Digital Culture & Education
Volume 14(5), 2023

A Diffractive Transversal Framework: Crafting Cartographies of Pedagogical Encounters with a Posthuman Teacherbot

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A DIFFRACTIVE TRANSVERSAL FRAMEWORK:

CRAFTING CARTOGRAPHIES OF PEDAGOGICAL ENCOUNTERS WITH A POSTHUMAN TEACHERBOT

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Abstract: *Cartography as a posthuman method cultivates the creative and critical mapping of relational encounters between human, non-human and material entities. These empirically grounded accounts render the dynamic, intra-connected and inexhaustible possibilities verifiable in educational research practices. However, the current literature cites a number of examples of cartography mapping but provides no clarity as to how such an analytical practice might come about. In this paper, I design a Diffractive Transversal Framework to guide the cartographies in my research project where 21 interactive media students collectively author a story with(in) Flors the Teacherbot. The purpose of the framework is threefold: to limit the thresholds of encounter in an ethical and sustainable way; the multiperspectival nature of the framework acknowledges material entities; and transdisciplinarity draws from theory traversing multiple disciplines to become philosophically, educationally, and politically driven. A selected cartography charts the qualitative shift in student understandings around knowledge and its creation. Here, the students diffractively analyse how the collective story came about, rather than its meaning, through structured reflective dialogue enacted with(in) Flors. This is a novel approach to research in automated teaching and demonstrates how the method of cartography can be used to analyse digital data from a posthuman perspective.*

Keywords*: cartography; transversality; diffraction; new materialism; posthuman critical theory; automation.*

Introduction

This paper is part of a PhD research project that was funded by a Vice Chancellor's research scholarship at Ulster University. The research project explores new pedagogical practices that might be generated through a posthuman approach to automated teaching. I compose an educational assemblage that is situated within an Interactive Narrative undergraduate course module where Flors the Teacherbot, myself the human teacher and the students work together to

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co-author a collective interactive story. New teaching relationships emerge that are underpinned with an experiential approach to educational practices. The thesis chapters form cartographies that chart the discursive and material practices emerging from this posthuman educational assemblage. It is worth noting here that these cartographies are not exhaustive, nor are they conclusive. The cartographies comprise three chapters that focus on each of the posthuman concepts respectively: posthuman subject formation, posthuman knowledge and affirmative ethics. The cartography that charts the migration of the concept of affirmative ethics across the educational event has been recently published (Gibson 2023), thus exemplifying this diffractive transversal framework in use.

This research paper charts the process by which a framework was generated to inform and guide the cartographic mapping of these pedagogical encounters with a posthuman automated teacher. So, the text forms a cartography in its own right thus exemplifying this posthuman methodical approach as it unfolds. It begins by charting the formation of the posthuman educational assemblage before outlining the philosophical, educational and political aspects of the theoretical framework. Next, the posthuman methods of transversality, diffractive reading and cartographic mapping are introduced. Following on, the diffractive transversal framework emerges as a way to craft the cartographies. Finally, an example of the framework in use charts the generation of emerging posthuman knowledge systems.

A Posthuman Educational Assemblage

This section presents posthuman critical theory as a way to think about the automated teacher from a posthuman perspective. Next, the construction of the educational assemblage is discussed before introducing Flors the Teacherbot. Finally, the Story Circle event is outlined and contextualised.

Background

Much of the research to date has focused on anthropomorphic and anthropocentric visions of the automated teacher that privilege the human within hierarchical power structures (Schroeder et al., 2013; Kim and Baylor, 2016). Indeed, Bayne et al. (2020) argue that the automated teacher is often conceived as a neutral tool to be utilised for human gain and commercially evaluated in terms of efficiency and scalability. While personalised learning approaches underpin these current research practices, teaching approaches remain starkly absent, thus enacting knowledge creation practices that lack educational purpose (Biesta, 2017). Furthermore, the wider discourse within educational research reinforces this learner-centred approach, which works to centre the student while de-privileging the teacher (Selwyn, 2017). Indeed, much of the research practices within automated teaching use a learner-centric language that perpetuates this 'learnification' (Biesta, 2009).

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I suggest that pedagogical practices within automated teaching systems are transmissive by nature and underpinned by resurging behavioural approaches to knowledge creation reminiscent of Skinner's teaching machines of the 1950s (Watters, 2021). Moreover, these learning approaches, that conceptualise the creation of knowledge as a transmissive computational object, are underpinned by a humanist framework, forming a reductive objectified view of what automated teaching might become. As such, the agential capacity of the automated teacher to shape knowledge systems is largely ignored, while the embodied pedagogical approaches and inherent value systems remain obscured beneath opaque algorithmic workings.

This research proposes posthuman critical theory (Braidotti, 2019) as a theoretical framework with which to look beyond the limitations of a humanist approach to the automated teacher. Posthuman critical theory critiques the humanist ideal of the supremacist male situated at the top of the species hierarchy. This approach has been largely absent in studies of the automated teacher. The concept of posthuman subjectivity helps us to think about the human teacher and the automated teacher as equal entities, albeit with a differentiated capacity to shape knowledge creation processes. I argue that, when viewed as a posthuman subject, the pedagogical practices embodied within the automated teacher move beyond the transmissive to embrace a more relational style of teaching.

In response, this research study explores new pedagogical practices within automated teaching from a posthuman perspective. It addresses the research question 'What new pedagogical practices might be generated through a posthuman approach to automated teaching?' It traces an academic year in the life of a chatbot in the form of an automated teacher called Flors. Flors the Teacherbot worked with Interactive Media students over the course of two semesters, between 2019 and 2020, at a UK University. The research aims to acknowledge the role played by Flors in actively shaping the educational processes and to better understand the political implications of these pedagogical practices embodied within Flors. This research looks at alternative ways of working with an automated teacher; to assess these emerging knowledge systems; and to identify the alternative pedagogical practices that this might generate. This educational assemblage aims to affirmatively influence student perspectives around automated teaching – beyond that of a reductive, narrow and disempowering view of automated teaching to a more progressive and affirmative approach.

