Analysis of the Feedback Digitization Needs in Higher Education: Experiences from Lockdown Education in the Netherlands and Germany

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***Abstract*—After some time of lockdown experiences, limited attention for feedback and the absence of feedback digitalization frameworks suggests rethinking traditional feedback practices toward post-pandemics digital/hybrid education. This research surveyed feedback digitalization needs in the context of online education in high education institutions in the Netherlands and Germany during the COVID-19 pandemic. The dimensions surveyed included preferences for feedback such as typology of feedback (e.g., cognitive, behavioral, etc.), formats (e.g., written, audio, video), online instruments, and features for communicating feedback. The results suggest that online instruments supporting features for effortless interactivity are among the highly preferred digital options for giving/receiving feedback. When given online, inclusive formats of feedback that inform learners not only about their own but also peer performance were also found to be among highly rated options. The increased need for inclusive feedback with peers, however, may also negatively affect students' mastery orientations. Thus, balancing online with offline approaches should also be recommended when considering feedback digitalization approaches.**

***Index Terms*—Digital feedback, online feedback, feedback communication instruments, use of technology for feedback**

I. Introduction

Feedback is key to learning process quality and outcomes. In the academic setting, teacher guidance is usually available when some kind of learning task is completed which is referred to as outcome feedback [1]. Research shows that guiding a learning process from earlier stages using intermediate feedback loops benefits students learning quality and outcomes [2, 3]. Online teaching and assessment during lockdown education in the times of COVID-19 pandemics showed how challenging this task has become [4]. COVID-19 made the largest disruption of education systems in human history and affected learners in more than 200 countries [5]. Most educational institutions transferred to online education using virtual learning environments and instruments [6]. Due to the situation, both teachers and students were challenged to properly give, receive and/or seek feedback. Despite the evidence and relevance of the problem domain, as well as the importance of the digital transitions in educational processes that will likely become the new norms of online and/or hybrid classrooms of the post-pandemics world, research on online feedback to guide feedback digitalization process is scarce [7]. Questions such as "which new formats, instruments, and features used by teachers proved effective among students?", "what new formats/elements of the feedback are likely to continue when the lockdown education disappears?" remain actual. This works attempts to answer the above-mentioned questions by surveying needs and preferences in digital feedback types, formats, and communication instruments among learners and teachers in higher education institutions in the Netherlands and Germany. The results contribute to feedback digitalization theories that are currently largely lacking. The findings also serve as a starting platform for researchers and educators to further explore post-pandemic adaptation needs in the domain of digital education and feedback.

The paper is structured as follows. Section II presents the related work in the domain by also outlining how the current work is situated with respect to the existing literature as well as the research questions that the work will aim to answer. Section III describes the methodology used to achieve the research aims. Section IV describes the analysis results. Section V discusses the findings by also relating them to the research questions. And finally, section VI concludes the work by outlining the contributions and limitations of the work, as well as suggesting possible directions for further research.

II. Related Research

Very few studies can be found that provide theoretical frameworks and guidelines on the digitalization of feedback both before and during lockdown education. A limited number of studies outline dimensions such as socio-psychological factors [8] or focus on a very specific type of learning case for feedback [9]. Furthermore, none of them considered the experiences and needs of massive switching to online education as observed in lockdown learning processes. Numerous studies have been conducted related to education during the lockdown. Both challenges, as well as opportunities, have been highlighted.

Among challenges, access to technical infrastructure (e.g., access to the Internet from home, the financial implications of investing in tools and online licenses), competencies, and pedagogies for distance learning (different pedagogy types and skills are required for distance teaching and learning) have been reported. Other challenges for students included a lack of opportunities to collaborate with other students, staying motivated, and missing the presence of the instructor and peers to get immediate feedback as reported by Means and Neisler [10].

Duraku and Hoxha [11] reported on the concerns of

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parents and teachers regarding the circumstances caused by social isolation, including increased stress and anxiety. Furthermore, according to the results of the study, teachers' attitudes toward changes are additionally influenced by the lack of experience in online learning, insufficient level of skills and knowledge with the use of technology, lack of clear guidelines for putting online learning into practice, and lack of cooperation.

The study by Hwang *et al*. [12] aimed to investigate the effect of loneliness and social isolation and the ways to cope with these feelings during the COVID-19 pandemic.

