Post-Pandemic Intended Use of Remote Teaching and Digital Learning Media in Higher Education. Insights from a Europe-wide Online Survey.

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ABSTRACT

The COVID-19 pandemic has had a transformational and potentially long-lasting impact on higher education institutions, with the rapid shift to "Emergency Remote Education". Two years after the begin of the pandemic, institutions are either returning to presence formats with different speed or converging towards hybrid formats, begging the question what remains of

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the newly acquired skills and experience with remote teaching and digital learning media? Here, we present the findings of the first European-Union-wide survey on the potential long-term impacts of COVID-19 on higher education, evaluating over 800 responses from students and faculty members of higher education institutions located in 17 different European countries. Our survey – developed in the context of the ide3a university alliance (http://ide3a.net/) highlights possible differences between students and instructors in their attitude toward retaining digital teaching formats and media, examines which formats have increased in use over the course of the pandemic, and investigates which of them are intended to be kept and consolidated post-pandemic. The tools and formats examined in this survey include tools for communication and collaboration, formats of didactic activity, as well as assessment formats. Survey responses reveal that all evaluated tools and format have significantly increased in use during the pandemic and most of them are intended to be used at lower frequency in the future, while still at significantly higher frequency than before the pandemic. Moreover, attitudes toward long-term use of remote teaching and digital learning media seems to be comparable between students and faculty members, except regarding some tools.

1   INTRODUCTION

1.1 Background

Over the course of the COVID-19 pandemic, remote teaching and various digital learning media ensured that higher education could continue. Two years after the initial shift to 'Emergency Remote Teaching', institutions all over Europe are either returning to presence formats or converging towards hybrid formats. As many tools and formats were new to many students and instructors, the pandemic may have provided a glimpse into an entirely transformed educational system [1]. However, the transition to remote teaching was not strategically planned and occurred as an emergency shift in most cases. Thus, the question whether digital education formats will persist in post-pandemic scenarios and, if so, which tools and formats students and instructors will want to use remains unsolved. Other studies to date have evaluated the reception of the shift to emergency remote teaching and pandemic experiences [2],[3]. Yet, to the authors knowledge, none of them examined the attitude of students and instructors toward long-term changes. Their focus on (early) pandemic experiences and limited, sector-specific, samples make it difficult to evaluate whether the pandemic has the potential to cause an overall lasting paradigm shift in higher education in Europe [3],[4].

1.2 Research Objectives and Hypotheses

This paper examines in how far students and instructors alike intend to utilize remote teaching and digital learning media within higher education across Europe in the long-term. Given that the weight of additional effort related to remote teaching and digital learning is distributed differently between the two groups [5], we also investigate whether there is a difference in attitudes toward teaching formats between students and instructors. The two hypotheses tested in this paper are as follows: H1) a large majority of formats used during emergency remote teaching will be kept long-term, post-pandemic (by both students and faculty members); H2) attitudes towards using e-learning formats post-pandemic differ between instructors and students. To test these two hypotheses, we conducted an online survey between August 2021 and January 2022 investigating the attitudes and intended frequencies of use of remote teaching and digital learning media with students and instructors from different universities in Europe.

2   METHODS

2.1 Participants

The sample of survey respondents (after data cleaning) consisted of 658 students from 14 different European countries and 121 faculty members from 13 different European countries. Figure 1 summarizes the geographical distribution of

