Navigating the Current "New World" of Teaching with Technology: A Glimpse into Our Teachers' Minds

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Abstract. The COVID-19 pandemic helped spark a surge in innovative usages of technology in education, from robot-based remote graduation ceremonies to immersive learning through extended reality, meetings in fantastical game worlds, automatic examination methods, and flexible learning options such as hybrid classes. It's been said that we can't go back to "normal" because *this is* normal now–but what exactly is today's "new normal"? The current paper reports on the results of an anonymous online survey conducted with 42 teachers in business, IT, nursing, and education at our university in October 2021, to gain insight into where some teachers on the "front lines" currently stand on the use of technology in education. Some insights included that: More teachers than we had expected were using robotics and extended reality (XR), suggesting that silo effects can exist in education, even at small universities; furthermore, the rates of teachers who had seen such usage seemed close to the rates of teachers who had tried using them, suggesting the usefulness of raising awareness to promote professional digital competence (PDC). Rates for using games and exam tools were lower than expected, despite the availability of game platforms and a growing need to consider the threat of how technology can be misused to cheat in exams, possibly due to teachers' limited time for pedagogical development. Also, teachers appeared to have strong and differing opinions about learning formats, although a general preference was observed for physical classes and exams, and hybrid teacher meetings. Our aim is that these results will be used by our university's pedagogical center to support our teachers' PDC and uses of edtech in the near future.

Keywords: edtech · educational robotics · XR in education · gamification in education · hybrid learning · professional digital competence

1 Introduction

Teaching in contemporary higher education institutions (HEIs) is in a transformational phase, where the role of a university teacher is changing, also due to

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rapid and continual developments in educational technology (edtech). As well, the COVID-19 pandemic recently resulted in university teachers being more or less been forced into digital teaching. This combination of a natural trend toward increased use of technology in education, in conjunction with the temporary needs of "emergency teaching", has led to an emphasis on the importance for teachers to develop professional digital competence (PDC) (e.g., [5,14]): To compete and excel in a world in which digital literacy is vital and students have increasingly many choices of where and how to study, a fundamental goal of teachers should be to maintain some degree of awareness of the opportunities and challenges presented by the use of current technologies. For example, it's been said that a revolution in education is occurring due to incorporation of technological approaches related to robotics, extended reality (XR), and games, which can engage students and provide enriched experiences in various learning contexts [3,17,21]. Also, the pandemic-driven switch to online or hybrid learning required many teachers to learn how to use tools such as Zoom, that could meet basic safety requirements and also provide some enhanced flexibility [24]–conditions can change quickly, and we don't fully know what is waiting around the corner.

A downside is that PDC can be costly for busy teachers to develop: The e-learning landscape is vast, spanning many topics like robotics, XR, and gamification above, such that it could be time-consuming and difficult for regular teachers to maintain a picture of current developments that is both accurate and broad. Given that lack of time could also affect teachers' abilities to communicate about the methods they use, another danger could be that teachers might sometimes feel the need to develop solutions to problems that others have already faced or overcome; i.e., there might be educational silo effects. This could be also related to the "drawer effect" in statistics,[1] in which "non-significant" results are not published, leading others to repeat failed experiments and lose time and productivity. It's also not clear how much of a divide exists between researchers prototyping new systems, and teachers using them in practice, given also that academic organizations can differ in size, strategy, and resources allocated to teachers.

Thus, the goal of the current study was to gain some insight into the current state of how technology is being used in education at our university, by checking where some teachers on the "front lines" currently stand. After summarizing some related literature in Sect. 2, we report on an online survey in Sect. 3. We aim to use some insights regarding current opportunities and challenges in the area, which are discussed in Sect. 4, to better support our teachers, both by disseminating information at a workshop and identifying potentially useful research directions relevant to our long-term strategies.

[1] research.uh.edu/the-big-idea/what-went-wrong/behind-closed-drawers-the-file-drawer-effect.

2 Related Work

Various previous work describes ongoing efforts toward understanding the current state of edtech. For example, Laufer et al. conducted a multinational survey of HEI leaders from May to November 2020, finding that, although challenges exist–such as inequalities in access to technical resources and digital skills, and a need for strategies and leadership–some positive effects of edtech were seen in regard to improved access, individualized learning, and lifelong learning skills [20]. Williamson likewise reported musings in 2021 that new technologies like robot teachers capable of analyzing students' data could be the "future of education", and that there is great interest in the possibilities for AI to be used to 're-engineer the classroom' in post-COVID education; although various meta-edtech platforms are gradually springing up–such as *evidence intermediaries* that gather evidence on successful efforts and market intelligence groups that advise investments in the field, like the U.K.'s EdTech Impact site, the U.S.'s Edtech Evidence Exchange, and HolonIQ–there seems to be no *one* "go-to" place yet [29]. Thus, we believe there is still a benefit to probing teachers and gathering information on interesting use cases and insights, which is our goal in the current paper. Below, we further describe some work related to new technologies–robotics/XR, gamification, and exam tools–as well as perceptions of learning formats at the level of an individual class (campus-based, online, or hybrid). We note that this work is not limited to studies conducted at HEIs, given that work in some areas is still sparse due to the rapid pace of technological development, and our belief that insight can also be taken from other contexts such as children's education.

