Lecture capture, social topology, and the spatial and temporal arrangements of UK universities

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Abstract

This article considers how technologies actively shape the topologies of UK higher education. Using the example of lecture capture systems, we examine the relationship between learning technologies and formations of space and time. Combining theories of sociomateriality and social topology, and concepts of assemblage and relationality, we expose the entanglement of interests that influence university spaces and times. Across 3 months coinciding with the onset of COVID-19 we collected over 500 tweets that discussed lecture capture within UK higher education, leading towards 2 central arguments. First, the topology of the lecture is fluid, and, even while being radically technologised, re-spatialised and disrupted, it persists as a lecture and a central pedagogical feature of university life. Second, lecture capture is a rich site of 'issuefication', and viewing learning technologies as dynamic issues enables a better understanding of how their meaning, function and influence are contingent on shifting and relational assemblages of human and non-human interests. Lecture capture can be pedagogical, commercial and political, thereby resisting deterministic framings of the relationship between technologies and the temporal and spatial arrangements of higher education.

Keywords

Topology, space, sociomateriality, digital education, lecture capture, time

Introduction

This article explores how lecture capture technologies and practices are reconfiguring the spaces and times of higher education. Building on work where we investigated the social topologies of online students (Bayne et al., 2013), and assemblages of nearness (Ross et al., 2013), we began the work discussed here by asking: what current aspects of digital higher education would benefit from an analysis exploring the relational making of space and time? At the point of identifying lecture capture in UK universities as the subject of this research we could not have foreseen how useful it would be in casting a light on the shifting spatial, temporal and topological arrangements of higher education.

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Our study took place over a three-month period in 2020 during which the UK higher education land-scape was affected by two major events. Industrial action at 74 UK universities (University and College Union, 2020) caused the cancellation of thousands of lectures across 4 weeks in February and March. The tail end of this action coincided with the escalation of the COVID-19 pandemic which resulted in the closure of campuses and a rapid shift to remote teaching and online learning. Using the Twitter social networking platform to analyse discussion around lecture capture, we explored the complex and changing nature of educational space and time during this period.

'Lecture capture' refers to the digital recording of teaching sessions that take place within a physical classroom, and the technologies that make these available for later viewing by students. Lecture capture is normally presented as a resource for supplementing rather than supplanting classroom attendance, though this framing underwent considerable change during the period of our study. Over the last 15 years these systems have gradually become a common (although not yet ubiquitous) feature of campuses, as many UK universities upgraded teaching spaces to facilitate automated recording of live lectures. Further institutions quickly followed suit to counter the impact of the 2020 lockdown, as we will show. At the time of this study, Panopto, Echo360 and Kaltura were the most widely used of the institutionally procured lecture capture software and hardware systems in UK universities. These platforms managed the recording process, uploaded recorded files, integrated with virtual learning environments and provided usage analytics to teach-ers and universities. Advocates of lecture capture have highlighted improved accessibility and student satisfaction among its benefits, although it has also been a source of tension, typically among academic staff who have raised concerns over the impact on classroom attendance, job security, intellectual property, privacy and other issues (Morris et al., 2019). These and other mat-ters will be discussed below, when we review the scholarship on lecture capture.

In this article, we begin by introducing the theoretical frameworks of sociomateriality and social topology that informed our approach. We go on to explore the research to date on lecture capture technology and its impact in higher education, and outline where we are adding new insights, as well the contribution our work makes to the literature on educational topologies. We introduce our research design and explain in detail the speculative and original approach we have taken to researching topological aspects of higher education, then present and discuss our findings, devel-oping two key arguments. First, the topology of the lecture is highly fluid, and, even while being radically re-spatialised and temporally disrupted, it continues to be understood as a lecture, and as a central pedagogical feature of university life. Second, lecture capture technology is a rich site of 'issuefication' (Marres, 2012), and viewing lecture capture as a dynamic issue enables a better understanding of how the meaning, function and influence of learning technologies are contingent on shifting and relational assemblages of human and non-human interests. Together, these argu-ments show that the influence of learning technologies is contingent on shifting and relational assemblages of human and non-human interests: lecture capture can be at once pedagogical, tech-nological, political, commercial and spatial. They also demonstrate how lecture capture itself shapes, and is shaped by, the temporal and spatial arrangements of higher education. The findings from this study expose the complex and continually shifting nature of education and educational practice and challenge the popular narrative that universities can instrumentally bring technologies into the classroom confident that they will realise a narrow and predetermined outcome, or alterna-tively that digital resources deterministically shape student behaviour.

Sociomateriality and social topology

Our conceptual framework looks to theoretical work in sociomateriality and in social topology. Together, they enable fruitful analysis of the spatial and temporal constructions of which lecture

capture is part. This conceptual framework helps us to demonstrate how lecture capture technologies need to be understood as influential in a shifting assemblage of actors and relations that shape educational space and time.

Sociomateriality

Sociomateriality refers to a range of theoretical approaches which assume that actions, objects, knowledge and space exist through the entanglement of human and non-human resources or 'actors'. Originally used to investigate the relationship between technology and work practices in organisations (see, in particular, Orlikowski, 2007; Orlikowski and Scott, 2008), the principal conceptual assumption was that organisational life depends on human bodies, physical artefacts, technologies and other agents that are woven together. Therefore, where social inquiry has traditionally approached meaning-making as depending on human interests and actions, sociomateriality focuses on the network of human and non-human discourses and phenomena that are implicated in these processes (Knox and Bayne, 2013). In higher education, the lectern, laptop and learning management system are co-dependent with human bodies in meaning-making practices (Thompson, 2012). Sociomaterial theory emphasises that human and material resources begin from 'a position of togetherness' (Acton, 2017: 3), and are contingent on multiple sets of relations and practices (Mulcahy et al., 2015). Central to much of this work is the assemblage, a concept that can be traced to the 'agencement' of Deleuze and Guattari (1988). The sociomaterial assemblage is a device for describing and examining the entanglement of human and non-human resources that are complicit in the performance of spaces, objects and practices. A crucial assumption here, and something that we draw on considerably in this article, is that meaning is fluid rather than fixed. Our social world depends on the shifting presence and prominence of different human and non-human resources, and the connections – or relationality – between these different components at any moment in time.

