

Chapter 8. Networks of Knowledge, Students as Producers, and Politicised Inquiry

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Introduction

In this chapter, we will explore the relationships between a number of patterns and trends in higher education, namely the reconceptualisation of students as producers rather than solely as consumers of knowledge, and the evolution of the idea of digital and data literacies, in relation to the development of ideas about networked learning. We will explore these relationships through the lens of a series of inquiries which were part of programme of technological and pedagogical research and development designed to explore the educational potential of semantic web and linked open data approaches. This involved participatory design and development activities involving teacher and students in higher education institutions in the United Kingdom. Our contention is that this provides insights into the development of critical perspectives on networked learning and highlights ways in which teachers and students can reconnect with the radical and emancipatory purposes of higher education.

The Student as Producer

One of the most influential framings of teaching and learning in higher education in the UK over the past decade has been Neary and Winn's work on the 'student as producer' (Neary & Winn, 2009). This has, in our experience as teachers in higher education, been interpreted largely in relation to concerns about students becoming consumers or customers of higher education institutions. It has underpinned a continuing commitment to active, participatory pedagogies, and this is indeed one way in which Neary and Winn have articulated the idea. This has an obvious appeal in the context of the development of digital technologies: many pedagogical initiatives which involve the introduction of digital technologies involve some form of individual or collaborative production, and in the course of our work with semantic web and linked open data technologies, students could be said to be producers, as they were

involved in the design, development and evaluation of new digital platforms and applications (Martinez-Garcia, Tracy, Tscholl, Morris, & Carmichael, 2012).

However, Neary and Winn also advance a more radical notion of what they mean by production, and, in turn, what it means for students to be producers. Rather than defining this in terms of enhancement of ‘student experience’; or by arguing that students need to produce kinds of knowledge capable of contributing to dominant discourses in order to enhance their employability (Healey & Jenkins, 2009); or to cope with the complexities and uncertainties of modern life (Barnett, 2012), they locate the idea as part of an effort to rediscover the radical purposes of the university. They point to the alignment of the idea with the objectives of nineteenth-century liberalism; but also, to avant-garde Marxism (Neary, 2010); the work of Walter Benjamin on the ‘author as producer’; and the aspirations of the student-worker uprisings of 1968 (Neary, 2012). Neary and Hagyard (2010) argue that this involves a “pedagogy of excess” in which:

“... students can be enabled to transcend the constraints of consumerism by overcoming the limits of what it is to be a student in higher education. They can do this through collaborative acts of intellectual enquiry, working with academics and with each other, on subjects that look beyond their own self-interest and identity as students.” (Neary & Hagyard, 2010, 210)

The idea of such a ‘pedagogy of excess’ reflects recurring themes, both in the Marxist humanism of the ‘new left’ Gorz (1970) and Illich (1971; 1978) and the post-Marxist tradition of operaismo (workerism) and autonomia (autonomism), particularly its practices of “workers’ inquiry” and *conricerca* (co-research) (Haider & Mohandesi, 2013; Alquati, 1993), and “militant metropolitan inquiry” that takes place beyond workplaces (Negri, 2018, 52). The importance of changes to educational establishments currently seen to be in crisis, is identified by a number of writers in this tradition, who are explicitly referenced by Neary (2012), notably Roggero (2007; 2011), who calls for the reinstatement of the university as an “institution of the common” and Dyer-Witheford (1999; 2005), who identifies ways in which university study and inquiry could be reoriented in order to involve students in the production of new knowledge and contribute to a new political economy.

Central to this argument is the idea that new forms of production, including the production of knowledge, be reoriented towards the use-value, rather than the exchange-value, of what is produced, resisting the tendency identified by Lyotard (1984) for relationships between

suppliers and users of knowledge, particularly in digital environments, to assume the same forms as has existed around other forms of commodities. In the autonomist tradition mentioned above, this is achieved through a shift toward what Negri describes as *autovalorizzazione* (usually translated into English as ‘self-valorization’), that is, “the autonomous elaboration of new ways of being, of new social relationships alternative to those of capitalism” (Cleaver, 1979, 17-18). It should be noted that Negri’s appropriation of this term from Marx has been criticised as being too vague and abstract to be useful (see Cleaver, 2011; Wright, 2002), but in the specific context of education, it means that learners are not simply encouraged to exercise greater agency regarding their own learning, but rather are empowered to set more ambitious and radical agendas, identify desirable outcomes based on their potential use-values, and undertake politicised and self-elucidating inquiries. This, then, is a more radical and expansive version of the idea of ‘student as producer’.

Research and development focussed on this more radical idea of student as producer has significant concerns, commitments and theoretical influences in common with that around networked learning. Both perspectives see learning as social and situated, while at the same time encouraging transgressions of conventional organisational and disciplinary boundaries; both are attentive to the significance of time and space; and both encourage pedagogies that are democratic and participatory. Furthermore, they reject the notion that technologies, including digital technologies, arise independently in society, arguing instead that they are co-constituted with, and reflective of, broader political and social developments. And, turning to the focus of this chapter, they share a commitment to inquiry on the part of learners: not simply as a means of exercising specific literacies, or evidencing competencies or attributes, but rather as a critical disposition to be developed and that is central to radical and potentially emancipatory change.

The Production of Knowledge in Networks

The role of networks and networking practices in the production of knowledge has been widely discussed. Paavola, Lipponen, and Hakkarainen (2004) and Hakkarainen, Palonen, Paavola, and Lehtinen (2004) advance the argument that, in addition to models or metaphors of learning based on acquisition and participation (as described by Sfard, 1998), there is a third, “knowledge creation metaphor” for learning. This views knowledge creation as a social process, albeit one in which individual actions as part of a stream of social activities

are significant; which acknowledges the importance of multiple forms of knowledge; which encourages criticism and questioning as a means of fostering insight and innovation; and which recognises the importance of “knowledge artefacts” both as a focus for collaboration and as products (Paavola et al., 2004). Accordingly, networked environments allow teachers and learners to form collaborative teams, share their ideas and engage in collective inquiry which may coalesce around specific artefacts, and generate new ones through networking practices which themselves may be emergent (Hakkarainen, Palonen, Paavola, and Lehtinen, 2004; 2011).