2.1 Engaging New Technologies

Robotics/XR. One technology intended to provide high feelings of engagement, immersion and social presence is robotics. Robots have been used in various roles: as learning materials for students to assemble and program, as remote attendance systems, as one-to-one tutors (e.g., intelligent tutoring systems and teachable agents), as class companions or mascots, and as teaching assistants; for example, the latter can read materials aloud, greet, help the teacher to avoid mistakes, provide complementary clarifications, and carry out physical tasks like handing out papers [8]. Recently, spurred by the pandemic, robots have also been used to conduct graduation ceremonies in Japan, Malaysia, and the Philippines.[2,3] Velinov et al. also reviewed recent studies on remote attendance robots, cataloguing benefits such as safety during a pandemic, and enhanced access for disabled, suspended, or remote students [28]. Yet, robots are still mostly rare in classrooms; Guggemos and colleagues, using a Pepper robot, targeted the

[2] businessinsider.com/philippines-sixth-graders-held-cyber-graduation-with-robots-2020-6.

[3] breakingasia.com/gov/malaysian-university-using-robot-for-graduation-ceremonies-to-cut-virus-risk.

problem of how to design robots that will actually be accepted into real-world classrooms, identifying important characteristics such as adaptiveness, trustworthiness, social presence and appearance [15]. Halbach et al. also reported on the practical challenges of robust sound recognition when using Nao robots to facilitate language learning–also assisting staff and increasing engagement–in two trials over the duration of several weeks in some day-care centers [16]. Additionally, Trombly et al. investigated how to achieve effective group interactions, in implementing games with a teleoperated Pepper robot aimed to help children with Autism Spectrum Disorder (ASD), noting a positive trend of similar results when using human and robot instructors [27].

Robotics is also sometimes referred to in the "same breath" as XR, as in "Virtual, Augmented, Mixed Reality Human-Robot Interaction" (VAM-HRI); e.g., some interactions use both separately to get the best of both worlds, or use XR to add dynamic capabilities to robots [12,13]). XR encompasses a spectrum of applications which involve the real and virtual worlds to different degrees, such as Virtual Reality (VR; full, immersive simulations) and Augmented Reality (AR; digital entities are overlaid onto the real world), as expressed in Milgram's Continuum. Although software programs are typically less engaging than embodied learning with robots, a benefit is that they cost less to scale and can thus reach a wider audience. One recent interesting example is an AR app developed by Itamiya et al. to show kindergarten students what a fire or flash flood would be like in a memorable, immersive, safe, and engaging way, almost like they were "there"; e.g., by self-experimentation, the children were able to learn that moving close to the ground in a fire can be safer due to less smoke [18].[4] Various XR apps have been described that could also be used in education, such as Snap Camera with AR filters that can be used in Zoom, Sketchar which projects strokes onto a page step by step to help people to draw,[5] 3D Scanner App which allows scanning of arbitrary objects,[6] as well as magicplan[7] and ARki[8] which automatically measure rooms and allow architectural students to speculate about how a scene might look if it were designed differently (e.g., if a road had an overpass). XR applications are often written leveraging packages such as Apple's ARKit and Google's ARCore through game engines like Unreal Engine and Unity, where a hope is that standards like OpenXR and AR Foundation will help reduce "fragmentation", allowing teachers to more easily develop and port their ideas to a range of devices.[9]

On the other hand, new technologies also introduce new challenges, such as ethical concerns (e.g., [11,25]): For example, current robot and XR tools could be inaccessible to some (e.g., due to being costly, complex to use, or unable to

[4] youtube.com/watch?v=gWG-GXEZQtw.
[5] sketchar.io.
[6] 3dscannerapp.com.
[7] magicplan.app.
[8] darfdesign.com/arki.html.
[9] gmw3.com/2019/03/make-arkit-and-arcore-development-easier-with-unity-ar-foundation.

deal with vision or speech-related disabilities). Mental or physical harm could result (e.g., by enabling new kinds of abuse or trauma, or falling on someone). Also, a negative influence could otherwise be exerted (e.g., by reducing opportunities for student-teacher interactions). Some strategies to avoid such problems could include clear instructions on how robots and XR should be used; guidelines for detecting and handling abuse and a focus on safety; as well as more generally, incorporation of key values for responsible and sustainable design such as autonomy, justice, beneficence, and nonmaleficence. Given the vast space of possible learning interactions, what was unclear to us was how our teachers were experiencing the good and bad sides of these technologies.

