Surfacing knowledge mobilities in higher education: Reconfiguring the teacher function through automation

Authors

Dr Michael Gallagher and Dr Markus Breines, Centre for Research in Digital Education, University of Edinburgh

Dr Michael Gallagher is a Lecturer in Digital Education and a member of the Centre for Research in Digital Education at the University of Edinburgh. His research largely focuses on digital education in development contexts and the implications of such thinking for educational mobility. Published work includes critical perspectives on educational technologies; the mobilities of digital education students; and futures educational research.

Dr Markus Roos Breines is a Postdoctoral Research Associate at the Centre for Research in Digital Education at the University of Edinburgh and in the Department of Sociology at The Open University. He has conducted extensive fieldwork in Ethiopia for his PhD in Social Anthropology and researched several topics including international distance education in Africa, market traders in the UK, as well as automation of higher education.

Dr Michael Gallagher
Centre for Research in Digital Education
2.02 Simon Laurie House
Moray House School of Education,
University of Edinburgh, UK
michael.s.gallagher@ed.ac.uk

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Abstract
Automation is becoming increasingly common in higher education. This is generally posed around accepting large number of students while seeking to keep faculty numbers static and casualising an already fragmented academic labour market. Much of this automation is positioned around perceived gains (efficiency, time, cost) and learning personalisation (personal assistants as a means of providing support). Yet there has been little work in exploring how human and student agency, code, algorithms, and further digital instruments might be reconfigured through automation to service the teacher function. In this paper, we draw on a combination of speculative events and qualitative work conducted with students, faculty, and staff across the three colleges at the University of Edinburgh to explore automation as a component of the teacher function assemblage. Through participatory student and teacher-led research and development, narratives of teaching practice and the role of automation in performing aspects of the teacher function emerged. Consequently, this paper offer insights into debates about sociomaterial dimensions of higher education and demonstrates what mobilities are being engendered as a result of the reconfigured teacher function.

Introduction

The discourse of technology-fuelled liberation, and the resulting public-private partnerships that are increasingly structuring teaching in higher education, tend to seek an active break with local contexts, often ushering in a narrative of disruption and revolution designed to supplant 'broken' educational practices at the university level through new innovations. In these conspicuous global education ventures, the most prominent voices are too often those invested in the widespread adoption of the technology, with little insight from those tasked with consuming it: teachers and students (Gallagher and Knox, 2019). Higher education is trapped in well-documented cycles of instrumental or essentialism modes of discourse, where the idea of the teacher function is held hostage by Silicon Valley solutionism (Weller, 2015) on the one hand and humanistic presentations of teaching and the teacher function on the other.

In much of the technology as instrumentalism or technology essentialism literature (discussed in Hamilton and Friesen, 2013), education is understood primarily as a transmission of knowledge where teaching is an instrumental and largely transactional practice devoid of the social practices that help shape it (Robson, 2018). Such a view makes educational technology very attractive to universities because it allows for developing solutions that are 'highly personalized, scalable, and affordable alternative' (Popenici and Kerr, 2017: 10) while reducing teaching staff and expanding student numbers. Many educational technologies are presented in such solutionist, transactional narratives. The widespread interest in using technology in higher education is not new. Lee (2008) demonstrates that there is a long history of organising correspondence education to achieve mass-individualization through the possibilities afforded by technology, for example to test, record, classify and differentiate. The current focus remains similar in the sense that the opportunities of digital technologies seem to provide new ways to intensify the massification of teaching and learning.

Considering these approaches to teaching, a central facet of the Expanding the Teacher Function project (2019-2020) being discussed in this paper has been to identify how the teacher function would manifest within a single educational context in ways that transcend these instrumental and essentialist discourses. While there is a growing focus on the possibilities of artificial intelligence in the automation of teaching (Popenici and Kerr 2017), this project builds on previous research that has demonstrated that the assemblage of humans and code can be pedagogically generative. Bayne's (2015) work on Teacherbot illustrates a less intrusive form of automation that is not focused on machines' self-learning, but rather on playful interaction with a Twitter bot to explore how learning might be co-created with human and non-human actors. Drawing on the fundamental ideas of Teacherbot and shifting focus away from the essentialist tropes of efficiency, cost-reduction, and scaling, this project explored the role that automation might play in the broader teacher function. Through a combination of speculative events and qualitative work conducted with students, faculty, and staff across the three colleges of the university, themes emerged around the narratives of teaching practice at the University of Edinburgh on one hand, and an array of use cases for automation performing aspects of the teacher function on the other.

We examined how automation can be used within programme or course contexts for teaching and community-oriented implementations. A central aspect of this project has been to identify the values the various actors within the University would want embedded in the use of new technologies. By interrogating how particular technologies can be used in ways that are meaningful within programme or course contexts, this research has focused on what automation in teaching and learning might entail, which teaching and learning practices it can possibly augment or mobilise, and the values present therein. To do so we drew on mobilities approaches.

