category that have the word "student" as the subject of the sentence. These results imply that the students prefer that their instructors facilitate their engagement with the content instead of being active participants in the creation of the content. In fact, creating online content requires additional time and effort that students in low-resource contexts might not be able to afford due to a lack of convenient tools and sudden increase in instability. Indeed, our results showed that students with computer access perceived the two above mentioned strategies as more effective compared to students using smartphones or tablets. Moreover, in developing countries, where little or no support was provided by governments, the pandemic created additional time-consuming worries for students regarding their personal finances, future education, or loss of part-time jobs [49] which leaves them with very little extra time.

Additionally, the student–student engagement strategies were perceived as the least effective strategies even though student–student interaction can lead to a sense of belonging and an increased engagement [50]. Martin and Bolliger [22] had similar results and reported that the student–student engagement strategies were perceived as the least important strategies in online learning. However, the average rating of importance/effectiveness varied considerably between their study and ours (3.92 and 3.45, respectively). Martin and Bolliger [22] also found that using a virtual lounge to meet informally was the top strategy in this category, whereas this strategy was rated second to last in our study. Our results also differ from the study by Chen et al. [30] that showed that students taking emergency online classes in the United States felt more engaged during student discussions. A factor contributing to this difference in results could be the cultural background of the students, which affects learning and teaching styles, the goals of the students, and the reasons they put effort into learning [51]. The majority of our study participants are from Lebanon, where an authoritarian style of teaching was still recently the norm [52], and classrooms are teacher-dominated and lack student–student interactions. Moreover, the majority of our respondents are young adults experiencing a pandemic as well as extreme political and financial instability; their reasons for and goals of learning may differ from those of students in other contexts. It is important for instructors and institutions conducting emergency online learning in low-resource contexts to understand their students' goals and motivations and adapt their engagement strategies accordingly.

5.3. Recommendations

Based on the results, we provide a 10-level guide for engaging students in emergency online learning in low-resource contexts. The levels are ordered based on the students' perceptions and are shown in Figure 4. Ideally, instructors and institutions would aim to ensure that the requirements of each level are completed before shifting to the next level. Instructors could also tackle several levels simultaneously while keeping in mind that the upper levels should be prioritized to keep students engaged.

Level	Recommendation	Example strategies
Level 1	Effective delivery of content in synchronous mode	Screen sharing, class summaries, Q&A sessions
Level 2	Engagement with content in asynchronous mode	Materials on the LMS, class recordings on the LMS, reminders and announcements, group chat for Q&A
Level 3	Diversifying means of content provision	Content and interactions in various formats, case studies, online resources
Level 4	Providing and receiving feedback	Feedback from students and feedback for students
Level 5	Continuously clarifying requirements	Practice tests, checklists, and updated due dates
Level 6	Personalizing student-instructor interactions	Reachable for student queries, referring to students by their names
Level 7	Providing a space for student-student interactions	Students group chat
Level 8	Turning students into creators of content	Student presentations, students choose the content, materials, and delivery methods
Level 9	Content-related student-student interactions	Collaborative projects, presentations, exam preparation, moderation of discussion, peer review of work
Level 10	Personal student-student interactions	Ice breaking sessions, students profiles on the LMS

Figure 4. Guide for engaging students during emergency online classes in low-resource contexts.

5.4. Limitations and Future Research

The biggest limitation of the present study is the fact that a substantial portion of the results is based on self-reported perceptions. Self-reporting can be vulnerable to distortions, as respondents may adapt their responses to appear either socially desirable or more distressed than they actually are in order to gain certain benefits [53]. The anonymous aspect of the survey may have reduced any social desirability bias [54]. On the other hand, although we clarified that the survey results would only be used for research purposes, the students may still have tried to appear more distressed than they were to appeal for leniency and indulgence from the involved faculty. To address these limitations, future work could aim to automatically collect data about the students' learning activities to detect engagement (e.g., [55]).

Even though teachers in developing countries are used to low resources, continuous crises, rapid changes, and uncertainties and can rapidly adapt [56], educational planners in emergencies need to consider the effectiveness of student engagement strategies to prioritize interventions. Moreover, the students' socio-economic status affects their access to ICT tools and environments that support their learning [57]. Providing instructors and institutions with equity and poverty education can help them support their students [58] during the fast transition to emergency online learning. To this end, further research is needed to identify how a lack of resources affects students' engagement and capabilities in emergency online learning.

To our knowledge, no previous study examined the effectiveness of engagement strategies during emergency online learning. Moreover, studies on student engagement strategies mostly targeted WEIRD (Western, Educated, Industrialized, Rich, and Democratic) contexts [59]. The importance of this study stems from the focus on emergency learning and previously overlooked contexts. Our study shows a difference between emergency online learning in low-resource contexts and distance education in high-resource contexts. Further research is needed to understand which differences can be attributed to a lack of resources and which can be attributed to the emergency.

6. Conclusions

Our study fills a knowledge gap by providing (1) engagement strategies perceived as effective by students engaging in emergency online learning in low-resource settings, (2) differences in student perceptions of engagement strategies in those contexts based on individual characteristics, and (3) a guide for instructors to engage students in those contexts.

Our study confirms that the student perceptions of the effectiveness of engagement strategies are unique to emergency online learning in low-resource contexts. Our findings suggest that students in those contexts perceive student–content interactions as the most effective, followed by student–teacher and student–student strategies. We also showed that students with different individual characteristics like gender, and access to computers have different perceptions of effective engagement strategies.

To ensure that students' priorities are being met, instructors need to first facilitate an effective interaction between the students and the content in synchronous and asynchronous modes. Once those levels are met, instructors can focus on diversifying means of content delivery, providing and receiving feedback, and continuously clarifying the requirements. The next levels in priority include personalizing student–teacher interactions, providing a space for student–student interactions, and turning students into creators of content. Finally, instructors can encourage student collaborations and personal student contacts to foster student–student interactions.

The results from this study can inform instructors, instructional designers, and system designers who need to design, teach, and support emergency online learning in low-resource contexts.

Author Contributions: Conceptualization, V.A.-K., S.H. and E.K.; Data curation, V.A.-K.; Formal analysis, V.A.-K. and M.A.C., and S.H.; Funding acquisition, V.A.-K.; Investigation, E.K. and R.M.; Methodology, V.A.-K. and E.K.; Project administration, V.A.-K. and H.O.; Writing–original draft, V.A.-K.; Writing–review & editing, V.A.-K. and S.H. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Japan Society of Promotion of Science (JSPS), grant number 19J15167.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Acknowledgments: We thank all the instructors that forwarded the survey to their students, and all the students that participated.

Conflicts of Interest: The authors declare no conflict of interest.

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