Games and Gamification. Robotics and XR are also related to, and can be used for (serious) games and "gamification"–the use of engaging, game-inspired elements such as rewards like scores, virtual items, or achievement badges; progress tracking; competition; enjoyable narratives; and freedom to choose various ways to learn. For example, Parnes et al. have described an open platform, WalkAbout, which is a distributed virtual world application intended to engage and facilitate gamification in education (e.g. with points, activity tracking, and missions), that can act as an alternative to Zoom [22]. Also, various generic virtual worlds/game apps exist such as Decentraland, Second Life, Avakin Life, Roblox, World of Warcraft, Pokemon, and Minecraft. For example, the latter, although not free, was used to enable virtual graduation ceremonies by children in Japan, and meetings between teachers; other games such as Assassin's Creed have also allowed high school history students to explore and take quizzes related to Ancient Egypt.[10] Also of interest for education are "proximity chat" programs, such as Gather (Gather.town), Skittish, SpatialChat, Airmeet, Whereby, Rally, Daily, InSpace, Wonder, Kumospace, and Topia. Such programs make it easy for users themselves to dynamically form smaller groups for discussion, as in physical classes, which currently in Zoom would require effort for a host to coordinate.

At the same time, the literature also suggests the existence of a "dark side" of gamification [26]: Regarding the use of 12 game elements (denoted as Leaderboard, Badge, Point, Level, Progression, Social Status, Social Interaction, Instant Feedback, Avatar, Economy, Challenge and Narrative), Toda et al. reported negative effects included lack of interest or declining interest over time, demotivation due to being penalized, frustration due to not successfully fulfilling game goals, confusion about rules and complex game elements, distraction and transfer of focus to games rather than evaluation, and lingering worry that game activities could affect grades. Thus, as with robots and XR, appropriate design principles should be followed to realize the interesting opportunities that emerge from the use of such engaging tools and approaches, which we wished to learn more about.

[10] washingtonpost.com/video-games/2020/04/15/teachers-video-games-coronavirus-education-remote-learning.

Exam-Related Technologies. Various software programs are also being designed to help teachers to conduct exams, via proctoring, plagiarism detection, and automatic assessment and clustering. Tools like AutoProctor, e.g., with Google Forms, can be used to ensure that students complete tests within allotted times, there is no one else in view, and students do not switch to a different application; evidence such as trust scores and images can also be reviewed by human teachers afterwards.[11] Various plagiarism detection softwares also exist, such as Ouriginal, SafeAssign, Turnitin, and Copyscape, which match exam text with previous text in databases. Automatic assessment of English language ability has been conducted with the Duolingo English Test [23], and code has been automatically graded via nbgrader with JupyterHub[12], or CodeGrade.[13] As well, Overcode and interactive Bayesian Case Model (iBCM) seek to cluster students' programs in a way that helps teachers to understand the underlying quality of programming exam responses, which has been used in both on-campus or edX courses with thousands of students [19].

On the other hand, such new technologies also introduce new possibilities for misuse. For example, proctoring software can introduce privacy and security concerns in regard to surveillance of students and increased vulnerabilities [7]: Basically, room scans, checks, and monitoring could result in leakage of sensitive personal data, including audio; images and videos containing fingerprints, ID cards, or irises; or text representing addresses (IP, email, or home), names, phone numbers, ages, genders, passwords, medical conditions, or even keystroke cadence (e.g., for typed signatures). Furthermore, software can be hacked and used for malicious purposes, even after appearing to have been uninstalled.