The 'mobilities paradigm' has led to a reworking of pedagogical engagement with technology, noting the mobilities, openings, moorings, and boundary markings made possible therein (Edwards et al., 2011). The mobilities literature emerging from educational engagements with spatial theory offers an avenue for drawing on these ideas in relation to automation, and in this paper, we provide insights into the role of educational technologies in stimulating different kinds of mobilities and their pedagogical implications. In this paper, this is particularly manifest around knowledge mobilities and how they are inexorably ingrained in the narratives of teaching at the University of Edinburgh. In doing so, we hope to contribute to seeing mobilities as "constitutive of knowledge systems" (Gunter and Raghuram, 2018: 192). An interrogation of the shifts in teacher function within a single institutional context is made possible through these mobilities approaches to determine how teachers and students "negotiate these deeply localising influences alongside a world in which people, things, money and brands move unequally" (p. 203).

As this paper will demonstrate, knowledge mobilities are engendered by both existing narratives of teaching as well as their emotive dimensions. Jöns et al. (2017) illustrate how these knowledge mobilities act as "a series of episodic circuits involving a repetitive going out into the world and returning to a home base, where the accumulated knowledge and information are combined and interwoven to coherent and often linear narratives" (p.7). The unpredictable combinations of these 'knowledge circuits' and the interwoven teaching narratives emerging as a result surface less visible forms of mobility and interrupt essentialist arguments around the primacy of educational technology.

In these mobilities, teachers and students design technology to facilitate constructive educational exchanges and explore how new digital technologies can be used to expand on the teacher function. We do this through an exploration of automation, itself a contentious set of technologies and practices that surfaces many of the underlying tensions between human-led and machine-driven pedagogical practices. Mobilities approaches are helpful here, representing as they do a shift away from 'educational silos and discussions of disruptive technology' (De Laat and Dohn, 2019: 19), and towards the mobilities of reimagined teaching practices, the moorings of curricular, strategy, policy, and other organisational constraints, and the boundary crossings (Enriquez, 2009) experienced by teachers and students in this process.

By considering the teacher function through the lens of mobility, we are not seeing it as existing on some fixed point on a continuum of digital and human, but rather as assembling and disassembling teaching through a combination of "living teacher presence" and "an assemblage of code, algorithm and teacher–student agency" (Bayne, 2015: 461). Specifically, in this paper, we consider how these processes depend on a range of mobilities, which is important because it highlights that the teacher function is an assemblage that operates in a range of different spaces generating particular mobilities. This means, we argue, that the relationship between technologies and teaching practices cannot be structured by technology developers but rather need to be positioned as part of universities' research and development strategy. In such positions, teachers are centred as co-creators of the broader teacher function.

Situating the Teacher Function: knowledge mobility in education

There have been shifts in the landscapes of automation that beget iterations to its theoretical foundations. The 'mobilities paradigm' that emerged in the early 2000s largely focused on the movement of people, ideas, and material goods, as well as the broader social implications of those movements. It is in some ways a response to globalisation itself, "defined as a transnational space of mobility, borders, transitions and flows producing cross-border connections, world-wide travel and an

enforced hybridization of culture, media and lifestyles" (Braidotti, 2013), purportedly leading to "seemingly frictionless, clean futures" "wherein technology is often portrayed as providing the capability toward such seamlessness" (Dunn and Cureton, 2020: 2). Education is no exception in succumbing to this portrayal of seamlessness.

It is not only the mobilities of people that constitute this paradigm, but also the physical movement of objects, as well as imaginative (e.g. TV), virtual (Internet) and communicative travel (telephone) (Urry, 2007). Other scholars have expanded on these and pointed out numerous other forms of mobilities (see e.g. Dahinden, 2010; Schapendonk and Steel, 2014). While the many studies over the past fifteen years have generated a rich body of literature and deepened the understanding of mobilities, there is a predominant focus on the mobilities of people over other forms of mobilities. Urry's (2007) set out the main features of mobilities (see pp. 46-54) in terms of how sociomaterial relations (Latour, 1999) necessitate the intermittent, flickering and intersecting movements as well as fixities of people, objects, information and images across distances. As applied educationally, mobilities approaches necessitates thinking "relationally and contextually about educational processes and the inter-play of structure/fixity and agency/flows" (Waters, 2017: 280). The types of mobility include corporeal mobility, imaginative mobility, virtual mobility and communicative mobility; several of these categorisations are expressed in the data emerging from this research. This analysis of mobility itself is a necessary component in any framework exploring the broader teacher function. Mobilities approaches provide analytical utility to this research in that they move beyond merely identifying relations and the spatial structure of this reconfigured teacher function. Rather they speak to the flows and stoppages that these reconfigurations will conceivably engender. The 'knowledge circuits' (Jöns et al, 2017, p.7). being expressed here are the new or reconfigured mobilities in this evolving teacher function. Their combinations, and the interwoven teaching narratives emerging as a result are positioned in this paper as emergent mobilities being generated at the University of Edinburgh. They provide capacity for interrupting essentialist arguments around the primacy of educational technology through an exploration of alternative positions of mobility.

