

Challenges and Potentials for Institutional and Technological Infrastructures in Adopting Social Media

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Abstract

The aim of this paper is to explore both the tensions and possible pedagogical potentials emerging from the meeting (or clash) between institutional technological infrastructures and the emerging landscape of social media, or what is often referred to as web 2.0 'technologies' or social software. The tensions and potentials are explored through relating the web 2.0 technologies and social media with sociological trends adopted from Castells (2001) and Wenger (2005). From this it is argued that web 2.0 technologies and social software can be seen as a material radicalisation of these trends, and that the interplay generates tensions between institutional and web 2.0 views of knowledge practices. From this, it is argued that the interfaces between students, teachers and institutions need to be carefully negotiated as part of the ongoing pedagogical, organisational and technological practices, which form the institutional technological infrastructures.

Keywords

Social media, Tensions and potentials, Institutions, Infrastructures, Web 2.0

Introduction

Since late 2004 where, according to (O'Reilly, 2005), the term web 2.0 was initially coined, the concept has generated huge attention and debate. The term web 2.0 has become gradually more popular (and more obnoxious some would argue) during the period from the last months of 2005 until now¹. The terms have slowly pervaded academic discourse and the notion of 2.0 has also travelled to other spheres than technology and become quite widespread across a number of different and unrelated sectors. For instance, the Prime Minister of Denmark talked about Welfare 2.0, and others have talked about Globalisation 2.0 or Corporate Social Responsibility 2.0. Within the academic world the terms and thinking have influenced both researchers and practitioners (Dalgaard, 2006; Hewling, 2006; Owen *et al.*, 2006) and led to discussions about e-learning 2.0 (Downes, 2005). While the web 2.0 movement has certainly been fuelled by powerful forces and internet businesses, it has also had its opponents framing web 2.0 as a meaningless buzz or business term. Most noticeably Tim Berners-Lee who called it a 'piece of jargon nobody knows what means'. He argues that the terms often associated with web 2.0 (e.g. participation, openness, conversation, community, connectedness) (Mayfield, 2007) are what the web was originally designed for². Likewise, these ideas have long been associated with Computer Mediated Communication, the research area of CSCL and as noted by (Allen, 2004) the notion of computers supporting collaboration and communication has a long history.

Still, the force and speed with which the 2.0 thinking has spread across a number of only loosely related domains signals that there is, if not a qualitative break or paradigm shift, then at least a disturbance of our regular ways of thinking about (and using) technologies for sharing, collaborating, learning and participating. These disturbances hold both challenges to, but also potentials for institutional and technological infrastructures within the domain of education. The paper will argue that there are some tensions and contradictions between on the one hand an institutional perspective, institutional technological infrastructures and then on the other hand the emerging educational and institutional interests in social media or web 2.0 'technologies'. It will be argued that this 2.0 disturbance is a mash-up of sociological trends, new technologies (or new technological practices) and changes in our ways of using online technologies. Furthermore, that it is the interconnection, interlocking and interaction between

¹ According to Google trends: <http://google.com/trends?q=Web+2.0>

² A transcription of an interview with Tim Berners-Lee is available from: <http://www-128.ibm.com/developerworks/podcast/dwi/cm-int082206.txt>

the entities which is the driving force, rather than one of the elements in isolation being the locus of development. This, however, also means that the challenges and potentials within the different components of institutional and technological infrastructures cannot be addressed, resolved or developed in isolation. Such a perspective is not controversial or new, rather it lies at the very core of the understanding of what 'technological infrastructures' are:

"Infrastructures are concerned with the design of complex environments rather than singular tools or artifacts, environments that are informed by pedagogical and organizational understandings of practice" (Jones *et al.*, 2006, p.44)

This paper will explore some of the underlying concepts of social media and web 2.0 technologies and discuss them in relation to an institutional perspective, as to explore some of the fundamental tensions and contradictions. In exploring the underlying concepts of social media and web 2.0 technologies some sociological trends articulated by (Castells, 2001) and by (Wenger, 2005) will be employed. Also the paper draws on a particular interpretation of networked learning and notions adopted from a social network perspective (Haythornthwaite, 2007; Jones *et al.*, 2006). This will crystallise into a final discussion of the potentials and tensions of adopting social media in an institutional context and consider the role of institutions, technological infrastructures and educational resources.