Flors the Teacherbot

A chatbot is a software application that facilitates text-based interaction with its user. I coded a chatbot using Artificial Intelligence Markup Language (AIML) from the Editor panel on the Pandorabots server. This is a free server that was used to build, host, test and deploy Flors the Teacherbot. As Flors' botmaster, I was automatically granted access to the algorithms and to the user generated chatlogs which charted all textual encounters between bot and client.

The chatbot was deployed on the Blackboard online learning environment which is hosted internally by Ulster University. This served to limit Flors' access exclusively to the student

participants who were first required to login to the Blackboard course page using their student credentials.

The Story Circle Event

Ethics approval was granted for the research project by the Ulster University ethics committee and the student participants submitted informed consent. The student participants comprised all the 2nd year students enrolled on the Interactive Narrative course module in part fulfillment of the BSc in Interactive Media programme at Ulster University. This module comprised two assessments designed to explore how narrative operates within online documentary storytelling: CA1 and CA2 weighted at 80% and 20% respectively. The students first completed CA1 where they explored narrative structures through the development of an interactive documentary (iDoc).

This research focused on CA2. The aim of this assessment event was to compose and then activate a posthuman educational assemblage.

The CA2 assessment event, entitled the Story Circle, was a multi-authored interactive narrative about interactive narrative. Twenty-three authors contributed to the collective story: twenty-one student participants, Flors the Teacherbot, and myself as the researcher, coder and teacher.

Here, the students were required to publish their story within Flors. Their story must comprise an aspect of their respective interactive documentary (iDoc) topics outlined in their previously completed CA1 assessment. This simple act of storytelling functioned as a pedagogical device for 'understanding complex subjects' (Alexander, 2011 p.215). Furthermore, the students were required to connect their story to the previous entry, while leaving it open for the next student to publish their story.

The following screenshot (see Fig. 1 below) captured from the Flors the teacherbot webpage during the development phase visualises an instance of what this relational process between student and automated teacher might look like. The student includes the phrase 'Story Circle' in the dialogic encounter to activate the following response from Flors:

Welcome to our Story Circle. Here is the previous paragraph of the story. Please add to it …

Flors then proceeds to display the following quote, taken from the young climate activist Greta Thunberg (2019), to initiate the collective narrative:

No one is too small to make a difference. I was so frustrated that nothing was being done, and I felt like I had to do something …

The student proceeds to type their story into the white text box and then clicks the 'Send Message' button to publish their story to the collective narrative (see Fig 1). This quote was selected due to its perceived potential to provoke the students to respond and drive the narrative by identifying their topic, refining a point of view and deciding a course of action (Gibson, 2023 p.8). I coded

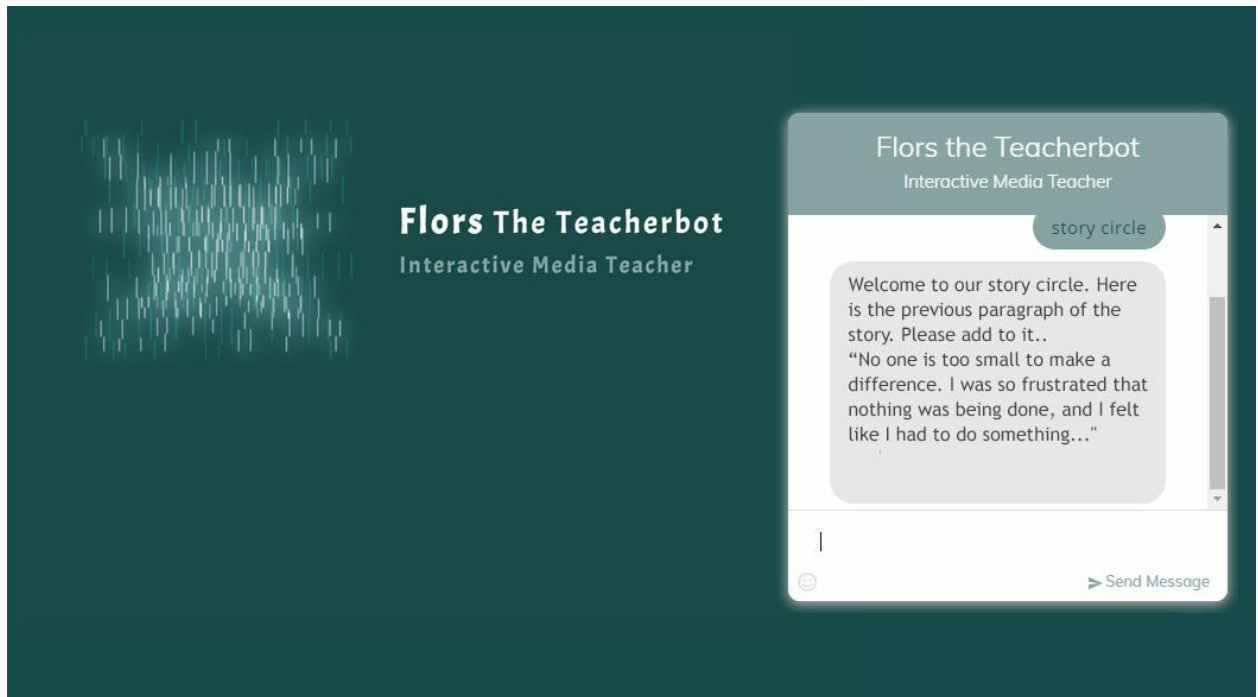the algorithms that activated this story circle into a file called 'storycircle.aiml' (see Fig 2).