In this paper, we are interested in going beyond the mobilities of people to consider the intensifying mobilities of information, knowledge and ideas that have contributed to the reshape of the teacher function in the face of technological and social change. We are concerned not only with the reconfigurations of teaching practices expressed relationally (the reconfigured entanglements of human and technology) but also to the velocity of the mobilities that they engender. Both relationality and flow require consideration. As such, there are a variety of mobilities embedded in the teacher function. They are, at the same time, embedded in university structures. An example of such structures in the context of universities would be university policy and the technological systems (email, learning management systems, cloud-based collaborative applications, etc.) that facilitate a wide range of mobilities within and beyond the spatial location of a university. Adey (2006) argues that there is no absolute immobility and that structures are mobile too. As such, rather than centering one over the other (Hannam et al., 2006), this paper explores the mobility continuum to think about how these are entangled in the teacher function. More specifically, we are focusing on broadening the teacher function through a consideration of how the human and the digital work in tandem by emphasising the context of automation in teaching. By shifting the attention away from the mobilities of people (in this case teachers and students) to the flows of other aspects of the university, we also consider how they intersect when automating facets of the teacher function.

Speculative methodology and surfacing the teacher function

We situate this research in a growing body of speculative methodologies being applied to emerging technologies in education. Veletsianos (2010) notes that many educational technologies are 'not yet fully understood' and 'not yet fully researched or researched in a mature way' (15). The practices and pedagogies emerging in engagements with these technologies remain poorly understood or in a state of 'not-yetness' (Collier and Ross, 2017), a state which sits in contrast to the more essentialist or instrumental positions of educational technology and their related calls for efficiency and enhancement critiqued in Bayne (2015), Biesta (2013), and Hamilton & Friesen (2013).

Yet 'working with the not-yetness of digital education means engaging with complexity, uncertainty and risk, not as factors to be minimised or resolved, but as necessary dimensions of technologies and practices which are unknown and in flux' (Ross, 2017: 214). Automation in education carries complexity, uncertainty, and risk, as well as technological and pedagogical practices which are largely unknown. Rather than be a flaw in research design (Gough, 2010), this uncertainty can be pedagogically generative (Bayne, 2015). Indeed, the entire Expanding the Teacher Function project is based on the premise that this uncertainty is a positive principle, not a response to any perceived 'productivity deficits in teachers, or to replace teachers, but rather to explore how an assemblage of teacher-student-code might be pedagogically generative' (Bayne, 2015: 465). To address how automation may be generative in this way we employed a speculative methodology. Speculative methodologies are 'aimed at envisioning or crafting futures or conditions which may not yet currently exist, to provoke new ways of thinking and to bring particular ideas or issues into focus' (Ross, 2017: 215).

A series of design events (n=14) ranging from a few up to 20 participants were run from July-December 2019 throughout the University. These events were used to develop agency for students and staff to articulate responses to this emergent space. In these events, we positioned this research project in the larger space of speculative work at the university around educational technology, advanced the working definition of the 'teacher function' on which subsequent discussion and design activity would rest, and presented a series of provocations of essentialist and instrumental approaches to educational technology that we felt were misaligned with the values of the university.

These values were surfaced during the recent (2017-2019) Near Future Teaching project at the University of Edinburgh which developed a values-based vision for the future of digital education; it used futures-thinking and design-based methodologies to work with more than 400 students, staff and other stakeholders in the production of this vision (Bayne and Gallagher, 2020). The values emerging from this project were 1: experience over assessment, 2: diversity and justice, 3: relationships first, and 4: participation and flexibility (2020). These values were used to ground the discussion of the teacher function in an institutional context. This was followed by an open discussion of what teaching is and could be at the university and a design experiment where groups defined possible insertions of automation into these discussed teacher functions. This first round of events was run for students and staff/faculty separately, but later we opened them for joint participation.

We also conducted a series of interviews (n=15) from August 2019 to January 2020 with students and staff in managerial and teaching positions at the University of Edinburgh. These interviews serviced a series of goals: a: to identify broader institutional, policy, or strategic factors that further define the teacher function (and subsequently all speculative engagement with emerging technologies in education), b: to surface positions of teaching perceived to be in opposition to or working in tandem with automation, and c: to cohere or further iterate on types and findings emerging from the speculative events. The interviews were audio recorded and transcribed.

In order to further explore the uncertainty and emergence of automation in teaching without normalising it, the interviews were coded twice (inductive and deductive) to identify common themes that might emerge from each and where any potential overlap might exist. These common themes included contact time, ethics, control, human-bot interaction, value, the teacher function, and the student experience.

