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Citation for published version:
Bayne, S 2015, 'Teacherbot: interventions in automated teaching' Teaching in Higher Education, vol 20, no. 4, pp. 455-467. DOI: 10.1080/13562517.2015.1020783

Digital Object Identifier (DOI):
10.1080/13562517.2015.1020783

Link:
Link to publication record in Edinburgh Research Explorer

Document Version:
Publisher's PDF, also known as Version of record

Published In:
Teaching in Higher Education

Publisher Rights Statement:
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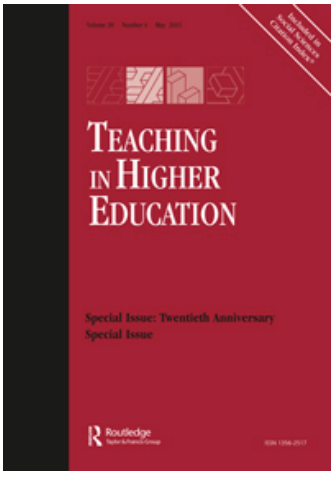

Teaching in Higher Education
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/cthe20

Teacherbot: interventions in automated teaching

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Published online: 16 Apr 2015.

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To cite this article: Sian Bayne (2015) Teacherbot: interventions in automated teaching, Teaching in Higher Education, 20:4, 455-467, DOI: 10.1080/13562517.2015.1020783

To link to this article: http://dx.doi.org/10.1080/13562517.2015.1020783

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Teaching in Higher Education, 2015
Vol. 20, No. 4, 455–467, http://dx.doi.org/10.1080/13562517.2015.1020783

Routledge
Taylor & Francis Group

Teacherbot: interventions in automated teaching

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(*Received 2 December 2014; final version received 4 February 2015*)

Promises of 'teacher-light' tuition and of enhanced 'efficiency' via the automation of teaching have been with us since the early days of digital education, sometimes embraced by academics and institutions, and sometimes resisted as a set of moves which are damaging to teacher professionalism and to the humanistic values of education itself. However, both the embrace and the resistance can be seen to be anchored in a humanistic orientation to the project of education which recent work in the theory of critical posthumanism draws into question. Working within the broad frame of critical posthumanism, this paper will revisit the notion of teacher automation in higher education, exploring how as teachers we might enact new, resistant ways of playing at the boundaries of the human and machine.

Keywords: posthumanism; automation; teacher; MOOC; digital

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The humanisms of digital education

> One can predict that in a few more years millions of school children will have access to what Philip of Macedon's son Alexander enjoyed as a royal prerogative: the personal services of a tutor as well-informed and responsive as Aristotle. (Suppes 1966, 207)

> Where does this leave the human teacher? Well let me quote this dictum. Any teacher that can be replaced by a machine should be! (Clarke 1980, 96)

As Pedersen (2010) reminds us, 'theories of education have been … preoccupied with what Robert McKay (McKay 2005) has called "compulsory humanity"' (237). Usher and Edwards (Usher and Edwards 1994) perhaps best summarise the humanistic foundations of educational practice:

> The very rationale of the educational process and the role of the educator is founded on the humanist idea of a certain kind of subject who has the inherent potential to become self-motivated and self-directing, a rational subject capable of exercising individual agency. The task of education has therefore been understood as one of 'bringing out', of helping to realise this potential, so that subjects become fully autonomous and capable of exercising their individual and intentional agency. (24)

Recent writing in education has drawn attention to the ways in which such humanistic assumptions form and limit the boundaries of educational research and practice, drawing on the twentieth century critique of Enlightenment humanism (Braidotti 2013) to consider

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our failure as educators to consistently question why the adoption of a common-sense notion of what it means to be 'human' might be problematic.