Furthermore, it is also becoming increasingly easy to cheat on exams by using digital technologies [1]: In 2020, Brown et al. from OpenAI reported that their GPT-3 algorithm could automatically generate writing that humans couldn't easily identify as being machine-written [6]: Similarly, in spring 2022, 32 engineering teachers from our university were asked to guess which of 10 texts, representing answers to an engineering exam question, were authored by a human [10]: 5 of the texts were written by a human, and 5 generated by OpenAI's GPT-3 model Davinci (text-davinci-001). The resulting number of correct guesses was only marginally higher than random chance (58%), indicating that teachers mostly had no idea which answers were written by an AI or a human. Although a RoBERTa model fine-tuned to detect output from a related model, GPT-2, fared somewhat better, it also mistook one of the human answers as AI-generated, reporting a probability of only 0.02% that the human answer was real. Numerous other, similar services exist, such as Jasper.ai[14] and Contentbot.ai,[15] including some simple free demos that can be accessed online, as of fall 2022.[16]

[11] autoproctor.co.
[12] nbgrader.readthedocs.io/en/stable.
[13] codegrade.com.
[14] jasper.ai.
[15] contentbot.ai.
[16] app.inferkit.com/demo.

Various mitigation strategies could be followed: To avoid concerns arising from proctoring software, institutions can aim to communicate clear privacy and security standards (e.g., minimizing personal data and clarifying data retention periods), while also generally prioritizing ethical design in regard to justice, beneficence, non-maleficence, and autonomy. For exams, teachers could ask for figures in exam responses rather than only text, and conduct supervised written exams and oral exams in place of reports or programs. However, these are not perfect solutions. Exciting work is also being done now with automatic generation of images and videos, using tools like DALL-E, which can be tried out online in a reduced form.[17] Also, a challenge with requiring a higher degree of supervision is that teachers tend to have little time. One possibility for the future could be to use robots: e.g., as in the modified Kobuki robot designed by Al Tarabsheh and colleagues to proctor exams in a safe, contactless way, while navigating around a class, answering student questions, detecting cheating, and scanning exam papers at the end [2]. Similarly, oral exams can be time-consuming in large classes, and online oral exams might furthermore become susceptible to misuses of AI. For example, filters and DeepFakes can be used to change the appearance of a person, and the use of tools like Ecamm Live/Loopback to automate a person's behavior in meetings has been reported.[18] In short, there might be some "trouble brewing" in regard to the way the quality of learning is currently evaluated, suggesting the usefulness of raising the topic with our teachers. At the more general level, we wished to also obtain some additional insight into the kinds of new technologies that can help students to learn better and reduce teachers' workloads, based on our previous prototyping efforts [9].

2.2 Learning Formats

Academic institutions typically provide various guidelines and rules to teachers to support good learning. One concern is that administrators might not always hear all of the teachers' voices; for example, false consensus effect, or consensus bias, suggests that managers might sometimes assume that teachers who do not speak up share their beliefs [30].

In particular, the teaching environment is an important factor in learning that can be modified via technologies, where one scenario whose pros and cons have been weighed in previous work is remote learning–most often from the perspective of students: For example, a survey of 1224 university students in Ukraine conducted by Bakhov et al. suggested that remote learning offered important opportunities to study in comfort, work while studying, practice self-control and self-motivation, and engage with technologies; demerits for some included a perception of enhanced complexity, fatigue due to computer-based work, and a lack of required equipment and internet access [4]. In our previous work on digital socialization and AI in higher education, presented at a teachers' workshop, we also suggested some potential benefits and demerits exist from remote

[17] huggingface.co/spaces/dalle-mini/dalle-mini.

[18] cnet.com/tech/services-and-software/how-i-pre-recorded-myself-in-video-meetings-for-a-week.

teaching from a teacher's perspective:[19]: Some benefits of remote teaching can include wider access (people with disabilities, children, or who are sick or traveling), hygiene and safety (COVID-19), new opportunities for self-expression of roles, interests, and humor (e.g., the ability to send chat messages and use filters and backgrounds), more time with family at the "home office", greater ease of seeing/hearing/file-sharing, ability to turn off cameras and mics (to be free to periodically relax/exercise/hydrate/concentrate/talk with others), ease of generating recordings that students can pause, playback, and view at their own pace, and opportunities to test new possibilities for technology that could lead to enhanced educational experiences. Some demerits could include the difficulty in checking if people are engaged and understand what is being discussed (e.g. if students turn off cameras and mics), non-optimal home office setups (e.g., cramped, or in proximity to noisy neighbors, children or pets), possibly missing out on some communications due to disconnections/WiFi instability or sound troubles, embarrassing mishaps with some people not used to such technologies (e.g. appearing naked on camera), a lack of ability to sense touch, smell, or taste, difficulty in "going around the table", new possibilities for hacking vulnerabilities (e.g., snooping, "zoombombing", or identity fraud that could be related to deepfakes or "catfishing"), depression or sleep-reduction due to excessive screen time, and difficulty of closely monitoring others (which could help some managers to feel empowered and in control).