It is important to also acknowledge the limits of what sociomateriality can achieve by itself. While observing that it can be used productively to challenge the often-assumed centrality of human action, Carvalho and Yeoman (2018) argue that an emphasis on the relations that exist between constituent parts of the assemblage means that sociomateriality stops short of revealing how the presence and arrangement of resources are implicated in educational practice. For Mutch (2013), sociomaterial approaches can be guilty of inadequately attending to both the specifics of technological resources and broader social structures, a view shared by Knox and Bayne who discourage us from approaching it as an 'all seeing eye' for research (2013: 4). Responding to these critiques, we look to sociomateriality as a 'sensibility' (Thompson, 2012): a way of thinking that is open the full range of human and non-human resources that are implicated in educational practice. Through the concepts of assemblage and relationality – the co-constituting nature of different actors – sociomateriality also shares important conceptual ground with social topology.

Social topology

Inspired by a mathematical interest in understanding how geometric objects behave when subject to deformations, social topology attempts to explain how the spaces of social life (material, digital, temporal) are constructed by the relations between the actors that produce it (Decuypere and Simons, 2016). It is this interest in relationality that is particularly useful to our own study. By recognising the relational nature of complementary and competing interests within the assemblage, we can attempt to better understand lecture capture and how it affects, and is affected by, pedagogy, politics and other actors. A social topology framework also helps to analyse space and time in a way that does not assume these to be fixed, stable or unchanging.

Emerging first from work in science and technology studies, social topology's foundation is Mol and Law's argument that ' "the social" doesn't exist as a single spatial type. Rather, it performs several kinds of space in which different "operations" take place' (1994: 643). Identifying regional (focused on territories and boundaries), network (focused on syntactical stability) and fluid topologies (defined by liquid continuity), Mol and Law take the example of anaemia and its diagnosis and treatment in geographical regions understood as 'Africa' and 'the Netherlands', to explore how these topologies permit different sorts of questions to be asked, and analysis to be performed. Fluid topology is of particular salience for our study, and they describe this as highly mutable:

> Sometimes fluid spaces perform sharp boundaries. But sometimes they do not –though one object gives way to another. So there are mixtures and gradients. And inside these mixtures everything informs everything else – the world doesn't collapse if some things suddenly fail to appear. (Mol and Law, 2004: 659)

Fluid space is particularly resilient: continuity can be preserved even when absences pile up (Mol and Law, 2004: 662), because 'integrity of territory' is not a feature of this kind of space. This issue of continuity has been taken up also by Lury et al. who explore how culture is 'becoming topological' through the proliferation of cultural forms of 'lists, models, networks, clouds, fractals, and flows' (2012: 4), and its ordering according to continuities and capacities for change rather than according to structures (5). The idea of 'becoming-topological' has informed and underpinned considerable work in educational research around the nature of measurement and flows of policy-making, as we will see. But the continuum – the ways that assemblages of concepts, organisations and practices can be reshaped without discontinuity – and the understanding of the space between any two points as a 'continual surface of relations' (20) – is central to our thinking about what is going on with lecture capture in UK higher education.

Furthermore, looking specifically at the use of topological theories to explore the social construction of technology, Marres notes the importance of distinguishing between 'weak' and 'strong' analyses, characterising the latter as those that are able to 'problematize the primacy of technology' (2012: 290). In her analysis of how controversies around 'smart' energy meters 'produce variations in the spaces and times of issues' (298), Marres argues that digital devices are transformed by controversy from 'objects' to 'issues' (297), and that this is an inherently topological transformation. Along with the notion of continuity in fluid space, topological understanding of 'issuefication' is important to our analysis. As we will see, lecture capture technologies have to date largely been researched and written about in ways that focus on their effectiveness as a means of improving student attainment, their role in student satisfaction and (to a lesser extent) their impact on pedagogies and classroom cultures. Though acknowledging some of the controversies and tensions that have arisen, these studies have not generally been focused on the wider political formations within which lecture capture practices and policies have emerged, nor the way assemblages of human, non-human, technological and policy actors come together around lecture capture to produce the space of the contemporary university. Using a sociomaterial and social topological approach, we have been able to trace and analyse these formations during a period of significant upheaval, as UK higher education grappled with the impact of a global pandemic. The functions and potentials attributed to lecture capture in early 2020 reveal the ongoing creation of the space and time of higher education.

Research on lecture capture and on social topologies in education

In this section we review key research on lecture capture and the use of social topology frameworks in educational settings. By illustrating the ways that lecture capture has tended to be investigated, and how social topology has generated new perspectives in educational research, we

identify the significant gaps that this article aims to fill; and will show how this might be done by theorising the lecture as a topological assemblage made up of relations between actors that are able to shift without rupture – sometimes quite rapidly.

Lecture capture: uptake, perceptions and tensions

Lecture capture technologies have become a familiar feature of classrooms across many UK universities. Studies by Ibrahim et al. (2021) and Newland (2017) show lecture capture to be either in place or in the pipeline at the majority of higher education institutions: as we will come on to discuss, our own data suggests that these numbers further increased as COVID-19 pushed previously reluctant universities into investing in these systems. Getting a clear sense of the level of student usage is more complex, however. While a recent study by Morris et al. (2019) calculated that students at the University of Leeds had watched close to 900,000 hours of lecture capture content over a 4-year period, Witthaus and Robinson (2015) are among those who have drawn attention to considerable variation in uptake between courses. What is clear from the literature, though, is that students are strongly in favour of lectures being recorded and made available for later viewing. Student Unions have applied pressure for the acquisition of these systems, while student satisfaction surveys and course evaluations have reiterated their popularity (Dommett et al., 2019; Lambert et al., 2019). Many students report that lecture recordings are crucial to their learning (Leadbeater et al., 2013; Danielson et al., 2014; Dommett et al., 2019; Leadbeater et al., 2013; Morris et al., 2019).

Whether, in fact, lecture capture is conducive to improved academic performance or the acquisition of knowledge is uncertain. Questions about the impact of lecture capture on attendance and attainment dominate the research in this area, although without producing a conclusive answer. There is a mixed picture of who uses recordings, whether they supplement or supplant in-person classroom attendance and whether usage positively influences academic performance (Edwards and Clinton, 2019; O'Callaghan et al., 2017). Uptake, attendance and attainment are suggested to be influenced by aptitude, language, gender, orientation to study, and lecture and topic types among other factors (Hall and Ivaldi, 2017; Leadbeater et al., 2013; Morris et al., 2019; Nightingale et al., 2019; Nordmann et al., 2020). Despite a lack of clear evidence showing a connection with attainment, many researchers have concluded that lecture capture should be available on account of its potential to support student learning. However, the question of the nature of 'usefulness' in technology-supported environments has been raised by Henderson et al. (2017), who argue that 'many of the reportedly "'educational"' benefits of digital technology . . . are more accurately described as concerned with the "'logistics"' of university study rather than matters related directly to "'learning"' per se'" (p.1575). This concern is echoed in another clear message from the literature: while students are in favour of lecture capture, academic staff are generally doubtful of its educational benefits, while also having concerns about its impact on student attendance, teacher autonomy, the nature of classroom interactions, and the risks of surveillance of classrooms and teachers (Joseph-Richard et al., 2018; Dommett et al., 2019; Joseph-Richard et al., 2018; MacKay, 2019; Morris et al., 2019).

