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UNCERTAINTY OF TECHNOLOGY USE IN TEACHING IN HIGHER

EDUCATION: A CASE STUDY AT ITMO UNIVERSITY IN RUSSIA

MA thesis

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Abstract

Teacher training in digital technology is vital in higher education, with the rapid development of technology, and reorganization of the teaching process due to the COVID-19 pandemic. However, such training usually does not address the uncertainties teachers face. This paper reports an action research single case study on providing a training course for university instructors on the uncertainty of technology use in their teaching. Semi-structured interviews and data collected from participants during their participation in the course showed how teachers articulate their uncertainties. The findings revealed that reflection and talking with colleagues about their doubts and concerns as well as the possibilities and opportunities in technology use in education helped teaching professionals to find ways to improve their practice.

    Keywords: uncertainty, educational technology, COVID-19 pandemic, technology use, teacher reflection, teacher training, higher education

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1 Introduction

With rapid technological advances becoming an accepted aspect of the 21st century, leaders in higher education around the world are attempting to evolve and adapt to the accelerated growth and advancement of technology. Unfortunately, their ability to identify and integrate these changes falls short of the speed at which development is being made (Brown & Keep, 2018; Sfredo Miorando, 2019). An increase in technological development in society means that there will be more alternatives to choose from in every sector (Bardone et al., 2020). Leaders and faculty in higher education are faced with a huge number of technological tools that can be implemented. They can also be applied in teaching in a variety of ways. These multiple options of technology use bring increased uncertainty, while these leaders attempt to make decisions as to how to deal with them. Technology has become one of the main sources of uncertainty in higher education as its development is unpredictable (Hackett et al., 2017).

The term 'uncertainty' in the context of technology use in education that will be used in this paper refers to openness or a continuum that represents doubt and questioning on the part of educators' use of technology in teaching and learning due to a wide variety of options. Uncertainty is an inherent nature of teaching (Helsing, 2007a). Teaching in uncertain times, no matter how experienced a teacher is, will be a source of uncertainty (Barnett, 2007). Being a teacher implies recognizing the reality that teaching seldom goes as planned, it is always unpredictable and requires an attitude of embracing change (Wassermann, 1999). On one hand, researchers argue that uncertainty can paralyze teachers, and force them into routine behaviors that lack the creativity and dynamism that teaching needs, on the other hand, it can also be seen as a positive force that helps improve practice (Helsing, 2007a).

In this era of uncertainty, everyone is clinging to something tangible, something that they know works, and that they can use. While every teaching context is unique, instructors with a desire to grow, flurry to workshops and professional development training that offer best practices in technology use in education. In these settings, they often find that the number of options is constantly increasing and their ability to sift through these various options is underdeveloped. Teaching is not one size fits all. The educational technology industry is becoming increasingly competitive and often several tools perform similar functions.

Answers do not make teachers the best they can be. They need to "give up the security of certainty and step gingerly into the risky world of meaning making, where they are on their own, applying what they know in interpreting the hundreds of events that make up their teaching day" (Wassermann, 1999, p. 468).

Schuck and Buchanan (2012) suggest that we should value uncertainty because "doubt informs and nurtures our teaching and our learning" (p. 4). As Helsing (2007a) outlines, the right kind of reflective practice and collaboration can help teachers deal with uncertainties. If teachers are to embrace uncertainty and accept it as their mode of functioning, then they need to be assisted to draw meaning from the variety of options they are faced with.

The Covid-19 pandemic in 2020 forced education into a frenzy of technology use which was only being gradually adopted into the higher education scene before that. The need to go remote meant teachers and learners had to quickly employ existing technologies into their teaching practices without the opportunity to reflect on their meaningful use. Rapanta et al. (2020) explain that the Covid-19 crisis has produced a lot of guidance based on resources and tools for teachers to use to deal with the reorganization of the teaching process "teachers have been offered hundreds of 'tips and tricks', mostly without the contextualizing knowledge needed to judge which teaching tactic is likely to work where" (p. 924). This has created more uncertainty among faculty in terms of how to integrate the repertoire of options of technology use into their teaching.

In Russia, all universities had to switch to online learning on March 16, 2020, practically overnight. University faculty were far from ready to teach their classes remotely, and the university infrastructure was not prepared for this transition. By the fall semester of 2020, the faculty at ITMO University in Russia had already built up enough knowledge in online teaching to offer their ideas to one another through a professional development training aimed at the entire teaching body. During this one-week course, offered by the university leadership, ideas and experiences from amongst the faculty were shared and teachers could choose to adopt them in their teaching. However, reflection on the use of these technologies was not an aspect of the training.

The role of reflective practice and embracing uncertainty in technology use is still limited. To understand more deeply the nature of such reflections, and how they can be of use to teachers in applying digital technology in their classes, a special course was offered to faculty at ITMO University in late fall of 2020, aimed at exploring the various digital tools available to implement in online teaching. The course looked at how these tools could be integrated into their teaching practice, the possibilities these tools offer as well as the doubts and uncertainties associated with implementing them.

Eleven university faculty chose to participate in this two-month course called "Digital Innovation and Online Education: A Course on the Meaningful Use of Digital Tools". A

single case study approach was used to understand more deeply the role of uncertainty amongst faculty in higher education in using digital technology in their teaching.

The study aims to explore the following questions:

Research question 1: What uncertainties in technology use are felt by teachers due to the reorganization of teaching and learning in higher education as a result of the pandemic?

Research question 2: How is uncertainty of technology use articulated in the context of a pandemic within a training course on the meaningful use of digital technology in education.

Research question 3: What perceived benefits are there for teachers participating in a course focused on reflecting on the uncertainty of technology use for higher education practitioners?

The data will be gathered through three main sources: participants' comments in the online course, participants' oral comments during virtual classes, and responses of course participants in semi-structured interviews after the completion of the course.

A theoretical overview of the course content will cover how uncertainty in teaching is explored in previous literature, as well as technology use in higher education as it relates to these uncertainties. The methodology of how the study was conducted and details about the course will be provided. Results in the form of analysis and quotations based on data collected during and after the course will be outlined, followed by a discussion on how these results relate to the research questions.

2 Theoretical overview

2.1 What is uncertainty

The word uncertainty is often associated with feelings of fear or concern, particularly when it refers to an uncertain future. To further highlight this point, Macmillan (n.d., Definition 1)'s first definition of the word uncertainty is "a nervous feeling that you have because you think bad things might happen". In the last 50 years, the usage of this word in English literature has steadily increased, according to the Google books repository, mirroring the feeling of uncertainty increasing in the world today. Climate change, wars, disease, food shortages, population growth, economic crises, all contribute to a sense of uncertainty and instability in the world.
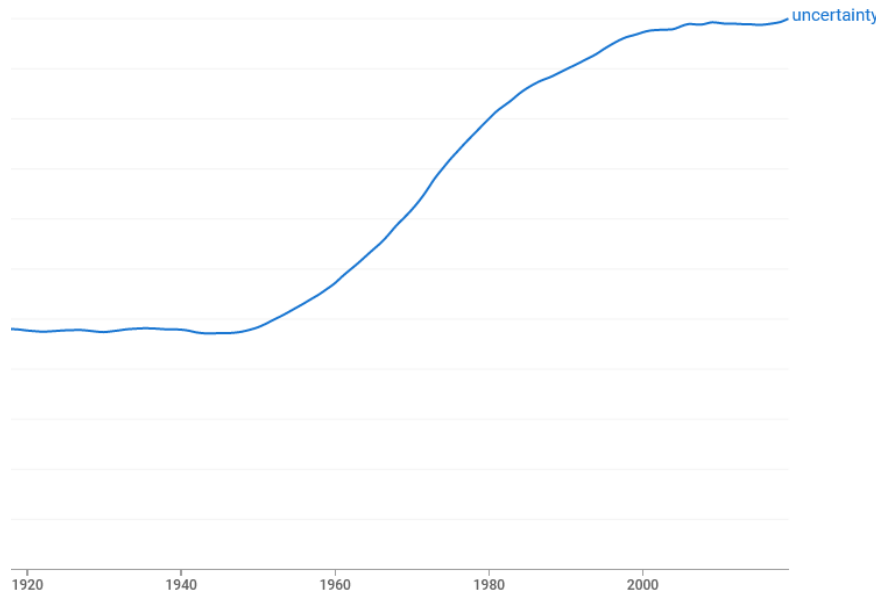
Figure 1: Screenshot from books.google.com/ngrams