respondents (A and B), as well as participating students' age (C), faculty members' years of teaching experience (D), and faculty members' role in their institution (E).
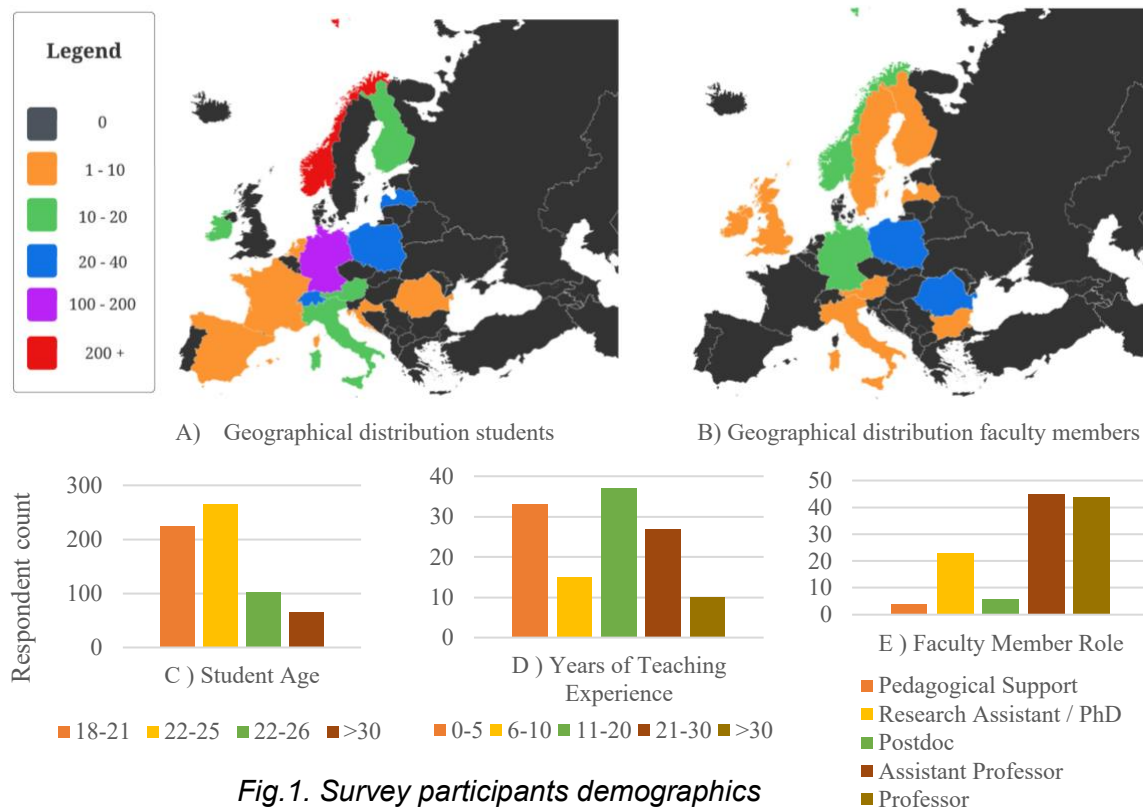

A) Geographical distribution students

B) Geographical distribution faculty members

Legend
- 0
- 1 - 10
- 10 - 20
- 20 - 40
- 100 - 200
- 200 +

C) Student Age
- 18-21
- 22-25
- 22-26
- >30

D) Years of Teaching Experience
- 0-5
- 6-10
- 11-20
- 21-30
- >30

E) Faculty Member Role
- Pedagogical Support
- Research Assistant / PhD
- Postdoc
- Assistant Professor
- Professor

Fig.1. Survey participants demographics

2.2 Survey Design

Our online survey consisted of two sections: (i) one section on demographic data and categorical attitude evaluation and (ii) one section evaluating the frequency of use of remote teaching and digital learning media. Tartavulea et al. [6] investigated how the frequency of use changed for a limited list of tools and formats at the beginning of the pandemic. Our survey builds on that list to compare results. Additionally, given that their study only captured a brief influence of the pandemic as it was conducted in April 2020, we extend its scope to include late-pandemic aspects and post-pandemic intentions.

Participants were asked to indicate their frequency of use for 21 tools and instructional methods, before and during the pandemic, as well as their intended frequency of use after the pandemic. Tools were categorised into those used for communication (6 tools), collaboration (3 tools), formats of didactic activity (6 formats), and assessment formats (6 formats and tools). Tool use frequency was determined on a 4-point Likert Scale (1 = not at all, 2 = rarely, 3 = sometimes, 4 = frequently), while also allowing participants to select that they were 'Unsure' [7].

Within the categorical section, questions were either of 'yes/no' nature or prompted participants to indicate the extent to which a statement was true, out of a given set of options. Participants who were located outside of Europe or were neither a student nor a faculty member at the time of the survey were automatically exempted from continuing the survey.

2.3 Statistical Analysis

To test H1, a two-way repeated measures ANOVA on actual and intended frequency of tool use was carried out using SPSS, comparing both students and faculty members groups. H2 was tested using a one-way between subjects ANOVA on various separate categorical variables [8], [9].