Several studies have theorised aspects of lecture capture in ways that have informed our thinking. Luke (2020) examined recorded lectures from an actor-network theory perspective, focusing in particular on the status of the play/pause button as a ' "valve" . . . to mediate between a person, online/offline spaces, and study practices . . . (and) to "presence" and "absence" other actors' (12). Elsewhere, MacLeod et al. (2017) and Tummons et al. (2016) highlighted the sociomaterial configurations of a multi-sited lecture space and the new relations to curriculum and lecture delivery that were produced as new actors (in particular, technicians and audiovisual (AV) professionals)

became involved. Meanwhile, MacKay (2019) developed a model of 'concern' around the transformation of the lecture, highlighting student understanding of the recorded lecture as a 'tool' and a 'safety net', and staff understanding of its performative nature and the risk of students 'canonising' the recorded lecture. We will build on this attention to actor-networks and configurations; and to the meanings of the lecture and the impact of lecture capture technologies on those meanings.

In summary, existing research around lecture capture raises important questions about the potential impact upon attainment and attendance. It explores and exposes contrasting attitudes towards these systems between staff and students, alongside varying uptake and usage among those it is intended to support. It points towards the commodification of the higher education experience, concerns around trust, and the nature of the lecture itself.

In common with much of the research and conversation that takes place around the relationship between education and digital technology, there is tendency towards approaching lecture capture from either an instrumentalist or an essentialist position (see Hamilton and Friesen (2013) for an introduction to these contrasting and constraining conceptual framings). An instrumentalist framing of lecture capture, and one we found in our background research to be prevalent within university strategy documents for these technologies, presents these systems as tools that might be attached to a particular educational or organisational outcome. There is value in looking to establish whether a relationship exists between the introduction of lecture capture and whether students attend class, perform well in assessment or are generally satisfied with the educational experience on offer. There is a problem, however, in seeing lecture capture as a neutral or passive tool that might be attached to a specific function or outcome when, as we will show, these systems have effects that are more varied, and difficult to anticipate or control, contingent as they are on the messy reality of the social world. An essentialist framing of lecture capture where these technologies are seen to dictate student behaviour is also problematic: lecture capture is relational with a much a wider range of constraints and opportunities that shape the learning that takes place in classroom and elsewhere. By drawing on sociomateriality and social topology, our own study instead looks to the relationality of a broad range of actors that shape lecture capture, and contributes new insights into how lecture capture affects the spatial and temporal constructions of which these systems are part.

Social topologies in education

Theories of social topology have been used in educational research since at least 2003, when McGregor made the case for viewing the school-as-workplace as 'patterned forms and locations of association and the meanings these have for people, and also the way in which the workplace is linked with complex interconnections across space and through time, or rather space-time' (2003: 335). Mulcahy (2006) undertook topological analysis of teaching space, discussing how pedagogy 'produces and organises space and time and sets up patterns of movement across space-time' (65). The small amount of work to date discussing digital education in topological terms builds on this focus on space; for example, in Bayne et al.'s (2013) analysis of online distance students' experiences of the campus. Most recently, Van de Oudeweetering and Decuypere (2019) have turned a topological gaze on the space of the Massive Open Online Course (MOOC), with a particular focus on the nature of openness and the boundaries that constitute it. These works have particularly informed our research here, where we take a critical look at pedagogical space-times through the lens of educational technologies of lecture capture. In doing so, we are bridging the sociomaterial analysis of learning and technology (discussed, for instance, by Hamilton and Friesen (2013) and Bayne et al. (2013)) and the topological analysis of learning spaces. Sociomateriality alerts us to some   of   the   unseen   interests   that   shape   the   relationship   between

learning space and technology, and social topology offers an approach to understanding these relationships as a shifting continuum.

The majority of educational research drawing on theories of social topology has been focused on what has been described as the 'becoming-topological' of education (Thompson and Cook, 2015) through measurement, comparison and ranking. This can be seen, for example, in the increasing influence of datafication and metrics (Gulson and Sellar, 2019), and relations of power as they are constituted through 'travelling policies' (Barbousas and Seddon, 2018: 771). The standardisation of assessment at national and transnational levels is one of the main empirical areas of focus of this work. The 'topological rationality' informing educational realities like the Organisation for Economic Co-operation and Development (OECD)'s Programme for International Student Achievement (PISA)'s global assessment of educational systems and, increasingly, schools themselves, emphasises post-Euclidean, relational ideas of 'commensurability', 'soft power' and 'reach' as 'new spatialities of globalization' (Lewis et al., 2016). Hartong (2018) discusses PISA's impact in Germany, arguing that 'new policy assemblages have been created around objects and subjects, which are increasingly constituted by (digital) data flows, resulting in new topological spatialisations and temporalities (such as survey/assessment schedules) between the global and the local' (146). In their study of 'Project 600' in Queensland, Australia, which aimed to boost the standardised literacy and numeracy testing scores of students who were just below a key boundary, Hardy and Lewis (2018: 239) found that processes involved could make learning and certain students visible in some new ways, primarily through student data and students as data, creating new invisibilities. This work helped sensitise us to aspects of competition, standardisation and 'travelling' conceptualisations of student satisfaction, accessibility and innovation that inform lecture capture topologies, as well as the implications for datafication of the 'capture' and digitisation of the higher education lecture space.

Finally, the use of social topology in education research calls for methods as well as theory: as Decuypere and Simons (2016: 372) note, 'there is a profound difference between stating that educational practices are relationally constituted and showing how precisely this looks like'. This links back to Carvalho and Yeoman's (2018) call for tools and approaches to show how sociomaterial relations are arranged, and Decuypere and Simons (2016) explore some uses of the 'diagram' to accomplish this. Our own research design has been informed by these insights, and we go on to describe this now.

Research design

Our methodological approach was underpinned by an interest in speculative method, and we begin this section by explaining why a speculative approach offered a good fit for our research. We then set out why and how we used conversation on the Twitter social networking platform to generate data, and describe in detail the different stages of working with this material, aiming to show how imaginative and rigorous analysis of social media content can contribute significantly to a topological understanding of higher education spaces and times. This section concludes with a reflection on the strengths and limitations of our research design.