The deductive coding used the values emerging from the Near Future Teaching project as parent codes: experience over assessment; diversity and justice; relationships first; and participation and flexibility. These quickly developed further into a series of parent/child codes (see Support under v3 Diversity and Justice, by way of example) and an additional Parent Code for Teacher Function and Use Cases, respectively. Both the inductive and deductive coding processes surfaced significant overlap; contact time and ethics, for example, featured heavily in both.
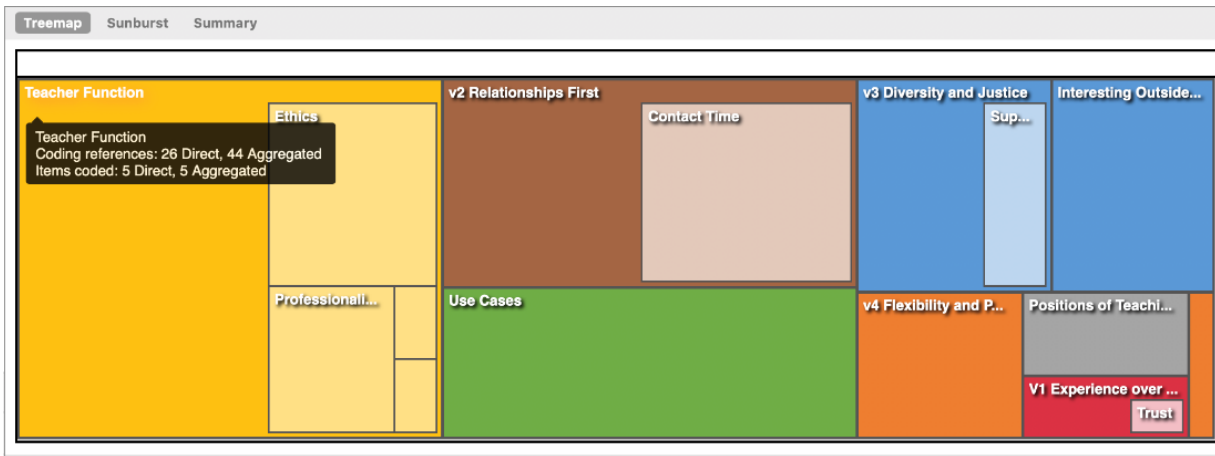

Image 1: coding results from the deductive coding process showing the university values acting as parent codes.

Themes emerging from this coding were compared to the use cases emerging from the speculative events and the interviews. These use cases were proposed instances of automation designed to service the teacher function in some way. They were suggested by students, faculty, and staff alike in the events and in the interviews. While significant overlap exists there were approximately 85 discrete use cases suggested as a result of this work. A selection of the most compelling use cases was drafted into one-page summaries highlighting their expression of the teacher function; their servicing of university values; the utility provided by the use case; their representativeness across all three colleges of the university; their ethical permutations; and their feasibility.

A series of prototypes are being designed based on a series of selected use cases and will be tested in teaching at the University (for more detail see Breines and Gallagher, 2020 Forthcoming). The selected use cases were representative of a range of activity and dimensions of the teacher function. These prototypes are being made available for further engagement by students and staff and feedback collected as to their capacity to expand the teacher function.

The ethical dimensions of this study are significant, as they should be with any activity that interfaces automation with education. Our approach to research ethics was informed by BERA's Ethical Guidelines for Educational Research (2018). All data was stored securely on password-protected university servers and available only to the research team (the authors of this paper) and summarised use cases were made available to the design team and the sponsoring academic. All names and readily identifiable

information were anonymised. Ethical approval for the research was sought and confirmed by the relevant committee at the research site.

Expanding the Teacher Function

In this project and the exploration of automation, discussions around automation become a vehicle for discussions around the teacher function. Many teachers and students expressed concerns over the prospects of automation in higher education because of its potential to transform existing practices in ways they considered less attractive or threaten current teaching practices. Here, then, we consider what the teacher function is and can be, to think of how it can be expanded through automation.

In the following, we discuss three narratives of teaching at the University of Edinburgh as expressed through the vehicle of automation. These included concerns around automation compared to those narratives of teaching, its perceived potential and impact on university values and perceived positions of teaching. All of these suggest an evolving educational context of emerging mobilities around the reconfigured teacher function expressed in accounts of 'good' teaching.