3 RESULTS

3.1 Pre-pandemic, Present, and Intended Post-pandemic Frequency of Use

All evaluated tools and formats increased in frequency of use during the pandemic across both students and faculty members, except from e-mailing, which was equal to pre-pandemic times for faculty members. The intended frequency of use after the pandemic indicates that most tools (16 of the total 21) are intended to be used at lower frequency than during the pandemic, but all 21 tools will be retained with significantly higher frequency than before the pandemic, both by students and instructors (again except for e-mailing, which remained relatively constant across all three time-points for faculty members). The evaluated tools and formats can be categorised into different clusters according to the intended post-pandemic frequency of use by the participant groups. Table 1 summarizes all findings on tool and format frequency use before, during and intended use after the pandemic, reporting the mean and standard deviation (Std. Dev.). It further indicates the different clusters by colour. The clusters are described in the following.

The tools and formats that both groups want to continue using at the same level of frequency as during the pandemic are indicated in pale yellow in Table 1 and consist of crowd questioning tools, asynchronous digital group work, and media production for assessment. These tools and formats show no significant frequency change to during the pandemic. Forum and collaborative text editors also want to be kept at the same level of frequency as during the pandemic, but students want to retain them with significantly higher frequency than faculty members.

Tools which students want to use even more frequently than during the pandemic, while instructors intend to keep it at the same level as during, are indicated in pale blue and contain virtual brainstorming tools (such as miro [10]) and asynchronous interaction with digital tools or plug-ins (such as H5P [11]). Interestingly, these tools are also among those with the lowest intended frequency for instructors (together with online ice-breaking sessions). An evaluation of whether familiarity of these tools and willingness to try new formats correlates with intended frequency of use might be useful to explain difference between students and instructors. Asynchronous plug-ins such as H5P were also the least frequently used tool during the pandemic, suggesting low familiarity across both groups.

Tools that students want to use at significantly higher frequency than instructors, although still at lower levels than during the pandemic are indicated in orange in Table 1 and include chat functions, Learning Management Systems (LMS, e.g., Moodle), online quizzes, and digitally supervised exams.

Likewise, tools that instructors want to use at higher frequency than students, although at still lower levels than during the pandemic, are indicated in pale green

and include online office hours and online oral examinations (e.g., virtual presentations).

Lastly, tools that both groups would like to use at lower frequency than during the pandemic are indicated in pink and include video conferences for lectures, virtual whiteboards, synchronous digital group work (such as break-out rooms), media production for knowledge transfer, online icebreakers, online submission of assignments, and online projects.

For some of the tools and formats there are also significant differences between students and instructors for frequency of use during the pandemic, which could be explained by the fact that some tools are more aimed to be used across groups and some are for in-group collaboration or communication. The 'collaborative text editor' for example, would be one tool that students use amongst each other, as well as faculty members with each other, but apparently at different frequency. How relevant and useful a certain tool is to a group might also influence their intended frequency of use.

Table 1. Overview of tool and format frequency use before and during the pandemic, and intended use after the pandemic across survey participants

Tools / Formats		Before Pandemic			During Pandemic			After pandemic (Intended)		
		Mean	Std. Dev.	Significant Difference Between groups?	Mean	Std. Dev.	Significant Difference Between groups?	Mean	Std. Dev.	Significant Difference Between groups?
Communication Tools										
Chat	Students	2.52	1.202	Yes	3.41(***)	1.193	No	3.24(***)	.930	Yes
	Instructors	2.09	1.083		3.30(***)	.846		2.91(***)	1.042	
Forum	Students	2.22	1.018	Yes	2.92(***)	1.063	Yes	2.88	1.081	Yes
	Instructors	1.94	1.080		2.43(***)	1.230		2.53	1.203	
E-Mail	Students	3.25	0.879	Yes	3.60(***)	.694	Yes	3.51(***)	.787	Yes
	Instructors	3.83	.529		3.83	.545		3.72	.608	
Video Conference	Students	1.50	.819	No	3.92(***)	.382	No	2.93(***)	1.017	No
	Instructors	1.67	.970		3.97(***)	.224		3.13(***)	.801	
Online office hours	Students	1.31	.673	Yes	3.06(***)	1.084	Yes	2.62(***)	1.096	Yes
	Instructors	1.70	.958		3.77(***)	.621		3.15(***)	.943	
LMS	Students	3.14	1.173	Yes	3.67(***)	.767	Yes	3.46(***)	.914	Yes
	Instructors	2.51	1.355		3.17(***)	1.189		2.88(***)	1.300	
Collaboration Tools										
Virtual Whiteboard	Students	1.45	.794	No	3.08(***)	1.070	No	2.64(***)	1.105	No
	Instructors	1.37	.775		2.94(***)	1.182		2.59(***)	1.087	
Collaborative Text Editor	Students	2.59	1.090	Yes	3.18(***)	.990	Yes	3.12	.998	Yes
	Instructors	2.26	1.188		2.88(***)	1.120		2.84	1.147	
Virtual Brainstorming Tools	Students	1.47	.766	No	2.12(***)	1.140	No	2.29(***)	1.104	Yes
	Instructors	1.37	.762		1.89(***)	1.123		1.99	1.156	
Formats of Didactic Activity										
Crowd Questioning	Students	2.37	.949	Yes	2.93(***)	.945	No	3.01	.985	No
	Instructors	1.99	1.074		2.81(***)	1.127		2.84	1.011	
Synchronous digital group work	Students	1.34	.675	No	3.13(***)	.963	Yes	2.34(***)	1.082	No
	Instructors	1.34	.724		2.74(***)	1.229		2.31(***)	1.142	