When someone faces uncertainty it's not unusual for them to feel anxiety or frustration (Helsing, 2007a). It is natural that when one is faced with numerous paths, and a lack of control over which path to choose and which path will lead to the greatest success, that a person will feel this way. But this isn't the only way uncertainty can be viewed. Uncertainty is not only characteristic of foreboding of the future. Uncertainty is also a part of human life, it's normal, it's something that we can expect (Coles, 2013; Nowotny, 2015). If we take Macmillan (n.d., Definition 1a)'s next definition, it refers to uncertainty as "the fact that something is not known or has not been decided". This understanding of uncertainty implies an openness to learning, a range of possibilities, an opportunity to explore new ways of doing things. In fact, uncertainty can be linked to innovation (Nowotny, 2015). Surprise, confusion, doubt, ambiguity, and uncertainty lead a person to inquire, to reflect, and ultimately change (Wheatley, 2002).

While practitioners of almost any profession may strive for certainty because it evokes a sense of confidence, trust, and comfort, it is a disposition towards uncertainty, albeit less conventional, that can breed innovation, generate new knowledge and find new paths of development. Uncertainty is described as a "powerful incentive in striving for more knowledge" (Nowotny, 2015, p. 1).

In the words of Feynman (1999) "To make progress in understanding, we must remain modest and allow that we do not know. Nothing is certain or proved beyond all doubt. You investigate for curiosity, because it is unknown, not because you know the answer. (p. 247)"

Floden and Buchmann (1993) also proposed a redefining of uncertainty, by describing it as "'openness', 'awareness of possibilities', 'fluidity' or 'freedom from rigidity'" (p. 377).

The world is constantly undergoing massive changes, the technological changes that are taking place are so swift that organizations and institutions can barely keep up, leaving most professionals in constantly uncertain situations. New decisions must be constantly made, adapting to changes, by doing, reflecting and learning, but this can only be done as individuals make inquiries, ask questions, and search for new truths in the face of uncertainty (Jarvis, 2004)

Uncertainty is about seeing multiple potential outcomes (Smithson, 1989), while certainty in one's profession admits to only one potential outcome to a situation. In a world beset with uncertainty, how can there only be one correct outcome? According to Fromm "The quest for certainty blocks the search for meaning. Uncertainty is the very condition to impel man to unfold his powers… Creativity requires the courage to let go of certainties" (as cited in Jordan et al., 2014, p. 326). Uncertainty, therefore, begets variety, it suggests that there isn't only one way of doing things but multiple options and possibilities.

2.2 Uncertainty in teaching and education

So, let's look deeper into uncertainty as it relates to the work of teachers. In multiple sources, the work of a teacher is labelled as inherently uncertain (Floden & Buchmann, 1993; Helsing, 2007a; Labaree, 2000). Uncertainty is not just an inevitable aspect of teaching but also something that teachers must learn to live with (Labaree, 2000). Uncertainty is also described as a "vital part of all practice in all professions" (Floden & Clark, 1988, p. 9)

Barnett (2007) suggests that "teaching for an uncertain age" must in itself "embody uncertainty", that experience and knowledge that a teacher may possess will not make them immune to the uncertainty of teaching. He describes teaching as "open", "daring", "risky" and "unpredictable" (p. 137). A teacher's everyday work is riddled with unknown outcomes (Rogers, 2016).

McDonald (1986) illustrates that at the centre of the teaching process is uncertainty as an inevitable tension. Rogers (2010) explains that uncertainty in teaching comes from the "open-ended nature of teaching" (p. 21).

In the words of Wassermann (1999), "Teaching is a profession that is full of surprises. Being a teacher means accepting the fact that things never go as we think they will. It means being prepared for the inevitability of the unexpected…It means embracing change" (p. 468).

Helsing (2007) identifies different effects that feelings of uncertainty can have on teachers. She says that some see it as a source of "anxiety, frustration, burnout, and poor teaching", while others acknowledge uncertainty as an "important ingredient to improved practice and that it protects teachers from pessimism, guilt, and frustration" (p. 1318).

Schuck and Buchanan (2012) describe the value of doubt in teaching and learning, that it "provides more sustenance" (p. 4). Doubt is a matter of questioning the current mode of functioning. Since uncertainty in teaching draws the teacher to a state of doubt, a place of "genuine questioning" of approaches and methods of teaching, then the teacher begins to recognize what they do not know (McDonald, 1992, p. 41). Uncertainties thereby "become the means by which we may see beyond what we think we know" (McDonald, 1992, p. 7). Doubt has in multiple occurrences proved to contribute to more effective teaching (Wheatley, 2002). Expressing doubt is also an aspect of being a reflective teacher. Recognizing the assumptions that guide our teaching work, analysing them from a different viewpoint, and questioning their validity helps us to be critically reflective (Brookfield, 2017)

When teachers acknowledge uncertainty in their teaching as fact, as an undeniable aspect of their teaching, then the next step is to accept and embrace it (Schuck & Buchanan, 2012). Orienting one's mindset towards a positive view of uncertainty can motivate teachers in their careers (Şenol & Akdağ, 2018).

So, the question of teachers' attitude towards uncertainty comes into play. When teachers are aware of the uncertain nature of teaching and look at it in a positive light, this allows them to make improvements throughout their teaching careers (Costache et al., 2019). Teachers can even find joy in the surprises that constantly present themselves throughout their daily work (Rogers, 2010).

A disposition that includes flexibility, and openness on the part of the teachers, contribute to their success (Rogers, 2016). Looking towards uncertainty and questioning ones' teaching can enhance a teacher's ability to learn (Helsing, 2007b).

On the other hand, when there is certainty in teaching, it can lead to routine behaviour, with little experimentation and change (Helsing, 2007a). When teaching professionals allow themselves to question their approaches and reduce the certainty that they feel, they are faced with more options, and more decisions that need to be made (Coles, 2013). By acknowledging uncertainty, "we become more open to the range of possibilities that might exist" (Schuck et al., 2018, p. 260). Just by simply entertaining uncertainty, teachers can reflect on their teaching practices more effectively (Clarke, 1995). A disposition towards uncertainty, then,

opens teaching staff into a realm of options that allows them to experiment, explore and allow for innovation in teaching.