The study by Almaiah *et al*. [13] lists several challenges regarding usability, e-learning website service quality, and financial support problems since each university has limited resources. The authors also mentioned factors such as the availability of hardware and software, and the technical skills to use those, e-learning system quality, self-efficacy factors that are key in determining the adoption of e-learning systems in educational institutions, while also indicating trust to be yet another important factor to increase the rate of e-learning system adoption, which consists of system protection, information privacy, and system reliability.

Among other weaknesses of fully online education, Dhawan [14] indicated the challenges to engage students to participate in the teaching-learning process. In addition, the study mentioned that there is a lack of standards for quality, quality control, development of e-resources, and e-content delivery. E-learning, in addition, is time-consuming and costly, e.g., preparing the devices and equipment, maintaining the equipment, and training the human resources.

Interestingly, Iglesias-Pradas *et al*. [15] reported that the overall academic performance of students in an online class (remote teaching) was found to be significantly higher than in traditional face-to-face instruction which is in line with the results found by Gonzalez *et al*. [16]. The study presented by Eberle and Hobrecht [17] reported students experienced ceased commuting between home and campus as a positive effect. Students' skills to maintain social contacts for interactive learning activities emerged as a crucial aspect, as many students were not able to cope appropriately.

The study by Paudel [18], Sun and Chen [19], and Finch and Jacobs [20] claimed that online education increases opportunities to access and collaborate with expert professionals in a global range. Furthermore, the participants indicated that online courses are beneficial for them because they provide them flexibility in terms of time and space for teaching and learning.

The study by Dhawan [14] reported that online learning has been also mentioned to offer a lot of opportunities to bring innovations and digital developments, e.g., by allowing teachers to design various flexible formats to support better understanding, e.g., the course content made available in different formats such as audio, video, and text which also creates a learning environment where students can give or receive their immediate feedback.

Despite the relevance of the topic, not many studies were found that explore the effects of online education on educational feedback and digital formats that optimally support the aims of educational feedback in the context of online education.

Research on digital feedback during lockdown focus on limited types of feedback, such as the use of feedback in online education to promote self-regulation [21], evaluating effects of peer feedback [22], or online feedback limited to the scope of a specific learning case, such as English [23] and Chinese language education [9] or the effectiveness of automated feedback in online learning [24]. A few studies focused on audio/video feedback in the context of switching to online education [25]. Video as digital technology has been used successfully in teaching, learning, and peer feedback [26]. For instance, the study by Istenič [27] investigated the use of video technology for providing feedback to students by exploring if video technology can enhance the feedback experience for staff and students. The main advantage of video technology includes providing a video file that can be stored and replayed at the staff and students' convenience. Furthermore, the video feedback was found to be clearer to understand.

The aim of our research, however, differs from the problematics introduced in the recent literature in terms of its research questions that target specifically *feedback* in the context of *digitalization experiences* in the context of broader learning cases such as courses taught at high school, bachelor's and master level programs with different study directions including engineering/IT and social science programs.

In addition, we examine the digital feedback through the prism of challenges and opportunities of lockdown education (e.g., isolated learning).

In particular, this research attempted to answer the following research questions:

1) What types/formats of feedback were most demanded through digital channels?
2) Which digital instruments/formats/features proved effective to communicate feedback in the context of online education?

III. Methodology

The survey technique is among the most common study methods allowing obtaining information from a population of interest. To collect data from students and teachers from higher education institutions a survey has been designed, which was distributed through institution networks using faculty, department, and course mail lists. Participation was anonymous and voluntary. The survey has been conducted in the context of a research project. Subsequently, ethical approval has been achieved from the appropriate committees for the collection and use of the data.

The survey took place in the winter (18 participants) and spring (56 participants) semesters of the academic year 2021–2022 when the educational institutions already had approximately a year of experience in lockdown education using various online environments and instruments for feedback provision. The respondents included students from high school, and university bachelor's and master's programs, as well as researchers and teachers in the Netherlands and Germany.

A. Survey Design

The survey comprised 20 questions and sub-questions. The first 7 questions aimed to collect information on participants' demographics such as age, gender, field, level of study (e.g., high school, bachelor, master, postgraduate, PhD), role (student, teacher, researcher), and country. The remaining questions aimed to reveal perceptions among the respondents on the following main questions:

- What are the dimensions of learning that learners need more feedback for during the lockdown online education (e.g., do they lack information on theory or content, assignments outcome or process-related difficulties, guidance in group work, etc.) ?
- What types of feedback do the learners need more within the context of online education (e.g., did they lack teacher guidance, on what aspects they needed more guidance on such as cognitive or behavioral, performance or competence related, did they need more/less peer feedback, etc.) ?
- What perceptions do the learners have about the feedback communication channels that they experienced during online education (e.g., mail, educational platform, videoconference, or messenger software?
- What features/elements did the learners find more optimal in the context of online feedback (e.g., chat rooms, features allowing audio or video communication, etc.)?
- What formats do the learners find preferable (e.g., online, written, offline, combination balance)?