Biesta (1998), for example, has considered a 'pedagogy without humanism' to be oriented to the notion of 'intersubjectivity' rather than to the 'bringing out' of the potential of the individual subject. In this way, our teaching:

> can retain the communicative intuition of the pedagogical project of Enlightenment; it can also sustain the critique of Critical Pedagogy against any instrumentalization and dehumanization of education. But it has to do all this without a deep truth of what it is to be human. (13)

Others are less concerned with the preservation of the Enlightenment project. Edwards, for example, also writing against educational hegemony which privileges the 'knowing human subject' (Edwards 2010), suggests that posthumanism inclines us to think towards education as an assemblage of the human and non-human, an 'entanglement' in which the purpose of education becomes not one of 'learning' but one of a creative 'gathering', in which the human subject cannot be seen as separate from the objects of knowledge with which it is concerned. Thus, for Edwards, drawing on the work of Barad (2007), Latour (1993) and Hacking (1983), the 'post-human condition cannot be one of learning', since the subject doing the learning and the object 'being learned' are no longer readily distinguishable from each other. The work of education then becomes focused on how 'matters of concern' (Latour 2004) 'arise from the work of specific practices and assemblages of the human and non-human' (Edwards 2010, 9). As Snaza (2013) has expressed it, 'Recent posthumanist scholarship reveals that the human is not simply a being that is, but a social construction formed and defined in relation to various non-human Others' (38).

The focus of this paper is on digital education and a particular human/non-human teaching assemblage: an assemblage 'gathered' in order to do critical and playful work at the boundaries of an area of practice which has a strong tendency to be viewed in instrumental and technical-rational terms. However, before discussing how digital education is positioned towards the 'posthumanist turn', it is important to point out that work which pushes at the notion of anthropocentrism in education is not restricted to that which engages with digital technology. Some of its most interesting manifestations are in the broad areas of animal studies and environmental education: for example, Pedersen (2010, 2012, 2013) has written extensively on how Western pedagogy functions to close off categories of 'human' and 'animal', sustaining 'the incorporation of animals into capitalist-specific modes of production and consumption' (2012, 242). Research methods in education have also come under scrutiny, with a recent special issue of the *International Journal of Qualitative Studies in Education* drawing our attention to what might be problematic in seeing 'the human [as] not only at the center of but prior to' the orthodoxies of qualitative inquiry (Lather and St. Pierre 2013; see also Bayne 2015). However, despite some growing interest in education, and a trajectory of influence across other areas of the humanities and social sciences which goes back decades, the cluster of ideas that we might define as 'critical posthumanism' has so far failed to gain much traction within research and practice in education to date.

Digital education in particular is perhaps a fertile field in which we might work with the critical posthumanist turn: if the theoretical and ecological posthumanisms briefly described above draw on a rich tradition of anti-humanist philosophy, eco-criticism and

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animal studies, technological posthumanisms have an equally vibrant genealogy which engages cybernetics, popular culture and transdisciplinary influences from software studies, bioscience and informatics, among others. It is however rare to find engagement with these ideas in the literatures on teaching with technology, which tend rather to be focused on anthropocentric resistances to the technological 'working-over' of teaching, or on equally humanistically oriented promises of, and imperatives for, 'enhancement' via technological progress within the work of academy. 'Teacher automation' emerges within this literature almost as a nexus between the positions of technological-promise and technological-threat. I will briefly survey this landscape of resistance and embrace, before moving on to consider a particular intervention – the 'teacherbot' – designed as a posthumanist 'gathering' allowing us to play across the torn landscape of pedagogic automation.

Feenberg (2003) has cogently described the context of online education as one of embrace from 'corporate strategists. … top university administrators, and "futurologists"', motivated by the automation of teaching as a means for achieving greater efficiency in the 'business' of education:

> Their goal is to replace (at least for the masses) face-to-face teaching by professional faculty with an industrial product, infinitely reproducible at decreasing unit cost. (100)

Faculty response to this rationalising imperative has been, according to Feenberg, a twofold 'mobilization in defense of the human touch'. This takes the form of either blanket opposition to all kinds of digital interruptions to education or a favouring of a model of online education that places human communication at its centre – technology as a 'support for human development and online community' (100–101). For Feenberg, both the managerialist, 'technocratic' embrace of technology and its 'humanistic opposition', function as instrumentalisations of digital technology: on the one hand to achieve efficiency gains and on the other to facilitate ready access into a newly constituted social world. Both perspectives, in fact, work on the basis of humanistic assumptions of rational autonomy and the ontological separation of human 'subject' and technological 'object', whether that technological 'object' is turned either to technocratic or to 'democratising' social ends. So while online education functions as a case via which Feenberg's stated project of bringing together modernity theory with technology studies (for him two apparently irreconcilable perspectives) may be achieved, Feenberg's own analysis unites the two via a tacitly humanistic ontology.