Within what Jones (2015) describes as the “networked learning paradigm”, these characteristics have been explored and elaborated in a range of contexts including schools, universities and different kinds of professional learning. Across these contexts, there is a broad consensus that knowledge is not a ‘body’ nor is it reducible to a set of skills or aptitudes: rather, knowledge is “emergent: a socio-culturally influenced outcome of sense-making of experiences through relational dialogue, and/or collaborative interactions” (Hodgson, McConnell, & Dirckinck-Holmfeld, 2012). A key aspect of networked learning is that the networks in question are not solely digital, or social, but are, rather, heterogeneous. Learning activities or aspects of practice which are often site, domain or discipline-specific, provide a focus, point of intensity or stabilisation of the network, (Goodyear, L. & Dohn, 2016, 94) stating that:

“We take a learning network to be a heterogeneous assemblage of people and things connected in activities that have learning as an explicit goal or a significant side effect. Coherence among the activities helps resolve the learning agenda of the network, which, in turn, helps trace the limits of the network.”

This recognition of the heterogeneity of networks is reflected in the increasing numbers of contributions to the biennial Networked Learning Conferences that refer to and apply concepts from socio-material theories such as Actor Network Theory (de Laat & Ryberg, 2018).

This heterogeneity means that even in ostensibly ‘digital’ or ‘online’ activities, there will be iteration between contexts. For many students, the “primary context” of their activities will not be online (Dohn, 2014), so activities may be initiated in an online environment before extended to a physical location or practice; or, alternatively, aspects of practice or the objects

of inquiry may be represented in digital environments through processes of translation which may be tentative or iterative. Networked learning, therefore, is understood to involve more than online training or distance learning, and teachers need not simply to author and structure online content, but rather to design and develop activities that enable and mediate iteration between the digital and physical contexts of learning, so as to develop new assemblages and knowledge artefacts. This has implications for what ‘production’ is understood to mean in the context of networked learning. Student production is, according to this view, not solely a matter of reporting or representing activities via online tools, nor of development of personal capacities, but as participation in the co-production with others of new material, digital and knowledge artefacts and networked assemblages, which may include redesign and reconfiguration of learning environments themselves. All of these represent elements of what Neary and Hagyard (2010) would describe as a pedagogy of excess.

Within networked learning, as in the student as producer agenda, there is a well-developed radical strand which frames educational research and development not simply in terms of enhancing learning, but in terms of critical pedagogy and radical societal transformation, drawing on sources including Illich, Freire, and McLaren. McLaren and Jandric (2015) echo many of the arguments made about students as producers and discuss how a key task for educators is to explore how technological developments have been appropriated under capitalism and to consider both how to resist and to develop alternatives; and Jaakkola (2015) argues that the reflection expected of teachers needs to be extended beyond immediate pedagogical concerns into a broader critical heutagogy. Also paralleling more expansive ideas about student production, Dohn, Sime, Cranmer, Ryberg, and de Laat (2018, 201) reflect that commitments in education to a broad notion of social justice may not be particularly helpful in practice, and they cite the call by Czerniewicz (2018) for more critical and politically astute studies of how inequalities are created and reproduced, and how networked learning might address them. This involves looking beyond rhetorics of transformation, novelty, and openness which may not be accompanied by changes in structural changes or improvement in learners’ experiences or opportunities.

In the remainder of this chapter, we will consider some of these tendencies and rhetoric, and two in particular: that of ‘openness’, specifically as it relates to research data generated through student inquiry; and the idea that student learning in networks can be expressed in

terms of some form of digital literacies. Our argument is that, as with the idea of student as producer, and networked learning more generally, there are opportunities to engage critically with these and conceptualise these in more expansive and politicised ways. ‘Linked data’ or ‘linked open data’ approaches (Heath & Bizer, 2011; Pereira, Siqueira, Nunes, & Dietze, 2018) provide opportunities for the realisation in practice of student as producer initiatives. Neary, Saunders, Hagyard, & Derricott (2014, 25) state that they can be directed “towards a greater strategic priority of reconfiguring the nature of teaching and learning in higher education and encouraging students to become part of the academic project of the university”, whether these involve the contribution of the outcomes of student inquiry to collective knowledge resources such as archives, or peer-to-peer collaboration in the production of new knowledge artefacts. Linked open data approaches go beyond the generation of new data sets and may involve the production of co-authored content in wikis, collaborative annotation environments and other shared information ecologies, which in turn employ open data approaches to structure and share information. However, as Raffaghelli (2018) has suggested, while the potential for open data approaches have been recognised at a macro level, and open approaches have been implemented across large-scale collaborative networks, they have seen only limited uptake at local and individual level. If we are to explore the potential of open data in the production of knowledge more widely, then we need to explore how literacies might be understood in the context of open data specifically, but also in relation to production as well as consumption.

Dimensions of Digital Literacies in the Ensemble Project

Ideas about digital literacies have moved beyond concerns with the acquisition of ‘computer skills’ to incorporate conceptual understanding (Gilster, 1997) and more recently they have come to be understood as situated practices (Gillen & Barton, 2010; Lankshear & Knobel, 2008) which are developed through discourse and involvement in digital production processes (Buckingham, 2006). Gourlay and Oliver (2013; 2016) further advance this idea of digital literacies as situated networked learning practices, positioning them not as a set of competences that reside in individuals, but rather as complex and heterogeneous assemblages of human and non-human actors. They caution against trying to identify hierarchies or sequences of digital literacies as this hides the nuanced and situated nature of practices (Gourlay & Oliver, 2016). It is notable, however, that recent discussions of ‘data literacies’

have tended to revert to focus on technical skills emphasising the role of statistical knowledge in informing decision making (Calzada Prado & Marzal, 2013; Mandinach & Gummer, 2013), although there have been more nuanced discussions which point to the need for a critical awareness of data practices that are shaped by policy contexts (Williamson, 2016) and of the place of individuals within rapidly evolving data economies (Pangrazio & Selwyn, 2018).