2.3 Technology use in higher education

Over the last century, rapid advances in technology have taken place, naturally influencing the educational sphere as well. But the speed at which information communication technology is changing has outpaced the ability of higher education to integrate it (Brown & Keep, 2018; Kearney et al., 2020; Naidoo, 2020; Oliver, 2002; Selwyn, 2016). With new technology comes more possibilities and more variety. The traditional classroom is transformed and now with the presence of new technology, there is more choice on "what is learned", "how it is learned" "when and where learning takes place", and "who is learning and who is teaching" (Oliver, 2002, p. 2). Educational technologies allow teaching and learning to move "beyond the four walls of the classroom" (Schuck et al., 2018, p. 4).

With the introduction of different types of technology into the educational process, research is constantly being conducted to measure the efficacy of this or that technology, but often without conclusive results on the impact on student learning. For example, instructional delivery technology has been researched since the 1920s, but none of the options were found to be better than another (Clark & Mayer, 2016). Even the use of computers in teaching and learning has come out with mixed reviews (OECD, 2015). Research into the effect of educational technology on student engagement also returns little clarity with emphasis rather on "careful planning, sound pedagogy, and appropriate tools" helping students to learn (Bond et al., 2020, p. 2).

Many people in higher education already regard students' use of new technologies as an inevitable aspect of modern academic life (Selwyn, 2016). For teachers living in a technology-driven world, they're called upon to shift their mindsets and approaches to embrace technology since it permeates their classroom whether or not they have chosen to integrate it (Schuck et al., 2018). New teachers entering the teaching profession are already engrossed in a technology-driven life, and may not even understand teaching without the use of pervasive technologies (Royle et al., 2014). Since these technologies are already entering the educational sphere through students' and teachers' personal use of devices, with or without the wider adoption from educational practitioners, they are inevitably contributing to further complexity in the higher education space. Perhaps the reason that technology has not been as efficiently adopted into education as it has to other aspects of life, is because it brings a large

dose of uncertainty into the teaching profession. Teachers need to be persuaded of the educational importance of a certain tool, before even considering integrating it into their practice (Kearney et al., 2020).

Beyond teachers, current curricula also have not been able to adequately embrace technology (Kearney et al., 2020; Schuck et al., 2018). This suggests that beyond educators themselves, there are broader structural issues in higher education settings that need to be addressed when considering the implementation of technology (Selwyn, 2016).

Technology is seen as a force in higher education implying that change is unavoidable and therefore those involved in higher education need to develop the capacity to keep up with new means of delivery (Brown & Keep, 2018; Oliver, 2002; Pucciarelli & Kaplan, 2016; Waller et al., 2020)

2.4 Variety in educational technology

Changes in our environment, such as the proliferation of technology, contribute to an increase in the amount of variety within an educational institution. With more accessibility to computers, new gadgets, new applications, and online materials one can see how this technological advancement has given us more options. In this light, technology does not necessarily imply improvements or better practices, it just means we have more to deal with. Then we're faced with the question of how we deal with variety, which could either lead us to instability or an adequate working system. (Bardone et al., 2020).

When we approach technology use in education we should not just be thinking about how to use these technologies but how to use them thoughtfully (Hybrid Pedagogy, n.d.). Roberts (2008) reinforces the notion that with such a plethora of technological tools available for educators, we have to recognize that their creation is also guided by consumer culture, and adopting them doesn't necessarily lead to the best outcome.

2.5 Communicating uncertainties

Literature on uncertainty in teaching also sheds light on the reflective nature of teaching (Helsing, 2007a). Teachers can learn to embrace and deal with their uncertainties by communicating them with others. McDonald (1986) describes this phenomenon in his reflection with teachers, "But what if teachers, recognizing the uncertainty in their work, raised their voices instead of growing silent?" (p. 362).

McDonald's approach to articulating uncertainties was reflected in regular meetings of teachers where they shared their experiences while eating and drinking together, helping them cope with the uncertainties of their teaching practice (Floden & Clark, 1988).

Mackay and Tymon (2013) explain the importance of being mindful of their personal biases when professionals are trying to make sense of their own experiences. In some respects, talking with peers and colleagues about one's uncertainties means admitting to not knowing it all, a challenge for any experienced professional. Using talking as a way to deal with uncertainty depends on two important factors, the teacher's willingness to talk, and their colleagues' willingness to listen (Floden & Clark, 1988). If the doubts and conflict that teachers are feeling are not discussed with others, they may only assume that these feelings are evidence that they are not good teachers (McDonald, 1986).

Floden and Buchmann (1993) evaluate the importance of communicating with other teachers to alleviate the burden of uncertainties. They mention three reasons why talking about our uncertainties can be useful. The first is that talking about "one's doubts and fears" with their colleagues can be a huge relief, as it helps a teacher to understand the intrinsic nature of uncertainty and ambiguity in teaching by hearing it from others, thereby mitigating any feelings of "personal failure" (p. 380). The second reason is that by communicating their uncertainties, teachers can see that it is not a weakness but rather an "essential driving force" in teaching (p. 380). And the third is that by learning to express their uncertainties with their peer teachers, this would help them to do the same with a broader audience thereby eliminating inappropriate demands for certainty in the profession.

As is explored in this theoretical overview, much has been explored about the role of uncertainty in teaching, and while uncertainty in technology use in education is inevitable, there is little empirical data on how teachers express their uncertainty in using technology in education. The COVID-19 pandemic forced teachers to reorganize the way they teach. This study aims to explore what uncertainties were felt by these teachers in higher education, how they articulated these uncertainties, and what kind of perceived benefit a reflexive style course on uncertainties in technology use had on them.

3 Method

3.1 Type of research and design

This study uses a qualitative action research single case study approach to investigate how uncertainty of technology use is articulated in the context of a pandemic within a training course on the meaningful use of digital technology in higher education. Qualitative research aims to help describe the behaviour of human beings within their own contexts through in-depth studies (Lichtman, 2012). A qualitative research method was appropriate as the research question looks into how teachers articulate their uncertainties within their natural settings. The action research method was used as the researcher, is also the course trainer. Action research in education is usually done by teachers, focuses on a particular problem, and finds ways to improve a situation in a given setting (Creswell, 2012). By exploring this topic through a single case study approach, more insight into the nature of uncertainty in technology use in education can be gained, particularly as it pertains to higher education. A single case allows for a more in-depth exploration of the way in which things take place and the reasons for it, resulting in deeper insights (Ridder, 2017).

The chosen case is an intervention conducted at ITMO University, where a course was offered on the meaningful use of educational technologies, and participants (teachers) were encouraged to reflect on and articulate their uncertainties regarding the use of certain types of technologies within their teaching. This type of study is used to look at a specific situation within its own context rather than for making generalizations. The intimate involvement of the researcher in the case study also allows for a more in-depth description of events (Hitchcock & Hughes, 1995).

I had worked with most of the group on a course in English Medium Instruction teacher training before and this course was the first time talking about technology use in their teaching. The course was conducted entirely in English. The native language of the participants is Russian.

The course was offered online over a period of two months, in November and December 2020. During this time the university itself was conducting most classes online, with some face-to-face classes being held in early November before the university was closed to students for a second time due to the pandemic. The course was designed to reflect on emergency remote teaching as a result of the pandemic and how to meaningfully use the digital tools at our disposal. It was made up of four main blocks, followed by a personal project. The topics

for each of the blocks are described below. The course was organized using Trello as a type of learning management system, all participants were enrolled in the Trello course and could interact with each other and the trainer using this medium. Trello doesn't allow for private messages, as it's a collaborative tool. So, all comments and messages from any participant within this tool were shared with the entire group. Four synchronous online sessions were held using [Zoom](), the video-conferencing tool, and recorded. These sessions were held before Block 1, and after Block 2, 3, and 4.