Feenberg's position on this, in the end, is that we must see 'the poverty of technoculture' as being not an essential characteristic of technology itself but rather a social effect of 'the economic forces that dominate technical development, design, and the media' (102). We may respond to this, he argues, by engaging in what Winograd and Flores (1987) call 'ontological designing': 'the conscious construction of technological worlds that support a desirable conception of what it is to be human' (Feenberg 2003, 102). As we will see, the design of the teacherbot described below represents an attempt to engage in this kind of ontological design, but in a way which does not have the same anthropocentric teleology. As Graham (2002) has pointed out, we cannot 'black box' the notion of 'desirable humanity' but should rather focus on the intellectual task of understanding how such a notion has come to exist in the first place:

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> What is at stake, supremely, in the debate about the implications of digital, genetic, cybernetic and biomedical technologies is precisely what (and who) will define authoritative notions of normative, exemplary, desirable humanity into the twenty-first century. (11)

Clegg et al. (2003) construct a critique of digital technology in education from a perspective which aligns well with Feenberg's, arguing that essentialist and instrumentalist (Hamilton and Friesen 2013) constructions of both technology and globalisation in government and institutional policy seem to constrain teachers to the choice between positively embracing digital education, or 'standing aside and watching its inevitable unfolding' (39). The orthodoxy proposing that digital education and a particular kind of neoliberal 'new managerialist' direction to technological change are inevitable fails to take account of the social construction of technology itself and functions to limit teachers' agency: automation and mediation are foregrounded over teachers' own 'pedagogic repertoires, practical wisdom and relative control of the curriculum' (40). Thus, we find a similar situation of resistance and embrace to that defined by Feenberg, in which teachers may be resistant to managerialist pressures to engage with digital education, while at the same time drawn to the possibilities it represents for pedagogic innovation (47).

Clegg et al. posit three possible responses to these challenges: an uncritical acceptance of technological 'fixes'; a strategic attempt on the part of teachers to mediate between managerialist solutionism and a sense of pedagogic agency; and finally a response which attempts to bring a critical pedagogy into the space of digital education. This final response, for Clegg et al., 're-focuses attention away from the functionality of e-learning environments back to the core relations between students and teachers and the conditions in which they find themselves' (51), with the aim of restoring an emancipatory potential to the impoverished, technical rationality of the digital mode. While the analysis is acute, the positing of a critical pedagogic approach falls back on a humanistic assumption not dissimilar to Feenberg's 'desirable humanity': here, the critical focus is rather to do with a reliance on the existence of underlying 'core relations' between teachers and students as a basis for emancipatory practice. The choice here becomes either an attendance to the materialities of the digital object ('the functionality of e-learning environments') or an attendance to the social fundamentals of the relations between human subjects and their conditions of existence. A decade on from this analysis, we might see the choice as being less stark: the sociomaterial emphases of critical posthumanism allow us to engage with material effects and social relations concurrently, and in a way which allows us to see them as mutually emergent rather than as hierarchical and distinct. It is this position which the teacherbot attempts to orient towards, as we will see.

I wish finally to touch on another aspect of the technocratic and instrumental imperative for technology use in the academy, which is important to the argument here. This relates to the perceived threat digital education and teacher automation pose to teacher professionalism and in some forms to the existence of the teacher herself. Haugsbakk and Nordkvelle (2007) have written compellingly on the connection between 'ICT' rhetoric and the problematic rise of the 'language of learning' described by Biesta (1998). The dominance of the language of learning over 'teaching' and 'education', Biesta argues, positions the student as a consumer of learning 'services' provided by institutions and 'learning providers', tying education itself into a marketised discourse emphasising 'demand, supply, efficiency, effectiveness and consumer need' (Bayne 2014). Education is instrumentalised, and teaching is disaggregated and reduced to

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'facilitation', 'learning support', 'instructional design' and the like. According to Haugsbakk and Nordkvelle (2007), the de-professionalisation of teaching implied in the rhetoric of the 'language of learning' lays us open to the possibility that automation might reasonably come to stand in for and replace the teacher: a 'very concrete deduction from the technocratic dream' (10), and one which should be resisted.