We draw here on our experience of a large research and development programme, ('Ensemble: Semantic Technologies for the Enhancement of Case-Based Learning') which was funded by the UK's Economic and Social Research Council and Engineering and Physical Sciences Research Council to explore the pedagogical potential of the semantic web and, latterly, linked and open data technologies and approaches, in higher education. As these technologies were novel, and unfamiliar to many of the teachers and students with whom we worked, we were concerned to explore how related digital and data literacies could be developed and supported. These needed to be situated in disciplinary and professional contexts, often in areas where practice was complex or evolving rapidly as a result of the adoption of new technologies. But they also needed to reflect emergent pedagogical contexts, specifically those which used some kind of case-based learning as a response to that complexity and change (Martinez-Garcia et al., 2012).

The project worked in six main disciplinary areas (plant sciences, archaeology, management, education studies, contemporary dance and environmental and earth sciences, with smaller-scale projects in law, journalism, and history). The project team included software developers as well as educational researchers, and a range of new digital tools and platforms were developed in the course of the main project and as part of an associated doctoral study.

The project also evolved over time with a number of distinct phases, and led to a number of follow-up projects and applications. These are summarised in Table 1.

Table 1: Main Phases and Activities of the Ensemble Project and its Successors

Phase	Location*	Curriculum Contexts	Participants
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Pilot Projects 2009-2012	University A	Plant Sciences Epidemiology History	Undergraduate students involved in student researcher scheme, working with teachers and developers.
Phase 1 2009-2012	University A	Plant Sciences Archaeology	Primarily teachers of undergraduate programmes
	University B	Marine Operations and Management	Primarily teachers of postgraduate programmes
Phase 2 2010-2014	University A	Plant Sciences	Teachers and students on undergraduate programmes
	University C	Education Studies Environmental Education	Teachers and students on undergraduate programmes
		Contemporary Dance	Students involved in choreography and curriculum development project
Follow-up Projects 2013-present (selected examples)	University C	Education Studies	Students involved in undergraduate projects
		Accounting and Finance	Teachers of undergraduate programmes
Archiving Projects 2010-present	Various	Education Studies Research Methods Workers' Education	Teachers and researcher users of 'teaching archives' using semantic web technologies

* University A: An 'old' research-intensive university; University B: An urban university specialising in professional and business education and research; University C: An urban, 'modern' university with specialisations in vocational and professional education, and applied research.

In the Phase 1 of the Ensemble project, there was a greater emphasis on working with teachers to produce rich web applications such as interactive timelines, maps and catalogues of resources with associated semantic search interfaces. Applications were developed using the Exhibit web application framework (Huynh, Karger, & Miller, 2007) which was developed as part of the SIMILE project (<http://www.simile-widgets.org>) based at the Massachusetts Institute of Technology, and, where necessary, using the Fedora digital repository (<https://duraspace.org/fedora/>) for larger-scale datasets and digital content. Data presented through the visualisations and catalogues were linked to other web resources such as learning resources, wikipedia pages, publishers' websites and online databases. An interactive timeline of plant evolution for bioscience undergraduate students, for example, displayed important points in plant evolutionary development, geological events, levels of atmospheric gases and temperatures; and was also linked to key readings, wiki pages, images of plants, and maps of the world at different periods in its history (Jordan, Griffiths, & Johnstone, 2010). Data sets presented were generally simplified and other resources to which students were directed were selected, rather than the students being encouraged to explore and identify sources from across wider online networks.

Phase 2 of the project involved positioning students much more explicitly as co-designers of semantic web platforms to support collaborative learning activities. This involved the identification of online resources and their collaborative annotation, with examples including shared bibliographies by science students; and the annotation of student-produced video content by groups of contemporary dance students (Brooks, 2012). Our work did not take place in isolation: other teams working on semantic web and linked data projects at this time, including the group in Finland mentioned previously who were responsible for theorising learning in terms of the generation of knowledge artefacts, also identified semantic web technologies, and particularly semantic annotation of multimedia content, as a potential basis for reframing learning in terms of collaborative production of such artefacts (Batatia, Hakkarainen and Mørch, 2012).

Another example of the project's work in this second phase involved teachers and students of environmental and earth sciences. Pedagogical 'cases' such as location studies or fieldwork investigations included data collected via remote sensing and involved new data practices around the use of very large datasets from diverse sources, alongside local data that might be collected by the students themselves. Thus, any development of digital or data literacies in such educational settings involved teachers being aware of the changing nature of broader disciplinary practice and mediating these changes through curriculum design and pedagogical interventions (Carmichael & Litherland, 2012). The situated and semiotic approach to digital literacies of Kress (2010), in particular encouraged us to connect our participatory research methods to the development of digital literacies by encouraging both teachers and learners to develop their understanding of learning, discipline-specific data practices, and technological affordances, through their participation in design, development and evaluation.

The examples mentioned here involved research and development in varied educational contexts (although the majority involved undergraduate level study); involved different combinations of new and emerging technologies; and drew on data of different kinds and from diverse sources. Additionally, each was designed and developed to support a different pattern of student participation and engagement and demanded or supported the development of particular and situated digital literacies. While remaining mindful of the argument made by Gourlay and Oliver (2016), about the need to avoid thinking about digital literacies as simple sequences or hierarchies of skills, it is possible to identify patterns from across the

project of how combinations of semantic web technologies were incorporated into teaching and learning activities, and the digital literacies that they involved.

At the time of the project, advocates of semantic web approaches generated a number of visualisations of the semantic web ‘technology stack’ and we used these as a starting point for an inductive analysis of applications, pedagogical activities, and emerging digital literacies. Very few of the applications that were developed used all of the technologies associated with the semantic web, and some used only one or two, in combination with other, more established web technologies. This analysis drew on a range of sources, from use cases developed to inform the design of the applications; researcher and developer diaries; observations of the applications in use by students; and teacher and student analysis.

