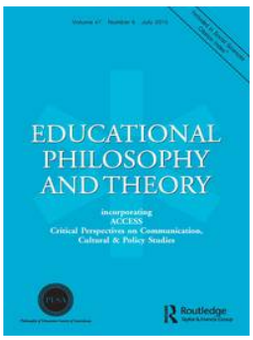

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Short Cuts and Extended Techniques: Rethinking relations between technology and educational theory

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Abstract

Building upon a recent call to renew actor-network theory (ANT) for educational research, this article reconsiders relations between technology and educational theory. Taking cues from actor-network theorists, this discussion considers the technologically-mediated networks in which learning actors are situated, acted upon, and acting, and traces the novel positions of creative capacity and participation that emerging media may enable. Whereas traditional theories of educational technology tend to focus on the harmonization of new technologies with extant curricular goals and educational practices, an educational theory of technology *looks to novel forms of technologically-mediated learning experience—from production pedagogies to role play in the virtual—to make visible the surprising relations, techniques, and opportunities that emerging media, and their attendant social contexts, may offer educational research.*

Keywords: actor-network theory, education, new media, production pedagogy, role play

Staging Things: Actor-Network Theory

One of the defining features of actor-network theory (ANT) is its central premise 'that we are never alone in carrying out a course of action' (Latour, 2005, p. 46). This is particularly evident in the fields of education and technology studies, where ongoing shifts in learning media continuously restage relations between innovations, methods, communities of practice, and learning actors. With profound shifts in, and increasing reliances upon, new educational technologies and emerging media forms (from mobile apps and interactive game-controllers to art-making interfaces and distance-learning platforms) it is increasingly apparent that learning is not a private, cognitive act performed by self-sufficient actors.

One of ANT's contributions to the social sciences is its detailed analyses of the stage boards of agency, a rigorous foot-lighting of the material supports and symbolic forms that abet creative capacity and support participation. As one leading actor-network theorist, Bruno Latour, remarks, 'to use the word "actor" means that it's never clear who or what is acting when we act since an actor on stage is never alone in acting' (2005 p. 46). Indeed, everywhere there is rigging, scaffolding, lighting, and backdrop, as well as community support (backstage, in the pit, encoded in script) and audience spectatorship (in the auditorium, on the street, or through web servers). Such considerations of 'where the action' is put us 'immediately in a thick imbroglio where the question of who is carrying out the action has become unfathomable' (Latour, 2005, p. 46).

Shifting Latour's theatrical metaphor to an educational stage, our learning dramas are increasingly mediated by digital stage boards and new learning interfaces, and it has become increasingly important to understand the specific ways in which learner agency is networked, co-constituted, and never a 'standalone' accomplishment. This makes it important to investigate the ways a learning actor is both *acting* and *acted upon* by technologies. As John Law (1999) emphasizes the anti-essentialist stance of actor network theory, ANT involves 'a ruthless application of semiotics': that is, ANT elucidates how human actors and non-human actants 'take their form and acquire their attributes as a result of their relations with other entities' (p. 3). In the field of technology studies, Dourish (2001) emphasizes 'a growing recognition that the activity of [a student] sitting at a computer is not defined simply by the patterns of their immediate interactions, but by web of surrounding relationships, practices and activities in which they are each embedded' (p. 3).

Our purpose in this work is to discuss a specific pedagogical approach that is informed by ANT's position that learner actions are very much *situated* within a broader *network* of actions, actors and activities that are community-based and technologically supported.

Building on a call (Fenwick & Edwards, 2011) to mobilize ANT for educational research, this article considers technical innovation in terms of the technologically-mediated networks in which learning actors are situated, acted upon, and acting within. Our foremost goal is to make visible key educational forms, relations, and positions of creative capacity that new technologies enable, as well as the pathways to embodied participation that emerging media support. In contrast to theories of educational technology that see technical innovations as tools of enhancement, this article will develop an educational theory of technology that examines the novel actor roles and dynamic production pedagogies that new media, and their attendant socio-technical ecologies, may offer.

Toward an Educational Theory of Technology

While there may be many theories of technologies and education, there is still a need for an *educational theory of technology* (de Castell, Bryson, & Jenson, 2002; Nordkvelle, 2004). Theories of educational technology typically frame 'educational technologies' as discrete technical artefacts that enhance existing practices, or make extant methods

more efficient, for example, using technologies such as interactive white boards and course-building software to facilitate student engagement. An *educational theory of technology*, however, examines how new technologies support the *re*thinking and *re*making of traditional curricular forms and methods, including assessment.

