Work in progress: Reducing the Impact of Emergency Remote Teaching Through an Understanding of Personal Digital Ecosystems

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***Abstract*— This work in progress research will interest educational stakeholders in the STEM area dealing with Emergency Remote Teaching (ERT) and researchers interested in the affordance of Information and Communications Technologies (ICT) for education and especially providing personalized learning opportunities. The first question of this research seeks to identify students' general attitudes toward educational ICT. The second question is to identify any common usage patterns. And the third question is to identify affordances of the technology from the perspective of the students. The preliminary findings suggest that recent graduates in the United States have a sophisticated understanding of what educational technology is and how it can benefit their education. This is reassuring when considering the need for a sudden move to off-site teaching necessitated by an ERT. Several concerns were identified, including information quality and distractions from online entertainment. In addition, technical issues are a concern for many respondents. The qualitative questionnaire and coding have provided some insight into the perceived view of educational technology held by recent engineering graduates in the United States. This is an initial phase of this research which is ongoing and will be expanded to include a broader range of analysis techniques.**

Keywords—e-learning, ICT, Education, Digital Ecosystem, Emergency Response Teaching, COVID-19

I. INTRODUCTION

This research will interest educational stakeholders in the STEM area dealing with Emergency Remote Teaching (ERT) [1] and researchers interested in the affordance of Information and Communications Technologies (ICT) for education, including providing personalized learning opportunities. The COVID-19 crisis forced a shift to either a hybrid learning experience or entirely off-site learning, so requiring a waiving of the usual planning and design [1]. This study developed from this need to understand how ICT could be efficiently leveraged to create an ERT off-site learning environment for undergraduate computer science students at a technical university. This off-site move and the need to minimize the impact on students[2, 3] and faculty[4, 5] motivated this research. If educators can better understand students' ever-evolving personal digital ecosystem[6], this information can inform the development of online learning systems and lessen the impact of ERT while considering the already existing challenges[7]. A better understanding of the digital ecosystems of today's students can inform course design that better fits individual learner expectations instead of forcing them to adopt devices or approaches they rarely use.

II. METHODOLOGY

A. Research questions

The research questions are as follows:

1. What are the students' general attitudes toward educational ICT?
2. What are the student usage patterns of educational ICT?
3. What are the affordances of the technology from the perspective of the students?

B. Data collection and analysis

The initial data collection was a broad survey (n=208) of college graduates between 18 and 35 years old currently living in the United States. In Table 1, the breakdown of the respondent ages can be seen. The respondents were 48.08% male and 51.92% female. In this study, a short survey of five open-ended questions was employed to obtain a better understanding of the degree of technological adoption in relation to participants' educational activities. Since this was an exploratory study, five open-ended questions were used to allow a wide range of possible answers from participants [8]. The questions are as follows:

1. What is educational technology?
2. How do you use technology in your education?
3. How does technology improve your education?
4. How does technology hinder your education?
5. Think about the future. What would you like educational technology to do that it does NOT do now?

Question 1 was intended to get a broad definition of what educational technology is for the participants. Question 2 was directed at the uses to which participants put the technology. Questions 3 and 4 give insight into the perceived positive and negative affordances of educational technology. Question 5 is included to shed some light on those affordances the students value but are not available to them.

The answers were collected through an online system and classified thematically into codes. In line with the exploratory nature of this study, thematic coding [9] was used to allow the coding to emerge from the data as opposed to forcing a predetermined coding. This resulted in 16 coded themes that emerged from these five open-ended questions. These themes represent the factors that the participants perceived as related to their uses of ICT for education. In the future, a quantitative

analysis is planned in the form of a transformation of the data from text to quantified data so an applicable discriminate analysis can be applied to investigate these issues in greater detail.

TABLE I. RESPONDENTS

Respondents		
Respondent Age	***Response %***	***Response #***
< 18	0.00%	0
18-29	58.65%	122
30-44	41.35%	86
45-60	0.00%	0
> 60	0.00%	0
Total		208

III. RESULTS AND DISCUSSION

Again, this is a "work in progress" paper, so the results are tentative in the sense that only the qualitative analysis has been performed. A quantitative analysis is planned in the form of a transformation of the data from text to quantified data so an applicable discriminate analysis can be applied. Once the discriminate analysis is performed, the sample size will be increased, and the methodology will be repeated to enhance the validity of the findings.

While this textual coding is a limited data source, it does provide insight into students' perceptions of educational technology. These insights could inform the move from on-site to off-site and possibly reduce the ERT impact. The core themes that emerged are listed in Table 2 and separated by question.

Question one code asks for a description of educational technology, and the themes included "technology" and "setting." Under the broad theme of "technology," the term educational technology was described by them as hardware, including computers, tablets, e-books, and smartphones, as well as learning games and any electronic device used for teaching. The classroom technology included smart whiteboards, projectors, and the internet. Software apps were also included, such as mobile apps and commercial software like PowerPoint, Zoom, and browsers for YouTube. In terms of ERT, all these technologies would support the move online without the smart whiteboards. This suggests the infrastructure is common in most US schools to support a move to off-site learning. The second theme is "setting" and includes codes related to the location in which the learning takes place. The codes indicated that educational technology is considered an integral part of in-class and online learning, and a key use was to create a new virtual space in these locations. This again suggests that these respondents were very familiar with online learning, so they may be less impacted by ERT.