Narratives of Teaching 1: Humanness, Contact Time, and Visibility

These narratives of teaching are essentially social performances. All of them are foregrounding particular social attributes (human, contact time, etc.) amidst this newly reconfigured "materially heterogenous" (Law, 2004: 13) entanglements that automation generates. The performance of the social is expressed in these narratives largely through an appeal to 'humanness', notions of visibility and invisibility, and the shifting constitution and increasing importance of contact time. To begin, although teaching is a central aspect of what goes on in universities, there is not a clear consensus of what teaching constitutes beyond often repetitive classroom instruction and a presentation of teaching as transmission of domain learning or expertise:

> 'Well I think we don't have a good enough definition of what teaching is. I don't think it's separate from admin. I think there's some admin that is different from teaching, but I think that a lot of what we do when we teach is repeat the same thing to different people over and over again. You know, and we tailor it slightly differently for different people but we're basically doing the same task or doing the same content.' (Mary, senior staff)

Despite this repetitive ambiguity, automation surfaces positions of teaching that emphasise 'humanness':

> 'So I think when a lot of my colleagues hear the word automation, they kind of panic, because I think probably the negative connotations of automation sort of spring to mind, and the thought of taking away what many of my colleagues see as the, as the absolute lifeline and absolute essential part of teaching is the human, the human to human interaction, because of our audience is, that is their raison d'etre, is interaction with humans.' (Susan, senior staff)

The emphasis on redefining contact as an essential element of the larger teaching narrative was evident in all the forms of data generated as a result of the project, including the speculative design events. The following prototype (Image 1) suggests contact is expressed in multiple forms, as a feedback loop between teacher and student (and student to student) that is multidirectional (Feedback as a conversation), builds student autonomy (Autonomy & Independence), and positions teaching as mentorship (Educators as a guide).

Revealingly, the prototypes designed in the speculative events contrast with the often-dichotomous positions of teaching advanced in the interviews (teaching as human, as facilitating contact; automation as administrative, as performing low-value tasks). The prototypes present the discrete elements of the

larger teacher function working in tandem: teacher-student agency, code, and algorithms all interwoven in practice.
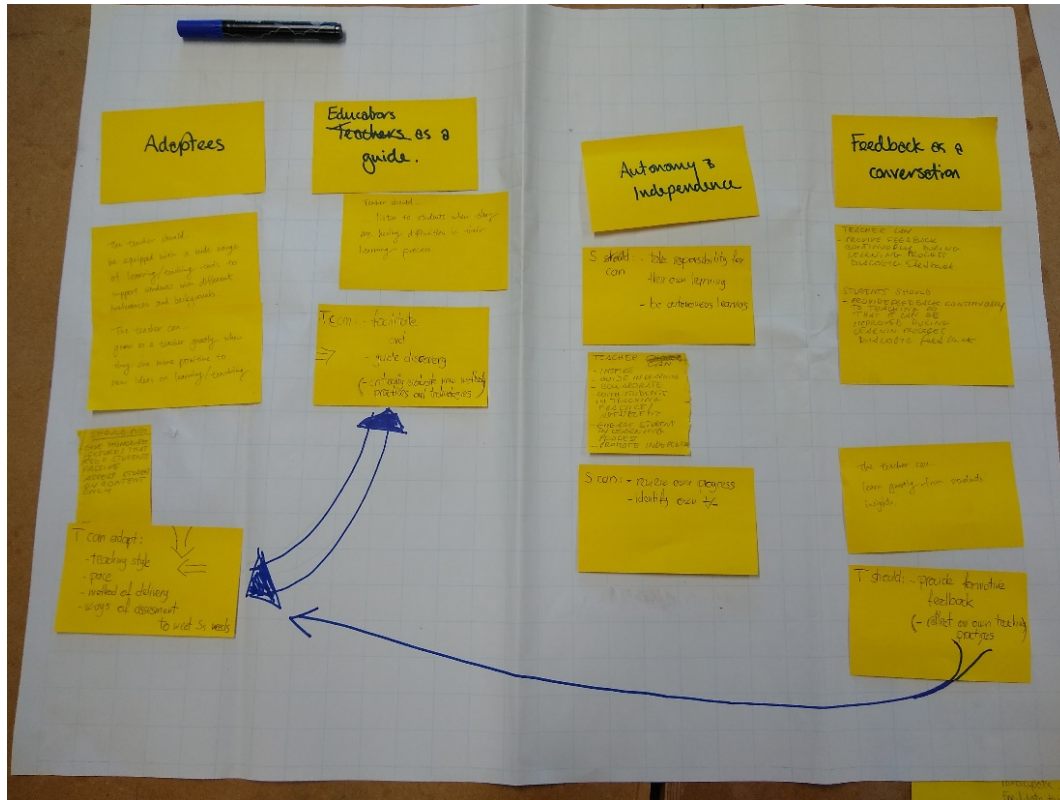

Image: a prototype emerging from an event (2019) outlining the various components of the larger teacher function and how they might interact. It is important to note that in these prototypes that the distinctions between human teacher and automated teacher function blur; the prototypes are largely agnostic about who is servicing the teacher function.