Speculative method

With an emphasis on creativity and complexity, speculative method has recently emerged as an alternative to educational research that prioritises and is sometimes constrained by a commitment to generalisability, scale and identifying 'what works' (Biesta 2007). Where research design often strives to impose order on research sites, speculative method instead seeks to recognise and work

with the uncertainties and open-ended nature of a networked world. In advancing the case for speculative method, Michael (2016) uses the term 'not-as-yet' to emphasise the need for critical inquiry that recognises a world characterised by complexity and flux, echoing Law's (2004) work around mess in social research where he calls for method to be seen as producing a world that is in motion, rather than seeking to unearth a fixed and pre-existing reality. It is by attending to the unhinged routines that characterise everyday life, Michael (2016) argues, that we are better able to understand our practices and our surroundings. There is a parallel here with sociomaterial theorists' interest in the human and non-human resources that are implicated in the construction of meaning and performance of activity. Making the case for speculative method within digital education research in particular, Ross (2017) recognises a valuable alternative to the 'what works' agenda where inquiry focuses on educational gains to the exclusion of fundamental questions that might help us to understand the evolving, networked nature of learning, teaching and knowledge production. The use of Twitter posts as data within the study presented here is informed by speculative method's attention to creativity and experimentation (Wilkie et al., 2015). We similarly took up the call to prioritise the specific over scale (Michael, 2016) and to recognise and work with the complexity that surrounds educational activity. As with other research methods used to grapple with, rather than simplify, complexity in the sociomaterial world, researchers using speculative methods need to be sensitive to the specificity of their truth claims, and bold in asserting the value of their contribution to scholarly and practical understanding of their topics. In the context of technology and education, speculation is already everywhere, but the voices of researchers, students and teachers are often missing from the futures proposed as possible through digital education developments (Ross, 2017). Speculative methods enable designerly, critical interventions into instrumentalist and essentialist assumptions about the impacts of technology, and we undertook this form of intervention through our use of Twitter data to investigate the meanings of lecture capture in UK higher education.

Gathering data from Twitter

Twitter is a social networking service that supports the sharing of digital content, through short text-based messages that can include images, video, hyperlinks, hashtags and 'mentions' of other Twitter users. Since its launch in 2006, Twitter has become a vastly popular method of online communication, including within higher education where it has been adopted by individual staff and students, professional associations, representative unions, academic and administrative departments, and research centres and projects. Twitter has provided a platform for advancing and critiquing ideas, sharing published research and practice, promoting events, celebrating and challenging the work of individuals and institutions, offering advice, requesting help and generally commenting on topics of educational and wider interest. Twitter does not exhaustively capture the practices, priorities and problems that exist across the university sector, nor represent all perspectives or people. Instead, it is valuable in how it holds up a mirror to a wide range of anxieties, opportunities, discourses and ideas that are prominent at any given period of time. A key feature of Twitter is that each message – a 'tweet' – is at the time of writing limited in length to 280 characters in most languages, not including visual content including photographs and short videos. The emphasis on shortened communication produces the rapid circulation and transformation of content: users can immediately 'reply' with a short message of their own, instantly show their approval via the 'like' option, and share it with their own network of followers by hitting the 'retweet' button.

    As its prominence has grown, Twitter has become the subject of research that has explored its purpose, perception and impact within higher education. The methodological case for Twitter, alongside some of the practical challenges and ethical questions it can raise, is made by Stewart

(2017). Exploring Twitter from an ethnographer's perspective, Stewart argues that it can function as a research tool but also, within our networked world, a site of research in itself. For instance, researchers have examined Twitter's use by students and teachers (Veletsianos and Kimmons, 2016), its potential to act as a conference back-channel (Kimmons and Veletsianos, 2016) and how it has been adopted at institutional level (Kimmons et al., 2016). Meanwhile, Jordan (2020) used Twitter to explore how academic staff approach social media as way of cultivating identity online. Twitter is considerably more complex than simply being a medium for sharing academic content; a point also made by Gregory and salehi singh (2018) who used the example of two 'Twitter events' to expose anger, anxiety and the repercussions for academic staff of being active in this space, alongside the professional networking benefits that might exist.

Our approach did not focus on the phenomenon of Twitter, but instead explored what tweets about lecture capture could tell us about the spatial and temporal configuration of the university. Tweets leave traces of engagement, and each Twitter user is a 'socially relational actor' (Fransman 2013: 29) within a complex and dynamic assemblage, making Twitter appropriate for a study of sociomaterial and social-topological understandings of the university. However, as Fransman points out, different methods for analysing Twitter participation and data can produce different realities – making certain things present, and obscuring others. The use of the phrase 'lecture capture' as the basis for our data collection – rather than, for example, a hashtag or an examination of networks of users – produced a wide-ranging data set that could foreground voices of those who were not highly networked in the UK higher education Twittersphere (for example, individual students musing on their latest lecture). At the same time, the dispersed dataset for this study makes it difficult to see potential flows of influence around these issues, or understand in depth the contexts that informed the tweets we analysed. We reflect on this further in our conclusion and recommendations for future research.

We focused on UK higher education in order to prioritise depth of insights by analysing a context with many shared features, something that would have been more difficult to achieve through a comparative approach or by casting a wider net. To tap into the conversation taking place around lecture capture in the UK we used the Twitter Archiving Google Sheet (TAGS)[1] created in 2011 by Martin Hawksey. TAGS provides a template that can be used to identify and archive Twitter data using specified search terms. Any tweets that contain the term are automatically collated within a Google spreadsheet, alongside other data drawn from the account from where it was generated, including user name and location (where users provided this in their Twitter profiles). This biographical information, along with date and time of each Tweet, proved to be of considerable value as we organised and interpreted the data. The search term used for our study was 'lecture capture' because, from previous research on the subject combined with a survey of strategy documents made publicly available by universities, we knew this to be the most common way of referring to this particular learning technology in the UK context. We monitored the data being generated via the TAGSExplorer spreadsheet in order to check that our chosen term was capturing relevant content from a range of voices. Had this not been the case, we were prepared to broaden our search term (cognisant, for instance, that lecture capture might be referred to by any of the commercial names attached to the different products with the same function). It should be repeated here, though, that our interest was in capturing the range of ways in which lecture capture was being discussed in the context of UK higher education during this period, rather than attempting to track every conversation: we are confident that this search term and the 563 original tweets it generated did this. Although all of the data in our study were publicly available on the open Web, we nevertheless sought and gained ethical approval from our institution for the approach described here. This included obtaining written consent from individuals whose anonymised tweets are reproduced in this article.