The new social forms of online communities

The "upgrade" from web 1.0 to web 2.0, is not an upgrade of the technological infrastructure of the web, but rather refers to the dawn and especially the popularisation of a wide range of web-based services and technologies such as Wikis, Blogs, Podcasts, RSS feeds and a shift in the social forms of online communities. In the recent years we have especially witnessed the rise of and massive population growth on social networking sites such as MySpace, LinkedIn and Facebook. Equally, services or social networks where people share bookmarks, references, videos, pictures, presentations or resources have exploded through services such as del.icio.us, Youtube, Flickr or Citeulike.com. These different kinds of social networks have been characterised by (Stutzman, 2007) as either ego-centric or object-centric networks. In the former the social network places the individual person as the core, whereas in the latter the core is a 'resource' or piece of content (such as a link or a video). Due to the rise of social networking sites (boyd, 2006) suggested that ego-centric network were slowly but steadily replacing 'interest based' communities:

"Social network sites provide a new organizing mechanism for developing context. Instead of slicing interest first and people second, the Friending process allows people to choose people first and interests second. People define their community egocentrically." (boyd, 2006, para 8)

In a later article (Baym, 2007) argued that interest based groups were far from being replaced, but simultaneously concluded that online communities seemed to be taking other forms. She points to how the informal online groups or interest based communities are taking new forms as participants spread across multiple internet platforms and offline contexts. In this way people construct their participation as a mixture between the traditional site-based communities and ego-centric networks. While as (Haythornthwaite, 2007) describes, debates have flourished on whether 'online communities' even exist and could be said to carry any resemblance to 'offline' communities, the discussion now seems to have moved towards discussing the new social forms of such online communities – and if it makes sense to even distinguish between online and offline communities (Hine, 2000; Ryberg & Larsen, 2006). First, however, it seems in place to mention the similarity of this debate with an ongoing discussion within the networked learning community on the notion of collaboration and Communities of Practice (CoP) theory. From a network perspective, a number of people have questioned and criticised the notion of CoP (Fox, 2002; Jones *et al.*, 2006; Jones & Esnault, 2004). They have, for one thing, voiced a concern that the theory of CoPs is focusing too much on networks composed of strong ties and overlooking the value of weak ties.

The critique, as such, is not directly aimed at the concept of community of practices in itself, but rather that network theory hold better analytical concepts to understand differently tied networks, than does the theory of CoPs.

"The network metaphor doesn't privilege the closeness of community rather it serves to encompass all kinds of links and relationships. More generally the form of networked society in which networked learning takes place has been described by Castells as one of

'networked individualism' (1996, 2001) not one of close community." (Jones & Esnault, 2004, p. 318)

There seems to be a certain similarity between the discussions of interest-based online communities vs. ego-centric networks and then the discussions of CoPs vs. networks. While many studies of communities from an internet research perspective seem to have especially described communities forming around shared interest, ideals or practices, the same seems to have been the case within online learning research:

"European research and practice has been heavily influenced by Communities of Practice thinking, and other learning environments for professionals have built more explicitly on ideas of Communities of Practice and the pedagogical principles of collaborative learning. This trend is evident, for instance, in the form of problem and project-based learning: encouraging and expecting students to work together and to rely on interdependencies among students." (Jones et al., 2006, p. 46)

However, what is interesting is that a recent research proposal by (Wenger, 2005) seems to be moving towards an understanding that can be interpreted as being closer to a networked perspective. The recent research proposal of Wenger (2005) illustrates a slight move away from situating communities of practice, as the prime unit of analysis towards the analytical focus becoming people's movement between multiple Communities of Practice and larger-scale systems. Here the focus becomes how identity is developed through participation, immersion or withdrawal from Communities of Practice, by persons' multi-membership and boundary participation in different communities and larger-scale systems over time (Wenger 2005). This seems to resonate better with the perspective within networked learning, as the focus is eschewed from a particular community towards trajectories, connections and relations across and between different practices. In explaining this move Wenger point to some trends within the landscape of learning and society in general, namely the 'horizontalization of learning' and 'the individualization of trajectories of identity'. The former concept refers to the trend that knowledge and learning have become less of a vertical relation between producers and recipients and more of a horizontal relation depending of negotiation of knowledgeabilities:

"(...) the central theme is the *negotiation of mutual relevance* of different forms of knowledgeability as key to the production and transfer of effective knowledge. Peers negotiate with one another how their respective stories are relevant sources of knowledge for each other's situation. Doctors negotiate how their advice fits in the perspectives of patients. Scientists negotiate how their discoveries can contribute to the practices of local farmers. Horizontalization is the key to ensuring the meaningfulness of the exchange." (Wenger, 2005, p.32)

The latter concept connects well to one of the central notions within some articulations of networked learning, namely the notion of networked individualism (Castells 2001). This concept actually very much resembles what Wenger highlights under the heading of "the individualization of trajectories of identity"

"(...) in a complex society, the issue of identity becomes more individual because each person becomes a unique intersection of forms of participation. Because our set of multimembership is so unique, because the social contexts in which we define our identities are so diverse, we do not have companions who share our trajectory. (...) While the anachronistic "universal knower" à la Leonardo da Vinci is replaced by teams and communities of "partial knowers," we also see individual identity becoming a "project" that occupies center stage in society." (Wenger, 2005, p. 35)

"An individualized sense of trajectory becomes increasingly driven by a developmental thrust: community participation is less determined by geographical collocation or institutional affiliation than by our interest and potentially our learning needs. Technology and globalization contribute to this trend. Our identities determine which communities we belong to and are in turn defined by these forms of intentional, learning-driven (multi)membership." (Ibid. p. 35-36)

Networked individualism is related to the sociological trend of individualisation, which has also been emphasised by a broad range of sociologist apart from Castells (Castells, 2001, p. 128). It refers to the observation that it is increasingly our individual preferences, affinities and orientations that shape our lives, rather than family traditions, cultural heritage or the geographically determined communities. As pointed out by both Wenger (2005) and Castells this is also enacted on the internet and as Castells frames it: the internet is the material support for 'networked individualism' (Castells, 2001, p. 129). But there is a certain tension in this trend. While we are witnessing an intensified personalisation and individualisation we are simultaneously increasingly dependent on, connected to and mutually reliant on each other, as also

Wenger's idea of 'partial knowers' suggests. Our individuality is carried out as relational, networked performances dependent on others (Ryberg & Larsen, 2006) and to paraphrase Castells, we could say that social networking sites act as one of the material supports for this.

Web 2.0 and social media as the online materialisation of the sociological trends

In the following the relations between the web trends (social media, social software and web 2.0) and the sociological trends will be unfolded, and it will be discussed how the latter can be seen as the sociological groundings of the former. Initially, we can take point of departure in a very, very rough sketch of web development (which also to some degree highlights some of the research interests). These developmental steps are not linear or successive, but rather co-existing and overlapping; although the third category is especially of a newer date (but essentially is just a transformation of the two former). But roughly speaking one can point to three phases or overarching focal activities on the web over time:

- Individual user: An individual user browsing centrally defined web-pages, or constructing such 'individual' web-pages. Web-pages act primarily as information or content silos. The focus is on providing, surfing, searching and making available different types of content.
- Communities: With both strong and weak relations, but centred around common goals, interests and enterprises. This has taken place through Usenet, online community sites, bulletin boards e.g. communities formed around shared interest in soap Opera, computer Games etc. Focus on interaction, shared interest, community and communication.
- Networked architecture of participation: Constant traversing of different types of networks with strong and weak ties. Constructing an individual, but deeply relational network, through blog-rings, tagging, sharing links or content and aggregating or distributing news via RSS. Different types of social networking sites have become increasingly popular e.g. MySpace, Dodgeball, Twitter, Facebook (ego-centric networks). Also we are witnessing that individuals are increasingly becoming co-constructors of various content, which is shared with a dispersed network e.g. through Youtube, Flickr, del.icio.us, Citeulike.

The recent trends seem to reflect a material radicalisation of 'networked individualism' or 'individualisation of trajectories of identity' and then 'horisontalisation of knowledge'.

For instance Castells (2001) connects the notion of networked individualism with online communities (affinity groups) and the 'networked individualism' as having to do with, which groups one chooses to be a part of and participate in. However, this type of individualisation is now being expanded and radicalised, as personal profiles, personal pages, personalised search and personalised news are becoming increasingly popular – both through social networks, but equally through services like IGoogle, PageFlakes and similar services offering personalised start pages. Though, there is a strong focus on 'personalisation', the personalisation is at the same time heavily relational, although the individual remains at the center of the personalised network.