However, more options exist, such as blended and hybrid learning. Blended learning, which combines some physical and some remote classes, was considered outside of the scope of this paper due to the difficulty of obtaining feedback on the potentially infinite number of combinations that could arise. Rather here, we looked also toward hybrid learning, which provides teachers and students with more freedom over their own educational experiences–allowing them to participate physically or remotely, depending on what is perceived as best–albeit at the cost of some extra work required from teachers.

Although decisions in regard to learning format are often made by management, e.g., in regard to when to provide online learning throughout the pandemic period, it was unclear to us how teachers might currently feel about learning formats and technology, and the degree to which individuals should have a choice about how they learn; it seemed like some teachers might have strong opinions, given that such decisions can have a large effect on their daily teaching, which we wanted to check.

3 Methods

To gain insight into how teachers perceive current technologies, we conducted an online survey at our university in southern Sweden in October 2021.

[19] youtube.com/watch?v=V8uYLqqTmec.

3.1 Participants

Feedback was obtained from the employees of Halmstad University, a small university founded in 1983, with 12,039 students in total (approximately 500 international) and 607 employees, of whom 384 are academic staff, 59 are professors, and 88 are PhD students, as of 2021.[20] The turnover is 70% education and 30% research, and 50 study programs and 200 single subject courses are available, organized within four schools:

- **Business.** Business, Innovation, and Sustainability
- **IT.** Information Technology
- **Health.** Health and Welfare
- **Education.** Education, Humanities, and Social Sciences

The survey was sent via an email link to all employees at each school, of whom 42 responded, comprising 16 in Business, 11 in IT, 8 in Health, and 5 in Education; 2 respondents indicated they were not actively teaching. Thus, the response rate was approximately 11% (42/384).

3.2 Ethics

The principles described in the General Data Protection Regulation (GDPR, 2018) and Declaration of Helsinki (World Medical Association, 2018) were followed: the purpose of the study and basic approach were explained, informed consent was obtained in writing before beginning, and data security measures were followed.

3.3 Procedure

Participants were sent a link to a Google Forms survey, which took approximately 5–10 minutes to complete. The survey was roughly centered around the two themes described previously, new technologies and learning formats:

- **Usage of new technologies. First, teachers were asked to describe their use of technologies related to robots/XR, games, and exams (not just Zoom) in their lessons. Simple yes/no questions were used for convenience in tallying answers, along with text fields which the respondents could use to freely add explanations.**
- **Preferences for learning formats. In the second half of the survery, teachers were asked, for each of three cases (regular classes, exams, and teacher meetings), to select one of three options: if everyone should have to meet physically or online, or have a choice to meet either physically or online. (Likert scale questions were also included in case more refined analysis might be required, but were**

[20] hh.se/english/about-the-university/facts-about-halmstad-university/halmstad-university-in-numbers.html.

not further analyzed in this study, since the results were felt to be sufficiently clear.) A yes/no question was used to check if teachers had ever conducted a hybrid class or meeting. Also, as before, text fields were used to collect any optional comments.

Our expectation was as follows:

- **Usage of new technologies. Very few, or possibly none, of our teachers would have worked with robots or XR. Some might have tried exam tools, and more would have used games.**
- **Preferences for learning formats. Teachers would be split in opinion regarding the benefits of various teaching formats, and have little experience with hybrid teaching.**

3.4 Results

Figure 1 shows some of the main quantitative results of the survey. Use of new technologies was generally low, as had been expected, and a difference was seen in preferences for learning formats based on the context.