What emerged were sets of activities and literacies involving:

- a) Navigation around online tools presenting linked data through interfaces or visualisation tools that could be manipulated in a variety of ways. This enabled exploration and encouraged the formulation of questions and framing of inquiries, but the data was typically simplified and bounded, and options for representation restricted by external developers or teachers. Examples include the plant evolution timeline mentioned above.
- b) Data searching and retrieval from external sources, typically using familiar software or prebuilt ‘portals’ or directories. Data were often selected and simplified, and might be used in illustrative ways, rather than being for extensive exploration and analysis. This might be oriented towards demonstration of the ways that data is used to represent concepts and cases, or to encourage students to assess the reliability and granularity of the data and consider social and political factors at work in its collection and representation. Examples included selected and simplified data sets used to support an undergraduate course in the history, philosophy and sociology of education, and a course in postgraduate marine operations and management studies which involved students being presented with exemplary data sets in support of ‘learning cases’.
- c) Working with ‘raw’ data that was ‘born digital’ , involving its manipulation in an online environment or other data analysis software which involved working with large datasets from multiple sources, critically evaluating data and sources, and explicitly

considering the data practices around its collection, categorisation and representation. A good example of this in the context of the project involved exploring epidemiological data relating to the spread of plant diseases and the physical and meteorological factors that might affect this.

- d) Generation of new data and metadata and linking these internally and to other resources. This required teachers and students to engage with data formats, metadata schemes and taxonomies, and to consider how these might affect knowledge representation and algorithmic treatments of the data. The contemporary dance students were involved in the production of video had to address issues of how its content could be described and annotated using established taxonomies as well as their own reflective narratives.

These activities in turn can be understood in terms of a set of dimensions which can be identified across curricular settings:

- Boundedness: that is, to what extent are the students working within closed ‘micro-worlds’ with selected data oriented towards predetermined learning outcomes (a) or across an ‘open’ and potentially global data space (b, c, d)
- Familiarity of Technologies: technologies that are stable and well understood by students (a, b) and those that are emergent and less well understood (c, d)
- Role of the students in knowledge production: primarily as consumers (a through c), or producers of data, analyses and interpretation (increasing potential from b through d)

The different projects and applications developed in the course of Ensemble can be located at the intersections of these dimensions. The timeline of plant evolution was, for all its visual appeal and complexity, deliberately bounded so as to limit students’ exploration, and to guide them towards specific learning outcomes: within the project, and echoing Papert, it was characterised as a ‘micro-world’ (Carmichael & Tscholl, 2013). In fact, in the design of this application it emerged that the pedagogical scenarios of which teachers were most wary were those in which students had full access to the global data space but were at the same time primarily positioned as ‘consumers’, their concern being that students, lacking the specific

data literacies that would enable them to critically evaluate them, would be at risk of importing and reproducing knowledge from unknown or untrusted sources.

Edwards, Tracy, and Jordan (2011) highlight the tensions between engaging students in networked learning in open and complex cyberspaces in (rather than the closed spaces of virtual worlds and simulations) and “keeping it in the comfort zone for the students” (227-228), which meant that while developing skills working with data handling and interactive representations, the students remained consumers, albeit of sophisticated and customised digital products. In other examples, where the boundaries around application were more permeable, the mediating role of teachers in supporting critical engagement with data and resources was essential. This was most obviously in encouraging students in type (b) scenarios to critically explore the extent to which data and the categories used to describe them were ideologically shaped and reflected dominant discourses.

The question of how familiarity, or a perception of familiarity, with digital technologies emerged as being of significance across the project. In some cases, teachers and students engaged with semantic web and linked and open data approaches with relative ease because they already used online databases (earth sciences); video for performance review (contemporary dance) or news aggregators (journalism), and in these cases they could identify desirable enhancements to existing ways of teaching, learning and collaborating. The dimension to which we will pay greatest attention here, however, is the third, and is that related to our opening discussion, namely, students’ roles as consumers and/or producers. The example we will primarily draw on relates to student learning in undergraduate education courses: specifically, about the history of education in the UK.

Student Inquiry, Research Objects and Knowledge in Networks

Following the completion of the main project’s work in 2012, applications during the project continued to be used in teaching and learning, and development work continued in several areas, including within education studies courses at Liverpool John Moores University (University C in table 1). By the end of the main Ensemble project in 2012, students of education studies at Liverpool John Moores University had access to a set of semantic web applications developed in the course of the main phases of the project. These included an interactive timeline of the history of education in the UK which allowed them to locate

educational developments, key writings, and legislation, against a range of other social, historical and political events. The timeline acted as a portal to a wide range of contextual information and datasets: events such as the Education Act of 1870, which initiated the provision universal elementary education could then be explored in their broader political context and in relation to changing patterns of work, urbanisation and public works, and students could access records of the public and parliamentary debates that took place at the time. Another web application provided semantic search access to collections of video, images, key documents, and data sets, some of which had been developed by teachers at the university, while others were existing open data resources published to the web by their originators.

In subsequent work, however, student roles changed significantly. A follow-up project in which undergraduate students were employed as researchers involved them in compiling an online directory of open data sources of relevance to student and professional inquiry in education. As well as collating existing metadata about the datasets and sources (from their providers, usually branches of government), they wrote additional narratives to accompany each source. These included notes on a range of technical issues (many of the data sets were incomplete, inconsistent, or included estimated values) but also raised broader questions about the application of problematic categories, indicators and concepts, often related to contemporary policy discourses. Such developments go beyond students contributing to the building of a bounded micro-world or providing teaching data sets for students with specific pedagogical purposes: the datasets were made available, with commentaries, for any student to use in the course of their own inquiries. And while the development of the directory involved only a small number of students and staff, its purpose was to encourage a larger audience to engage with open data and appreciate the complexities and problematic aspects of secondary analysis of existing networked data.

Perhaps the most ambitious developments activity involved students incorporating the data they had collected into existing semantic web applications and data networks. Litherland and Forrester (2013) describe how their work complemented and extended existing data presented in the timeline from phase 2 of the main project, and included historical studies of the UK national curriculum; UK educational policy post 1988; policy on special needs and inclusion; and the changing role of audio-visual technologies in education. As well as identifying

existing online data sources, the students also generated new data sets from existing sources, collected new data, and conducted interviews about their chosen focus of inquiry: these too were linked to the timeline. The students reflected not only on their experiences of developing specific new digital and data literacies, but also the ways in which policy contexts and political developments influenced what they had previously seen as unproblematic issues of educational practice. However, Litherland and Forrester (2013, p. 13) do identify the persistence amongst the students of epistemologically naive views about reliability and bias, and only limited awareness of how human intervention or algorithmic processes might operate in the context of complex networks of data.