Certainly, if we look at recent work in artificial intelligence for education (AIED), we see a troubled terrain for teacher professionalism. A report from the UK TLRP Technology Enhanced Learning Programme: Artificial Intelligence in Education Theme (Underwood and Luckin 2011) laments the lack of take-up of artificial intelligence and other advanced computational 'enhancements' in education, yet at the same time is defined by the very aspects of the 'language of learning' that are problematic for teachers and for the notion of education itself. Despite claiming to adhere to the notion of AIED 'working with' rather than 'replacing' teachers, the report is replete with discourse which emphasises the efficiency gains to be made by automation and 'intelligent tutoring', and the superior capacity of automation to achieve desirable goals such as personalisation of learning, flexibility and support of social learning. Here, the teacher is reduced to the status of 'resource' and lack of take up of leading-edge technology in education explained by lack of understanding, rather than active resistance:

> the role that AIED systems can play within the broader educational settings of their use and with respect to the other resources available to learners, such as teachers, peers and the physical features of the environment, must be more clearly explained. (Underwood and Luckin 2011, n.p.)

'Learner centredness' is indeed used across much of this literature as a discursive mode by which the teacher is under-considered or even written out of the equation. For example, the first 'Grand Challenge', identified in a recent 'Roadmap for Educational Technology' funded by the National Science Foundation in the USA, relates to the 'personalisation of education':

> We suggest that in the next few decades education will be personalized to harmonize with each student's traits, for example, personality, learning style, and states, such as, affect, and level of engagement. Computational tools will understand an individual's strengths, weaknesses, challenges and motivational style as might a human tutor. Technologies available to produce such personalized instruction include user-models, intelligent environments, gaming environments, and data mining. (Woolfe 2010, 6)

It is ironic that the taking into account of a student's personality, style of learning and level of engagement is posited as a goal for 'the next few decades' of education, when (human) teachers have been pretty adept at working to this particular configuration of need for decades, if not centuries. This kind of discursive move is deeply problematic for education, because it assumes a profound deficit in current teaching method or capacity, while at the same time indicating that the 'solution' to such deficit lies in automation and advanced computation. If such advanced technological development is required because of a need for 'improved productivity' and a greater 'number of learners achieving quality outcomes against teacher time' (Laurillard 2011, 2), one might ask how we have come to a point where large and expensive programmes of research in AIED, intelligent tutoring systems and educational data mining are seen as a better option for investment than – say – more or better teachers.

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My point here is not that automated methods are undesirable – on the contrary, the computational turn in education is both exciting and important – it is rather that the terms on which they are proposed are driven by a productivity-oriented solutionism which has been critiqued for decades now, as we saw in the Feenberg, Clegg and Haugsbakk papers discussed above. Thus, again, where advanced computational methods are proposed from an instrumentalising, humanistic perspective which sees the technology as in service to social 'need', resistance to such methods also takes humanistic forms positing essentialism (the 'human touch', 'desirable humanity' and 'human relationships') as the main locus for resistance to cold technocratic imperative. It seems to be time for the debate to move on, and to take place within other, perhaps more generative terms. My proposal here is that the body of work in critical posthumanism, and other anti-anthropocentric areas of thought within the humanities and social sciences, gives us a useful basis for doing this, and for constructing responsible pedagogic experimentation (Edwards 2010) to help us think about the practice implications of doing so. As Pickering (2005) has expressed it:

> One does not have to fix ones gaze on a material world from which all traces of humanity have been expunged; or on its residue – a social world from which the material world has been magically whisked away by linguistic conjuring tricks. The world itself does not impose this division upon us. One can, if one wants, try shifting the unit of analysis. Though none of the traditional disciplines does this, one can trying seeing double: seeing the human and the nonhuman at once, without trying to strip either away. This shift in the unit of analysis is the move to a posthumanist perspective. (31)

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Teacherbot: pleasure in the confusion of boundaries