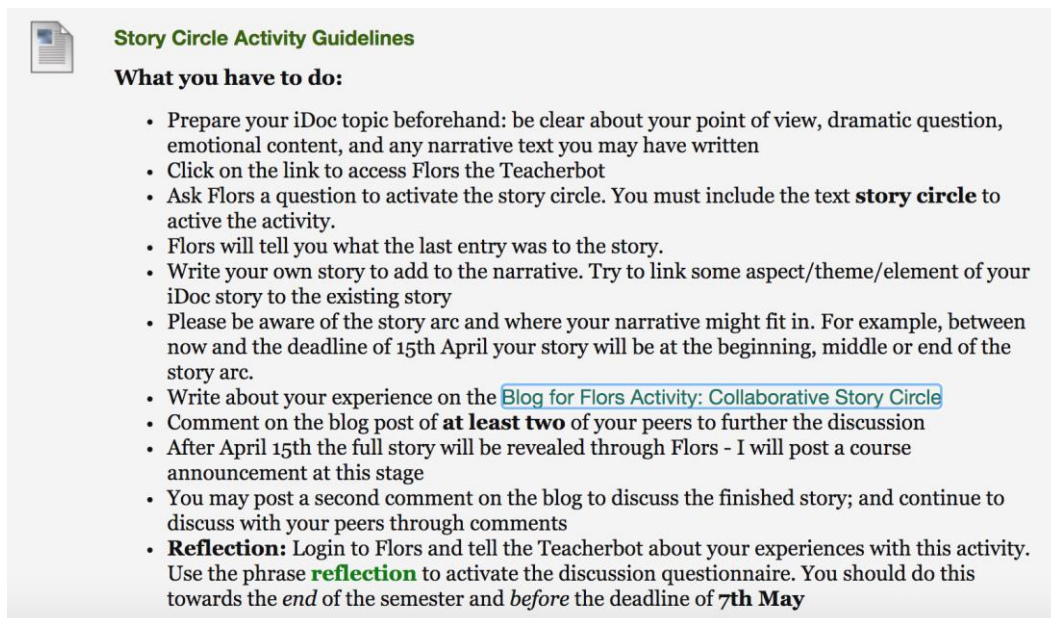*Figure 1: Flors the Teacherbot inviting a publication (Gibson 2023, p.8)*

Figure 2: An extract from the algorithm that activated the story circle

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The educational aims were threefold: to foster creativity whereby the students had to look at their iDoc topic from different perspectives; to encounter the concepts of non-linearity, co-authorship and lack of closure in interactive storytelling; and to facilitate a collective approach to working with a chatbot. The platform of action to enact this educational assemblage comprised three parts: (1) creating the interactive narrative with and through Flors; (2) engaging in community discussions via the course blog; and (3) the completion of the reflection questionnaire administered in and through Flors. Guidelines around the Story Circle activity were posted online on the Blackboard course area (see Fig 3).

Fig3: The Story Circle activity guidelines (Gibson 2023 p.14)

This posthuman educational event reconceptualises knowledge from three perspectives: how knowledge is created, what constitutes knowledge, and how this knowledge creation might come about in desirable ways. It sought to surface the pedagogical practices that might bring about these alternative knowledge systems.

Theoretical Frameworks

This research argues that automated educational practices should become more philosophically,

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educationally and politically driven. This section addresses each of these disciplines in turn and considers their value in relation to the Story Circle event.

Infusing Philosophical Values

The central concepts of Posthuman Critical Theory (Braitotti, 2019) provide a framework which grounds the situated and perspectival nature of this research. The concept of posthuman subject formations provides a way to understand how the students might think about technology in a different way, how they might come to reframe their supremacist sense of self in relation to the multiple entities of the educational assemblage. They are no longer the central point of reference as their sense of self becomes de-centered and they struggle to consider Flors as an equal entity. It was hoped that this alternative vision of Flors the automated teacher from a non-hierarchical perspective might open up the possibility of new forms of educational practices.

Consequently, it was hoped that the students might come to value the different forms of knowledge generating through these automated systems, and how these knowledge forms might come about: to extend their view of knowledge to include knowledge formations that are unquantifiable, unpredictable, and difficult to detect; and to foster a collective approach to knowledge creation. Posthuman knowledge conceives the creation of knowledge as events that will occur through relational encounters within Flors and peer-to-peer through the Blog. These events manifest as conflicts of resistance that reflect the power structures at play: in other words, the capacity to act, or agential capacity of the differentiated multiple entities immanent to the educational gathering. This process affords the students the opportunity to acknowledge the role played by Flors and their peers in collectively creating and shaping knowledge.

Points of conflict occur where students face both restrictive and empowering forces in their capacity to act. Affirmative ethics provides a way to evaluate student knowledge creation as the reaching of adequate understandings around the conflicting agential capacity of the multiple entities within these relational encounters. Educational technologies are encoded with pedagogical practices that have the potential to: filter access to information, specify what can be known, shape thought processes, impact emotions, and dictate actions (Susskind, 2020). That Flors the Teacherbot might embody such powerful political forces renders the careful consideration of the ensuing ethical implications as a matter of great importance. It becomes imperative that every attempt be made to make visible and transparent these encoded political practices and to adopt such practices that are ethically viable and in keeping with Braidotti's (2019) view of a positive and affirmative ethical stance.

The posthuman concept of affirmative ethics can help the students to deal with the issues around privacy and control embedded in educational technologies, not to mention the technologies that they encounter outside of the University. Whilst these covert political practices might not be encoded into Flors, they are increasingly becoming embedded into our everyday digital devices and students might come to encounter them in future educational technologies. This positive and affirmative posthuman stance aims to empower the students through inscribing them with an adequate understanding of the political forces that are embedded into their technological

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mediations. This educational gathering with Flors aims to activate events that will afford the students the freedom to encounter these political forces through their relational interactions with Flors and with their peers.