The topic for block 1 was **educational videos**, and participants were introduced to the tools, technology, and relevance of using educational videos in their teaching work, after which all participants were asked to make their own video defining their uncertainties in using educational videos in teaching. They were asked to answer the following questions in their videos:

● When you think of making educational videos and use them in your online/blended courses, what are you not sure of? What doubts or uncertainties come to your mind?

● How do you see educational videos could be integrated into your online course? And what are the possibilities or options that you see that educational video making can provide you or students with? How could educational videos help you and your students?

The topic for block 2 was **virtual classrooms**, and participants were introduced to the various options that video-conferencing tools provide students, they were also provided with options of types of tools that could facilitate different virtual experiences for students. They were asked to write their thoughts and comments on the following questions:

● Think of how you integrate (or would like to integrate) virtual classrooms in your online/blended courses. Think also of how you conduct or would like to conduct them. What are the major sources of doubts and uncertainties? What is it that are you not sure of?

● And what are the possibilities or options that you see when it comes to the integration of virtual classrooms in your own teaching practice? What are the opportunities and options that virtual classrooms could provide for your own teaching practice?

After they wrote their comments, which were open to all participants of the course to read, an online class was held to explore these questions and opportunities further.

The topic for block 3 was **formative assessment**. Participants were introduced to this topic and various online tools that they can use to facilitate formative assessment in their own classes. After exploring the tools, they each wrote their responses to the following questions.

● Think of how you approach formative assessment in your online/blended courses. Are you already using formative assessment? Do you plan to use it? What approaches and also

what tools interest you? What are the major sources of doubts and uncertainties? What is it that are you not sure of?

● And what are the possibilities or options that you see when it comes to the integration of various online tools for formative assessment in your own teaching practice?

This was followed by an online class where each participant shared their experience of exploring one of the tools and their uncertainties related to the use of this tool. The tools that were explored during the class were peergrade.io, wordwall.net, goformative.com, nearpod.com, mindmup.com, and miro.com.

The topic for block 4 was **learning management systems (LMS)**. Participants were introduced to various learning management systems, such as Moodle, Canvas, TalentLMS, Google Classroom, as well as other tools that could be used as an LMS, such as Discord, Google Drive, VK, and Trello. They were asked to review elements of an LMS that they might want or need for their teaching. They wrote their reflections on the following questions.

● What features of an LMS do you need or want to have in your course?

● What uncertainties do you have regarding learning management systems, what are you not sure of?

● What possibilities or options do you see for integrating an LMS in your online course?

After writing their comments in Trello, an online class was held to share their understanding, experiences, and uncertainties in using such tools for their teaching. All input material was prepared by me, and all online classes were facilitated by me.

3.2 Population

To find participants for this course, I contacted ITMO University's Faculty Support Office. The office invited all university lecturers at ITMO University to this new course called "Digital Innovation and Online Education: A Course on the Meaningful Use of Digital Tools". A minimum of B2 English level proficiency was the basic requirement for teachers' participation in the course. This language level wasn't formally checked by a test or interview before enrolment, however the majority of those who applied had previously completed the English as a Medium of Instruction teacher training course which was also conducted in English. I also contacted the English Language Office at the U.S. Embassy in Russia who contacted their network of teachers around Russia to share information about the course, and two participants from Smolensk enrolled. All participants were aware that their responses

during the course may be used for research within the framework of this thesis before applying to participate in the course.

The course had 11 participants enrolled in total. Nine of them from ITMO University, and two from Smolensk. By the end of the course, 4 of them had participated minimally in the online classes, and in completing the tasks between the classes. For the purposes of this study, the most active 7 participants' contributions will be analysed and explored. Pseudonyms are used to refer to each of these participants. These are available in Table 1.

Table 1: List of participants in the study and their background

Pseudonym	Gender	Field of teaching	Confidence in Technology Use	Teaching experience
Milena	Female	English & German	It's a challenge	2-5 years
Lada	Female	English	Advanced user	5 years
Rufus	Male	Mathematics	"I'm an IT guy"	7 years
Julia	Female	Science Journalism	Fairly confident	4 years
Isabella	Female	Computer Science	I'm ok	6 years
Inga	Female	Optics	Not sure I'm a very experienced user of different technologies	15+ years
Lucy	Female	Computer Science		-

3.3 Data gathering and analysis

The research data in this thesis is drawn from three main sources:

- participants' comments in the online course (text and video submitted in Trello),
- participants' oral comments during virtual classes (through Zoom video-conferencing) and
- semi-structured interviews that were conducted with course participants after the completion of the course.

The use of various ways of collecting data is known as triangulation and can produce more accurate results (Oliver-Hoyo & Allen, 2006). The three Zoom classes held after Block 2, 3, and 4 on 18 November, 24 November, and 2 December 2020 were recorded.

Six of the seven most active participants were invited to the semi-structured interviews. The one participant who was not invited did not participate actively in the last two blocks and failed to complete her final project. Interviews were conducted in groups of two over Zoom in

January 2021 by the author. The first interview was conducted with Rufus and Julia on January 13, the second interview was held with Isabella and Inga on January 14, and the last interview was with Milena and Lada also on January 14. Each interview lasted 30-45 minutes. All those interviewed accepted for their comments during the interview to be used for research purposes.

The questions for the interviews are provided in the appendix. Semi-structured group interviews begin with a structured list of questions but have the opportunity to unravel into a conversation where participants can discuss significant issues (Longhurst, 2016). This type of interview particularly suits case studies (Drever, 1995).

After the data was collected, I transcribed the text of the interviews using Descript by uploading the audio file, and then manually edited them for accuracy against the audio recordings. Video submissions provided after Block 1 with answers to the questions on educational videos were all transcribed manually. All the comments for the other three blocks were taken from Trello and put in a new file for analysis. The online classes held after Block 2, 3, and 4 had all been recorded, were reviewed, and partially transcribed. All transcriptions were further edited manually to remove unnecessary filler words.

Words were analysed using data.basic.io/en/counter to capture the frequency of words and phrases.

I conducted a thematic analysis on the data available to find common themes that addressed the research questions. The data analysis was treated abductively as described by (Timmermans & Tavory, 2012). This process is used to develop concepts grounded in empirical data and involves an iterative analysis between theory and qualitative data. Approaching the analysis abductively treats the results as 'uncertain' and the theory as tentative (Rambaree, 2017).

4 Results

4.1 Expressing doubts and concerns

When looking at the doubts and concerns teachers feel about educational technology, they fall into several broad categories: teachers' own confidence and skills in using technology, student response, and engagement in online learning, maintaining teachers' personal approach

in an online setting, whether or not there are advantages of using educational technology for students' learning, and time as a factor in finding and choosing the right technology.

Teacher confidence and skills

Uncertainties due to teachers' own skills and confidence arose during the course particularly as it pertained to educational videos but also with virtual classrooms and formative assessment. While filming oneself for students was attractive from the point of view of personalizing their videos, teachers expressed concern with seeing themselves in the videos and pictures. Inga explained that she preferred to make lecture videos with just slides and a voice-over to avoid filming herself.

She was not alone, Lada had similar doubts in terms of video-making. She was concerned with her own appearance in the video, and the potential lighting issues, and the noise that could ruin the video. "I have so many uncertainties regarding me, how I look, how I present the material, my gestures, my articulation…" (Lada, Block 1 video comments)

In the virtual classroom space, used as a response to the pandemic, Isabella was struck by a sense of being alone and almost giving a "performance" to a non-responsive audience of students. In her interview, she said "But, when I am online, I'm joking and I don't see a reaction. I feel like I'm by myself, and I don't know if it's a good joke or not. Sometimes I experience just a strange situation."