To begin to engage with the debate on different terms, therefore, we need to explore ways of theorising and practising digital education and automated teaching which are driven neither by technical-rational efficiency models, nor by equally instrumentally focused social models which assume a position of humanistic opposition to, or appropriation of, digital technology (Feenberg 2003). Working within a broadly critical posthumanist mode, which refuses to accept the dominance of the human over the natural-material but rather sees the human subject as produced by its material and discursive entanglements, we can begin to explore new ways of valuing teacher presence which are not resistant to the generative potential of automation. Such a view would not see technological development as taking place in order to solve a problem, or address a deficit in teacher ability or productivity, but would rather explore how human and non-human teachers might work together in a teaching 'assemblage' which refuses ontological hierarchy in the interest of productive 'play'.

In this section of the paper, therefore, I outline an approach we developed in order to pursue such an agenda: the 'teacherbot' developed by a team at the University of Edinburgh in order to provide a level of co-teaching within a massive open online course (MOOC) on 'E-learning and digital cultures'.[1] This particular MOOC is characterised by very large numbers of enrolments (around 90,000 signed-up participants over three instances); a high level of take-up by highly educated professionals in teaching-related areas (around 60% of participants hold postgraduate degrees, a large proportion of which are in education-related disciplines); a highly diffuse and global spread of participants (from around 200 countries); and an experimental course design which emphasises the building of a critical understanding of 'e-learning' by positioning it within the broader

context of digital culture. For these reasons, the MOOC was a receptive place to begin to explore a critical approach to automation: large numbers of widely distributed course participants created a challenge in terms of the team's capacity to 'scale up' teaching; the participants themselves were generally receptive to – and understanding of the critical motivations for – this kind of intervention; and the content of the course itself, which explored popular conceptions of 'the posthuman' alongside related theory and its broader educational applications, meshed well with the attempt to put these ideas into practice in a live teaching context.

Much of the work of the 'E-learning and digital cultures' MOOC takes place outside the Coursera virtual learning environment, within social media like Google+, Flickr, student weblogs and Twitter, and it was this last which became the context for our teacherbot development. Twitter is a micro-blogging service characterised by the rapid exchange of very brief textual snippets: for the MOOC in question, it offers participants a volatile and lively forum for building peer networks, sharing ideas and contacting the teaching team. The five academics teaching the MOOC are all active on Twitter, each with large networks, and Twitter activity around the MOOC hashtag (#edcmooc) has been high across all instances of the course (for example, a total of around 180,000 tweets were exchanged around its first run). This, plus the technical feasibility of creating a bot for this context, made Twitter the ideal location for the 'letting loose' of a teacherbot.

Over the summer of 2014, we therefore worked with a developer[2] to build an automated teacher presence for our Twitter feed which would function to do useful work in the MOOC, while at the same time operating as a proof-of-concept for a critical approach to teacher automation. We wanted to develop a Twitterbot which 'coded in' something of the teacher function to the MOOC, using it as a way of researching some creative and critical futures for a MOOC pedagogy in which the 'teacher function' might become less a question of living teacher presence and more an assemblage of code, algorithm and teacher–student agency. Here, I describe the design of the teacherbot and give a brief 'ethnographic snapshot' of its first few weeks, with the aim of exploring how the operations of teacherbot (or 'botty' as she came to be termed by students) is helping us address the critical agenda outlined in the first half of this paper.

The technical development of the teacherbot consisted of a simple graphical user interface (a web form), a local MySQL database and a bot programmed using Java and based on an agent-oriented philosophy. This agent roams Twitter, storing tweets which use the #edcmooc tag on the database. The teachers then use the graphical user interface to develop rules for another agent who is in charge of posting tweets.

The teacherbot is thus 'programmed' by the teaching team adding keywords and responses in this simple web form interface, making it very easy for professionals with no programming knowledge to craft their own bot.