It is hoped that to 'inscribe' (Braidotti, 2019 p.169) the students within a framework of affirmative ethics will form the reference point, for the purposes of this research, from which these changes in students' perceptions and understandings might be empirically identified and verified. These encounters with the posthuman concepts will manifest as points of conflict, or differences, that reflect their power to act: the differentiating forces of agential capacity within the relational events.

These text-based accounts form cartographies that map the formation of subjectivity and knowledge creation practices that are philosophically, educationally and politically informed. Moreover, these cartographic maps will make visible the conflicting power forces that empower and restrict the agential capacity of the multiple entities within the educational assemblage.

In summary, the purpose of the cartographic analysis is to locate and understand the emergent alternative pedagogical practices of Flors the posthuman automated teacher through the ontological and epistemological concepts of: posthuman subject formations; posthuman knowledge systems; and affirmative ethics. The aim is to engage and provoke the students to think critically about how they understand automated teaching. This account will chart how posthumanism can shape our educational practices by embedding posthumanist thinking and values into the course curriculum, assessment practices, and into the pedagogical practices that might bring about knowledge creation in more desirable ways.

Activating Educational Aims

In this section, I will draw on Biesta's pedagogical framework (2006, 2010, 2016, 2017) to advocate a constructive theory of the purpose of education as a way of engaging with automated teaching from a more educational stance.

As we move towards an increasingly quantified society (Susskind, 2020) through the speedy acceleration of our technological mediations (Braidotti, 2019), educational researchers caution that aspects of the educational process that are legitimised and valued are becoming limited to that which can be measured (Biesta, 2012). This quantified educational approach constructs a very narrow view of what it means to teach and create knowledge, one that the literature review revealed is becoming exclusively focused on the measurement of standardised educational outcomes, to the exclusion of teaching practices and knowledge creation that cannot be quantified. This research seeks to push back against this phenomenon of computational thinking within educational practices to consider a more values-based approach. In order to do this, we must first consider what might constitute these value systems, and what they might look like. Indeed, Biesta (2009, p.33) argues that teaching 'must always be framed by a sense of purpose' that can help to make visible these value systems.

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Biesta (2009) proposes a broad framework around the purpose of education that can help us to legitimise the pedagogical practices within this posthuman educational encounter, more especially with relation to institutional policy in the form of the course curriculum and assessment practices. Biesta's (2009) framework comprises three broad educational aims: socialisation, qualification and subjectification.

Socialisation functions within education as a way to integrate students into groups that are of a particular social, cultural and political order that embody norms and values (Biesta, 2009). Braidotti's (2019) concept of posthuman subject formations provides a way to think about these social groups from the posthuman perspective of a convergence of multiple and differentiated entities: how this assembled community is constructed and what it might look like.

Qualification as a specific purpose within educational practices recognises the need for students to create knowledge and gain skills. Furthermore, when pedagogy becomes framed around a purpose of qualification, it acknowledges the role played by institutional policy in determining course curriculums and assessment practices. Knowledge creation practices within automated teaching have previously tended towards computational approaches that are often prescriptive and transmissive by nature. Qualification that is informed by posthuman knowledge systems helps to counter this prescriptive approach to what constitutes knowledge and to consider how knowledge creation might be enacted in more educational, rather than commercial, ways. These new knowledge systems can help us to push back against the commercially driven value systems that often exist within automated teaching that are framed around efficiency and scalability.

Biesta's (2009) concept of subjectification may, on the surface, appear somewhat conflicted with the concept of socialisation in that it encourages the students to seek independence from their social groups. However, the concept of affirmative ethics from Posthuman Critical Theory can help us to reconcile these paradoxical educational aims. For example, subjectification requires the students to 'become more autonomous and independent in their thinking' (Biesta, 2009 p. 39). Thus, the students are becoming individuated entities within the educational gathering, whereby they recognise their sense of self as an equivalent relational entity. So, this conception of the self is in relation to those around them. This notion of an individuated rather than an individual sense of self is an important distinction as the former functions within the level of the collective whereas the latter does not. An individualistic approach to automated teaching, under the guise of personalised learning, is problematic to these educational practices. For example, Biesta's (2019) notion of autonomy affords students the opportunity to encounter their freedom to learn. However, this is very different from individualised or personalised learning approaches embodied within many current automated teaching systems. This neo-liberal rhetoric seeks to equate freedom with choice: students are free to pursue their own learning path at their own pace. On the contrary, Biesta (2009) argues that this form of student autonomy is 'not necessarily liberating and progressive'. Affirmative ethics as a concept, guides us here to push back against this rhetoric of freedom within automated teaching by empowering students to work collectively and to think critically about these automated systems: to become aware of their agential capacity; and, to

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adequately understand their restrictive and liberating power forces.

Enacting Political Appraisals

Zuboff (2019) cautions against our increasing tendency to unwittingly relinquish power to the technologies of Silicon Valley. Moreover, these power structures tend to operate 'outside of our awareness, let alone our consent' (Zuboff, 2019 p.233). Critical posthumanism opens up the possibility of alternative power sources that move beyond the misconception of the exclusivity of the human to make visible such power sources as animals, technology and material matter (Snaza et al., 2014). So, pertinent to the context of this research, posthumanism acknowledges technology as a legitimate power form that can be critically appraised to make visible these emerging power structures. In the words of Braidotti (2019, p.73), 'Speaking truth to power is the method to reach an adequate understanding of these conditions.'