Using educational videos as a replacement for traditional lectures during the pandemic was not at all straightforward either. Due to a lack of editing skills, Inga was forced to film entire videos in one go, which meant constant filler words. She explained:

> I understand that for me it's very difficult to record a long video, sometimes first of all because I cannot speak fluently for a long time without breaks, without pauses, without unnecessary words, so during my live lectures, it's usually a dialogue and discussion with my students. In video, I use many unnecessary words, so a recorded lecture doesn't look as good as I'd like it to look. (Inga, Block 1 video comments)

Student response and engagement

Concern around video-making was also connected to how students would perceive the videos, considering the high-quality videos that they're used to. Inga explained in her video comments that "Students are expecting good pictures and good quality because they're used to seeing nice videos. So, it's a problem for me to prepare high-quality pictures for my videos."

On the other hand, there was a view that, due to the pandemic, students had become used to low-quality videos since most classes were taught via video-conferencing "Now after a

year we're getting used to the grainy or blurry talking heads or virtual backgrounds." (Julia, Block 1 video comments).

Another uncertainty that arose for teachers in this respect was the lack of student response in the online classroom. Teachers found they were talking, sharing their presentations, and asking questions, but students were not responding. They didn't know what to attribute it to. This concern is felt acutely in this statement from Julia which she shared during the second Zoom meeting held to discuss virtual classrooms,

> My second biggest concern is when you ask a question and there is silence, and you don't know if people don't know the answer, don't want to answer, can't hear you, or walked away to have a cup of tea. I am anxious as a professor and instructor. Whenever this happens, I'm like oh my God, they've left, nobody is in my Zoom actually.

Isabella found that the virtual classroom in response to the pandemic differed greatly from the traditional classroom and created further uncertainty for her as a teacher. She was unable to gauge the students' understanding of the lecture, or tasks as a result, which made the teaching process harder. In her comments for Block 2 during the online course she explains the following:

> I miss the personal contact and the fact that I can't watch what my students are doing. If this is just a lecture, then I have to constantly address students with questions "do you understand?", " What do you think?". And then I wait blindly for an answer. Sometimes this wait can be prolonged for several minutes. This is a source of problems and uncertainty for me. I feel this especially acutely when I work with foreign students and school children. Here it is especially important to see the eyes of students and see who is doing what. I can't do this now, so I have to write more detailed instructions with tasks. For example, my (…) students received a very detailed description of laboratory work - I was afraid that they would not understand, and would hesitate to ask. And at the end of the course, I realized that the descriptions were too detailed.

To deal with the uncertainties related to student response, teachers were looking for ways to increase student engagement in the online setting, this brought with it its own uncertainties.

When producing educational videos, for example, there was no way of knowing if the students were understanding what they were being taught, so most of the teachers were considering adding interactive elements to their videos, comprehension questions, or follow up classroom quizzes to make sure the students understood the video content. "When watching a video in an online course, I can't be sure that all students are watching and understanding what I want them to see and know." (Lucy, Block 1 video comments).

> "I also teach a MOOC and know that video lectures can often feel like an optional activity, whether I can integrate these comprehension checks into the course in the most efficient way is the biggest doubt so far." (Julia, Block 1 video comments)

The same issue was true in a virtual classroom, and some teachers felt that having short quizzes during the class could help see if the students are involved, and paying attention. It could also help observe how much they're understanding. The need for student engagement was particularly acute in larger groups. Lada expressed this in her comments in Block 3 "It is almost impossible to pay attention to every person if there are more than 10. I use MyEnglishLab platform and YaClass. These programs measure progress automatically. Still, they do not assist much with formative assessment."

The new possibility that arose with online lectures was that they could be easily recorded. This brought with it the question of student motivation to attend class, as Julia describes in her comments in Block 2 "I am not even sure that students ultimately pay enough attention to me in a synchronous classroom — why bother when you can re-watch the video before the exam." Recording lectures also meant having to be careful what you say, which wasn't an issue in traditional unrecorded lectures.

Using formative assessment as a tool to gauge students' understanding of a topic which can then be used to adapt the lesson itself means that some or many of these forms of assessment do not need to be graded, but with this comes fresh doubts:

> I guess I am not entirely sure whether there is a way to motivate students to really make an effort on the ungraded assignments; literally the first question asked about the workbook was, "How are these tasks graded?" — I'm not sure students can appreciate the value of a graphic organizer if there is no grade-based incentive to try it out. I am also not sure about the best way to assess the assessments — that is, to see whether they do what I intended them to do, and whether students find them comprehensible, challenging in just the right way, and plainly interesting. (Julia, Block 3 comments)

Isabella justified the need to use online quizzes during her virtual classes because she felt students could be easily distracted. The classroom becomes just another window on the desktop when it's taught online, whereas in a traditional class it's the space you're physically in. Isabella's explained this in her interview,

> Using Mentimeter or something like that is useful for me because the traditional ways of online education don't work. It's not about students, but just human nature. When you see only the screen, you have the temptation to go on another site, to read a book to open some work, and don't follow the teacher, or the lecture. And I think that short quizzes can help to follow.

The online world also means shorter attention spans and a need for gamification, this was also a source of concern for Julia, who said in her comments for Block 2 "I am worried about the limits of student attention spans when they have to sit in front of a screen." Lada found the same when thinking about which LMS to choose. She explained in Block 4 comments "Some of my uncertainties are (…) how to adjust materials to these facts [attention span of students].

As many of my students are teens, they might not be very attracted by a "boring" academic system. So, another concern of mine is how interactive can I be online and how engaging can the system be. I've tried to gamify learning. It works well, and I need to find an LMS which allows for that."

The teachers were particularly concerned with the fact that students were sitting behind the computer watching lectures for 8 hours a day, and so when they joined a class at the end of the day, they were exhausted and tired of the screen.

Lada in her comments in Block 2 said:

> Another drawback of any platform, be that a simple e-learning system or a virtual classroom, is screen time. Over the pandemic, my screen time has quadrupled. Recently I have been getting headaches, nausea and apathy. Some of my colleagues and students have reported the same. If the virtual classrooms we introduce are here to stay, there is a need of new gadgets that use augmented reality and holograms, or any other type of environment to which our brain, our nervous system and our eyesight are more adapted.

During the second Zoom session about virtual classrooms, Lada said: "Depression and anxiety [are a concern] because people try to multitask which our brain is not capable of."

Losing a personal approach

For Rufus, using tools to automate grading was new, although he had dreamed of it for a long time, he never found the right tool for this because of the overwhelming possibilities available online. Now that he has discovered these tools, this brought fresh uncertainties that technology might take over. During the interview, he explained:

> I think that I'm a bit afraid that I will dig too deep into embedding digital tools into my teaching. It could come to a moment that there is no actual teacher in the course. I can do automatic testing. I can do video lecturing with interactive formative assessment in the video… if I move in that direction, I would lose some essential things which are hardly palpable and hardly formal, but they are there like my presence as a teacher, for instance, there is a difference if I check on that homework manually or if I do it in an automated mode.

Milena felt the same way when it came to using learning management systems. In her comments in Block 4, Milena said "Speaking about uncertainties (…) the lack of the personal approach. There is no face-to-face learning; The lack of control over a student. I reckon, it is necessary to have constant control over a student. There can be questions, which may remain unanswered."