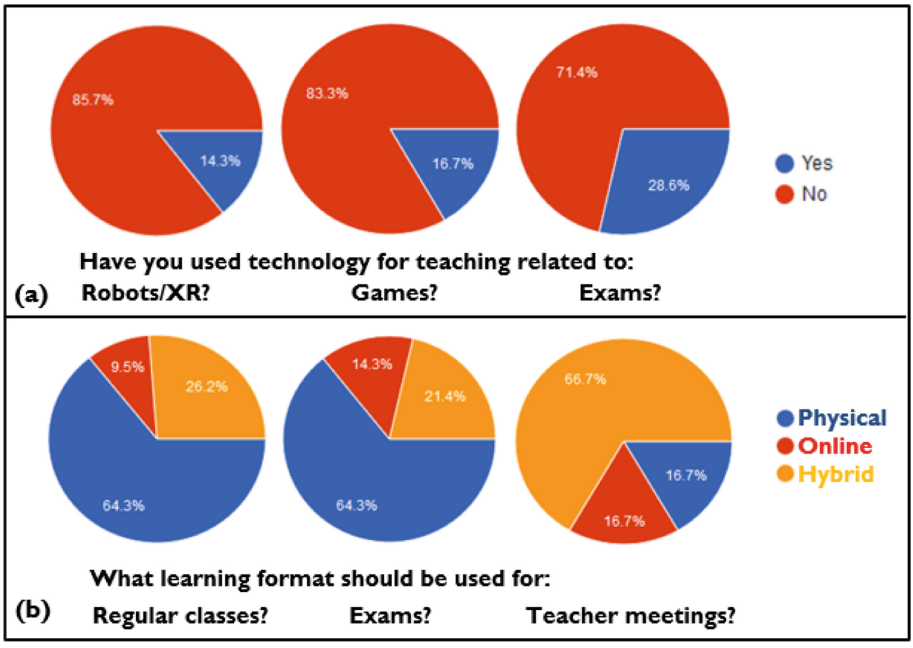

Fig. 1. Main results of the survey regarding: (a) use of technologies, (b) and preferences for learning formats.

Engaging New Technologies. About one in five respondents had witnessed some usage of robots and XR in the classroom, of which one in seven had themselves used robots or XR (21.4% vs. 14.3%). Specifically, participants described having used robots (3 participants), VR (3), and AR (1), with some indicating an intent to re-use (4). These tools were used to allow the students to learn about technology, to permit telepresence, and to enable learning experiences in a safe and easy manner that would not otherwise be possible (viz., to help students to see and learn about the aquatic world, large far-away ships, bullying at the workplace, and molecular shapes). Teachers who had not yet used such technologies indicated either interest (7), or lack of interest (3), in trying them. Some described lacking the competence needed (10), not being sure about benefits and what the technologies could be used for (8), having too much work and too little time and energy (5), or feeling that they had no access or opportunity (3).

Similarly, one in six had used some kind of game tools, including card games, simulation games, Quizizz (quizizz.com), Kahoot (kahoot.com), and physics and chemistry concept simulations and games (phet.colorado.edu). One teacher also mentioned incorporating game mechanics and having students develop their own games. Reasons for using game tools included to engage students, practice key concepts, and support interaction at workshop sessions.

As well, about one in three to four of the teachers had used some kind of tool to facilitate examinations, which included our learning management system BlackBoard (9), Moodle (to dynamically randomize multiple choice questions), GitHub (possibly also to check student involvement and activity in pushing commits during group work), and Safe Exam Browser (which locks a student's screen to deter academic dishonesty)–although one teacher noted potential dangers of using new digital tools given strict regulations regarding exams.

Teaching Formats. Some results are depicted in Fig. 2 and Table 1.

Almost all teachers (85.7%) indicated they had given a hybrid class or meeting. Teachers differed strongly in their experiences, with some saying hybrid classes went well and they would do it again (12), versus others who described it less favorably (7), even as a disaster, horrible experience, or worst-case scenario. There was some agreement from both sides that hybrid learning poses challenges (4) and that it helps to have assistance from others (2). Specific challenges mentioned included focusing attention (4), communicating with the online students (3), and treating students equally (2).

Relating to the kind of activity, our teachers preferred campus-based learning for both regular classes and exams, and a hybrid set-up for meetings between teachers (e.g., to discuss evaluations and plans for development within programmes and courses). Differences also appeared to exist between subject areas, as shown in Fig. 2: For example, some Business teachers felt online exams were acceptable, with fewer teachers choosing hybrid. As well, 100% of the IT respondents preferred hybrid meetings for teacher meetings. Online meetings were more

popular among Health teachers than hybrid meetings, and physical teaching seemed to be most preferred among Education teachers.