What was developed in the course of these activities was different to the previous examples, and differs from examples in environmental and earth sciences and in archaeology, the other project settings in which student-generated data might be shared across networks. In these cases, there are established data practices related to a long tradition of amateur and citizen science, but the data that are collected and shared are generally very specific and limited in nature (see discussion of this in Conde, 2014). In the case of the education students, the data, analyses and commentaries that were being generated involved self-directed inquiry and were much more varied in their form and critical in their content.

This reinforces a significant point made previously, however: namely, that not all pedagogical activities which invite student production are intrinsically as radical as Neary and Winn would intend. Simply involving students in the production of data through fieldwork activities does not necessarily develop their critical digital literacies; and at the same time, that many activities which are ostensibly directed towards student consumption do involve the application of critical analysis and expertise, and may lead to transformative insights on the part of students. In the case of the students who collated and assessed existing data resources, rather than simply regarding these as consumers, or producers it is perhaps more useful and accurate to understand them as being involved in a hybrid set of reconfigurative practices: what Gourlay and Oliver (2016) describe as the creation and coordination of socio-material assemblages, involving acquisition, curation, destruction and creation of texts.

Students as Producers of Research Objects

Little of the work carried out by students as part of the various Ensemble and post-Ensemble project activities was concerned with the creation of conventional texts. Instead, what were produced ranged from new data sets, metadata records, and annotations, to ‘packages’ of data and metadata: the dance students, for example, generated ‘bundled’ video content with segments identified which were tagged, together with annotations and reflective commentaries (Morris, 2012) and the education studies students produced packages of qualitative and quantitative data, research instruments, and interpretations. In other cases, what was produced was a new configuration of a digital tool (such as one of the timelines) which was then incorporated in some form into a more conventional representation such as an essay or report. All of these can be interpreted as examples of the networked knowledge artefacts theorised by Paavola et al. (2004). De Roure (2014, 236) describes such productions as semantically rich and shareable “research objects” which, he argues, will be significant in future models of academic publishing less dominated by articles and monographs (discussed elsewhere in detail by the authors: see Tracy & Carmichael, 2017). Such research objects can present the richness and complexities of research data, together with discussion of theories, interpretations and conclusions, but also enabling others to develop them further, adding additional data, annotations, analysis or interpretations. If students are to be involved in the production of knowledge, then learning activities and student inquiries need to be oriented towards the production of such flexible and generative research objects, rather than primarily towards extended essays and dissertations modelled on the conventional academic article.

This has significant implications for pedagogical practice and its organisational mediation within higher education. Our experience within some of the settings explored by the Ensemble project revealed how, while some teachers could see the potential of semantic web and linked open data technologies to address pedagogical challenges and offer new opportunities, and were keen to develop applications and integrate them into their practice, others could equally well see such potential, but were much more cautious about their adoption. Even in settings where there was a strong rhetoric of authenticity, currency and ‘real world experience’, and where case-based approaches were a pedagogy of choice, the cases that were taught were often selected and constructed to address specific and pre-

determined learning outcomes. The unpredictability and fluidity of learning in less bounded environments, either with students positioned as consumers, producers or a combination of these, was a concern for at least some of these teachers. In other cases, the introduction of new technologies, linked open data amongst them, was seen a challenge in relation to teachers' disciplinary identities, which had been established against a background of less technologically-mediated practice. Teachers of earth and environmental sciences, for example, expressed regret that digitally mediated practices were increasingly supplanting conventional fieldwork which they saw as intrinsic to their disciplinary practice and identities (Carmichael, 2015, 289).

The need for changes to pedagogical practice have been discussed by others working within the networked learning paradigm. Our experience of working with teachers as part of Ensemble aligns particularly well with the work of Jaakkola (2015, 172-174) who highlights the importance of personal and emotional factors in the adoption of new technologies and their associated pedagogies, and offers a model of how critical reflection of existing and potential future practice can be scaffolded; and Koseoglu and Koutropoulos (2016) discuss (in the context of the introduction of MOOCs) how activities need to be reframed and students given recognition for participation in learning activities such as reflection, artefact creation or project work, rather than simply for achievement in summative assessments. Perhaps most significant though (for the development networked learning, for the repositioning of student as producer, and for the realisation of the potential of linked open data) is a recognition of the central importance of student inquiry, and of the development of a disposition towards such inquiry as a desirable educational outcome for students and teachers alike.

Promoting Pedagogies of Excess

On reflection, the most significant changes in pedagogical practice and learning outcomes enabled by the Ensemble project and its implementation of linked open data were not those which involved the development and deployment of rich and complex, but still bounded, micro-worlds, but rather those that changed the relationships between teachers, students and knowledge and engendered new socio-material assemblages. This was where we saw instances of Neary's 'pedagogies of excess', as students were able to set the agenda for their own inquiries and contribute knowledge artefacts to wider networks. Where this was most

fully realised, students exceeded the conventional demands of curriculum and assessment: in the case of education studies students who contributed to the development of the timeline, Litherland and Forrester (2013) report how they reflected on having gained greater insights: into pedagogical processes; into the ways in which their own knowledge was mediated through digital networks; and about the relationship between their own and their families' educational experiences and broader historical developments. And the contemporary dance students' involvement in participatory design, development and evaluation of performance review tools led to the emergence of digital tools that were oriented not simply to satisfy university assessments, but rather to supporting their creative practices, online presence and aspirations beyond the immediate university setting. These students firmly redirected the design and development activities of the Ensemble project team away from some semantic web technologies towards others. Specifically, they wanted semantic annotation tools that would allow them to present their capabilities as dancers and choreographers to diverse audiences including those beyond the university setting (Carmichael, 2015; Morris, 2012).