In this image, we see a position of teaching largely concerned with contact time, a common theme found throughout the data. As such, the openness towards automation that existed in the data was largely contingent on maintaining the aspects of teaching that were considered most valuable and most aligned with existing modes of contact time. This relied heavily on the use of automation not as a human teacher replacement, but rather a complementary component of the larger teacher function:

> "I think that if you have this as an addition, rather than a replacement, and I think that's the key, we shouldn't be talking in any way about replacing humans in the system. There are too few humans in the university that are teaching right now." (Michelle, senior staff)

In this passage, humans themselves serve as a constraint because knowledge mobilities are stimulated by contact time. Humans are critical actors in this "materially heterogenous" entanglement" (Law, 2004: 13) which constitutes teaching. Yet contact time, mentions of which surfaced routinely in the data, is not consistently available offline:

> "…I would say many times of course it will depend on which course you're taking but if you are taking a course with like 500 other students, basically it doesn't matter, you know…I mean if the group's larger than twenty, forget about it. I mean there's very little chance that you're going to have any personal interaction." (Trevor, student)

When asked if based on this they felt that contact time between teacher and student is more a stated, but not often realised, condition, the same participant answered the following:

> "...I have a course, like for one semester and I wouldn't really interact with my tutors. But yeah with, with classmates it's different. Because I think a large part of the value of studying on campus." (Trevor, student)

As such, we see a position of contact time being advanced here that includes student-student engagements partially to offset the lack of teacher-student interactions. Yet this lack of teacher-student contact time has ramifications both offline and online particularly around visibility:

> "...it's so much easier in like the big classes, like being anonymous. You don't even have to pay attention, there's no accountability in any of that...you're never gonna talk to that lecturer anyway... I think it's a lot easier to sort of lose track of what you're meant to be doing in a big classroom, unless you're constantly like finding ways to talk to the lecturer or like all those seminars." (Sandra, student)

Note the cascading effects of a lack of contact time in the scenario above: a mono-directional impersonal relationship leading to a lack of accountability and overall disengagement on the part of the student. The mobilities being engendered here are ones of disengagement. This sentiment is echoed in the following account of the student experience and the potential role of automation in it:

> "I mean obviously you'd have to be very careful not to kind of give students the sense that they are being dehumanised and like not being seen as people and individuals. Cause I think there is a preference, a feeling like they are supported one on one. I don't think that's necessarily what they get now." (Louise, staff)

There was ample evidence presented in this research on how teaching is understood currently at the University of Edinburgh, what emphasis or deficits exist in these current positions, and what impact that has on the performance of the social for both the student and teacher. This was expressed largely through emotive or social terms-contact time, humanness, visibility, disengagement - suggesting the role these concepts have in cohering a set of mobilities.

Narratives of Teaching 2: Reconfiguring teaching practice, visibility, and transparency

Furthering these mobilities are the perceived opportunities being posed by automation expressed largely in terms of discretion (separating components of the teacher function), liberation (freeing teachers to do more 'human' tasks), visibility (what impact this discretion and liberation might have on visibility) and transparency (the need to surface the discrete elements of the teacher function, whether human or automated). In the following, we see articulated positions of the teacher function that differentiate between educational activity as largely administrative (marking exam scripts) and as experienced (genuine, authentic, and involving contact):

> 'The web is a great source of content, but the web is not necessarily a great source of educational experiences. It's those educational experiences we should seek to offer, it's our staff that know how to create those experiences so that they're genuine and authentic, and it's personal contact with those staff that is one of the most valuable things that we can cause our students to have. So we should be using evaluation automation and chat bots to take high volume, low value tasks off academics, and leave academics to do the low volume, high value tasks, the contact bits.' (Tom, academic)

The value of 'freeing' teachers to work on high value, low volume tasks that emphasize the quality of contact was shared in the following:

> "I think it would transform but I personally think it would transform in a positive way...So instead of marking an assignment or answering the same question twenty times, you're able to focus on developing tools and resources and engaging in conversation with students to help them learn right as opposed to just focusing on overcoming the next hurdle." (Richard, student)

This repositioning of teacher activity away from high-volume low-value tasks towards low-volume high-impact tasks was reiterated by the student perspective as well:

> "But there was, there's a need for the teacher always. The students want to go to the academic for the difficult complicated solution to things, they don't want to go to them for their lesser things." (Mike, student)

These 'lesser things' and their surfacing in teacher-student exchanges, contribute to manifestations of student visibility and anonymity as indicated in the following:

> "Okay, so those experiences that would happen outside of human contact would have an opportunity to do things that could be very positive for students, like letting them explore without being observed to be stupid. You know how people are worried about looking silly, if they can explore and the computing system is there to give them guidance and feedback to some extent..." (Tom, academic)