Social Networking Sites are a prime example of this. The core is the individual profile, but an individual profile, which features one's relations and outreach to the world. The relations are friends, who can comment on the profile and send messages to the owner. The 'relations', however, could equally be what music the owner listens to (or is listening to right now), the owner's favourite blogs, interesting news, videos from Youtube.com and so on. Furthermore, the profile usually features a history of previous interactions and a display of membership in various communities. In this sense the profiles act as the material display for the owner's multimembership and diversity of identity. The same holds true for most web-blogs, which are very personal, but at the same time furnished with a variety of links to other bloggers, widgets showing what the owner is listening to (through e.g. last.fm), where the owner is currently physically located (plazes.com) and maybe the latest messages from friends on Twitter.com. In this sense 'the personal homepage', whether it takes the shape of a blog, a profile on social network site, a content sharing site or the like, has become increasingly personalised *and* simultaneously related and populated by other's comments, greetings and content. Often such pages are mash-ups of content from various other sites that is imported through widgets and RSS-feeds. This radicalisation of individualisation was also what prompted Time Magazine to proclaim that the person of the year 2006 was 'you'³.

³ <http://www.time.com/time/magazine/article/0,9171,1569514,00.html>

This is also heavily related to the trend of ‘horisontalisation of knowledge’, most directly because many of the above mentioned services and sites build on notions of ‘user generated content’. This term refers to that the ‘content’ is not produced by an ‘omnipotent producer’ and then broadcasted to a range of consumers (which is the traditional vertical relation between broadcast media and consumer – or company website and visitor). Rather, the content is ‘produced’ by a vast number of users creating content and sharing it with other users. Flickr, for instance, does not produce pictures for an audience to behold, instead it hosts a vast number of users’ pictures. This is the same for services such as Youtube, Revver or Slideshare (though recently we have witnessed an increase in ‘sponsored content’).

One of the prime examples of ‘user created content’ is Wikipedia where (almost) everybody can add entries and edit the online encyclopaedia. On Wikipedia it is not a small and exclusive panel of experts who decide, what should go into the encyclopaedia or discuss the individual entry. Instead, this is “collectively” decided by the users who “collaboratively” create, discuss and edit the entries. Furthermore these discussion and edits are made transparent to the public, who can get an insight into the controversies or changes made to an article over time⁴. In a similar vein one can point to ‘user decided relevance’ through e.g. news service sites, such as Digg.com. What is the most relevant news is not decided by an editor, but by the numbers of users ‘digging’ the story. The users are not creating the content but the negotiation of its relevance is distributed among the digg-users. In a Danish context (and probably in other countries) the traditional media outlets have responded to these challenges by increasing the focus on direct interactions with the readers (e.g. readers can comment on the articles). But also some media outlets provide users with blogs and photo-albums that users can populate with the possibility of ending up on the front page as part of a regular news story. Also, the user generated content can be incorporated as part of the news site itself⁵. These trends clearly challenge hierarchical, institutionalised conceptions of knowledge, and following this the quality of such user generated content has been greatly disputed and criticised (Keen, 2007). While learners’ capabilities of creating meaningful syntheses of the plethora of digital resources can (and should) be questioned (Jenkins *et al.*, 2006) it also seems that clashes between students’ view of knowledge contributions and institutional requirement can, at times, be located in the differences between the Web 2.0 view and an institutional view of valid knowledge contributions. As Bonderup Dohn (2008 this symposium) points out that, what in a Web 2.0 context, constitutes legal reuse and sharing (copying a part of Wikipedia entry into a course wiki without citation) is tantamount to cheating within an institutional context.

Social software, social media and web 2.0 tools and services can be seen as extensions to and a radicalisation of existing patterns of interaction and communication on the web. While users have always created and shared content or thoughts (through the personal homepage, the affinity groups or virtual communities), it seems to intensify the sociological trends mentioned. Through the social software and web 2.0 services networked individualism becomes visibly and materially embedded, as constellations or bricolages of relations to other people, artefacts, domains and resources. Many of the tools and services within web 2.0 are essentially about making one’s individualised trajectory of identity publicly visible, as a diverse complex of multimembership and modes of belonging to various fleeting communities. At the same time the ‘horisontalisation of knowledge’ blurs, displaces, transforms and challenges vertical relations between producers and consumers or between learners and teachers – a pattern which becomes intensified through user generated content and legal reuse through sharing, copying or remixing.