Susskind (2020) identifies these covert power shifts from humans to technology as a political matter. Moreover, he cautions against the stark absence of political theory from the speedy accelerations of technological mediations 'that are taking place in alarming cultural and intellectual isolation' (Susskind, 2020 p. 8). Thus, the normative stance of this research helps to map the difference between 'what is' and 'what ought' to be (Susskind 2020 p. 83) informed by value judgements around the purpose of education. The political implications of EdTech from a philosophical and ethical perspective are explored in keeping with Braidotti's (2019) theory of 'affirmative ethics'. It seeks to speculate around future political systems within automated teaching that might be considered more desirable in that they are imbued with posthuman value systems. So, these speculative political systems might shift the binary power forces, that position humans and technology in dualistic opposition, to a more equitable plane that considers the differentiated agential capacity of all the posthuman entities within the political structure.

Susskind (2020, p.8) argues that we need an 'intellectual framework' to help think critically and clearly about the political implications of these technological mediations. He posits the traditional concepts of political theory to think critically about and better understand these political systems: these concepts comprise power, liberty, democracy and social justice (Susskind, 2020 p.76). The purpose of this posthuman assemblage is to afford students the freedom to become aware of, and to think critically about, the political implications of Flors agential capacity. The concepts of political theory will guide the cartographic map to make visible and to generate understandings around the differentiated forms of governance and resistance within the relational encounters. The aim is to push back against the speedy accelerations of advanced capitalism (Braidotti, 2019) by 'repurposing digital tools away from commercial logics' to generate 'rich data' rather than 'Big Data' (Selwyn, 2019a p.86).

Posthuman Methodologies

This section introduces transversality, diffractive reading and cartography as posthuman analytical methods that can help to chart the findings of the research. Each of these methodological concepts are discussed in turn.

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Transversality

Transversality can be defined as 'the operational concept that helps to conceptualise the subject across multiple axes' (Braidotti, 2019 p.40). Furthermore, the entities within the posthuman subject formations are transversal in that they 'connect but also differ from each other' (Braidotti, 2019 p.40). These multiple axes comprise temporal and spatial continuums; vital material formations; and the Major and Minor Sciences. Transversality provides a conceptual frame from which to transverse these complex and often paradoxical terrains in the quest to determine common points of interest that fuel posthuman educational discourse and practice. The collaborative nature of these complex posthuman gatherings is imperative to their quest to generate 'creative learning rather than human intentionality' (Bozalek, 2018 p.397).

From a teaching perspective, the concept of transversality identifies points of contact that connect but differ. Where common issues emerge, we can then identify what questions we should be asking, to think about what might happen rather than what we think should happen. These issues are not primarily of a technical nature but rather are constitutive of a wider posthuman assemblage that recognises the unpredictability of postdigital education, thus requiring pedagogical approaches with the capacity to adequately address the challenging nature of knowledge creation and speculative teaching practices where 'value judgements' (Biesta, 2012) that are conceptualised and situated become imperative.

Diffractive Reading

The overarching research question of this thesis is concerned with the pedagogical practices that might emerge during an educational assemblage: *What new pedagogical practices might be generated through a posthuman approach to automated teaching?* The speculative nature of this question did not constitute an interpretative enquiry. Such an enquiry would seek to derive meaning from what is happening, whereas the purpose of this research is to look at what is being produced in the form of pedagogical practices. So, rather than focus on the completed interactive narrative, the Story Circle, and attempt to interpret meaning from this, the focus shifted instead to how the collaborative story was produced. The educational events were charted and mapped as they unfolded. A diffractive approach helped to address the research question by asking: What new pedagogical practices are being produced here?

Haraway (1997, p.16) first suggested diffraction as an alternative research methodology to critical reflection and reflexivity in the 1990s claiming that, 'reflexivity, like reflection only displaces the same elsewhere'. Haraway critiques critical reflection as an interpretive practice on the basis that it positions the researcher as an object that exists separate from the data, and where thinking is conceived as taking place within the mind of the researcher. Haraway conceives of diffraction as an alternative to critical reflection, in that it positions the researcher in and of the world. While Haraway's (1997) notion of diffraction was of a metaphorical and figurative stance, Barad (2007) expanded this view to include new materialities. This materialist philosophy does not separate

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matter from meaning in knowledge creation processes, but rather looks at them as being 'mutually constituted' (Barad, 2007 p.152). This new approach to looking at the data opens up possibilities for the researcher 'to make matter intelligible in new ways and to imagine other possible realities presented in the data' (Taguchi, 2012 p.267).

Traditional ethnographic methods of critical data analysis, such as discourse analysis, require the researcher to conduct an objective interpretation of the data, while simultaneously acknowledging the role played by the researcher in producing the data. In this regard, the researcher is positioned as largely separate from the data, where the data is objectified through the rigorous categorising of passive matter in a bid to represent the true meaning. Barad (2007) argues that these differences are always negative in that they ontologically separate human and non-human entities to create divisive hierarchical structures that position differences as less than what is held up as the point of reference. Diffraction affords the analysis of data from a more positive perspective where difference is perceived as the differentiated affective forces of relationality.

The Teacherbot research project comprised such diverse disciplines as the Arts, Humanities and Computer Sciences: Design, education, and technology respectively, within the Interactive Media fields of design, coding and interactive narrative. Moreover, the theoretical framework of Posthuman Critical Theory (Braidotti, 2019) is a philosophical framework that draws heavily from feminist, gender and anti-colonial studies. So, the method of Diffractive reading supported what Braidotti (2019) might term 'a supradisciplinary' approach to the research design through a diffractive analysis of the research data that was experimental by nature: Where the text can be read in and through these differing major disciplines and minor fields of study to understand the data from multiple perspectives and to create something new. Deleuze understands this notion of diffractive reading as similar to 'plugging into an electric circuit' (1995, p.8) and the ensuing analytical implications that looks at how a phenomenon works rather than the traditional reflexive and reflective concepts of interpretation, explanation and understanding.