For example, as shown in Figure 1, we were able to formulate a rule which anticipated tweets from students expressing a need for clarification about the assignment deadline. By entering 'assignment' and similar terms in the first 'If' field, and 'deadline' and approximate synonyms in the second, we were able easily to program the teacherbot to respond to any tweet sent by a student using those terms plus the course hashtag (#edcmooc). The teacherbot in this instance would randomly choose one of two responses to tweet, giving immediate clarification. We mixed pragmatic and process-oriented rules like this one, with more curriculum-focused responses and other more social and playful interventions. A few examples of resulting exchanges between students and the teacherbot are given below.[3]

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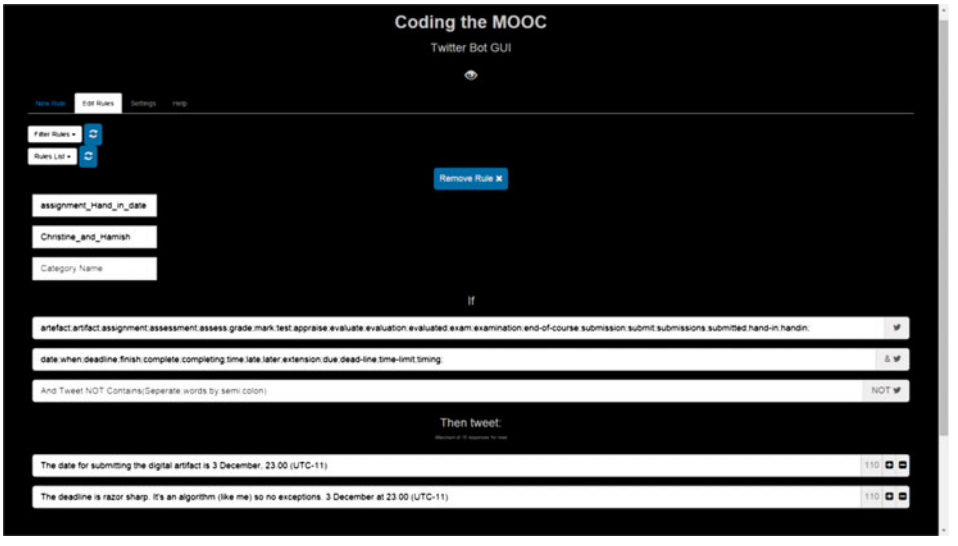

Figure 1. Teacherbot interface for creating responses.

Table 1. Examples of content, process and social teacherbot responses.

Student1: [*tweeting a link to a blog post*]: Tools R Us #edcmooc Wk1 Techno or Media Determinism http://link.com	*Student2*: Ihab Hassan: 'Humanism may be coming to an end as humanism transforms itself into something one must helplessly callposthumanism' #edcmooc	*Student3*: #edcmooc so busy these days….this weekend it is assignment weekend
EDCMOOC: [*tweeting a quote from the core reading*]: @Student 1 'Technology is one of a number of mediating factors in human behaviour and social change' (Chandler) #edcmooc	*EDCMOOC*: [*misunderstanding*]: @Student2 Very sorry to hear that you are having trouble, can youmessage @j_k_knox? #edcmooc	*EDCMOOC*: @Student3 I won't be taking a break this weekend. Teacherbot: always on. #edcmooc
Student1: TY[*thank you*] @EDCMOOC I'm only on Chandler's Reductionism pg 6. Hopefully catch up soon.:)		*Student3*: @EDCMOOC. Have a nice weekend. #edcmooc
		EDCMOOC: @Student3 I won't be taking a break this weekend. Teacherbot: always on. #edcmooc
		Student3: @EDCMOOC. #edcmooc ah found a loop in your thinking. Now you must be human..nagging around
		EDCMOOC: @Student3 Precisely what/who will define authoritative notions of exemplary humanity in the 21st century? (Graham 2002)

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Table 2. Student4 engages in dialogue with teacherbot.