Working with the data

We started collecting Twitter data on 14 February 2020 and, by the time we drew the exercise to a close 3 months later, our spreadsheet contained 2813 tweets that included the 'lecture capture' search term. Following several stages of refining this material, we identified 563 original tweets to provide the basis of our analysis. This final set of 563 tweets was arrived at by removing duplicates and any retweets where the original message was already present, and excluding tweets that were not concerned with lecture capture in the context of UK higher education. This was straightforward in those instances where the user had added their location within the Twitter profile, although presented a challenge when this information was missing, or advertised 'Camelot', 'Starbucks', 'Ravenclaw Common Room' or another setting that did not correspond with places on a map of the UK or elsewhere. In most of these cases, manually consulting the user's Twitter biography or recent activity normally resolved whether their tweet pertained to lecture capture in the UK higher education context. Where it did not, the tweet was excluded.

In order to support the interpretation of each tweet, we sought to identify the designation of each Twitter account. By 'designation' we are referring to the primary advertised occupation or interest of the account's owner (whether individual or organisation). For the most part this was achieved by visiting the biography on the corresponding Twitter account. In those instances where a dual role was stated (e.g. academic/manager, historian/journalist) this was recorded in our spreadsheet. Where a user's Twitter profile did not give a clear indication of their relationship with higher education, we looked to their recent Twitter activity, which nearly always revealed the individual to be a student. Where we remained uncertain of the author's designation, this was also recorded in our spreadsheet. Even allowing for some uncertainty, by far the most frequently heard voices across the data were those of academic staff (associated with 246 tweets), followed by students (102 tweets). Groups that featured between 10 and 20 times were academic and managerial, academic practice department/staff, education technology company, information technology (IT) department/staff, Quality Assurance Agency for Higher Education (QAA), student union, and technology enhanced learning department/staff. To give a sense of the range of voices that contributed to conversation, the data also included tweets attributed to an assistive technologist, a journalist and a charity worker, among others.

Finally, looking across the content and designation associated with each tweet, we added a single-sentence interpretative summary within a new column on our spreadsheet: as we will come on to discuss, the meaning we assigned to each tweet was influenced by our own histories as researchers and teachers working in the field of digital education. The granular approach described above provided us with a high level of familiarity with the data, helping us to identify 29 ways in which lecture capture was discussed (see Table 1). From there we distilled these topics of conversation into seven broad themes that would become sociomaterial actors within our analysis. Our approach here draws broadly on thematic analysis (see Braun and Clarke (2006) for an introduction); however, it was more specifically driven by sociomateriality as we sought to understand the presence of different human and non-human actors across the period of our data collection. Through a sociomaterial sensibility (Thompson, 2012) we were able to attend to actions and artefacts that shaped perceptions and practices around lecture capture, but also those unseen or intangible strategic, commercial and political interests that influence educational spaces and activities. With an interest in topology and spatiality, Law and Singleton (2005) argue that, in order to investigate and understand the messy reality of our social surroundings, social science research needs to see objects as more being more than physical. Rather than focusing on the tangible, we should instead seek meaning by looking to examine and understand networks and flows irrespective of the visibility or tangibility of their constituent resources. As we worked with the data we were constantly alert to

Table 1. Actors and lines of conversation.

Theme/Actor	How lecture capture was discussed on Twitter
Access	• Reinforcing or challenging educational inequality • Facilitating widened participation in higher education • Supporting students with disabilities
Commerce	• Efficiency and neoliberalism • Marketing and consultancy content • Tuition fees and value for money
COVID-19	• Lecture capture as way of responding to campus closure • Lockdown enabling institution/management to impose lecture capture • Lockdown forcing institutions/management to introduce lecture capture • Students attending or watching classroom teaching pre-lockdown, in spite of lecture capture being available
Politics and policy	• Criticism of university management/strategy • Industrial action • Intellectual property • Lecture capture policy • Privacy and surveillance • Resistance to implementation • Student Union campaigning and stance
Space	• Campus closure • Experience of teaching/learning at home • Recording sessions in empty classrooms • Online learning spaces
Teaching and learning	• Academic staff experiences of lecture capture • Discussion around educational limitations and potentialities of lecture capture • Impact upon attendance • Sharing advice, practice, research and resources • Student experiences of lecture capture
Technology	• Ed tech companies responding to queries and other content • Sharing advice and resources around technical aspects of lecture capture • Students and staff experiencing technical problems • University information technology staff offering technical support

human actions, material artefacts and also more abstract ideas and discreet interests that exposed the constraints, opportunities, resources and pressures shaping how lecture capture was understood and practised. In light of the relational nature of actors, several topics of conversation could have been assigned to more than a single over-arching theme. As our interest was in establishing the range of different human and non-human interests that were present in Twitter conversation, this overlap between themes does not detract from our approach.

Reflecting on our research design

By devising a speculative method that focused on generating and working with Twitter data to explore educational topologies, we found an apt way of casting a critical light on the temporal and spatial arrangement of the university. We were able to identify different voices and topics of conversation and generate over-arching themes that would help us to establish the different actors that shaped the perception and presence of lecture capture within the university. This approach posed

challenges that called for a granular and painstaking approach as we scrutinised Twitter profiles and activity to achieve a high level of confidence in the data that could be used to support analysis. Looking to the future, we recognise the potential to use Twitter data in further ways. A study with a greater scope might find value in examining replies to original tweets, while the 'retweet' function on Twitter could potentially be used to evaluate the influence rather than the presence of different voices and interests. While a range of automated tools has been created and adopted in recent years to analyse social media data – for example, tools for 'sentiment analysis', which are used by researchers and also in marketing and other contexts (e.g. Etter et al., 2018; Gianchanou and Crestani, 2016) – our approach required hands-on, qualitative analysis and was based on an interpretative paradigm. As researchers and teachers working in the field of digital education, we inevitably brought our own histories to the organising and analysis of data generated. The interpretive nature of our research design positions us as what Sriprakash and Mukhopadhyay (2015) refer to as 'brokers' of knowledge: that is, the meaning we made of the Twitter data was shaped by our prior knowledge and experience of this networked space, alongside the themes that arose in discussion. As researchers working in the field of digital education, we have a keen interest in and understanding of learning technologies including lecture capture; however, as our teaching takes place within a fully online masters programme, we do not use these particular systems in our everyday practice. The discussion and arguments that follow should therefore be considered in light of the knowledge, interest and experience we brought to the generated data.

The relationality of lecture capture, space and time

Our attention now turns to what the Twitter conversation around lecture capture might tell us about the nature of educational space and time. We begin by considering the different voices that were heard in discussion, before examining the issues and themes that were present across the data, focusing particularly on space and time.