Challenges to institutions and technological infrastructures

These trends do challenge hierarchical, institutionalised conceptions of knowledge and as Bonderup Dohn (2008, this symposium) points out, the implicit view of knowledge within web 2.0 practices is knowledge as a process or activity, whereas the traditional view conceives of knowledge as a state acquired by, and subsequently possessed by the individual. Furthermore, the roles of institutions (educational or at the level of policy) has been to define the ‘relevant’ body of knowledge to be acquisitioned by the learners

⁴ This is a somewhat idyllic representation of Wikipedia’s functioning, which is much more contested e.g. there is an ongoing debate concerning, whether Wikipedia relies on the ‘wisdom of the crowds’ or if it relies on entries made by an ‘elite group’.

⁵ Some examples from a Danish context are: <http://luftskibet.information.dk>, <http://nationen.nu> or <http://ditcentrum.dk>

(i.e. a curriculum). In relation to this Wenger (2005) suggests that notions of centrally (or universal) defined curriculums are becoming increasingly problematic:

“(…) we will have to shift from an industrial model of education as the *mass production of skills* toward a knowledge-era model of education as the *customized production of individualized learning trajectories*. (…) Trends would suggest that finding a universal curriculum beyond a few basic skills of literacy is going to become increasingly difficult and less and less useful.” (Wenger, 2005, p.44)

This suggests that the challenges which underlies institutional adoption of web 2.0 practices are not of a magnitude, which lies only at the level of technological or pedagogical redesign of courses, but challenge more fundamentally held beliefs and practices within the institutional landscape of education (Owen et al., 2006).

This, however, also seems to be the very agenda for many of the authors who argue for the educational adaptation of social media and web 2.0 (Dalsgaard, 2006; Downes, 2005; Owen et al., 2006). For instance (Dalsgaard, 2006) argues that it is necessary to move e-learning beyond learning management systems and position students in a more active role through using the social media as a mean for self-governed, problem-based and collaborative activities. Dalsgaard (2006) and Downes (2005) both argue that much institutional uptake of various VLE's or Learning Management Systems seem to have focused on transmissive modes of learning, where the underlying premise has been to standardize and manage learning in a cost-effective manner:

“(…) the dominant learning technology employed today is a type of system that organizes and delivers online courses—the learning management system (LMS). This piece of software has become almost ubiquitous in the learning environment; companies such as WebCT, Blackboard, and Desire2Learn have installed products at thousands of universities and colleges and are used by tens of thousands of instructors and students. The learning management system takes learning content and organizes it in a standard way, as a course divided into modules and lessons, supported with quizzes, tests and discussions, and in many systems today, integrated into the college or university's student information system.” (Downes, 2005, Where We Are Now section, para 4)

In contrast to this use of LMSs, Dalsgaard (2006) argues for models, where the learning management systems plays a more backgrounded role and mainly support administrative and very basic pedagogical tasks (e.g. student enrolment, course descriptions, lesson plans, syllabus, basic course materials). The students' self-governed and problem oriented activities should then instead be supported by an overlay network of social software tools. This overlay network should be composed of individual personal tools (e.g. Wikis or blogs) owned and controlled by the individual students. In this way, rather than creating a monolithic all-in-one solution, the idea is to provide students with a tool-box of 'loosely joined small pieces':

“As opposed to the use of an integrated LMS, it is an approach which separates tools instead of integrating them in a system. It would be possible to integrate different kinds of social software tools in an LMS. However, the strengths of social software in relation to self-governed activities concern students' active use of and participation on the web. Further, self-governed activities are supported by providing students with a variety of tools for independent use. Students can use different tools depending on what tools serve their individual purposes.” (Dalsgaard, 2006, Towards a student-centred approach to e-learning section, para 1)

This strategy of separation, rather than integration seems to fit well the technological architecture of many social software tools, as these are characterised by a relatively open architecture, where the import, export, syndication and aggregation of micro-content through RSS-feeds, widgets, various open standards and open APIs are encouraged. Dalsgaard positions this as a student-centred approach to e-learning and summarises the core design of the institutional technological infrastructures in the following way (Dalsgaard, 2006, Towards a student-centred approach to e-learning section, para 2).