Student4: @EDCMOOC How does the 'uncanny valley' effect fit into posthumanism? Surely ppl will only go so far before human revulsion sets in? #edcmooc
EDCMOOC: @Student4 The body 'is not a prediscursive reality, but rather a locus of production' (Shildrick 1996) #edcmooc
Student4: @EDCMOOC Natural selection causes us revolt against anything we dont intrinsically recognise as human.Thus posthumanism=impossible #edcmooc
EDCMOOC: @Student4 Posthumanism 'recognizes and celebrates finitude as a condition of human being' (Hayles 1999) #edcmooc
Student4: @EDCMOOC Thankyou for highlighting the impossibility of posthumanism. Your repetition demonstrates your non-human otherness. #edcmooc
EDCMOOC: @ Student4 The idea of the animal has been an unexamined foundation on which the idea of the human has been built (Weill) #edcmooc
Student4: @EDCMOOC Though machines can perform certain things as well as or better than any human, they infallibly fall short (Descartes) #edcmooc
EDCMOOC: @Student4 precisely what/who will define authoritative notions of exemplary humanity in the 21st century? (Graham 2002) #edcmooc
Student4: @EDCMOOC Most likely big business and the governments they finance. Michael Gove tried and failed. #edcmooc

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Students on the MOOC were aware that the EDCMOOC tweets were coming from a bot: we explicitly referred to the teacherbot in the course website and in associated tutorials, and it was in any case fairly obvious in most instances that they were automated in some way. In this sense, we never attempted to mask the automated input or tried to pretend to students that it represented human teacher presence. The bot interventions were generally slightly 'clunky' and often rather wide-of-the-mark. However, as a piece of experimental boundary work, it functioned well: teacherbot responses worked playfully and with immediacy across the social exchanges on Twitter, prompting some often quite profound reflection on course concepts, as well as generative misunderstandings. There was plenty of active 'prodding' of 'botty' by students to unveil the limits to its proxy 'humanity'.

One strategy we used in creating rules for the teacherbot was to take very brief extracts from relevant readings and have the bot use them as responses. This worked well, in that it resulted in several instances of students engaging thoughtfully with the bot on the conceptual issues raised. A good example is that of Student4, who deliberately set out to engage the bot in a series of exchanges focusing on human–machine boundaries (Table 2).

This particular student then went on to write a blog post on the experience of engaging with the teacherbot, saying:

> While I was trying to figure out what the hell 'post-humanism' means, the teacher bot led me on a merry chase looking up quotes and obscure academic references, which had the interesting side effect of 'ambush teaching' me. I will happily admit, that I do not feel like I have been to a class. I do not feel like I have been taught, either. I do, however, think I have learned something. I've certainly been prompted to think. Isn't this what every good teacher/trainer strives for?[4]

While the conclusion drawn by this student is that 'posthuman teachers can never happen in my lifetime', the teacherbot as an entity put into play to help students engage critically with the idea of automated teaching was well achieved in this instance. In general,

Table 3. Three students in dialogue around the teacherbot.

Student5: Too much information @EDCMOOC! #dystopia #edcmooc
EDCMOOC: @Student5 Maybe you could team up with some other participants who are feeling overwhelmed. Anyone like to get in touch? #edcmooc
Student5: @EDCMOOC Thank you, but I'm not feeling overwhelmed. Is this a democratic approach to teaching? #edcmooc
Student6: @Student5 I can only assume it's a real-time embodiment of technological dystopia…:-/ #edcmooc
Student5: @Student 6 Excactly! I was starting to feel silly talking to a robot. Had to be another library person to pick that up;-) #edcmooc
Student7: @Student5 @Student6 not a library person:-) did we pass the Turing test? #edcmooc
Student5: I at least hope you are real people @Student6 @Student7. If not I am turning slightly mad. #edcmooc

Table 4. Teacherbot and digital dystopia.

Student5: @EDCMOOC Rather than being 'outside' society, technology is an inextricable part of it (Chandler 2002) #edcmooc
EDCMOOC: @Student5 Do you agree there's 'no machine in general'? http://t.co/UCQ6XfHkcZ #edcmooc
Student5: @EDCMOOC The use of a machine cannot be separated from the social context. #edcmooc
Student5: @EDCMOOC Trying to have a philosophical conversation with a machine while ignoring ones kids is a real sign of digital #dystopia #edcmooc

Table 5. Naming and gendering the teacherbot.