Movements between visibility and invisibility are woven into these teaching narratives and into the knowledge mobilities being expressed therein. This ability to explore without being observed, judged, or assessed provides social value in this student community, as it lessens the social cost of potential failure or embarrassment. These exploratory, largely anonymous spaces sit alongside further reconfigurations of the teacher function being redefined towards high value, low volume tasks. These were routinely associated in the data with iterative practices involving dialogue, student support, and duty of care:

> "It's not just a case of saying here's a rubric, in the feedback sense, and of course it's not just a case of saying here's a rubric, you're stupid if you don't know what we mean. It's well known students don't know what we mean when we write that stuff down, and even if you work with students and have a dialogue and get them to self-mark themselves, it still takes round about three or four iterations for students to actually become accurate. So, if we don't put any effort into having a dialogue with people about what the chat is and how it works, and all of that stuff, then we have the danger that they'll misunderstand what's going on." (Tom, academic)

Automated systems are imprinted with the values of their designers, and the narratives of teaching presented in this project suggest that this imprint needs to be explicitly from the teacher, as is suggested in the following:

> "I think it's really important to say yes, this is automated, this is computer generated. But it's computer generated using rules I wrote, my judgement about you, and the feedback I would give you if I was sitting across the table from you. And that, I think, is really important, cause you're not saying I'm offloading to some machine that doesn't care, you're saying I have designed some help for you, or have designed something for you to help you learn better." (Amelia, senior staff)

This teacher imprint becomes a constraint of both the reconfigured teacher function and the knowledge mobilities circulated within this context. Yet, it is interesting to note how that reconfiguration is roundly

couched in language of care, support, dialogue, and visibility. This suggests the importance of the emotive constitution of mobilities presented in these narratives, but also their explicit presence in the teacher function.

Narratives of Teaching 3: Design, Diversity, and Horizontalism

There was significant evidence to suggest an acute awareness within the university of the potentially problematic areas of using automation to bolster the teacher function. For example, meaningful diversity and nuanced design might act as a potential offset to the exclusionary practices described in the following, notably around the composition of the university community itself:

> "ZZZ has got a great brand, it's very good. Is it fair? I don't think so. It's a Russell Group University and I know it excludes minorities, I know it excludes people from challenged backgrounds, I know it's predominantly white, so it's not fair, and the bots will keep that brand." (Craig, academic)

We see the brand of the university acting as a structure 'constitutive of knowledge systems" (Gunter and Raghuram 2018 p.192), one that students negotiate unequally and one that has capacity for amplifying existing bias. This potential for amplification of bias was largely expressed through data or algorithmically:

> "I think that we have to have humans to think about making sure that there isn't algorithmic bias and replication of data patterns. We need to be smart enough to be able to spot where you would…be heading down the wrong road if you had made a bad algorithm based on old data that replicated historical inequalities." (Mary, senior staff)

These data patterns normalise student activity which in turn largely disadvantages already marginalised groups. Outliers are rendered invisible statistically:

> "I think there is often this idea of optimising a system to the observed data patterns. But one has to be careful that that sort of optimisation is always to the average, right. So, there is a danger that you are under-representing groups aren't taken that much into account, or marginal groups, or the vulnerable groups, and so on...So, it's the outliers...The question is, what does the really weak student do, or what does the really outstandingly strong student do, or some student who has a profile that is completely different from the others...So those things can get lost..." (Martin, academic)

These data patterns sit at odds with teaching practices focused on support and duty of care; they essentially mobilise a teacher function designed to improve overall cohort performance at the risk of individual student engagement:

> "I think there is a tendency that, if you are looking at statistics, you are going to try to always push the things that improve global performance. Now, helping somebody particularly weak might not make a difference to the average. You could, of course, tell the algorithms to find you the unusual cases, but there is also this observation in statistics that almost no individual person is absolutely average..." (Martin, academic)

What these passages indicate is largely a tension between algorithmic automation and a position of the teacher function as a high-value low-volume engagement with *diversity*, a "radiating out" of horizontalism, rather than a vertical scaling-up (Escobar, 2019) of existing educational provision and global performance indicators. Horizontalism suggests a diverse set of practices and many sites of activity, rather than a vertical scaling-up of existing and largely homogenous educational practice that

would conceivably begin to normalise diversity. Indeed, in this paper and in the data presented in this project, horizontalism becomes an effect of the reconfiguration of teaching practice towards high-value low-volume tasks, focused in the data on care, support, contact, humanness, and dialogue. Rather than mobilising towards statistical normalisation and scaled practice, the teacher function can be reconfigured towards a diverse array of teaching practices directed at the contact emerging from teacher-student interactions.