In question two, the goal was to better understand how the respondents utilized technology for their education. The first theme is labeled "information" and includes codes related to gathering, distributing, accessing, and collaborating around online data sources. This supports the idea that one of the most valuable uses for technology in education is the interaction with information and the collaboration this makes possible. This is a positive indicator that the respondents would be able to function in a fully virtual learning environment. The pedagogy theme indicated that the respondents had a clear understanding that different stakeholders, such as teachers and students, required different information sources, tools, and processes when utilizing technology. Similarly, the "setting" theme supports the idea that technology is part of learning in the classroom, a blended environment, and completely online. Also, they recognized that most of the education activities could be done online, including full courses, individual lessons, research collaboration, discussions, assignments, and testing. This suggests that a move to online due to ERT would not expose them to much that they have not already experienced. This is further supported by the "resources" theme, which indicated that they are very familiar with using technology as a means to collect information, especially in video form from sites like YouTube. Finally, the codes that form the "technology" theme indicate that they identify educational technology as being hardware (computers, smartphones), software (word processors, Duolingo), and online web services (Google, YouTube).

Question three is similar to question two but asks how technology has improved their educational experiences. The themes coded indicate that technology is integrated into all aspects of education from learning activities, such as collecting information resources, enabling activities online and in the class, and scaffolding the administrative aspects like scheduling and assignment submissions. This again supports the idea that these respondents would be able to handle the administrative issues related to ERT.

TABLE II. CODING RESULTS

Coding Results		
Question	***Total References***	***Code Theme***
Q1	33	Technology
	19	Setting
Q2	22	Information
	21	Resources
	15	Technology
	5	Setting
	5	Pedagogy
Q3	38	Scaffolding
	13	Activities
	5	Resources
Q4	11	Learning Curve
	5	Information
	2	Technical problems
Q5	20	Information
	19	Technology
	11	Real-world

Question four looked at the negative effects of technology in education as perceived by the respondents. Information was seen as a problem due to the overwhelming amount available and the difficulty in determining the quality and relevance of the information to the current activity. In addition, the fear of

exposing young students to inappropriate or inaccurate information was a concern. This included the problem of distraction when working online and having immediate access to near-limitless entertainment. Also, the learning curve associated with new technology, both hardware, and software, was mentioned. Finally, the technical issues that frequently affect online learning, such as internet connection speeds and system crashes, were a concern. While these are legitimate concerns, it would be difficult to ensure that some or all these issues did not come into play during an ERT. These are issues administrators will have to consider carefully and plan for scheduling adjustments and flexibility in course procedures.

Question five looked at the future of educational technology. The codes here formed three themes "information," "technology," and "real-world." The codes that emerged indicated a wish for technology that is more accessible, simple to use, and virtual at a level that can accurately mimic the real world. In terms of information access, they want technology like Artificial Intelligence that can rate the quality of information, suggest relevant sources by need, and separate irrelevant information while guiding students through the maze of online sources. The need for automating the reliability rating of information seems to be a very important issue. While this is difficult to deal with, it is something that needs to be considered during ERT when students will have more independent work and, without the usual level of teacher support, may get frustrated and disengage from learning. The idea of realistic virtual worlds was mentioned several times and, if possible, would be invaluable in an ERT situation. The option of having students enter a virtual classroom, indistinguishable from the real world, from the safety of their homes, seems to be a popular idea.

IV. Conclusion

The purpose of this research is to better understand how students make use of educational technology. The hypothesis is that a better understanding of the perspective and use students have for educational technology can be applied to the sudden move from on-site to off-site formats precipitated by the current ERT to reduce any negative effects on education.

The preliminary findings suggest that recent graduates in the United States have a sophisticated understanding of what educational technology is and how it can benefit their education. This is reassuring when considering the need for a sudden move to off-site teaching necessitated by an ERT. Several concerns were identified, including information quality and distractions from online entertainment. In addition, technical issues are a concern for many respondents. These are clearly factors that would affect the success of an online course, so they need to be considered by administrators. The respondents outlined several future improvements to educational technology that they would like to see. These focused again on information quality, navigation through online databases to relevant information, increased ease of use technologies, and assistive technologies like AI that could give meaningful suggestions. Also, they requested improved virtual reality that could blur the gap between in-class and online.

As a "work in progress" paper, there are clear limitations to this research. The qualitative questionnaire and coding have provided some insight into the perceived view of educational technology held by recent engineering graduates in the United States. This is an initial phase of this research which is ongoing and will be expanded to include a broader mixed methodology approach[10]. A quantitative analysis is planned in the form of a transformation of the data from text to quantified data so an applicable discriminate analysis can be applied. Once the discriminate analysis is performed, as mentioned above, the sample size will be increased, and the methodology will be repeated to enhance the validity of the findings.

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