What this means for understandings of digital literacies is also significant. In the course of their pursuit of new lines of inquiry, and the production of new knowledge artefacts, students were required to draw on, reconstruct and reconfigure networks. While interpretations of digital and data literacies as a form of situated social practice still hold, the fact that the primary context, stimulus or point of departure for inquiry might be established by students means that the digital literacies that they need to develop will be shaped by their own concerns, intentions and existing network relations. This means that for pedagogies of excess to emerge and be fully realised, curriculum designs and learning activities need to be reframed in terms of their opportunities to enable this. Teachers and curriculum developers need to reposition themselves as creators of spaces for fruitful encounters and generative inquiries; and enablers of the kinds of projects and lines of inquiry that students wish to pursue. The specific digital and data literacies that develop in such settings are therefore necessarily contingent on the nature of the inquiries proposed and have more in common with the idea of data activism as advanced by Milan and van de Velden, who distinguish the conventional notion of digital literacies from "reactive" data activism (often based around issues of privacy, surveillance, data sharing and accountability), and "proactive" data activism, which involves the appropriation and creation of new data, representations and the development of "antiprograms" (Milan 2016; Milan & van de Velden, 2016).

With this, we return to the idea of student as producer. Combining inquiry and activism within student directed programs is a common theme across student as producer initiatives, the avant-garde and autonomist Marxist traditions that underpin them, and within more radical envisioning of networked learning. In each of these, self-directed and self-elucidating inquiry is a central and radicalising form of praxis. In the context of higher education, it involves a deliberate blurring of the distinction between academic work and activism, and the legitimising of more explicitly political inquiry as something to be undertaken by academics, workers, and students as workers-in-information (McLaren & Jandric, 2015). This requires a critical and selective appropriation and reworking of the resources and methods of academic study towards ends different to those mandated by capitalist production, business interests and concerns with the perceived ‘employability’ of students. Wardrop & Withers (2014), in their review of such initiatives from across the university sector (which includes examples of student inquiry, networked learning, and the repositioning of the university’s role more generally) characterise this as involving development of a new role: the “para-academic”.

This in turn involves positioning of the university as the locus of such inquiry and activism, Universities need to offer something much more than training for future employment, and instead become hubs or points of intensity in local, regional, or wider networks of which they are an intrinsic part. Tellingly, this is an area into which Neary and Winn (2017) have extended their work on student as producer, by looking to the co-operative movement for models of how universities might overcome the concentration of the means and outcomes of production in the hands of a powerful minority and to develop alternative civic roles. Co-research involving both teachers and students allows critical practice to be discursively constructed and modelled rather than taught as a set of competencies, skills or graduate attributes. Such developments also have the potential to support challenges to existing disciplinary norms as they are reproduced within educational organisations; Jandrić (2016, 176) suggests that: “transdisciplinarity ... questions the existing systems of knowledge and domination and acquires genuine potentials for emancipation and social change”. What the availability of networked and linked open data, and the opportunities to link, aggregate and visualise these from diverse sources enables is a means of articulating, focussing and exploring such questions. It makes it possible for researchers who have identified an issue of concern or a point of departure not only to contextualise their own inquiries, but, critically, to explore and critique how issues are conceptualised within alternative and dominant

discourses. Our experience within the Ensemble project provided us with models of such practice, the comparative freedom offered by a programme of research and development allowing teachers, students and researchers some space to position themselves differently in relation to each other, to the curriculum and to technologies; and to explore counter-discourses and antiprograms.

Conclusion

In conclusion, we would argue that the promotion of an expansive and radical version of the students as producers agenda, and the politicised inquiry that accompanies it, provides insights which can inform and guide the aspirations of those involved in network learning, and a framing for the development of networked learning more generally. However, while Neary and Hagyard (2010) are concerned to counteract the identity of the student as consumer there is clearly a need for both teachers and students to develop critical digital and data literacies that enable them to engage as both critical consumers and producers of data, knowledge and practice. Both historical precedents and our own experiences indicate strongly that this is best achieved through placing inquiry at the centre of curriculum design and pedagogical practice. Consumption and production are thus linked in cycles of inquiry which are represented and given substance as element of wider, heterogeneous networks.

Linked open data technologies and approaches provide many opportunities to realise both the potential of students as producers and a means of manifesting, accessing, and sharing the knowledge artefacts or research objects that are a key element of dynamic learning and knowledge networks. Linked open data technologies and the approaches and discourses that accompany them provide not only the resources for situated and politicised inquiry; they also provide a means of sharing and aggregating the outcomes of inquiry; act as a focus for nuanced and situated critical digital literacies; and represent a key means of developing counter-hegemonic data spaces. These can provide environments in which teachers and students can become investigators, researchers and activists. They can work with together to create new data and construct case studies, contribute new knowledge and interpretations to networks, develop alternative interpretations, frame new inquiries and establish emancipatory trajectories: the elements of a radical political economy of education.