Respondents' perceptions were measured using 6-point Likert scale question formats. In addition, yes/no, multiple-choice questions, as well as open-ended questions, were used that were intended to record learners' justification about their choices.

Among the extraneous variables, several personal characteristics have been chosen for assessment to control random effects. These variables included (1) Study level; (2) Study direction; (3) Gender; (4) Age; (5) Role; (6) Country.

IV. Main Results

Respondents included 74 participants with the demographics and personal characteristics represented in Table I.

Percentile proportions that are missing include the participants' clusters that preferred not to give a response to a particular question. For instance, participants' percentile that preferred not to identify gender in the survey should be interpreted as 0%, while those who preferred not to identify their age include 7% of the population.

TABLE I: Demographics of Participants

Variable	Percentile (rounded to the nearest whole number)
Study level	
Highschool	14%
Bachelor	48 %
Master	13%
PhD	18%
Study direction	
Engineering / IT	
Social Sciences	
Age	
17-25	72 %
26-35	8 %
36-45	11 %
46-58	2 %
Gender	
Male	59 %
Female	41 %
Role	
Student	80 %
Researcher	2 %
Teaching staff	12 %
Country	
Netherlands	54 %
Germany	24 %

The interpretation of data using visual analytics revealed the following information. The majority of the respondents thought that, even though the teacher input is well timed, it makes a difference for them whether or not the feedback is communicated online, and what type of communication channel is used, e.g., mail, messenger, educational platform, etc. (Fig. 1).

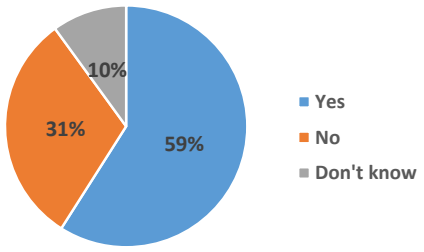

Fig. 1. Answers to the question "If the teacher input is well timed do the channel for communicating feedback make a difference (e.g., mail, messenger, educational platform, etc.)?"

Several *aspects of learning* were prioritized by the participants for which they needed the most feedback during the lockdown education when feedback possibilities were offered online. Among them, 1) *motivation* (e.g., guidance on the choice of the right goals/plans to keep energized and engaged in a learning process), 2) *social interaction* (e.g., the possibility to know what their peers are doing and how they are coping with similar situations/problems in learning, guidance on emotion regulation and stress management), and 3) *engagement* (e.g., guidance that motivates to actively invest effort across learning activities) were indicated by the majority of participants among their highest preferences, counting for 65%, 62% and 41% of the responses respectively.

Fig. 2 shows the visual representation of the above-mentioned preferences of participants using a multiple-choice answer model with more than one option being possible to choose.

Among the *types of feedback* the highly rated options included: 1) *process-oriented teacher feedback* such as systematic guidance to intermediate solutions followed by 2) *outcome-oriented feedback* such as indication if the solution of a given learning task is correct, why not, 3) *performance-oriented feedback* with respect to peers, such as an overview of how learner performs in comparison with peers and 4) *peer-feedback*, opted by 41%, 38%, 36%, and 29% respectively (Fig. 2).

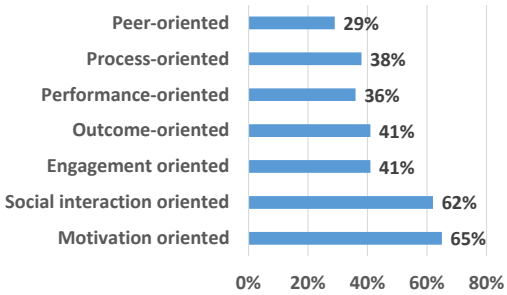

Fig. 2. Answers to the question "What type of feedback (and/or learning dimension) you would prefer receiving more attention for when communicating feedback digitally?"