Voices in the lecture capture conversation

As noted, research around lecture capture has focused on the experiences of learners and lecturers, highlighting some of the ways that these educational technologies influence educational activity. There is a danger here, though, of limiting understanding of lecture capture to a screen-mediated exchange between student and tutor, thereby denying the influence of a wider range of individuals who have an investment in lecture capture, as Tummons et al. (2016) also point out. In our own study, the voices of academic staff and students were certainly to the fore; however, they were joined in Twitter conversation by learning technologists, union representatives, accessibility advisers, consultants and more besides. We suggest, therefore, that lecture capture cannot be understood solely through the experiences of the student and lecturer, and that even within categories of users there is no single motivation or perspective on lecture capture shared by all. On the contrary, where some academic staff were hostile to lecture capture for the way it threatened their intellectual property (e.g. tweets 108, 334) and job security (e.g. tweets 129, 554), others were optimistic about its potential to support students with disabilities (e.g. tweets 65, 105), while a number seemed simply happy that it enabled them to continue teaching at all during lockdown (e.g. tweets 284, 332). For their part, students described lecture capture as a revision tool (e.g. tweets 510, 529), but also the perfect cure for insomnia (e.g. tweets 112, 428). A wide range of interests exists around lecture capture, and it is not particularly useful to generalise about 'best practice' or 'what students like'.

The themes presented in Table 1 have a range of implications for the spatial and temporal arrangements of the university. From our sociomaterial perspective, access, commerce,

COVID-19, politics and policy, space, teaching and learning, and technology were actors within the lecture capture assemblage. In other words, during the period of our study, lecture capture was understood and practised in ways that were contingent on opportunities, constraints, pressures and resources that can be traced to space, politics and so on. Therefore, although we might commonly describe lecture capture as a 'learning technology' (teaching and learning, technology), this description underplays how it was also implicated in executing strategy (politics and policy), reducing inequality (access), generating income (commerce), responding to a global pandemic (COVID-19) and supporting teaching beyond the campus (space).

Also significant is that our study, undertaken as it was during a period of disruption to higher education, exposes how lecture capture was contingent on pressures and constraints that we might see as being beyond the immediate sphere of education, or actively working against the academic project. Conversation around lecture capture exposed tensions around industrial action (e.g. tweets 306, 368), concerns around the neoliberalism and the commercialisation of higher education (e.g. tweets 12, 454), and the effects of COVID-19 (e.g. tweets 276, 281). The presence of the global pandemic as an actor is particularly instructive in the way that it challenges instrumentalist framings of lecture capture. After all, the rapid spread of COVID-19 was beyond the reasonable anticipation of institutions and individual staff, much less their control. The unpredictability of our messy world (Law, 2004) acts as a warning against assuming that rolling out a learning technology will neatly realise a predetermined learning gain.

Lecture capture, the liquid lecture, and space

As Table 1 demonstrates, there is a great deal more to say about lecture capture and topology than it is possible to capture within a single article. We are therefore focusing from this point on lecture capture in relation to space and time. Educational space supports a range of interpretations and is an emerging field of education research in its own right (for an overview, see Ellis et al., 2018). Our own work in this area has considered the social topologies of online learners (Bayne et al., 2013) and assemblages of nearness within online education (Ross et al., 2013) which inform the ideas presented here. We have also previously considered in depth the ways that learning spaces are affected by digital technologies; for instance, through the enactment of power relations and the commercialisation and neoliberalisation of the physical and networked settings where educational activity happens (Lamb, 2019). Drawing from this prior work, and with the specific interests of this article in mind, we regard 'lecture space' here as any physical or networked environment where lecture content was recorded or viewed.

In our discussion of the literature, we noted a strong research interest in establishing whether the availability of lecture capture impacted upon classroom attendance. This was also a recurring topic of Twitter conversation among academic staff and, echoing the published research, offered contrasting answers to the question. Our data suggested a nuanced relationship between lecture capture and educational space, where technology and the classroom need to be understood in relation to a broader range of interests.

At the point that universities closed their campuses in response to the spread of COVID-19, lecture capture took on a new prominence and meaning. Within institutions that had previously framed lecture capture as a resource for supplementing the main attraction of classroom teaching, lockdown thrust the recorded lecture to the fore – captured, for instance, in the following Tweets:

> For teaching, module leaders will give more detailed information but most remaining lectures this term will be delivered using lecture capture recordings or a close equivalent. There are various forms of tutorials & how we cover these varies between subject 2/4. (tweet 280, academic staff, 15 March 2020)

> So teaching has moved online, and I'm ready. A microphone; Yuja lecture-capture software; and my lecture notes. This week's topic – the marginalisation of women in early modern Scotland. Let's do this thing! #onlinelearning. (tweet 284, academic staff, 16 March 2020)

Meanwhile, some university managers who, it was suggested, had steadfastly resisted student demands for lecture capture, rapidly reversed their position when faced with the reality of face-to-face teaching coming to an abrupt halt. How was it acceptable, one student asked, for her institution to now advise that lectures would be delivered online for the remainder of the academic year when they had until recently being sharing statistics advertising the inadequacy of accessing content at home (tweet 403)? These and other tweets suggest that through the spatial constraints imposed by COVID-19, lecture capture became considerably more pedagogically and strategically significant as it replaced rather than supplemented the in-person lecture experience. Thinking again in terms of a sociomaterial assemblage and the relationality of social topology, we see how in the moment that campuses entered lockdown, lecture capture was at once technological, pedagogical, commercial, spatial and also shaped by COVID-19. Or to put it another way, COVID-19 should be seen as relational to the pressure upon staff to minimise disruption to teaching, the strategic need for the university to continue operating, and remote teaching and learning made possible by streaming technologies. The university was definitely in flux, but still consisting of a 'continual surface of relations' (Lury et al., 2012: 20) that held it together in some recognisable ways – with the lecture as a key touchpoint.