To illustrate the distinction, in terms of traditional theories of educational technology, Internet resources and digital media are conceived and incorporated as resources that augment established methods, support content-delivery, or make educational experiences more palatable or globally-connected. While celebrating the radical potential of technical innovation, this theoretical orientation seeks and maintains concordances with traditional educational forms, techniques and actor-positions (Christensen et al., 2008).

As many digital-era theorists have argued, digital technologies are commonly welcomed as 'additive', 'objective', 'neutral' resources (Kenway, 1996; Postman, 1992; Teils & Oberdiek, 1995) that refine existing techniques, extend given environments, and leverage assessment transparency in relation to reproducible outcomes and corresponding 'cognitive processes' (Pelletier, 2006). Technical innovation is seen to yield logistical virtues, such as increased accessibility and accelerated processes, while broadening administrative oversight over correspondingly novel forms of feedback (e.g., user data, which in turn extends the school's ability to test and assess student growth data, increase program and subject accountability, and further refine 'proven' teaching techniques) (de Castell, Bryson, & Jenson, 2002; de Castell & Jenson, 2003; Gee, 2004; Kenway, 1996; Postman, 1992; Zuboff, 1988).

As Christensen et al. (2008) have updated this discussion, educational technologies are frequently incorporated as 'sustaining technologies' that are organizationally adapted to streamline and extend prevailing methods without challenging fundamental educational suppositions, routines, and standardized role-functions among actors. By prefiguring what is visible, sayable, or doable in relation to technical innovation, this mode of incorporating new technology thus enacts, from the practical standpoint of actor/user performance, an *inertial* 'structuration' (Orlikowski, 2000) of role-positions and corresponding practical possibilities.

In this context, advances in instructional technology are ubiquitously synonymous with online learning management systems, course-building software-suites, distance learning platforms and, more recently, MOOCs. These advances, we argue, integrate technology/practices in terms of concordance and continuity, particularly in an era of accountability pressures and standardization imperatives. Here, the so-called 'interactivity' of e-learning suites is limited by encoded presentational constraints that prefigure 'good' lesson-building. And distance-learning platforms in the field of teacher education, for example, often rely upon enterprise-scale 'management systems' which anticipate, coordinate, and validate a narrow horizon of possible (thinkable) classroom procedures and acceptable role-performances. Rhetorically put, these instructional technologies are—as a *medium* of experience and action—analogous to a massively-multiplayer technology of social reproduction, a kind of cybernetic theater through which conventional routines and role-relations are prefigured and performatively (re)enacted, *in practica*—a kind of tightly-scripted 'synchronized swim' in which student agency centers on compliance.

In contrast to sustaining technologies, web-based sites like Khan Academy are often presented, or present themselves, as *disruptive innovations* (Christensen et al., 2008; Noer, 2012), as cutting-edge digital solutions to pressing educational crises of 'educational underachievement' and 'student disengagement'. Khan Academy, for example, is seen to disrupt traditional schooling practices by 'flipping the classroom', that is, by disrupting the lecture method and establishing 'studentcentric' controls over the rate, time, and space/place of learning. These disruptive innovations are characterized by customization tools and modal-flexibility, as well as server-side programs that can dynamically read user action/data, and then 'informate' (Zuboff, 1988) instruction and content delivery to a unique user's specific patterns of attention or initiative (Noer, 2012).

While Khan Academy may indeed disrupt the institutional timetables, passivity, and 'one-size fits all' instruction emblematic of the lecture-hall, there *still* persists a *student* actor sitting (somewhere) in asymmetric (broadcast) relation to an *expert*, and the horizon of possible action is delimited by discrete outcomes, and governed by overarching outcome-based metrics of progress (through back-end modules that allow teachers to assess student activity). While much may be 'new' about these learning environments, what is nevertheless indefinitely sustained are the role-relations between those who know and those who don't, the pre-determination of 'significant learning', and divisions between professional knowledge and the means of actional knowledge-making and cultural design.

Part of the dilemma, as we identify it, with traditional *theories of educational technology* is that they more or less accept traditional curricular structures and educational role-relations as self-evident forms, as a 'natural' staging upon which the new technology is to be patched. Even so-called disruptive innovations unwittingly continue the 'business-as-usual culture of schooling' (which, paradoxically, is often what the innovation was supposed to magically transform in the first place) (de Castell et al., 2002).