Can educational technology improve the learning experience of students?

One of the teachers, Julia, was particularly concerned about this question. Several times, when discussing the use of educational technology in the class, she called on her need for certainty in this question, whether or not these tools are helping students learn. A few quotations below illustrate this.

> As with any online tools, I wonder whether there is a way to measure added value from an LMS for students: I know I find semi-automated grading convenient, but do they get anything out of it other than having to remember another login/password? I can imagine it must be handy to have everything related to a course online in one structured place, but, having taken some LMS-using courses, I can't say they are absolutely essential. (Julia, Block 4 comments)

> I wasn't entirely sure that some of the digital tools that we're able to use in our teaching practice online were really useful. Sometimes it just feels you're using them just for the sake of using them. They don't really add anything to the student's experience. (Julia, Interview)

> But, I'm still a bit concerned whether this [interactive quizzes during a class] actually adds anything to their learning experience. So, yeah, I mean, I guess they don't feel perhaps as bored or, you know, as disengaged as they would…. I wonder if there's a way to measure this. (Julia, Interview)

Variety and time

I've decided to create a sub-heading for variety and time because this was brought up several times, and both seem to be connected to each other. A few comments were brought up by the participants of the course on the topic. The first is that due to a large amount of various digital tools available with overlapping functions, it's quite difficult to choose which one to use. Rufus found that trying to find an appropriate tool by searching online, can be quite overwhelming. Whereas talking with other colleagues, for example, during this course, could help with choosing the right tools.

In his interview he said:

> My main concern was that there is an abundance of those digital tools, which are intersecting, mostly, and their functions are close to each other (…) Like for instance, grading or automated testing and you do not know what to choose, but when you have some people who have already made up their mind on that, so you can see where they are clinging and maybe that will give you some peace of mind and it was helpful.

Similarly, when it came to using educational videos, he found he was faced with many options, whether to film it himself or provide students with an already existing video from Stanford or Cambridge.

The question of time came in from Julia's comment during the interview, that to sift through the various tools, one needs both effort and time. She explains:

> I think that it takes a lot of effort from the instructor's side to create all those tools that you might use, to study them and then to actually create content on them. So, for me being able to test whether it actually produces an outcome that I want would be critical in deciding whether I want to spend time doing this.

Inga found that teaching online can be much more time-consuming than teaching face-to-face because of the complexity of using technology. In her Block 2 comments, she explained:

> So, one of the disadvantages that I can find as a teacher is that it takes a LOT of time to prepare such a virtual classroom (prepare more tests, more illustrations, additional presentations, figures, drawings, searching for videos or preparing videos to discuss in the class etc.). Additionally, it is necessary to plan the time more carefully compared to offline classes. It is also necessary to think about some technical issues from the side of students, for example (as for our (…) students who cannot use google classroom or google forms).

When it came to creating educational videos, Lada felt that it takes a "great deal of time to compile all the material" and to record, edit it and make it interactive. Isabella, who had some experience with making educational videos before, said that it takes more time to prepare a high-quality video than to prepare a high-quality lecture. Julia explained that the extra time that teachers would need to take to make videos doesn't fit into their paid working hours, so there's no incentive to do this.

Using new technology in the classroom can also take up valuable class time if the teacher is not well prepared. Isabella's uncertainties were sparked when thinking about using a quiz tool in her class, and the concern she had for things going wrong. In her interview she explained:

> I'm not sure about Mentimeter, but maybe (…) it's my personal problem. All students use smartphones, for me, it's not suitable to ask to bring your smartphones and make a link. I think it might take a lot of time to open the site, but maybe it's all in my head. When it's 20 people it's ok, but when it's 200. Someone might say, I don't have the opportunity, I don't have Wi-Fi. It's my fear that it'll happen and then I will need to spend more time to come up with a solution.

In the course itself, the participants were offered many tools to help with creating educational videos, teaching virtual classrooms, using formative assessment, and finding the right LMS. In this way, the course provided participants with variety, but variety, according to Inga, and an openness to using new tools also needs more time.

To illustrate this point, in the interview Inga explains:

> "I liked the additional materials… [they] made me think, additionally about how I can improve my courses and improve the presentation of the courses…. And, this course gives me many, many, many ideas, how I can improve it, but unfortunately, it's the problem of time. In fact, we need much time to use new technologies, new tools and any digital tools to present our courses better."

The use of any kind of learning management systems to offer online or blended learning to students also requires time. Lada in her interview described the issue of time in this context:

> "As for blended learning, I noticed that there is a huge time issue. Because I tried to use a few programs along with Trello, in the way you did. So just post their homework and share what we covered. And it's a very nice idea if you have lots of spare time, but it takes so many hours, if you want to really do it throughout the week, that I just cannot devote. So, this is more of a concern, how am I as a teacher going to find more time for online settings, if I can barely find time for an offline setting, homework checking etc. Because filling up those platforms, I know that especially Canvas is a huge amount of work, which is supposed to be done before the course."

Isabella explained that one of the challenges with technology use is the amount of work that is needed to achieve a high-quality product, and during the interview, she explained that the challenge with using technology is not that she doesn't know how it's used but rather how time-consuming it is. "But it's a lot of work, and I would have to spend a lot of time to do that, and maybe it's not but I think there is lots of work."

4.2 Expressing possibilities and opportunities

The second type of uncertainties described by teachers in this study is related to the possibilities and opportunities that they discovered in educational technology when shifting to remote teaching. These are such possibilities as using "chat" in a virtual classroom, in turn creating a new dimension of interaction, pre-class video tutorials that created a type of flipped classroom, more flexibility to use asynchronous methods, and more straightforward use of interactive quizzes since all students were already online and had access to a device already.

Reduce students' stress

One of the teachers, Julia, expressed that she had made an instructional video for the first time this semester. She recorded a 30-minute talk over a presentation, explaining a task that the students would need to do during the class. "Thanks to the pre-recorded video we ended up having a more casual and conversational class without me droning over a PowerPoint presentation," she explained in her video comments. She found that this approach reduced the student's stress, and they were able to work at their own pace at home. Despite confidence that this approach was effective, she still expresses some doubt when describing it "So, saving classroom time for the latter [completing the task] seems like a good priority. I think I might look into recording more parts of my class for this purpose. To get the theoretical stuff out of the way for practice."

Saving teacher time

Another teacher, Rufus considered implementing educational videos into his course. This possibility was something he hadn't considered before and had limited experience in it. Not knowing whether or not this approach would be effective led him to consider it scientifically, that by integrating this new approach to technology in his teaching, he may or may not have some good results. He explained in his video submission:

> I guess I could just record the video once, and just distribute it to new students each year and it will save some time and give them some preparation before starting to learn. I guess I will implement this thing maybe soon, and then I can say what are the results, what is the outcome.

Build students' interest and creating more interaction

Lucy felt that due to the practical nature of her course, videos could not replace actual practice, but she did search for possibilities to integrate educational videos into her class "I think I can use educational videos to build interest and learning in the course and to connect with students, in discussing, in viewing, know something new for me, for them, new views on the problems, new tasks maybe sometimes" (Lucy, Block 1 video submission).

The teachers found that while there was a more acute need to capture the interest of the students during a virtual classroom, they had greater resources at their disposal in an online setting. A plethora of online technologies could be harnessed to allow for audience interaction, which was even more accessible because everyone had access to a device and the Internet. Julia explained in her comments in Block 2:

> The possibilities for audience interaction when every student is in front of a digital device are stunning. I've experimented with live audience interaction before, with a tool called Sli.do, and doing it in an online classroom is even easier and more illustrative.