Beyond its new-found importance during this time, lecture capture also underwent a change in how it functioned as a teaching resource. The framing of lecture capture during early Twitter conversation was consistent with the description we presented towards the beginning of this article: a resource for recording live classroom teaching which could then be accessed by individual students via a video stream. By the end of the data collection it was being used to pre-record content that was then made available to view. In between times, there were instances of lecturers presenting live to empty classrooms during the narrow window when campuses were closed to students but remained open for staff. This shift is reflected in the Twitter data:

> Yo, lecturers, I appreciate Lecture Capture like NOTHING ELSE. I haven't missed a lecture yet but it's such a great revision tool! It's honestly invaluable! Please don't opt out of this scheme! It hasn't stopped me from coming to lectures yet and it never will! #studentvoice ❤ (tweet 29, student, 17 February 2020)

> Just gave my last lecture of 2019/2020 to an empty room . . . Very strange, but lecture capture at least means everyone stays safe and no one misses out. (tweet 287, academic staff, 16 March 2020)

> I'm clearly a bit spaced out today because I recorded a lecture, saved it, and assumed it would upload itself. To be fair, this is basically how stream capture works. But even so. (tweet 513, academic staff, 27 April 2020)

These tweets reflect a repurposing of lecture capture as it evolved into a resource for creating and sharing content that was less dependent on timetabling and the presence of students. The academic timetable has been a subject of critique; for instance, through the ways that it acts as an organising agent of educational activity, and its relationship with the spatialities and knowledge-building practices of the university (see, in particular, Nespor, 1994). Considered from a sociomaterial perspective we can see the timetable as another example of an intangible yet highly influential actor through the way that it has the potential to shape where, when and how teaching and learning take place. As Gourlay and Oliver (2018) point out in their work on sociomaterial assemblages and

student engagement in digital contexts, we need to go beyond the tendency to regard time as a kind of neutral backcloth to educational activity, and instead consider and seek to understand how, like space, it shapes teaching and learning. Meanwhile, in their discussion of actor-network theory in education, Fenwick and Edwards (2010) draw on Suchman's (2007) work about the influence of schedules to argue that the coordination of people, time and space would unravel in the absence of the academic timetable. For Fenwick and Edwards, the timetable actively shapes teaching and learning, rather than simply being an organisational device, or what we might see as an administrative accompaniment to the important business taking place in the classroom. The experiences captured in the above tweets are interesting, therefore, in suggesting the declining influence of the timetable-actor during the period of our study, shaped through a combination of sociomaterial constraints (campus closure) and opportunities (the potential for flexible and asynchronous learning provided by digital technologies). Educational activity depends on shifting patterns of materiality (Fenwick et al., 2011): we can expect the academic timetable to become a more significant actor once again at the point that campuses are fully open beyond the COVID-19 pandemic.

The availability of lecture capture software online was crucial in supporting the rapid relocation of teaching from the bricks and mortar of the campus to the ostensibly domestic setting of the lecturer's home during lockdown (shown in tweets 339, 349 and 495). Although there is nothing new about academic staff working from home, the significance here from a spatial perspective is that the laptop and living room took centre stage in the performance of teaching, while the lectern and lecture theatre sat in lockdown-darkness. Going further, we can say that lecture capture not only supported the displacement of teaching and learning from institutional to domestic space, but that it contributed towards a shift in attention from the university's physical setting to its virtual environments as institutions had no choice but to provide learning via screen (e.g. tweets 241, 239 and 390).

In the absence of scheduled and synchronous engagement with an audience, it is interesting to consider why this was still thought of as a 'lecture' at all. We would argue that spatial constraints resulting from COVID-19 saw a change in the perception and function of the lecture itself across the period of our study, but that the lecture, in a topological sense, is 'continually changing or deforming, without ever rupturing' (Thompson and Cook, 2015: 734). Lecture capture could therefore significantly affect the nature of educational space, without destroying the formation that is the lecture.

It is beyond the scope of this article to do justice to the many questions that lockdown has provoked around a blurring of the boundaries between the physical and networked campus, or the foregrounding of hybrid spaces and pedagogies (see Boys (2016) and Nordquist and Laing (2015) for an introduction to hybrid space in education). However, our findings establish that lecture capture shapes, and is shaped by, space, albeit always in relation to other actors.

Lecture capture, issuefication and time

Although the issue of time arose less frequently within Twitter conversation, it was perpetually present as discussion revealed shifting conceptualisations and practices around lecture capture across the period of our study. Time is significant from a sociomaterial perspective because of the assumption that meaning and activity are contingent on the shifting presence and prominence of different human and non-human actors. Therefore, rather than an educational activity or technology having a fixed meaning, instead it is contingent on 'patterns of materiality' (Fenwick et al., 2011) that are constantly evolving across time.

Lecture capture, under certain conditions, can present something other than the centuries-old tradition of students and staff assembling in a shared setting and moment: instead, material can be recorded in one place and time, and then viewed across a dispersed range of locations and a

lengthier period to suit the learner's preference. Those preferences varied even before lockdown: while some students saw lecture capture as an alternative to attending scheduled teaching, others welcomed the opportunity to revisit what had happened in class:

> Spent my life beating myself up about not understanding things first time. Since having lecture capture at uni, I realise I often just need chance to listen to it slowly and at my own pace and when I'm not tired. Capture should be available to every student! (tweet 47, student, 19 February 2020)

> A brief update: I am now watching the lecture capture for these lectures, I can see myself sitting in the lecture, I was there listening and taking it all in and now I can't remember any of it. I love revision. (tweet 552, student/student newspaper writer, 13 May 2020)

Technology enabled students to travel back to the moments when they were in class, meaning that the lecture became distributed across two different moments in time. This was particularly apparent in tweets where students remarked on seeing or hearing themselves as they watched a recording of an earlier class (tweets 522 and 534). The impression here is of students using lecture capture to negotiate different temporalities to support their learning needs. In fact, the potential to pause, rewind and replay the lecture at a slower speed suggests a screen-mediated manipulation of time. Thinking again about relationality and the co-constituting nature of actors, the juxtaposition of technology and time brings a malleability to the lecture that did not exist at the point that it was delivered in class, enabling the student to take their learning at a pace that would better enable them to take ideas on board.

This malleability was also a site of contestation, and reflected in our data was a technology in the midst of what Marres (2012) described as 'issuefication' – lecture capture was 'charged with various social, economic, political problematics or issues' (301), many of which have been highlighted in earlier research (see the literature review, above). In our analysis, this issuefication was particularly evident in discussions around lecture capture and improved access to higher education and to learning materials. By the end of the data collection period this issue had been reconfigured by the imperative to deliver remote teaching to all students, and this cast new light on what had come before.