Complicating this reception of new media, Walker (1987) has argued that educational media, method, and techniques are often instructionally conveyed to practitioners through 'pre-theoretical' narrative forms. Practical educational discourses 'emplot' (Ricoeur, 1990) a pragmatic 'story-line', a narrative for the specific application of a technology that both structures and rhetorically circumscribes the reception of technologies (and their uses) while evacuating any space for theoretical reflection, imaginative mis/appropriation, or un-preprogrammed agency. Walker argues that the discourses informing educational technologies employ rhetorical genres and imperative modes of address that perpetuate inherited practices while rarely articulating any relationship between an *educational technology* and *a theory of education*. These informative discourses, by rhetorically delimiting horizons of visibility, practical action, and reflection, not only forestall thinking outside the box, they preclude critical apprehension of any box, as well as any outside to it.

From Disruptive Innovation to Networks and Ecologies

Taking up the call for an 'educational theory of technology', Nordkvelle (2004) urges a re-examination of relations between technology and educational theory. To this

end, Nordkvelle traces the historical relationship between two terms—technology and pedagogy—first by reminding us that in the early modern era the term *technology* was closely associated with *didactics*: the theory and art of teaching. Indeed, technology and the art of teaching (*didactics*) were, to some extent, co-mappable terms. However, from the nineteenth century onward, the term 'technology' becomes more 'closely associated with mechanical engineering [and] its link to the structure of academic subjects and their teaching vanishes' (Mitcham, cited in Nordkvelle, 2004, p. 430). As Nordkvelle's Foucauldian analysis demonstrates, the intimate link between technology and didactics is gradually forgotten. What's more, since the 1960s, an ascendant term, *educational technology*, becomes increasingly associated with the discrete mechanical artefacts—tools used to better 'steer' inherited instructional methods. As Nordkvelle (2004) punctuates this material and epistemological shift, when 'educational technology' is narrowly defined in this 'restricted sense' (as a discrete means of delivery or tool of efficiency), then prevailing teaching practices are naturalized as 'simply method' (p. 435), and *educational technology* becomes the means to enhance 'simply method' (or to extend what passes for curricular 'common sense', as well as the actor-roles sustained by that common sense). The logic of enhancement, like the logic of 'school reform', thus already takes for granted 'the system of reason' that orders given curricular presuppositions, roles, and practices (Popkewitz, 2010, p. 185).

While technology may be typically understood, today, in this restricted sense, as discrete mechanical *artefacts*, a more fruitful (and critical) way to look at technology, argues Nordkvelle, is in terms of a complex and ongoingly transformative interplay of knowledge, practical activity, volition, *and* artefacts (Mitcham, 1994; Nordkvelle, 2004). The shift from a *theory of educational technology* to an *educational theory of technology* is assisted by reviving and renewing this use of the term 'technology', and not only to identify artefactual innovations, but to describe entire *ecologies*: the narratives in-forming new technologies; the surrounding discourses and rhetorical modes which script (or reimagine) modes of engagement, techniques, or practical 'arts of doing'; the actor roles, social identities, and socially-mediated desires that emerge in relation to new technologies; the shifting positions of access and the novel pathways to qualification which these technologies may afford. Moreover, renewing this expanded sense of technology reminds us, too, that our most intuitively-given schooling methods can also be seen as technologies—as forms of *techne*, or as *arts* of teaching—that is, as subject-forming techniques (Foucault, 1995) that might be reconstructed and performed otherwise.

What ANT affords this discussion is its attention to *shifting relations of agency and capacity*, and particularly to those forms of creative capacity that do not conform to the most predictable uses, paradigmatic scripts, or apparent constraints of a given artefact. What ANT suggests is that a new (or old) technology is, in itself, neither intrinsically sustaining nor disruptive. Rather, it becomes sustaining or disruptive by virtue of the surrounding socio-technical ecologies that modify states of affairs: the discourses, practices, material contexts, and social desires, as well the (unauthorized) actors who may unexpectedly engage a novel technology, or re-script associated techniques and performances. Here, we argue that an *educational theory of technology* can

help us identify the diverse ways networked learning experiences eventuate themselves, and thus help mobilize new relationships between technologies, theories of education, and arts of learning in ways that productively challenge sustaining, and pre-theoretical, receptions of 'educational technology'.

For instance, it is difficult to consider Sugata Mitra's recent 'Hole in the Wall' experiments without rethinking the link between technology and educational theory. In these studies, Mitra and Rana (2001) have shown that, in the absence of expert/teacher supervision or formal instructional practices, learners can, in direct relation to digital media, 'teach themselves and each other, if they're motivated by curiosity and peer interest' (Mitra, 2010). In Mitra's experiment, the 'hole in the wall' was 'a computer connected to the Internet and embedded into a brick wall near a [New Delhi] slum. … It was reported that most of the [illiterate] children were able to use the computer to browse, play games, create documents and paint pictures within a few days' (Dangwal & Kapur, 2008, p. 339). Mitra thus signals that 'groups of children can learn to operate and use computers with none or minimal intervention from adults … irrespective of their social, cultural or economic backgrounds' (Mitra et al., 2005). Based on these experiments, Mitra developed the notion of Minimally-Invasive Education.