References

- Alquati, R. (1993). *Per Fare Conricerca*. Torino: Calusca Edizione.
- Barnett, R. (2012). Learning for an unknown future. *Higher Education Research and Development*, 31(1), 65-77. doi:10.1080/07294360.2012.642841
- Batatia H, Hakkarainen K, Mørch A (2012) Tacit knowledge and trialogical learning: towards a conceptual framework for designing innovative tools. In: Moen A, Mørch A, Paavola S (eds) Collaborative Knowledge Creation. Sense Publishers, Rotterdam.
- Brooks, P. (2012). Dancing with the Web: students bring meaning to the semantic web. *Technology, Pedagogy and Education*, 21(2), 189-212. doi:10.1080/1475939x.2012.697400
- Buckingham, D. (2006). Defining digital literacy: what do young people need to know about digital media? *Digital Kompetense*, 1, 263-276.
- Calzada Prado, J., & Marzal, M. Á. (2013). Incorporating Data Literacy into Information Literacy Programs: Core Competencies and Contents. *Libri*, 63(2). doi:10.1515/libri-2013-0010
- Carmichael, P. (2011). *Networking Research: New Directions in Educational Enquiry*. London: Continuum.
- Carmichael, P. (2015). Not just about gadgets: time, innovation and change in the design of learning technologies. *E-Learning and Digital Media*, 12(3-4), 279-294. doi:10.1177/2042753015571052
- Carmichael, P., & Litherland, K. (2012). Transversality and innovation: prospects for technology-enhanced learning in times of crisis. In D. Cole (Ed.), *Surviving Economic Crises through Education*. New York: Peter Lang.
- Carmichael, P., & Tscholl, M. (2013). Cases, Simulacra and Semantic Web Technologies. *Journal of Computer Assisted Learning*, 29(1), 31-42. doi:10.1111/j.1365-2729.2011.00459.x
- Cleaver, H. (1979). *Reading Capital Politically*. Austin: University of Texas Press.
- Cleaver, H. (2011). Self-valorization in Mariarosa Dalla Costa's "Women and the Subversion of the Community". Retrieved from <https://la.utexas.edu/users/hcleaver/357k/HMCDallaCostaSelfvalorization2.htm>
- Conde, M. (2014). Activism mobilising science. *Ecological Economics*, 105, 67-77. doi:10.1016/j.ecolecon.2014.05.012
- Czerniewicz, L. (2018). Inequality as Higher Education Goes Online. In N. B. Dohn, S. Cranmer, J.-A. Sime, M. de Laat, & T. Ryberg (Eds.), *Networked Learning* (pp. 95-106). Dordrecht: Springer.
- de Laat, M., & Ryberg, T. (2018). Celebrating the Tenth Networked Learning Conference: Looking Back and Moving Forward. In *Networked Learning* (pp. 1-20). Cham: Springer International Publishing. doi:10.1007/978-3-319-74857-3_1
- De Roure, D. (2014). The future of scholarly communications. *insights*, 27(3), 233-238. doi:10.1629/2048-7754.171
- Dohn, N. B. (2014). Implications for networked learning of the 'practice' side of social practice theories - a tacit-knowledge perspective. In V. Hodgson, de Laat, D. McConnell, & T. Ryberg (Eds.), *The Design, Experience and Practice of Networked Learning* (pp. 29-49). Dordrecht: Springer.
- Dohn, N. B., Sime, J.-A., Cranmer, S., Ryberg, T., & de Laat, M. (2018). Reflections and Challenges in Networked Learning. In N. B. Dohn, S. Cranmer, J.-A. Sime, M. de Laat, & T. Ryberg (Eds.), *Networked Learning* (pp. 187-212). Dordrecht: Springer.

- Dyer-Witheford, N. (1999). *Cyber-Marx: Cycles and circuits of struggle in high-technology capitalism*. Chicago, IL: University of Illinois Press.
- Dyer-Witheford, N. (2005). Cognitive capitalism and the contested campus. In G. Cox & K. J. (Eds.), *Engineering Culture: On the author as (digital) producer* (pp. 71-93). New York: Autonomedia.
- Edwards, R., Tracy, F., & Jordan, K. (2011). Mobilities, moorings and boundary making in developing semantic technologies in educational practices. *Research in Learning Technology*, 19(3), 219-232.
- Gillen, J., & Barton, D. (2010). *Digital Literacies*. London: London Knowledge Lab/TLRP.
- Gilster, P. (1997). *Digital Literacy*. New York: Wiley Computer Publishing.
- Goodyear, P. C., L., & Dohn, N. B. (2016). Artefacts and activities in the analysis of learning networks. In T. Ryberg, C. Sinclair, S. Bayne, & D. L. M. (Eds.), *Research, boundaries, and policy in networked learning* (pp. 93-110). Dordrecht: Springer.
- Gorz, A. (1970). Detruire l'université. *Les Temps Modernes*, 285, 1553-1558.
- Gourlay, L., & Oliver, M. (2016). It's Not All About the Learner: reframing students' digital literacy as sociomaterial practice. In S. Bayne, C. Jones, M. de Laat, T. Ryberg, & C. Sinclair (Eds.), *Research, Boundaries, and Policy in Networked Learning* (pp. 77-92). Dordrecht: Springer.
- Gourlay, L., & Oliver, M. (2013). Beyond 'the social': digital literacies as sociomaterial practice. In R. Goodfellow & M. Lea (Eds.), *Literacy in the Digital University: critical perspectives on learning, scholarship and technology*.
- Haider, A., & Mohandesi, A. (2013). Workers' Inquiry: A Genealogy. *Viewpoint*, 3. Retrieved from <https://www.viewpointmag.com/2013/09/27/workers-inquiry-a-genealogy/>
- Hakkarainen, K., Palonen, T., Paavola, S., & Lehtinen, E. (2004). *Communities of Networked Expertise: professional and educational perspectives*. Amsterdam: Elsevier.
- Healey, M., & Jenkins, A. (2009). *Developing Undergraduate Research and Inquiry*. York: Higher Education Academy.
- Heath, T., & Bizer, C. (2011). Linked Data: Evolving the Web into a Global Data Space. *Synthesis Lectures on the Semantic Web: Theory and Technology*, 1(1), 1-136.
- Hodgson, V., McConnell, D., & Dirckinck-Holmfeld, L. (2012). The theory, practice and pedagogy of networked learning. In L. Dirckinck-Holmfeld, V. Hodgson, & D. McConnell (pp. 291-306). Dordrecht: Springer.
- Huynh, D., Karger, D., & Miller, R. (2007). *Exhibit: lightweight structured data publishing*. Proceedings from WWW '07: Proceedings of the 16th International Conference on World Wide Web, Banff, Alberta, Canada New York, NY, USA.
- Illich, I. (1971). *Deschooling Society*. London: Marion Boyars.
- Illich, I. (1978). *The Right to Useful Unemployment and its Professional Enemies*. London: Marion Boyars.
- Jaakkola, M. (2015). Teacher Heutagogy in the Network Society: a framework for critical reflection. In P. Jandric & D. Boras (Eds.), *Critical Learning in Digital Networks* (pp. 163-178). Dordrecht: Springer.
- Jandrić, P. (2016). The Methodological Challenge of Networked Learning: (Post)disciplinarity and Critical Emancipation. In T. Ryberg, C. Sinclair, S. Bayne, & M. de Laat (Eds.), *Research, Boundaries, and Policy in Networked Learning* (pp. 165-182). Dordrecht: Springer.
- Jones, C. (2015). *Networked Learning: a paradigm for the age of digital networks*. Dordrecht: Springer.