Asynchronous digital group work	Students	1.46	.738	No	2.11(***)	1.125	No	2.09	1.106	No
	Instructors	1.49	.781		1.90(***)	1.018		2.05	1.111	
Media production for knowledge transfer	Students	2.09	1.027	No	2.55(***)	1.158	No	2.44(***)	1.166	No
	Instructors	1.90	1.074		2.50(***)	1.170		2.30(***)	1.161	
Online icebreaker	Students	1.30	.623	No	2.14(***)	1.063	No	2.01(***)	1.077	No
	Instructors	1.31	.703		2.05(***)	1.158		1.90(***)	1.062	
Asynchronous interaction with digital tools	Students	1.22	.514	No	1.68(***)	1.021	Yes	1.76(***)	1.047	Yes
	Instructors	1.19	.486		1.45(***)	.821		1.47	.882	

Assessment Formats

Online Quizzes	Students	2.36	.950	Yes	3.07(***)	.946	No	2.97(***)	.961	Yes
	Instructors	1.90	1.057		2.88(***)	1.199		2.64(***)	1.106	
Online Submission	Students	3.32	.948	No	3.85(***)	.485	No	3.68(***)	.678	No
	Instructors	3.18	1.069		3.79(***)	.672		3.66(***)	.692	
Digitally Supervised Exam	Students	1.65	.973	Yes	3.12(***)	1.142	Yes	2.57(***)	1.194	Yes
	Instructors	1.40	.842		2.52(***)	1.350		2.03(***)	1.131	
Online Project	Students	1.99	1.001	No	3.24(***)	.947	Yes	2.58(***)	1.086	No
	Instructors	2.03	1.054		2.78(***)	1.275		2.47(***)	1.099	
Media Production as assessment	Students	1.68	.870	No	2.20(***)	1.175	No	2.14	1.139	No
	Instructors	1.57	.959		2.09(***)	1.210		2.08	1.137	
Online oral examinations	Students	1.21	.551	Yes	2.65(***)	1.170	Yes	2.14(***)	1.142	Yes
	Instructors	1.46	.884		3.42(***)	.930		2.48(***)	1.075	

Pre-pandemic, present, and intended post-pandemic frequency of use for several tools and didactic formats was reported in the survey on a 4-point Likert scale (1= not at all, 2 = rarely, 3= sometimes, 4 = frequently). Answers indicating 'Unsure' have been excluded from analysis. N for each tool/format therefore varies. The significant statistical differences at 0.05 level between during vs. before, and after vs. during pandemic are reported as ***. Significant differences at 0.05 level between students and instructors are indicated by 'Yes' or 'No'.

3.2 Attitude towards use of e-learning tools long-term

None of the one-way between subjects ANOVAs conducted on the three questions relating to the analysis of H2 yielded significant differences between students or faculty members. Attitude towards the long-term post-pandemic use of remote teaching and digital learning media therefore appears to be similar.

In response to the question whether participants see the pandemic as an accelerator for the modernization of higher education, response patterns are very similar $(F(1,778) = [.112], p = .738)$. The majority (65.8%) of students and faculty members (66.4%) believe the pandemic to be an accelerator for modernization, while 16.1% and 16.4%, respectively do not. 16.1% of students and 13.9% faculty members are unsure, and the remaining 2% and 3.3% are not interested.

Similarly, 62.5% of students and 69.7% of faculty members wish to continue to use remote teaching and digital learning media complementarily to presence teaching, another non-significant difference $(F(1,778) = [.256], p = .613)$. Only 12.5% and 8.2% would be glad if teaching stayed mainly remote, also after the pandemic. Also, only

20.2% of students and 19.7% of faculty members believe that these tools are something only to be used in emergencies. A minority of 3.8% students and 0.8% instructors do not want to use remote teaching or digital learning media again. Only 1% and 1.6% respectively are unsure.