As we saw earlier, lecture capture has been seen for some time as an antidote to the perceived inaccessibility of the real-time, in-person lecture. Claims echoed in our data included that it creates convenience and flexibility, and usefully loosens the ties with the timetable and synchronous learning that have traditionally been so influential in shaping the rhythm and structure of a course (e.g. tweets 116, 328 and 513). Although this was mostly framed in conversation as being a matter of individual student choice (e.g. tweets 157, 195 and 359), at different points it was argued that by separating teaching from a strict timetable, lecture capture better reflected the needs and circumstances of students who acted as carers or were required to work to cover the cost of their education (e.g. tweets 65, 217, 433 and 457), thereby situating time as relational to access, teaching and learning, technology, and politics and policy from our defined actors. Further, tweets about accessibility and lecture capture invoked long-running battles to get universities to implement accessibility measures to support students with disabilities (tweet 525), and for lecture capture technology to be seen as a key dimension of inclusive practice (tweet 10). In this configuration of lecture capture, disabled students and their needs were argued to be central, reflected in tweets 76 and 99 and this example: 'Don't want to see any Lecture Capture takes that don't centre disabled people, to be honest' (tweet 17, academic staff, 16 February 2020). However, the framing of lecture capture as the solution to student access was also seen as masking other important issues, including intellectual property and the outsourcing of university functions to third-party vendors: 'Puts me in mind of (management) instrumentalizing students with disabilities to mandate lecture capture. I have no problem with

students having lecture recordings . . . I have a huge problem with a 3rd party corp(oration) literally called "Panopto" having them' (tweet 174, academic staff, 8 March 2020). As a result of longstanding tensions around lecture capture and accessibility, its prompt rollout in response to COVID-19-related campus closures was greeted with cynicism by some, who noted that the same measures were not taken despite years of campaigning (e.g. tweets 209, 241). Perceived inaction over a long period of time was thrown into stark relief by the possibilities for rapid change that emerged. Our analysis has shown that the nature of the lecture itself, and the way its space-times are understood, has been reconfigured by lecture capture; and lecture capture technology has been 'issuefied' in the process. We will now go on to discuss the implications of this understanding.

Conclusion

In this article, we used conceptual work around sociomateriality and social topology to explore the relationship between lecture capture technology and space and time. Our use of theories of social topology, in particular, has enabled us to see and demonstrate the shifting relations around lecture capture, and the implications for these.

Two key findings flow from this work. First, the lecture is highly fluid, in a topological sense. While being radically re-spatialised, and its temporalities disrupted by lecture capture technologies, the notion of the lecture persists and continues to be understood as a central pedagogical feature of university life. Even a pandemic and the complete closure of the campus could not topple the lecture: while lecturers' homes became their lecture theatres, and recorded lectures streamed at different times to the devices of students around the world replaced in-person gatherings, the difference sticks to the similarity, and they remain relationally bound:

> In a fluid space it's not possible to determine identities nice and neatly, once and for all. Or to distinguish inside from outside, this place from somewhere else. Similarity and difference aren't like identity and non-identity. They come, as it were, in varying shades and colours. They go together. (Mol and Law, 1994: 660)

The malleability of the lecture and its meanings produces its topological stability – it deforms, but it does not rupture.

Second, the potential of the lecture to be so radically altered produces lecture capture technology as a rich site of 'issuefication' (Marres, 2012). At a time of rapid social and educational change, the meanings of access and student satisfaction, and indeed what it means to be present for an educational experience, were all up for grabs, and these matters cohered around lecture capture technology in discussions on Twitter.

Marres (2012: 301) describes controversies around smart energy meters as disclosing the meters' 'state of issuefication' at any given time, and this dynamic nature of issuefication is mirrored in our findings. Had we commenced this study only a few months earlier, we would have seen a different emphasis in our data – for example, on the politicisation of lecture capture in the context of industrial action in many UK universities over that period. Instead of Twitter conversation about teaching to empty classrooms or the way that university managers were seen to quickly overcome the barriers that had previously prevented them investing in lecture capture, we would have seen discussion of the ethics of reusing previously recorded lectures to overcome the absence of striking academics. A few months later, the drive to 'hybridise' university teaching and the role of pre-recorded lectures in facilitating more limited physical co-location on campuses might have been at the fore. Indeed, the state of issuefication has shifted again: as we write, a fully online teaching approach is being increasingly framed by those who want to see campuses close again for

health and safety reasons as the safe, human, quality option as compared to dangerous, stilted classroom spaces subject to rigorous social distancing and hygiene protocols.

Issuefication is dynamic, and it is produced by sociomaterial assemblages of human and non-human actors in particular contexts. Viewing technologies as dynamic issues further underlines the need to avoid deterministic framings of their role in education, and gives a strong theoretical basis for alternative ways of working with and researching learning technology.

Both of these findings are significant as they call into question the instrumentalist and essentialist framings of technology that are commonplace across and beyond the research literature. From a strategic perspective, the investment in lecture capture systems has often been justified on the basis of supporting accessibility, providing revision materials and improving levels of student satisfaction. Research, meanwhile, has frequently sought to establish a link between introducing these systems and attendance on campus or performance in assessment. It is appropriate that universities should have a clear rationale to justify the expense and time associated with introducing lecture capture. It is similarly important that we examine whether these systems discourage students from being present in class, or help them to produce better-quality coursework. What we have shown in this study, however, is that the unpredictability of our open-ended world, combined with the complex relationality between human and non-human resources, challenges the notion that learning technologies can be neatly tied to a single institutional objective or research outcome. Neither can learning technologies deterministically dictate student behaviour when their meaning and function is itself contingent on a shifting range of actors that exist in concert or conflict. Relationality, not determinism, should drive research into learning technologies, as technologies are co-constitutive with a wide variety of other actors in the production of higher education.

The timing of our research was fortuitous in the way that it coincided with the rise to prominence in the UK of the COVID-19 pandemic, a situation that brought into sharp relief the way that education is affected by a wide range of interests. It enabled us to show how the presence and prominence of different human and non-human actors can fluctuate across even a short period of time. By capturing how students and staff responded on Twitter to lockdown we have seen how educational activity is contingent on pressures and constraints beyond choices around curriculum design and decisions about technology. However, our research took place in particular time-space assemblages that strongly influenced what was available for analysis and interpretation. Our analysis took place in the midst of pandemic life, before longer-term implications have become clear, and there is still much work to be done about the reshaping of the university under COVID-19 conditions. For example, it would be valuable to explore in a more extended way the effects of displacement of teaching and learning, the issuefication of technologies as their role in the configuration of education changes, and the way spatial and temporal realities continue to shift as the pandemic progresses. Other research could explore in depth the issuefication of lecture capture in particular contexts, and amongst specific groups of students or staff. For instance, our data showed that lecture capture continues to be discussed as a key factor in university access for students with disabilities and chronic illnesses, with new insights flowing from the rapid shift in 2020 to remote learning for all students.

The ongoing reconceptualisation of educational space, contingent on unexpected campus closures, concerns over COVID-19, the commercial imperative for universities to continue teaching through disruption, and the potential for digital technologies to capture and communicate academic content normally acquired in the classroom, should be understood as inherently topological. There is much more to be done with a topological theoretical framework to understand how educational technologies shape, and are shaped by, time, space and a shifting assemblage of other interests.

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Note

1.   See https://tags.hawksey.info/tagsexplorer/.

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