The chat function on modern video-conferencing tools like Zoom also added a new dimension to classroom teaching which was not available in the face-to-face mode.

In his comments for Block 2, Rufus explained:

> The possibilities I discovered later were connected with a wide usage of chats, which allow to receive questions from the students without being interrupted during the lecture, or asking students to answer the questions by typing. This option somehow compensates for the lack of eye-to-eye contact with the students.

It was also expressed by other teachers that the chat feature was also especially useful for shy students who didn't want to speak up, they could just write in the chat or in a private message, and the teacher would be aware of how they're following the class. This is a feature not available in a face-to-face setting.

Flexibility

Milena saw that using a learning management system would offer more asynchronous study options to her students, and with that comes many advantages. She lists them in her comments in Block 4:

> As for possibilities and options (…) the most crucial one is a free schedule and speed of education. Learning speed increases due to system mobility and learning at a convenient time. We can observe, in most cases, the whole statistics. The system tracks attendance, academic performance and how a student owns the material. LMS teaches remotely on any gadgets qualitatively and efficiently, is easy to use and carries a lot of useful information.

4.3 Terms used by teachers that reflect uncertainty

Words and phrases that could be associated with uncertainty were identified and counted in the data available. These are presented in Table 2.

Table 2: Number of times words and terms associated with uncertainty appeared in the available data

Words associated with uncertainty	Instances of the word in transcribed data
think(ing)	94
time	87
maybe	46
problem(s)	32
a lot of	31
concern	23
not (…) sure	18
I guess	18
opportunit(y/ies)	17
difficult(y/ies)	10
challenge/challenging	8
hope/hoping	7
don't know	7
doubt(s)	7
wonder(ing)	6
uncertaint(y/ies)	6
possibilit(y/ies)	4
afraid	3
pain	2
fear(s)	2
anxiety/anxious	2
shame	1

The word "time" was used very frequently. In reviewing the usage of the word time, teachers mostly referred to the fact that adopting new technology takes a lot of time and effort to set up. Some teachers also used the word "time" in a positive light, referring to how using technology helps them save time in teaching. Another commonly used word was "a lot of", oftentimes referring to the amount of effort and time it takes to implement technology in their teaching, and sometimes referring to a lot of options, a lot of students, a lot of material that teachers are faced with. The word "maybe" is also frequently used, and it really highlighted the uncertainty in technology use in teaching. The teachers found that they were faced with so many options of what technology to use and how to use it. As they described their uncertainties, each of these options were described as a list of things they could "maybe" do. Teachers also referred often to their uncertainties of technology use in a negative light, as a "problem" or a "concern", suggesting that the idea of implementing new technology in their teaching comes with difficulty.

4.4 Expressing certainty

Although the participants were encouraged to share their uncertainties related to the use of educational videos in their online courses, one teacher, Isabella, had a lot of experience using educational videos and felt that they are perfect to use in her courses. "I believe that educational videos are perfect for analyzing blended learning and for offline learning too, if I can say so. And I don't feel any uncertainty about it, and am sure in educational videos."

4.5 The effect of the pandemic

While the pandemic forced teachers to adapt to the new reality very quickly, the fact that they were forced into it meant little space for doubt. However, those who struggled with technology, according to one teacher, had big problems. The pandemic showed that technology is and will be needed in teaching and we have to be open to it. In her interview Isabella expands on this point:

> "I **think** that now I don't have any doubts because we don't have the opportunity to change the situation in which we are. So, we don't have a choice, really, and maybe I have doubts but ok I can just do it. There are professors who have doubts about anything in the technology world, they have big problems and the students have big problems. So, I think that we should use every opportunity to know something new about technologies and, we should always be searching for more useful technologies, and more useful tools for doing our job."

While teachers and students are grappling with new technologies in light of the pandemic, Julia is searching for reassurance "I would be really interested in having some sort of reassurance that students are not losing faith in education through this [pandemic]"

4.6 Reflections on the course itself

A chance to reflect and connect with other colleagues

Rufus and Julia, in their interview, both described how discussing with other colleagues helped them see that they weren't alone, that others were dealing with the same issues and agreed with a reality that they were encountering. They would have preferred to have more synchronous sessions in order to exchange more experiences about how technology is used in their courses. The quote below illustrates this point.

> Oh, I **guess** for me it was, mostly about seeing how people are dealing with the same problems as me and, to see how do they apply the technologies in their particular situations, because as they say the best thing, to learn something is a hands-on approach. (Rufus, interview)

As a stimulus for improving a part of the course

Rufus had wanted to implement a form of automated grading in his course, and improve other parts too, and he never got around to it. This course was a motivation for him to do this and also exposed him to some ready-made tools he could use for achieving this purpose. Inga was also inspired to add quizzes to her lectures using the tools provided. Milena found that the course gave her some "independence and confidence working with some technical programs" (Milena, interview).

Practical nature of the course

Both Julia and Isabella were participating in another course offered at the university which also talked about digital tools. They found that the difference with our course was that it was more practice-oriented. In our course they had to try things themselves, and immediately implement what they learned about.

> "Some information was the same but, in our course, there was more practice, more practical experience, more practical exercises and more practical information. Because we had to communicate in different platforms. And we tried it ourselves." (Isabella, interview).

The use of Trello as an LMS

Using Trello as an LMS was an experiment for me for which I had many uncertainties, but it was received very well by the participants to the extent that they wanted to implement it themselves in their own courses.

> I also liked the interesting use of Trello as a kind of meeting space for a synchronous, coordination and work for the course. It was interesting because I haven't really ever tried it this way and it looks like it could be useful for someone who's especially very eager to use Trello because they apparently like the format, like they're familiar with it. (Julia, interview)

5 Discussion

This study reinforces the notion that uncertainty is an inherent part of teaching (Floden & Buchmann, 1993; Helsing, 2007a; Labaree, 2000). The context, in this case, is the use of technology in education, which comes with a plethora of options due to the proliferation of technology as a whole (Bardone et al., 2020). The study showed that teachers in higher education are still grappling with the variety of technological solutions available to them, and searching for the right methods or approaches to technology use in the classroom. The pandemic forced a reorganization of teaching and learning which created new uncertainties. An attempt to mirror a traditional classroom online was not a simple fix (Sun et al., 2020). Teachers had to find innovative ways to deal with the new uncertainties they were facing. For example, in a traditional classroom, teachers can see reactions of their students and gauge their understanding, whereas in a virtual classroom, students often had their cameras switched off and teachers felt alone. The teachers said: "I don't see reactions" and "My… biggest concern is when you ask a question and there is silence".

To tackle these newfound issues, a direct result of using new technologies, teachers turned to other technologies for help. In this case, regular online quizzes seemed to be an appropriate way to find out how students are learning, and easy to implement in an online class. However, employing formative assessment methods to test students' comprehension introduces new obstacles. For example, one teacher was concerned that students were reluctant to do ungraded quizzes in class. Even deciding which of the myriad programs to use to effectively capture students' learning was fraught with uncertainty. One teacher explained: "My main concern was that there is an abundance of those digital tools, which are intersecting, mostly, and their functions are close to each other (…) Like for instance, grading or automated testing and you do not know what to choose."