Lastly, as for the quality of personal interaction with each other, both groups almost equally agreed that it was worse than before the pandemic (55.7% of students and 60.7% of faculty members). About 26.3% and 31.1% respectively thought it was of adequate quality, and 9% of students and 4.9% of faculty members evaluated it to be even better than before. 9% and 3.3% respectively are unsure. Again, these percentages indicate non-significant differences in attitude between the two groups of interest ($F(1,778) = [.110]$, $p = .740$).

Notably, even though the majorities of both groups indicate the quality of their interaction to have worsened, indicating that certain elements of presence teaching are irreplaceable by its digital counterpart, they both wish to continue using remote teaching elements long-term. The answers to these categorical questions also reflect the desire to decrease entirely digital formats such as video conferences, online projects, and media production for knowledge transfer. While attitude toward long-term use of remote teaching and digital learning media appears to be similar between students and faculty members overall, the results from Section 3.1 indicate that there are differences when it comes to specific tools and formats and how frequently they should be applied.

3.3 Additional Analyses on Respondents' Experience

Analysis of additional categorical questions to account for any prior experience with remote teaching and digital learning media yielded interesting results as well. In response to the question whether participants had knowledge of remote teaching and digital learning media before the pandemic, students indicated significantly more prior knowledge than faculty members, as evaluated using a one-way ANOVA ($F(1,778) = [31.37]$, $p = <.001$). Nonetheless, both groups indicated equally low prior experience with remote teaching or digital learning media.

Faculty members also attended trainings for further education significantly more often than students both before and during the pandemic (($F(1,778) = [14.383]$, $p = <.001$) and ($F(1,778) = [9.919]$, $p = <.001$)) and acquired significantly higher levels of new skills during the shift to emergency remote teaching ($F(1,778) = [50.703]$, $p = <.001$).

4 DISCUSSION AND CONCLUSION

4.1 Discussion and implications

Overall, as evaluated in this Europe-wide online survey, attitudes toward long-term use of remote teaching and digital learning media seems to be comparable between students and faculty members. The majority of students and faculty members would like to use them complementary to presence formats, likely to compensate for the decreased quality of interaction with each other during virtual classes. Evaluating different tools and formats however does reveal differences in preference for frequency of use for certain tools. While the use of remote teaching and digital media increased significantly during the pandemic, almost all evaluated tools and formats

want to be used at lower frequency after the pandemic, yet all still more frequently than before the pandemic. This stands in contrast to Tartavulea et al. [6], who, in the beginning of the pandemic, found that certain tools (e.g., virtual whiteboard, pre-recorded videos) would be used at an even higher frequency than during the pandemic.

For a few tools, such as virtual brainstorming software and plug-ins such as H5P, students would even like to use them more frequently than during the pandemic, indicating that instructors should not necessarily follow only their own preferences, but also continue to experiment with tools to cater to their students' needs [12]. The 'winners' of the pandemic tools, which want to be kept at the same frequency of use as during the pandemic, suggest having offered additional pedagogic benefits. These tools were crowd questioning tools, asynchronous digital group work and media production for assessment, as well as the forum function and collaborative text editors. In the context of the ide3a project [13], we have used all of these with great success and believe these tools to be of additional benefit in compensating missing social interaction especially in entirely virtual, international, and collaborative courses.

4.3 Limitations

This study aimed to provide a pan-European perspective on the intended frequency of long-term use of remote teaching and digital learning media. While participants were recruited from 17 different countries, the sample representativity remains somewhat poor. The number of participants per country was neither evenly distributed, nor representative for each country, which is why this study, and its results can only be understood as a glimpse into a European overview, but do not capture country-specific differences or those between different types of study programs (e.g., humanities vs technical). We encourage additional, national, or even local inquiries into the preference of specific tools and teaching formats to complement our aggregated results.

4.4 Recommendations for Further Analyses

Possible interesting additional analyses could include one-way ANOVAs of tools comparing different age groups or different levels of teaching experience to see whether they influence intended frequency of use. It is plausible that especially younger students might be less keen on continuing to use remote teaching, as they are most affected by the lowered social interaction, having never attended presence formats. Additionally, further insights into the psychodynamics of the attitude toward remote teaching and digital learning media could be derived by further quantitative analysis, e.g., using a Technology Acceptance Model (see [14]).

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