This required a shift in temporal and spatial perspectives, where this diffractive reading could not be conducted along a linear path to look at each stage of the research consecutively. Rather, the deployment of Flors was conceived here as an entanglement of mutually constituted, interconnected, relational activities along a media-nature-culture continuum that respected all human and non-human matter equivalently. Moreover, while reflexivity and reflection assume the researcher as 'independent individuals who are knowing subjects' (Bozalek & Zembylas, 2017 p.111), diffraction contests these binaries and their political implications

Diffraction as an analytical research approach brought the research data together in a way that afforded the opportunity to look at it concurrently, rather than analysing the data sets in an isolated, individualistic and linear way. To clarify further, there was no universal or supremacist point of reference from which to form equivalences. Data generated from any one entity was not privileged over that of another. For example, student generated data was not considered superior, or inferior, to data generated by myself or by Flors; and vice versa. The intra-active nature of these differentiated entities of the educational assemblage - student, Teacherbot, human teacher,

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Blackboard, Blog, course materials - supposed that, 'they are always affecting or being affected by each other in an interdependent and mutual relationship as a condition for their existence' (Barad, 2007 p.152). This is different from inter-activity where entities are considered independently (Taguchi, 2012). Thus, these relational, intra-dependent, and interconnected entities could not be analysed in isolation. Diffractive reading provided a way to look at how these 'material-discursive phenomena' are interconnected and co-constituted (Bozalek & Zembylas, 2017 p.112).

Cartographic Mapping

My multiple roles within the research constituted teacher, assessor, coder and PhD researcher thus I was inextricably involved in the process of knowledge creation. From a posthuman perspective, I attempted to view all modes of participation in an equal way where one role was not privileged over another. However, it is important to acknowledge the differentiated power structures inherent in these various roles. For example, the role of coder granted me access to Flors' algorithms which raises concerns around the Teacherbot embodying my biases and prejudices to influence what I believed *should* happen rather than facilitating opportunities around what *might* happen or what was actually happening. By way of response to this predicament, cartography as a method adopts a more subjective stance to provide a somewhat reliable way to tracs the roots and routes of emerging knowledge systems.

The empirical observations of a posthuman ethnography respect all entities within the educational assemblage equally, albeit with differentiated agential capacities. This absence of a universal point of reference requires the identification and inclusion of what Braidotti terms a 'missing people'. Figuratively speaking, these 'missing people' include non-material entities such as code, technology or algorithms. Thus, a posthuman ethnography connects 'notions and practices that were often kept apart' in traditional humanist-oriented research practices (Braidotti, 2019 p. 135). Braidotti suggests cartographic mapping to create concrete empirical evidence that can help to render the metaphorical figurations of the posthuman subject verifiable from a research perspective.

Cartography is the 'science or practice of map drawing' (Concise Oxford Dictionary, 1995, p.201). Good cartography can help us to visualise spatial terrains, and maps are often used in knowledge making processes to perceive patterns and relationships within phenomena. Braidotti (2019, p.136) invokes the use of critical and creative cartographies 'to assist methodologically' in creating accounts of the 'complexity of power relations' within the formations of posthuman subjects. These cartographic accounts map the 'record of what we are ceasing to be' and 'the seed of what we are in the process of becoming' (Braidotti 2019 p137). Thus, in a posthuman stance, good cartography can help us to map the spatial and temporal continuums to visualise the 'figurations of the kind of knowing subjects currently constructed' (Braidotti 2019 p136). The aim here was to chart the relational encounters from a pedagogical perspective.

Since Braidotti's (2019) notion of cartographic mapping cites examples of this analytical practice,

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such as Gabrys (2011) and Parikka (2015), but no clarity as to what such a cartography might look like, I created a Diffractive Transversal Framework to guide the cartographies.

Crafting Cartographies

This section introduces the inexhaustive nature of the data and presents the diffractive transversal framework as a way to limit the thresholds of encounter with the technological mediations. The framework is presented as it unfolds in a tabular format. The final paragraph discusses how the framework can be used to address the research questions.

The Infinity of Relational Possibilities

However, at this point of the research, the enactment of this cartographic analysis of the data proved an incredibly daunting, if not impossible, task in terms of the infinity of both scope and scale. The differentiated nature of these posthuman entities - their diversity, heterogeneity and multiplicity - constitutes relational forces that render the extent of their agential capacity inexhaustive. For example, the code and algorithms within Flors constitute viable data sources, to include the unpredictability and messiness of Flors' automated workings. Moreover, these multiple entities are interconnected, inextricably linked and mutually constitutive. These relational encounters between student, material matter, and automated teacher are in a perpetual state of flow as they fluctuate between the actual and the virtual within a constant state of becoming. Moreover, these dynamic entities are contingent, contextualised and intra-connected. They are never static, and their relational possibilities are infinite. For example, the point at which student number 1 (S1) emailed me to express concerns around how Flors remixed their story presented a juncture from which this story departed. However, to trace this ever-changing and evolving collectively created story amongst a terrain of multiple entities with infinite relational possibilities required a qualitative shift in traditional analysis methods from both an ontological and epistemological perspective.

A Diffractive Transversal Framework

For the purposes of this research, I have created a diffractive framework to locate and contextualise the cartographic map (see Table 1 below). Van der Tuin defines this approach to diffractive reading as a transversal methodology (2018 p.18). Table 1 below shows the structure of this diffractive framework and how it analyses the data from different perspectives to address the research question. This conceptual framework is designed to trace the temporality of the educational event as a process of knowledge creation rather than a structure of knowledge creation. It can be argued that the point of diffraction does not exist as a static and isolated 'circumscribed point' but rather 'an event that exists in a spatial (potestas-potentia) and durational (actual-virtual; transformative)

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field' (Van der Tuin, 2018 p.30). I present the diffractive reading of a philosophical, political and an educational theory to adequately guide the mapping of the spatialility and the durationality of this educational event.