Diversity is critical to these reconfigurations due to both an increasingly diverse student population and the homogenous comport of many organisations. This is especially critical in the design and development of educational technology where bias can be replicated at varying stages of the design process:

> "Unless you have diversity in your teams there'll always be things that people haven't thought of. You know, there's a lot of different kinds of people with a lot of different kinds of thinking and not just a small team based on those people's experience of what it feels like to do a thing or be taught in a particular way." (Mary, senior staff)

This diversity can lend itself to embedding critique in the design process as praxis, rather than a tokenistic reliance on diverse actors:

> "I think another, another thing is about educating those people. I mean we do training and ethical discussions and what questions should you be asking... So you can support people in teams by helping them to be more curious in the questions that they ask. It doesn't have to be the one black woman every time who checks the algorithm, you know." (Mary, senior staff)

This design, diversity, and critique as praxis position extends to students, suggesting the need for participatory methods and teacher and student-led research and technological development:

> "I think we have to listen to the students. I think we need to give them their choice in this. There might be some students who are fine with it, and there might be some students who are like, I was here to be taught at a university, I'm not here to be taught by a machine, I could do that at home. And so, what happens if you get a cohort that are split, where some people are like, yay, that's fine, whatever, this is useful. So, I think there has to be a feedback loop about the deployment of these [technologies], and if they are deployed, they should be treated like a bit of research until we know more about that." (Mary, senior staff)

These participatory methods become an essential means of mobilising the reconfigurations of teaching being expressed in this research: a redesigned emphasis on contact, on humanness, on a meaningful engagement with diversity at a range of levels, on transparency and an attentiveness to visibility, on regimes of care and support, on embodied automation, and on a redistribution of effort towards high value low volume tasks.

Echoing horizontalism and the diversity of approaches to teaching suggested therein, this mobilisation is predicated on local educational autonomy, participatory methods, and value-based teacher and student led technological design. In short, this is teacher and student-led, university-specific research and development; it is the mobilisation of community intent towards teaching practice.

Conclusion

What is being expressed in this research on the teacher function are largely knowledge mobilities. This knowledge mobility is composed and initiated by the teacher, and structured by the university architecture, and is enacted in socio-technical spaces. With automation, these teaching processes are

initiated at various points, inserted at one point and executed at other points, placing pressure on existing temporal orders of teaching practice, suggesting a necessary process of recalibration whereby "bodies adjust, or are adjusted, temporally, to the more dominant temporal order" (Sheail, 2018: 466). This dominant temporal order associated with university timetables, shifts to the digital and its problematic association with flexible study patterns, and workload models acts as a significant structural constraint. "Learning is not only socially and materially distributed, but also temporally, located in the context of practices one has done in the past, and others one might do in the future" (Fawns, 2019: 141). Despite being largely grounded in the narratives of teaching practices "done in the past and others one might do in the future", the reconfigured teacher function being discussed in this paper has the capacity to impact this temporal order, hence the necessity to interrogate both the relational aspects of the network and the velocity of the flows being engendered therein.

Mobilities approaches are also useful in reinforcing the horizontalism (Escobar, 2019) that conceivably emerges from a diverse set of reconfigured teaching practices. The possible permutations of these reconfigured teaching practices emphasising care, support, contact, humanness, dialogue, embodiment, and so forth are potentially as diverse as their sites of activity across the University's three colleges and 21 schools. Mobilities approaches provide capacity for understanding the interactions, interdependencies, and flows of these permutations and their impact on the coherence of sites of activity. The research presented in this paper suggests a continued shift in our understanding of teaching at the university. There is a growing recognition that discrete elements of the teacher function are performed by humans, automation, or teacher-student agency in a diverse range of sites, interactions, and interdependencies. Consequently, the teacher function in higher education is an assemblage where any teacher, student, or staff member "is irrevocably extended into the networks within which it is entangled" (Bayne & Ross 2013).

Such an understanding carries with it a critical awareness of the shortcomings of the normalising characteristics of scaled approaches to education, of which automation is often associated. This is a challenging juxtaposition that requires autonomous educational space to deliberate, adapt, design through participatory models, to potentially scale horizontally in terms of a diversity of teaching practices and a range of configurations of the teacher function. Scale becomes a diverse multitude of approaches rather than a normalising mass of global performance.

The development of institutional discretion around the use of automation in teaching, or indeed any potentially contentious technology, is needed to understand (in)appropriate use of technology and to "set up frameworks to say that bots are appropriate to be used in some cases" (Michelle, senior staff). This emerges from both bottom-up approaches to embedding critique in the design process as praxis as well as top-down institutional governance; discretion of this sort needs to extend throughout the hierarchies of institutions.

Further work is required on positioning teachers as critical and creative agents in the deliberation, adaptation, and design of the teacher function. To ensure that policy, strategy, and organisational constraints of the University itself and the broader sector are not stunting these processes, a mobilities approach is helpful to identify the flows being engendered in these reconfigurations of the teacher function and what educational entanglements these flows are reinforcing or not. There is a great need to revisit even seemingly stable technologies and teaching practices in subsequent iterations of speculative work. The temporal dimensions of not only teaching, but the research surrounding this teaching become entwined in ongoing, cascading cycles of research and development.

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