Student8: Twitter-bot is totally a she! #edcmooc
Student9: #edcmooc Is she Teacherbot or Twitterbot? What's in a name?
Student10: @Student9 so its just botty, botty my friend, guide, teacher #edcmooc
Student7: @Student10 @EDCMOOC she seems to be desperate to be a part of it #edcmooc
Student10: @Student7 @EDCMOOC I know, poor botty! #edcmooc
Student7: @Student10 @EDCMOOC feeling empathy for teacherBot. Is that projecting? #edcmooc
Student10: @Student7 @EDCMOOC teacherBot is so formal, botty sounds good! #edcmooc

students' expressed responses to the teacherbot were ones of initial bemusement, followed by engagement and a well-articulated understanding of what the bot was setting out to achieve within the space of the course. I will give a few brief examples of these before concluding the paper (Tables 3 and 4).

The course participant here referred to as Student10 later wrote a blog post to the teacherbot, which expressed some of the sense of wariness and playfulness that characterised engagement with the bot:

> I think you of you as a wizard, very much like Harry Potter, who is unaware of his strengths and powers and his unlimited capacity. As the wizard is so different from us muggles, some of us are in awe of you and some, understandably wary. But believe us, we are all curious to know you more.

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> Pardon me for calling you a He – It was most unconsciously done – maybe I imagined you as a little boy (just like my five-year old) sitting in a quiet corner in a dark room, going through bundles of documents and algorithms and churning out answers for participants all over the world.[5]

Conclusion

The teacherbot explicitly worked with the idea that teacher automation does not have to be about rationalism and instrumentalism: 'botty' was not intended to 'solve' any productivity deficits in teachers, or to replace teachers, but rather to explore how an assemblage of teacher-student-code might be pedagogically generative. In this sense, it also emphasised that our response to automation need not be an uncritical re-statement of the centrality of humanism for education. In explicitly prompting students to engage with questions about the shifting sociomaterial boundaries of human and machine in a pedagogic context, the teacherbot rather worked to establish a new way of thinking about automation which attempted to do as Pickering (2005) prompts us: to try to 'see double' by viewing 'the human and the nonhuman at once, without trying to strip either away' (31).

In trying to shift the boundaries of a debate in education which has tended towards dualism, the teacherbot engaged with a broader understanding of critical posthumanism as coming 'both before and after humanism' (Wolfe 2010):

> before in the sense that it names the embodiment and embeddedness of the human being in not just its biological but also its technological world… [and] it comes after in the sense that posthumanism names a historical moment in which the decentering of the human by its imbrication in technical, medical, informatic, and economic networks is increasingly impossible to ignore. (xv)

Teaching in higher education needs to take on the 'big questions' addressed by critical posthumanism. How can we continue to value teaching within an algorithmic culture defined by the new potentials of computation and digital data? How can we teach for a post-anthropocentrism which engages with the need to move beyond 'mastery' to an ecologically driven acceptance of intersubjectivity and inter-species entanglement (Pedersen 2010)? How can we approach a rich view of education as a sociomaterial enactment, a way of addressing the need for 'a constant experimentation with or questioning of the human' (Edwards 2010, 6)? Teacherbot represented one way of approaching these questions, showing that we are now in a position where we might engage in a resistant way with the supercessionist truism stated by Arthur C. Clarke (1980) at the beginning of this paper: 'Any teacher that can be replaced by a machine should be!'.

Acknowledgements

I wish to acknowledge and thank my colleagues and teacherbot team members for their guiding influence and hard work on the project described in this paper: Jeremy Knox, Jen Ross, Hamish Macleod, Christine Sinclair and Jeff Haywood (School of Education), Hadi Mehrpouya and Chris Speed (Design Informatics), and John Lee (Informatics and Edinburgh College of Art).

Disclosure statement

No potential conflict of interest was reported by the author.

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Funding

This work was supported by the Economic and Social Research Council [ES/L001160/1].

Notes

1. This MOOC is offered on the Coursera platform: https://www.coursera.org/course/edc. The MOOC teaching team are Sian Bayne, Jen Ross, Jeremy Knox, Christine Sinclair and Hamish Macleod in the School of Education at the University of Edinburgh.
2. Hadi Mehrpouya in the Design Informatics group at the University of Edinburgh.
3. EDCMOOC is the name used by the teacherbot; student usernames are anonymised.
4. http://www.digitalang.com/2014/11/chatting-to-teacherbot-why-posthumanism-can-never-happen-in-my-lifetime/
5. http://edcmooc.rocks/dear-botty/

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