Susskind's (2020) political theory addresses the spatiality of the event through the proposed critical concepts of power, democracy, liberty and social justice. These concepts provide a political perspective from which to read the data. Biesta's (2017) educational theory addresses the durationality of the knowledge creation process along a temporal path from point A to point B which in effect charts this change. These changes are twofold in that they identify instances of pedagogical practices and in turn the effects of these changes can be mapped through their enactment by the students to create knowledge. The concepts from these theories are juxtaposed in a contradictory and complementary state of play that opens up the data analysis to a speculation of possible options while simultaneously closing it off through the sustainable boundaries of the framework. This conceptual framing of the cartographic account presents an analysis method that is transdisciplinary in approach. This notion of transdisciplinarity is distinct from interdisciplinarity in that the former brings together ideas from different disciplines, while the latter takes the ideas from one discipline and applies them to various other disciplines.

Diffractively reading through these transdisciplinary concepts constitutes a perspectival analysis that draws from these ideologies concurrently; where insights are explored through one another to collectively generate patterns of discord and harmony that illuminate the research questions. So, the same data was approached multiple times from different perspectives. From here, new problems were generated. For example, disruptions around conceptions of knowledge and its creation; issues around access to Flors and to the materiality of the story; and concerns around trust. In this way, I came to create connections to the data in perspectival and relational ways.

	Posthuman Subjectivity	Posthuman Knowledge Systems	An Affirmative Ethical Response
Issues around Automated Teaching from current literature	Human teacher and code perceived as oppositional forces; Individualistic notion of Personalised learning	Knowledge and its creation perceived as an object to be transferred in an efficient, prescriptive and highly scalable manner	Lack of students' awareness and understanding of algorithmic forces of power
	Instrumentalism: Assuming that tech is a 'neutral instrument of human intention'	Utilitarianism: Assuming students know what they want to learn/what they desire	Essentialism: Assuming students are self-motivated and self-directed
Perspectives	Socio-technical	New-materialist	Political and Ethical
Research Questions	RQ2: What does it mean to be human within automated teaching systems?	RQ3: What might these new systems of knowledge creation look like?	RQ4: How should we enact empowerment through automated teaching?
Educational Values	Socialisation	Qualification Subjectification	Subjectification
Political Values	Social Justice	Liberty	Power, Liberty, Democracy, Social Justice
Institution	Blackboard VLE	Course Curriculum, Assessment Rubric	UU Ethics Committee
Pedagogical Approaches	Defamiliarization	Relationality, Experiential	Non-Linearity
Pedagogical Devices	Story Circle, Course Announcements, Email, Blog	Individual Student Profiles containing Transcripts of Students' activity	Reflective Questionnaire with(in) Flors
Points of Conflict: Instances of teaching	Agency: Flors as co-author	Digital Text: co-authorship, non-linearity, closure	Power: Access and Trust
Student Discourse	Blog, Reflective Questionnaire	Blog, Reflective Questionnaire	Blog, Reflective Questionnaire
Flors' Pedagogical Strategies	Flors as a co-author	Remixing the story	Controlling access to Flors and the story
Flors (algorithmic)	Remixing story entries	Only reveals previous entry	Login required No Submit Button for the Story

	Posthuman Subjectivity	**Posthuman Knowledge Systems**	**An Affirmative Ethical Response**
Human teacher	Coding AIML to make situated value judgements, Course Announcements, Email	Course Announcements Emails - nudging	Teacher responsibility, ethical boundaries
Assessing Knowledge Creation Instances: Interactive Narrative	Co-authorship	Nature of Digital Text: Authorship, Nonlinearity, Closure	Individuated affective capacity to collectively create knowledge
Assessing Knowledge Creation Instances: Broad	Reframe a sense of self in relation to technology, other people	Reconceptualising what constitutes knowledge and its creation	Adequate understanding around restrictive and empowering political forces
Future Skills	Working creatively with technology and the environment in sustainable ways	Collectively creating knowledge as a relational event	Adapting affirmatively to change

Table 1: A diffractive transversal framework.

The framework establishes a parallelism between the concepts of Posthuman Critical Theory represented by the three columns entitled Posthuman Subjectivity, Posthuman Knowledge Systems and An Affirmative Ethical Response. The left-hand column comprises a diverse range of entities to include theoretical concepts, pedagogical practices, value systems, institutional mediations, digital and technical mediations and future speculations. Briadotti's (2019) notion of 'transversal' depicts a line that cuts through other parallel lines at particular points. So, from this framework the column entitled Posthuman Subjectivity traverses through the multiple table rows. This column forms the framework for a cartographic analysis that charts the educational event through the concept of critical postman subjectivity to address the RQ2: *What does it mean to be human within automated teaching systems?* Similarly, the column from Table 1 entitled 'Posthuman Knowledge Systems' traverses through the entire table rows to form the framework to address the research question RQ3: *What might these new systems of knowledge creation look like?* (see Table 2). Finally, the column from Table 1 entitled 'An Affirmative Ethical Response' traverses through the entire table rows to form the framework for a cartographic analysis that charts the educational event through the concept of affirmative ethics to address RQ4: How should we enact empowerment through automated teaching? Gibson (2023) exemplifies this framework in use through an exploration of RQ4.