- Jordan, K., Griffiths, H., & Johnstone, K. (2010). An interactive timeline of plant evolution - a HEA Bioscience case study. Retrieved from <http://www.bioscience.heacademy.ac.uk/ftp/casestudies/jordan.pdf>
- Koseoglu, S., & Koutropoulos, A. (2016, May 9-11). *Teaching Presence in MOOCs: Perspectives and Learning Design Strategies*. Proceedings from Networked Learning Conference 2016, Lancaster.
- Kress, G. (2010). The profound shift of digital literacies. In J. Gillen & D. Barton (Eds.), *Digital Literacies* (pp. 6-7). London: London Knowledge Lab/TLRP.
- Lankshear, C., & Knobel, D. (2008). *Digital Literacies: concepts, policies and practices*. New York: Peter Lang.
- Litherland, K., & Forrester, G. (2013, September 3-5). *Undergraduates as co-producers of a history of education timeline*. Proceedings from BERA Conference, Brighton.
- Lyotard, J.-F. (1984). *The Postmodern Condition*. Manchester: Manchester University Press.
- Mandinach, E. B., & Gummer, E. S. (2013). A Systemic View of Implementing Data Literacy in Educator Preparation. *Educational Researcher*, 42(1), 30-37. doi:10.3102/0013189X12459803
- Martinez-Garcia, A., Tracy, F., Tscholl, M., Morris, S., & Carmichael, P. (2012). Case Based Learning, Pedagogical Innovation and Semantic Web Technologies. *IEEE Transactions on Learning Technologies*, 5(2), 104-116. doi:10.1109/TLT.2011.34
- McLaren, P., & Jandric, P. (2015). The Critical Challenge of Networked Learning: using Information Technologies in the service of humanity. In P. Jandric & D. Boras (Eds.), *Critical Learning in Digital Networks* (pp. 199-226). Dordrecht: Springer.
- Milan, S. (2016). Data activism as the new frontier of media activism. In G. Yang & V. Pickard (Eds.), *Media Activism in the Digital Age: Charting an Evolving Field of Research*. Abingdon: Routledge.
- Milan, S., & Van der Velden, L. (2016). The alternative epistemologies of data activism. *Digital Culture and Society*, 2(2), 57-74. doi:10.14361/dcs-2016-0205
- Morris, S. (2012). Semantic Web Use Cases and Case Studies: Using the Semantic Web to Enhance the Teaching of Dance. Retrieved from <https://www.w3.org/2001/sw/sweo/public/UseCases/LJMU/LJMU.pdf>
- Neary, M. (2010). Student as producer: a pedagogy for the avant-garde? *Learning Exchange*, 1(1). Retrieved from <http://eprints.lincoln.ac.uk/4186/>
- Neary, M., Saunders, G., Hagyard, A., & Derricott, D. (2014). *Research-engaged Teaching: an institutional strategy*. York: Higher Education Academy.
- Neary, M., & Winn, J. (2009). The student as producer: reinventing the student experience in higher education. In L. Bell, H. Stevenson, & M. Neary (Eds.), *The Future of Higher Education: policy, pedagogy and the student experience* (pp. 192-210). London: Continuum.
- Neary, M. (2012). Student as producer: an institution of the common? [or how to recover communist/revolutionary science]. *Enhancing Learning in the Social Sciences*, 4(3), 1-16. doi:10.11120/elss.2012.04030003
- Neary, M., & Hagyard, A. (2010). Pedagogy of excess: an alternative political economy of student life. In *The Marketisation of Higher Education and the Student as Consumer* (pp. 209-244). Abingdon: Routledge.
- Neary, M., & Winn, J. (2017). Beyond Public and Private: A Framework for Co-operative Higher Education. *Open Library of Humanities*, 3(2), 1-36. doi:10.16995/olh.195
- Negri, A. (2018). *From the Factory to the Metropolis*. Cambridge: Polity Press.

- Paavola, S., Lipponen, L., & Hakkarainen, K. (2004). Models of Innovative Knowledge Communities and Three Metaphors of Learning. *Review of Educational Research*, 74(4), 557-576. doi:10.3102/00346543074004557
- Pangrazio, L., & Selwyn, N. (2018). 'Personal data literacies': A critical literacies approach to enhancing understandings of personal digital data. *New Media & Society*, 146144481879952. doi:10.1177/1461444818799523
- Pereira, C. K., Siqueira, S. W. M., Nunes, B. P., & Dietze, S. (2018). Linked Data in Education: A Survey and a Synthesis of Actual Research and Future Challenges. *IEEE Transactions on Learning Technologies*, 11(3), 400-412. doi:10.1109/tlt.2017.2787659
- Raffaghelli, J. (2018, June 17-20). *Open Data for Learning: A case study in Higher Education*. Proceedings from European Distance and E-Learning Network, Genoa.
- Roggero, G. (2011). *The production of living knowledge: the crisis of the university and the transformation of labour in Europe and North America*. Philadelphia: Temple University Press.
- Roggero, G. (2007). The Autonomy of the Living Knowledge in the Metropolis-University. *Tranversal*, 2007(5). Retrieved from <http://eipcp.net/transversal/0707/roggero/en>
- Sfard, A. (1998). On two metaphors for learning and on the dangers of choosing just one. *Educational Researcher*, 27(2), 4-13. doi:10.3102/0013189X027002004
- Tracy, F., & Carmichael, P. (2017). Disrupting the dissertation: Linked data, enhanced publication and algorithmic culture. *E-Learning and Digital Media*, 14(3), 164-182. doi:10.1177/2042753017731356
- Wardrop, A., & Withers, D. (Eds.). (2014). *The Para-Academic Handbook*. Bristol: Hammer-On Press.
- Williamson, B. (2016). Digital education governance: data visualization, predictive analytics, and 'real-time' policy instruments. *Journal of Education Policy*, 31(2), 123-141. doi:10.1080/02680939.2015.1035758
- Wright, S. (2002). *Storming Heaven: Class composition and struggle in Italian autonomist Marxism*. London: Pluto Press.

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