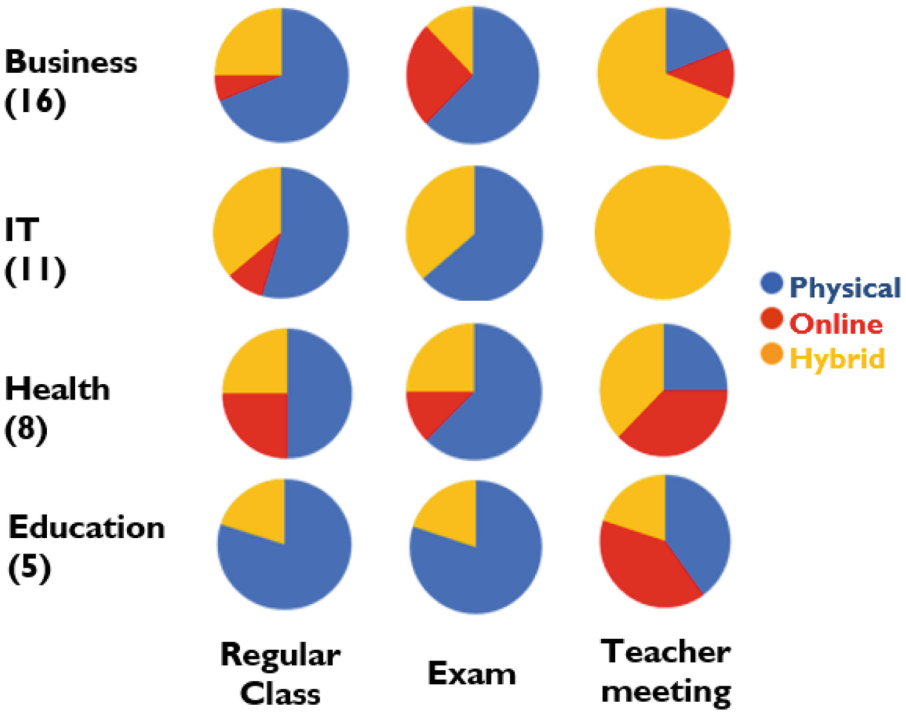

Fig. 2. Teaching format preferences by school.

Various free comments were also provided at the end of the survey, as shown in Table 1. Comments have been translated from Swedish when needed and paraphrased to remove specific details.

4 Discussion

In summary, the contribution of the current paper lies in reporting on some teachers' experiences with, and attitudes toward edtech, with responses obtained from all schools at our university:

New Technologies. Rates for usage of robots and XR, although low, were higher than we had expected, which felt promising; this appeared to support our idea that silo effects might exist in the communication of teachers' work, even at a small university, and raised the question of how such communication could be further facilitated. Another positive point was that applications covered

Table 1. Comments about teaching formats.

More participants attended when hybrid
The text messaging function online is nice because people who might not otherwise ask questions out loud feel like they can, also recording
My students appreciate very much being able to attend even if they cannot physically do so. It does cost me an extra 15–20 min of preparation before and after the teaching for preparation and packing but I reckon it is well worth it
During the pandemic, I built my "own" studio in a classroom where I lectured in front of a camera online. On one occasion I was "stormed" by a group of students who wanted to sit at the back of the classroom. That was quite a positive experience
I would like that online or hybrid is here to stay. I remember arguments with managers in the past about physical presence, and now it has been demonstrated that the world can keep rolling. I must also say that I have been much more productive during the pandemic than ever, and I can attribute it directly to remote work
I think that this new world (of teaching with technology) is very interesting. I would love to learn how to use and work with games, robots and VR. I think that courses for us teachers would be a golden opportunity to encourage new thinking about pedagogy and to make teaching more fun
Using technology and distance formats has helped a lot of students who need to travel longer distances. It has also opened up the opportunity to do small research and group discussion projects, or to engage with online simulators/teaching materials during lectures/classes. ... but I do like the familiarity of actually meeting people too. I feel you get more personal, meaningful responses in a real classroom (just a gut feeling). I intend therefore to use a hybrid format, trying to get the most out of each method
I think that hybrid is more productive, e.g. you can switch between tasks in seconds (don't have to move physically), you can attend if you are travelling, you can meet physically if you do not want to miss the social interaction, etc.
3D holograms in natural size would be ideal
I gave the message to the "online" people that they would not be focused on
Hybrid is not good for large classes, and is better for small ones
Hybrid format are limited by 1-mindset, 2-available technology, 3-a clear framework for hybrid meetings
It's hard to say how a teaching format should be, since it depends on the kind of class or exam, and the intended learning outcomes
Exceptions are okay (e.g., if ill, taking care of a sick child, or abroad) but to always cater to two options is useless
We should be consistent as teachers to avoid confusing students (all teachers should offer hybrid or not, at the programme level)
There can be concerns with copyrights and GDPR

a broad spectrum of subject areas, from physics and marine science to psychology, indicating such technologies can be generally useful. Furthermore, although correlation does not indicate causation, similar rates for awareness and usage, along with comments from some teachers, suggested the potential usefulness of spreading awareness of potential benefits and use cases. In contrast, the rate of game tool usage was lower than expected, suggesting that spreading information also about easy-to-use tools like Gather.town could be useful. The rate of using technology to facilitate examinations was low, as expected; furthermore, the majority of responses merely described using tools that all teachers at our university are obligated to use, and for simple functions like randomly ordering quiz questions. This felt interesting because there seems to currently be a mismatch in teachers' abilities to use technology for exams and the growing ease in which technology can be misused (e.g., in automatically writing reports in a manner that is difficult both for human teachers and computer programs to detect).