The majority of the respondents agreed that, when given online, the *feedback format* needs to be more inclusive (Fig. 3), meaning that it should allow the learners to compare their performance with peers, to understand if, for instance, they do better or worse than the average of class, where their progress in the learning process with respect to course goals is with respect to peers, what milestones have been already covered by peers so far, etc.

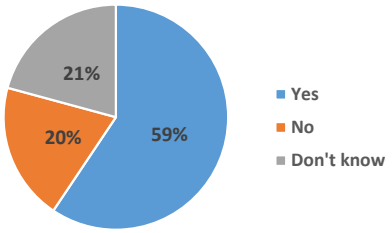

Fig. 3. Answers to the question "Would you prefer more inclusive formats of feedback comparing own vs. peer performance when communicating feedback digitally?"

Regarding the *online communication channels for feedback*, following options were evaluated:

- Mail
- Educational platform
- Conferencing tool
- Messenger
- Other

Given a multiple-choice answer model with more than one option being possible to choose, the majority of the respondent opted for a *Conferencing Tool* such as Teams, Zoom (89%), and *Mail* (61%), followed by the *Educational platform* (55%), *Messenger* such as Whatsapp, Slack (22%) and *other* (7%) as can be seen in Fig. 4.

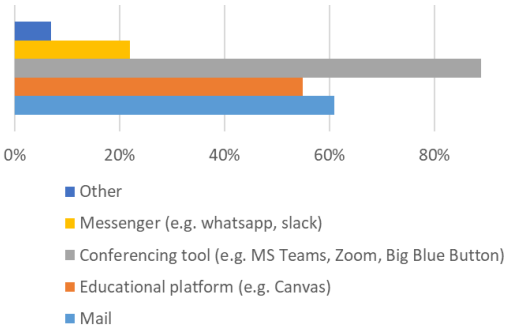

Fig. 4. Answers to the question "What communication channels would you prefer when communicating feedback digitally?"

Participants were also asked about the features that made the feedback communication instruments more optimal for them. The preferences of respondents are illustrated in Fig. 5. Majority of the respondents indicated that ease of use was their preference when opting for an instrument (63%).

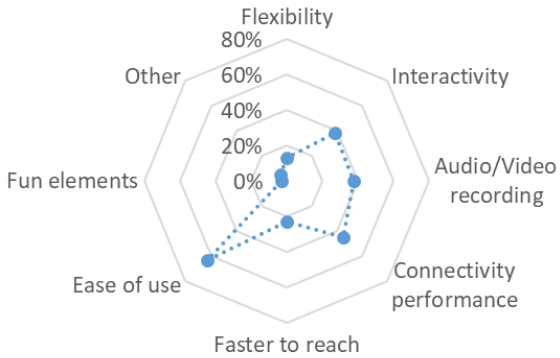

Fig. 5. Answers to the question "Are there any specific features that make these channels more attractive to you in terms of communicating feedback?"

Among other preferences *connectivity performance* to function uninterrupted (45%), *interactivity* (38%), and a possibility to create *audio and video* recordings (38%) were mentioned.

Relatively lower preferences included dimensions such as *faster to reach* (23%) and use of *fun elements* (3%).

More elaborate comments with the answers were also provided. These comments were further coded and classified into main categories presented in Table II.

TABLE II: FEATURES THAT MAKE FEEDBACK COMMUNICATION CHANNELS ATTRACTIVE TO USERS

Feature	Percentile (rounded to the nearest whole number)
Allowing to create breakout rooms for students to work in small groups, review each other work and give peer-feedback	55%
Enabling feedback to feedback and immediate follow-up with a teacher	31%
Allowing search in history	12%
Allowing to create sub-groups for topics	43%
Other	6%

A. *Extraneous Variable Effects*

Several compound variables were chosen to be controlled in this study, including age, gender, role, country information, study level, and direction of the participants.

In general, no significant effects were found using correlation analysis. Nevertheless, there were observations of moderate effects.

The percentage of distributions of participants' preferences suggests that higher degree program students, in general, reported higher satisfaction with the amount and frequency of feedback they received through online channels in lockdown education e.g., PhD researchers, master program students (80%), whereas bachelor and high school level students reported relatively lower satisfaction and higher needs for feedback (59% and 53% respectively). Furthermore, the technical direction of the study might have potentially affected the level of satisfaction positively (73% engineering/IT directions vs. 43% of social science students),

suggesting that there could also be computer self-efficacy effects that made the use of digital instruments easier to use for this cluster.