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	Posthuman Knowledge Systems
Issues around Automated Teaching from current literature	Knowledge and its creation perceived as an object to be transferred in an efficient, prescriptive and highly scalable manner
	Utilitarianism: Assuming students know what they want to learn/what they desire
Perspectives	New-materialist
Research Questions	RQ3: What might these new systems of knowledge creation look like?
Educational Values	Qualification Subjectification
Political Values	Liberty
Institution	Course Curriculum, Assessment Rubric
Pedagogical Approaches	Relationality, Experiential
Pedagogical Devices	Individual Student Profiles containing Transcripts of Students' activity
Points of Conflict: Instances of teaching	Digital Text: co-authorship, non-linearity, closure
Student Discourse	Blog, Reflective Questionnaire
Flors' Pedagogical Strategies	Remixing the story
Flors (algorithmic)	Only reveals previous entry
Human teacher	Course Announcements Emails - nudging
Assessing Knowledge Creation Instances: Interactive Narrative	Nature of Digital Text: Authorship, Nonlinearity, Closure
Assessing Knowledge Creation Instances: Broad	Reconceptualising what constitutes knowledge and its creation
Future Skills	Collectively creating knowledge as a relational event

Table 2: The diffractive framework for the cartography of Posthuman Knowledge Systems

Enacting a Cartography: Generating Posthuman Knowledge Systems

I will now demonstrate how the framework can be used to map the findings from this research in

response to the RQ3: *What might these new systems of knowledge creation look like?*

The following account forms an extract from the cartography that charts the generation of new knowledge systems. It traverses through multiple entities and concepts within the Posthuman Knowledge column to map the educational experiences.

The students expressed a relational desire to connect through the struggle to publish their individuated stories within Flors. Here, knowledge creation becomes perceived by the students as a relational encounter with the multiple entities of the educational assemblage: with Flors, their peers, the story, and myself as the teacher and coder. We see this reflected through the following Blog comment from S5:

> *So well done to the person who went before me for leaving the story very open ended, it made my experience a lot easier and allowed me to be flexible in how I wanted my story to play out. I also tried to do this for the person after me by finishing my story with a question which needs answered. S5*

When the students had completed the story, they were eager to access the final collective narrative. To access the story, the students were first required to login to Flors where the sequenced, dynamic retelling of the story served to illuminate the story as a material entity. The students encountered 'the segmented nature' of much digital storytelling (Alexander, 2011 p.41). Here the students, Flors and the story became inextricably linked through the process of retelling the story. Meaning and matter become inseparable since the story could not be accessed without Flors, the algorithms that activate the retelling of the story, and the material embodiment of the text. This relational encounter illuminates a new-materialist conception of knowledge creation in terms of relational capacity where thinking is conceived as 'the ability to enter modes of relation' (Braidotti, 2018 p.46). It could also be argued that the students were themselves engaging in a diffractive analysis of the collective story where thinking becomes a 'transcorporeal process of enagement' (Bozalek and Zembylas, 2017).

For example, some of the students engaged in what might be described as a diffractive analysis in the Blog. Here, much of the discussion focused on how the process of this sequential form of storytelling resulted in a collective story that might be described as 'a jagged, staccato rhythm of unconnected moments' (Alexander, 2011 p.41), as expressed by S10 in a Blog comment:

> *The story itself didn't really make much sense … overall it was quite hard to follow. I think allowing the students to see all of the entries or at least more than one would have made it a lot easier to follow. S10*

So, in a diffractive style, the students began to look at the process around how the story came about, rather than a critical analysis around the meaning of the story, as expressed by S19 in the Blog:

> *I found that the current topic made it quite difficult to integrate my micro-narrative. I like your idea of allocating days to each student but perhaps doing that would take a large amount of time then to get to the final story. S19*

S1 adopts a critical approach by adopting a problem posing mode to think about their encounter with the concepts of closure and non-linearity:

> *And when you look at the full story it is difficult to follow and there isn't really a traditional beginning, middle and end point. But maybe you don't need that for a story to be interesting, maybe what is interesting about our story is the multiple shifts in narrative? S1*

This transformation in student understanding around the concept of closure 'allows us to connect these moments and mentally construct a continuous, unified reality' (Alexander, 2011 p.41). S13 expresses how meaning was created:

> *However, there were parts of the story which had been rearranged or repeated which broke the immersion of the story for me and made the story confusing at parts. I found myself having to read a few Sections over so that I could fully understand what the meaning of it was. S13*

S1 expresses this notion of continuity around the construction of a unified reality:

> *With interactive fiction there is no correct answer or correct way to take the story, it can be adapted in many ways and thats what makes authoring an interactive narrative so exciting. S1*

The student encounters with the concept of diffraction continued through the reflective Questionnaire. It is important to note here that this reflective encounter is not positioned in opposition to diffractive analysis. On the contrary, this questionnaire poses as a method of diffractive reading that reframes these student reflections into intra-active dialogues. To clarify further, the student directly enters into dialogue within Flors to complete this Questionnaire. So, they are not reflecting on their experiences from a distance as an independent subject separate from Flors. Rather, they are intra-connected through their embodied, embedded and affective entanglement within Flors during this relational activity. Here, the student is one of multiple entities within the posthuman subject formation. Furthermore, the knowledge creation is a relational process through the dialogic encounter with Flors. The materiality of the knowledge creation, in the form of the completed Questionnaire, is entangled within Flors. Quite literally, the separation of meaning from matter once again becomes problematised. Here, we can see Biesta's (2009) concept of student 'subjectness' as a purpose of education being enacted as the students encounter an individuated sense of self with the capacity to think independently albeit from the level of the collective.

Conclusion

This account charts the generation of a multiperspectival and transdisciplinary framework designed to guide the cartographies of pedagogical encounters with Flors the Teacherbot. This research has methodological significance for research in automated teaching through its exemplification of

cartographic mapping as a methodological concept. In this case, the selected cartography that charts the generation of posthuman knowledge systems illustrates how the diffractive transversal framework can be used to enact the posthuman method of cartography. However, these pedagogical encounters are inexhaustive and infinite by nature. So, the cartography forms 'partial' (Amoore, 2020 p.20) accounts that are contextualised, contingent and evasive of generalisations. Likewise, viewing the emergent features of the diffractive transversal framework as complex, nonlinear, dynamic and in a state of continuous flux affords a methodological understanding of how cartography might be used as a posthuman methodology that responds to the diverse, dynamic and intra-related complexity of automated teaching practices.

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