Teaching Formats. As expected, not all teachers agreed on teaching formats, but the rough pattern was that slightly over half of teachers favored forcing students to attend physical classes, while allowing teachers a choice in hybrid teacher meetings. The former result might have been in part because our university up until the pandemic had almost exclusively focused on campus-based education, which might have contributed to a conservative trend in thinking. Also, one potential explanation for why the preference for teachers and students was different was described by one teacher, who commented that there is a large difference in Zoom if faces can be seen or not, and that teachers often show their faces but students often turn off their cameras.

Regarding differences between schools, the preference for online exams among Business teachers might have been since some online education had been conducted there prior to the pandemic. The 100% preference in IT for hybrid meetings might have been due to various factors, including a positive attitude in engineers toward using technology, as well as some history of difficulty in finding sufficiently large, close-by physical spaces for school meetings that allow all attending to hear and see presentations easily. The preference for online meetings rather than hybrid among Health teachers might have arisen due to increased awareness of health concerns: a hybrid format, while offering more freedom and convenience, can also be unsafe like physical classes during a pandemic. The preference for physical classes among Education teachers might have emerged from such teachers having been drawn to our university, given the university's almost complete historic focus on physical teaching.

We had also not expected the high rate of teachers who reported having experience with hybrid activities. In line with this, teachers did not mention using the university's hybrid classrooms in the survey; e.g., one comment was "Do we have hybrid classrooms?" One possible explanation for the high self-reported rate was that the term "hybrid" might have seemed ambiguous; it's unclear if a positive answer might have meant that a teacher had connected a

laptop or smartphone to Zoom, attended an online school meeting from their office, or even merely uploaded a recording of a classroom lecture. Likewise, this raised questions about what a hybrid classroom should look like, and what it means for a classroom to be considered "hybrid".

More teachers seemed to be for hybrid than against, but the ones who were against it seemed strongly so. The challenge of focus was mentioned, as more things to keep track of puts more extra work on the teacher, suggesting the benefit of finding ways to make the process easier (e.g., a feature to automatically read comments in the chat window could help solitary teachers who have their hands full managing presentations).

Interestingly as well, the free comments at the end of the survey mostly focused on learning format preferences and hybrid classes, possibly since this had been the last question beforehand in the survey, or because few teachers had experience with new technologies like robots but all teachers had experience with campus and online teaching, possibly leading to stronger feelings.

4.1 Limitations and Future Work

Our study is limited by the group of teachers who provided feedback, representing a small sample size from only one small university in Sweden engaged in only four subject areas. "Demand characteristics" might also have played a role; i.e., some teachers might have said what they thought we wanted to hear. Moreover, due to the exploratory nature of this study and the rapidly changing state of new technology, an existing survey with the questions we wanted to ask was not found, leading us to create our own survey; this leaves questions about the reliability and validity of the questionnaire items. To avoid survey fatigue, the number of questions was also limited; e.g., feedback was not obtained regarding blended learning. As two comments in the survey highlighted, the survey also did not probe teachers' perceptions of how meetings between students and stakeholders outside campus should take place. Also, although this was outside of the current scope, we acknowledge that technology is not just for teachers or teaching, in that teachers should strive to equip students with the tools they need to shape the world for themselves and become "agents of change".

Our next planned step is to conduct a workshop at our university. PDC will be scaffolded by providing some basic info and links to tutorials, which will also be used in courses for students on XR and robotics. As one comment in the survey mentioned, teachers can also be advised to start simple (e.g., H5P[21] to create HTML5 content like quizzes with Javascript) and then progress from there. Benefits and a list of specific examples of use cases will be discussed. Opportunities at our university will be clarified by sharing a list of tools available (first hardware, then potentially software). For exams, teachers will be shown automatic writing tools and mitigation strategies will be discussed (e.g., tools for detection and how to select exams to deter misuse of such technologies). Regarding teaching formats, we will spread knowledge of classrooms aimed to

[21] h5p.org.

support hybrid learning, and discuss experiences and strategies. Additionally, support will be sought at the organizational level, since time seems vital (as seemed to also be supported by a separate survey we had conducted previously on digital competences): e.g., how we can allocate time for teachers to take the leap into pedagogical development, since it is not enough just to have access to technologies. In addition to supporting awareness, we aim to also continue to explore how to design technological prototypes that can help teachers and students to achieve better learning.

Thus, the survey results seemed to suggest some interesting possibilities that will be explored in future work. By understanding the opportunities and challenges related to how our teachers are working with technology, our aim is that this line of research will hopefully help to support PDC and enriched educational experiences, within the ever-changing "new world" of teaching with technology.

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