Gender-wise differences in feedback channels and formats differences were detected. For instance, male respondents had higher preferences for in-person online feedback (56%) and written (e.g., via mail) feedback (48%), whereas female respondents in addition to similar preferences for written (54% and in-person online feedback (48%), also reported significantly higher preferences for video recorded (74%) and audio recorded feedback (69%) unlike their male peers (31% and 27% respectively). Female respondents also gave a higher preference to feedback given on the level of a learning task (64%) than their male peers (36%), whereas male respondents showed a higher preference for feedback for organizational aspects (76%) compared to female respondents (26%), while both genders showing almost equal interest in behavioral feedback and feedback comparing own performance to peers (in the range of 55%–59%). No significant effects from country variable measured by correlation analysis were found.

V. Discussion

The results of our study suggest that the needs for feedback varied based on the level of study (high school, bachelor, master, PhD) with relatively higher needs for feedback at lower levels, e.g., students from high school, and bachelor programs reporting somewhat higher needs. Similarly, the direction of the study was observed to make moderate differences: the respondents whose study areas/background were technical reported relatively higher satisfaction with the amount, frequency, and formats of digital feedback. This could potentially be attributed to easier learning curves due to higher self-efficacy with digital environments and instruments.

Dimensions that the respondents thought digital feedback lacked addressing during the lockdown education were found to be motivation, the need for enhanced interaction to stay engaged, and social aspects. This could be potentially attributed to the feelings of isolation, as respondents also reported that during lockdown they were rather inclined to seek more reassurance from teachers and peers that they are on track with their performance compared to their peers, and that they are not alone with their struggles in lockdown education (Ref. RQ1). Both outcome- and process-oriented feedback types for learning tasks as well as feedback for behavioral and organizational aspects were found to be in high demand when receiving feedback digitally (Ref. RQ1). It is difficult though to judge whether or not these preferences are significantly different from pre-pandemic education needs as there is no baseline to compare the findings with.

The feedback that compares own performance with that of peers was found to decrease the participants' feelings of isolation while also contributing to feelings of higher inclusiveness (Ref. RQ1). Similarly, frequent group tasks and the possibility to review, provide and receive feedback to/from peers were observed to be the highest priorities among the respondents (Ref. RQ1) which could also potentially be attributed to the lockdown education effects during which the respondents had to learn in isolation thus being exposed to increased needs for social interaction. Regarding online formats preferences in audio, and video feedback (Ref. RQ2) that would make it possible to engage in optimal interactive dialogues with the teacher were dominating. This could be attributed to the need of increasing social presence. Communication channels were observed to matter for the respondents, the highest preference was reported for the feedback written in the mail, followed by feedback provided online via an educational platform or other teleconferencing instruments such as Microsoft Teams, Zoom, etc. (Ref. RQ2). Among the requirements for the online channels and instruments for communicating feedback ease of use, the ability to provide interactivity, video, and audio communication features, the possibility of creation of breakout chat rooms for targeted activities, asking and receiving feedback, as well as connectivity quality to perform uninterrupted were found to affect the instrument preferences of the participants the most (Ref. RQ2).

Still, the findings of this study need to be interpreted with caution due to the absence of baseline information as well as the omitted variables (e.g., self-efficacy) from the design of the survey.

VI. Conclusion

While educational feedback is central to learning process quality and outcomes, frameworks and guidelines on the digitalization of feedback are largely lacking in the scientific literature. In addition, there have been not many studies on the digitalization of feedback that considered experiences and needs from massive switching to online education as observed in lockdown learning processes.

While this study was conducted during lockdown online education, the results are relevant for the feedback digitalization domain in general. In addition, the experiences from lockdown education showed how relevant the topic and advancement of this domain can be for further research in this domain to adapt traditional feedback practices to post-pandemic education where online and hybrid learning can become a new norm.

In summary, 74 respondents (students, researchers, teachers) aged 17–58 from the Netherlands and Germany took part in a survey that aimed to explore experiences from digital feedback at educational institutions during the times of lockdown education.

The main finding from this study is that the use of online instruments and the switch from offline to online education can affect the preferences for educational feedback types and formats to address the needs that are influenced by lockdown issues, e.g., isolated learning. Preferences for digital feedback were also found to vary based on the level of study. Respondents with lower levels (e.g., high school, bachelor programs) reported relatively higher needs, while participants with higher levels (e.g., master, PhD) reported moderate needs in cumulative feedback communicated through digital channels during online education. Moreover, respondents from technical study programs/backgrounds (e.g., Engineering/IT) showed less interest in instrument features such as ease of use, in contrast to participants with

less technical backgrounds (e.g., social sciences), which could potentially be attributed to higher self-efficacy with digital environments and instruments.