The switch to online learning also meant that catering to students' attention spans was now more critical than ever. The temptation for students to multitask was greater online, and exhaustion of long days behind the computer meant that teachers had to think about how what they were offering was truly engaging. The teachers expressed the burden of having to find the right tools and knowing how to use them in the right way to keep students focused.

Uncertainties faced by teachers in technology use were not just expressed as issues or concerns, they were also articulated as possibilities and opportunities. Without the lack of student response in the virtual classroom, the teachers may not have even considered using online formative assessment tools. Simply by expressing their uncertainties they began to find new ways of resolving them. Exploring new tools and expressing their uncertainties during the course allowed the teachers to see what they could do beyond their existing repertoire.

The study's findings also indicated that gathering teachers to explore a variety of ways to implement educational technology in their teaching and reflect on their uncertainties along the way is a valuable and practical method for helping teachers step outside of their comfort zone and challenge themselves to new ways of teaching. As described by Floden and Buchmann (1993), teachers communicating about their uncertainties can be helpful because it can be a huge relief for teachers to talk about their doubts and hear about them from others. The university instructors who participated in this course acknowledged that reflecting with other teachers helped them see that they were not alone in their struggles "I guess for me it was mostly about seeing how people are dealing with the same problems as me". The practical nature of the course encouraged them to attempt to use different technology in order to identify their uncertainties. This allowed them to be comfortable with making mistakes and gave them the time to explore, play, and be open. They acknowledged that the course gave them "independence and confidence working with technical programs" and they appreciated the practical aspect that "we tried it ourselves".

This study showed that teachers need a space to explore their uncertainties in technology use because whether or not they're acknowledged, they do already exist (Helsing, 2007a; Labaree, 2000; Rogers, 2016). Talking together can help teachers to cope with the uncertainties in their own teaching (Floden & Clark, 1988). This study further built on the importance of teachers reflecting and sharing their uncertainties, yet this time it was explored in the context of technology use.

While the participants of the course were facing uncertainties, I was also encountering many uncertainties as I designed and implemented the course itself. I decided that I had to also use new technology as well as repurpose technologies I'd used before to suit this course.

My own exploration and experiment with using Trello as an LMS, while nerve-wracking for me, proved to be quite successful. Teachers are often clinging to "technology that works", and "best practices". Because Trello worked really well in this particular context and was easy to use, the teachers were enthusiastic to implement it in their own courses. However, this was met with varying levels of success. For one teacher, mirroring the use of Trello turned out to be completely unsuitable for her context. Although the course encouraged experimenting and finding new tools and new ways of using them, teachers fell back into the routine of copying what seems to have been proven to work successfully, highlighting the need to normalize uncertainty so that technology can be used in a meaningful way.

While the focus of the course was mostly on helping teachers explore their uncertainties, there was also a case where one teacher was completely certain about a particular use of technology "I don't feel any uncertainty about it, and am sure in educational videos." This highlights that although uncertainty is an element of teaching, certainty can be also, and with greater experience with a particular technology in one's context, one might feel less uncertainty about what to use and how it should be used. I'm quite sure though that this very same teacher, when exposed soon to more complex technologies that achieve the same ends, may no longer have the same certainty about educational videos.

An acknowledgement of uncertainty and an openness to ask questions, search for new ways of doing things and see multiple outcomes is indispensable to improving in one's profession (Feynman, 1999; Floden & Buchmann, 1993; Jarvis, 2004; Smithson, 1989).

This study showed that embracing and accepting uncertainty as described by (Schuck & Buchanan, 2012), can help teachers to think more deeply about their technology use and make efforts to integrate different technologies into their teaching in a coherent way. Hearing the experiences of other instructors provided comfort.

So far, very little attention has been paid in research to the uncertainty that is brought about in education by the proliferation of technology. It was clear before the COVID-19 pandemic that technology was entering the classroom with or without the teacher's instigation (Schuck et al., 2018). Emergency remote teaching as a result of the pandemic accelerated the adoption of education technology in higher education. This thereby highlighted the need for more training and more support of higher education instructors in the use of various technologies. Despite the attempt by teacher trainers to alleviate these uncertainties by offering "how-to" training courses in educational technology, they didn't account for reflection on its meaningful use through an open dialogue on uncertainties that arise when implementing these technologies within each teacher's specific context.

Teachers may benefit from being told how to use a particular software or technology in their teaching, or may also benefit from listening to experts in educational technology describing their experiences. This study shows that while these approaches might also be beneficial, teachers can become comfortable with the use of technology in their own teaching and their own context when they are given an opportunity to explore different tools and reflect openly, with their peers, on the uncertainties they face when using these tools in their teaching work. This allows them to make improvements to how they use technology, it allows them to adopt new technology in a meaningful way that suits their particular context, and it helps alleviate the fear of messing up or being an inadequate teacher because experimentation and uncertainty are the status quo.

This research also confirms the need to contextualize the many tools available for teachers and understand how to apply them to their own teaching (Rapanta et al., 2020). It also helps to show what is lacking in current approaches to professional development in educational technology that could be adapted and changed with the help of a dedicated member of staff at the university level, such as an educational technologist.

One of the limitations of this research is that it is focused on only one small group of teachers with varying backgrounds, who did not know each other previously. It could be redesigned to cater to a much larger group of teachers, it could also be focused on teachers within one specific subject area. The results could also look quite different if the teachers had known each other previously, it may have been easier or harder to express their uncertainties if they were colleagues working together within the same department. The teachers were also describing their uncertainties in their second language. The results could have been affected if teachers were involved in such a course in their native language. There were a few teachers who did not participate actively in the course, I did not however follow up with them to find out why they didn't contribute as much as the others, and why they didn't complete the final project. This may have also affected the results as their reasons for not participating could have been related to the nature of the course.

6 Conclusion

While uncertainty of technology use in education is not a well-researched topic, case studies such as the one presented in this paper offer insight into it. By creating regular spaces for teachers to reflect on the meaningful use of digital technology in their teaching and learning practices, teachers can constantly be thoughtful of how they can improve the way they use

technology in their work. Uncertainty may seem like a paralysing force for teachers but this study shows that it can be a driving force for change.

Further research into uncertainty in technology use in higher education is required to help define future approaches to professional development in technology use in education, incorporating the importance of reflecting on uncertainties. Future studies could explore the issue further, by focusing on uncertainty in the implementation of specific technology, or by using different research methods such as an ethnography, or a narrative inquiry.

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8 Author's declaration

I hereby declare that I have written this thesis independently and that all contributions of other authors and supporters have been referenced. The thesis has been written in accordance with the requirements for graduation theses of the Institute of Education of the University of Tartu and is in compliance with good academic practices.

Maryam Reyhani   June 5, 2021

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Appendix 1 Semi-structured Interview Protocol

Interview Questions

Section 1: Background

1. Can you tell us something about your background? How long have you been teaching? What do you teach? Whom?

2. Have you often participated in similar training courses? Would you tell us something about those courses?

3. How confident do you see yourself in using technology? Describe your relationship with technology.

Section 2: About the course

1. What did you appreciate about the course? Can you give an example?

2. What did you find was missing in the course? Can you give an example?

Section 3: About their teaching practice

1. Did you have the chance during the course to discuss opportunities related to the use of technology in your teaching practice? Can you make an example?

2. Did you have the chance during the course to sort out your doubts and concerns when it comes to the use of technology in your teaching practice? Can you make an example?

3. What kind of changes do you plan to implement in your teaching practice after the course?

4. What changes would you like to continue using when you return to a "normal" situation?

Section 4: Closing

5. Is there anything that you would like to add?

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