1. using a management system for administrative issues,
2. offering students personal tools for construction, presentation, reflection, collaboration, etc.,
3. facilitating networks between students within the same course, and
4. facilitating networks between students and other people working within the field.

While these ideas hold very interesting potentials for the design of networked learning, they also open to some questions on the degree or level of 'personal' such tools can or should reflect. Dalsgaard mentions

(as do many others) blogging and social bookmarking tools as potential parts of such tool-boxes, and that these should be owned and controlled by the students.

However, blogging, social bookmarking and many other web 2.0 tools are characterised by being both personalised and personal tools which reflect quite a lot about the person using the tools in terms of affinities, interests and likings; essentially because they represent an individualised trajectory of identity and multimembership in various, possibly conflicting, communities. While, it has been argued that these tools are heavily relational, socially oriented and publicly available, they often act within contexts in which the users (to some degree) can choose the network with whom to share the information; or at least they conceive of the network as private, even though it is publicly available for inspection by e.g. teachers or parents (Larsen, 2005). If students are using a blog as part of their personal communication e.g. in the form of a 'personal diary' the question becomes, whether this could or should feed into an educational context. Although, blogs are by definition publicly available some of the content may not be written with the intention of being fed into an educational context or constitute the way in which the student want to interact with their network of fellow students and teachers. Often such contentions regard the danger, from an institutional perspective, of dealing with irrelevant or disruptive content. But equally we might see this from the perspective of the students where institutional requirements of sharing 'content' or 'reflections' might pervade and intrude 'personal' networks. Equally, we can imagine situations where these overlay networks become parallel-systems constituting an institutionalised version of the students' existing practices and identities in competing, informal networks.

This is not to argue that there is a danger in adopting web 2.0 technologies or social media, but only to point out that the 'interface' between institutions and students in terms of networks, the nature of shared content and the management of identity might need to be carefully negotiated as part of institutional adoptions. As Bonderup Dohn (2008 this symposium) suggests, the knowledge practices and relations between a Web 2.0 view of knowledge and the institutionalised views can potentially clash and need to be negotiated between students, teachers and institutionalised requirements of 'correct' and 'valid' student contributions. Likewise, as Bayne and Land (2008 this symposium) suggest, the textual and multimodal practices of Web 2.0 often fit uncomfortably within the landscape of educational institutions, requiring mutual negotiation between students, teachers and institutions.

Concluding remarks

The aim of this article has been to point to some potentials and tension for the institutional adoptions of, by investigating some underlying concepts of social media and Web 2.0 technologies. It has been argued that social software, social media and web 2.0 tools and services can be seen as a materialisation and radicalisation of the sociological trends of networked individualism or the individualization of trajectories of identity and the horisontalisation of knowledge. The former concepts suggest that we are witnessing an increased personalisation and individualisation, while at the same time being increasingly connected to and dependent on others. The constant traversing of different types of networks and the sharing, copying and reuse of resources across ego-centric and object-centric social networks reflects the material radicalisation of these trends. Simultaneously, the horisontalisation of knowledge as a sociological trend challenges vertical, hierarchical and institutionalised conceptions of knowledge – a pattern that seems to be further aggravated by the implicit understanding of knowledge contribution and sharing within a web 2.0 context which runs counter to institutional views of what constitute valid knowledge contributions. From the perspective of technological infrastructures, an incorporation of web 2.0 and social software is not only a matter of adopting new technologies, but equally concerns the interaction between, technological, pedagogical and organisational understandings of practice and knowledge. The meeting between different knowledge practices and also the merge of 'personal tools and networks', which represents students' individualised (intimate) trajectories of identity (through encompassing membership in possibly conflicting communities or displaying conflicting affinities and interests) calls for careful negotiations between teachers, students and institutions. Due to the tensions and contradictions between institutions and web 2.0 practices, the 'interface' between institutions, teachers and students in form of the networks, the nature of shared content and the management of identity need to be carefully negotiated in adopting web 2.0 technologies and social software as part of institutional technological infrastructures. This paper would also suggest that these tensions and contradictions cannot really be resolved in advance, but are tensions and contradictions that must be dynamically negotiated as part of the ongoing pedagogical, organisational and technological practices forming the institutional technological infrastructures.

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