The highest preferences for consideration in digital feedback during the lockdown education were reported for performance-oriented comparative feedback that in addition to own performance also makes the learners aware of peers' performance and experiences. Next to this, feedback considering motivation and social aspects was found to rank highest among participants' preferences, which seem to contribute to learners' feelings of higher inclusiveness while also decreasing their feelings of isolation.

To compensate for the lack of social interaction when giving digital feedback, frequent group tasks were mentioned among the preferences of the respondents. The possibility to review, provide and receive feedback from peers was also found to be among highly prioritized activities when using digital channels of communication.

Needs for the outcome- and intermediate process-oriented feedback for learning tasks as well as feedback for behavioral and organizational aspects were found to be equally high.

Format-wise, the majority of respondents opted for in-person online feedback, which would let them have an immediate follow-up with the teacher, followed by preferences for audio, and video feedback.

Among the requirements for digital channels for communicating feedback, ease of use with interactivity features was reported as the highest priority (e.g., creation of chat rooms for group works to give/receive targeted feedback or peer feedback, audio/video features to enable more interactive communication of feedback).

It has to be noted that female respondents were found to be more inclined towards a larger choice of feedback channels and format variability in the context of online feedback. In particular, male respondents had higher preferences for written (e.g., via mail) feedback, whereas female respondents in addition also reported significantly higher preferences for video and audio recorded feedback. Female respondents also had higher preferences for the feedback given on the level of a learning task whereas male respondents showed a higher preference in feedback for organizational aspects, while both genders showed almost equal interest in behavioral feedback and feedback comparing their performance to peers.

In summary, the findings of this study also seem to suggest, that, when given online, feedback needs to be more inclusive, which in addition to traditional feedback will also inform learners about their peers' performance. However, this also may indicate that the increased need for inclusive feedback in the context of online education may potentially influence learning orientations. For instance, learners may become inclined more towards performance rather than mastery-oriented learning goals. The findings of this study suggest that tools that enable frequent interactivity in the digital classroom can be recommended to address the increased need for feedback and feelings of isolation in online classrooms.

In general, the results of this study suggest that while interactivity features of online instruments are key to ensuring social presence when opting for digitalized feedback, balancing online with offline approaches should be recommended.

A. Limitations

Several limitations need to be considered when interpreting the results of this study, as well as for the continuation of the research effort in this domain. Among them, the relatively small size of the respondents taking part in the survey can be highlighted. Other limitations include the design of the survey that does not allow directly measuring the computer self-efficacy effects on the respondents' choices which are rather assumed based on the level and direction of the study program of the participant. In addition, the baseline knowledge is absent in this study that would allow us to compare the results of the survey with online feedback format preferences from a regular period (e.g., using measured preferences of the participants in regular on-campus education), which, however, would be also challenging to obtain/measure during the lockdown. Finally, some "dropouts" from the survey could potentially be attributed to the size of the survey questionnaire, i.e., the high number of questions included in the survey.

B. Scientific Contributions

The results of this study contribute to the domain of feedback digitalization, theoretical frameworks, and guidelines which are largely lacking in scientific literature. In addition, the study reports on the potential effects of massive online learning experiences that can be considered by researchers and educators when further exploring and/or designing online feedback formats and instruments for online and hybrid classrooms.

C. Future Research

Replication experiments are one direction to progress this research to zoom into more detailed aspects of feedback digitalization and/or extra variables to contribute to further refinements and generalizability of the current findings. Further research can focus on testing the effects of field and level of study, gender, role, and self-efficacy to explore if correlations/causations can be established with larger studies. Replication studies conducted in post-pandemics education could provide a baseline to compare the findings from this study to further explore if the findings are significantly different and/or if any differences in online vs. offline education from this study could be associated purely with lockdown education effects.

Theoretical frameworks guiding the design process of online feedback in digital and/or hybrid classrooms, in addition to considering characteristics of massive online education, can be yet another direction to advance the research presented in this work. Ultimately, the results of this research can largely contribute to the advancement of theoretical frameworks that will guide the automation of educational feedback [28–31].

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

GS conducted the research, including survey design, data

collection, analysis, and writing the paper. SB, BV, and JH provided valuable scientific advice and edited the paper. All authors had approved the final version.

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