Minimally-Invasive Education is characterized by the *absence* of pedagogical interventions, developmental guidance, or teacher-mediated knowledge transfer and capacity-building (Stamp, 2012). But we emphasize that this 'absence' must be qualified by the material *presence* of other things: material modifications to the environment, pathways to interactive, feedback-rich media, network connectivity, as well as dynamic community-based support (among learning peers and local audiences including, in this case, technologies). From the standpoint of ANT, Mitra's *intervention* mobilizes 'things', and/or re-stages relations to them, and in ways that enable unexpected outcomes to eventuate themselves, or unanticipated engagements to persist. In terms of actor-roles, learners are no longer situated as subjects that are waiting for their minds to be filled with 'knowledge' (Freire, 2006) but instead enact, with and through a technology (in this particular case), *their own* course of learning, by engaging in idiosyncratic challenges, by figuring things out, and by co-producing multimodal artefacts (such as images, sounds, etc.). What this signals, then, is a difference between an instructional mediation, or pedagogical technology, and a learning event mediated, or co-constituted, between and among situated actors, interactive media tools, and informal social audiences.

By (literally) reconfiguring relations between human and non-human entities, states-of-affairs are thus modified, and in this case, such modifications may challenge conventional suppositions about the proper use of an 'educational technology', or about what bodies can learn, or might do, under different material arrangements and conditions of situated performance.

Taking ANT's methodological cue to 'follow the actors' (Latour, 2005), we believe it is possible for educators to learn as much (or more) from those actors who are *doing the doing* (vis-à-vis new technologies) as by relying solely on the words of experts, educational script-writers, or crisis-managers. To follow the actors means to focus on how new media are variously perceived, articulated and (re)mobilized by everyday

users. Speaking ecologically, to follow the actors means to trace the novel 'assemblages' and 'the surprising connections' (Latour, 2005, p. 252) between artefacts and learning actors, between learning pleasures and embodied competencies, between acts of improvisation and serious knowledge-making, serious cultural production, and 'serious play' (de Castell, 2011; de Castell & Jenson, 2003; Gee, 2003, 2007; Squire, 2008).

What is a Mediator? Counter-Environments and Extended Techniques

Challenging androcentric narratives of integral human agency, ANT makes visible the dynamic sets of human actors (and communities) that support an actor's ability to perceive, feel, think, make, do, design, learn. More distinctively, ANT renders visible the many *non-human* objects and technologies that support agency, be it a pencil, a pencil-sharpener, or a computer in a 'hole in the wall'. Situated within a network of human and non-human entities, actors are only able to do, obtain status, or participate in common by virtue of their embodied position within these complex and shifting sets of relations (Dourish, 2001; Law, 1999; Latour, 2005).

Here, meaning, function, ability—as well as disability—lie not *within* discrete things or bodies as essential properties of them: on the contrary, actors obtain capacity and cultural talents (as well as take their social identities and statuses as competent actors) by virtue of, or in relation to, the many human and non-human affordances that scaffold, model, facilitate, authorize, or accredit (Latour, 2005; Mehan et al., 1986; McDermott & Varenne, 1995; Skrtic, 1995). An affordance is an object, resource, or environmental contingency that supports, or can be *appropriated* (Wertsch, 1998, 1991) to support, capacity or accomplishment. Through this lens, we discern the symbolic and material affordances that 'co-constitute' (Latour, 2005) agency, role-taking, or common membership. By the same token, ANT helps make perceptible the material and symbolic constraints that obstruct agency, name the unqualified, or exclude certain bodies from participatory status.

Significantly, ANT draws attention to the environment, and particularly to those ecological relations and aspects which may be taken for granted as 'natural' features of the everyday (Latour, 2005, p. 79). For example, it is relatively effortless to identify various material prostheses which permit so-called 'disabled' actors to participate in ways that, prior to the introduction of the artefact, the actor could not have done, or could not have done without great strain. Crucially, what ANT makes perceptible is how so-called 'abled' bodies are always already similarly assisted and continuously supported by material artefacts and constructed environments, even if—or again, particularly if—these material and symbolic supports go unnoticed in the broad stream of perception. The countless prosthetic 'things' that scaffold the so-called 'able-bodied' may pass unnoticed as natural or intuitively self-evident aspects of environment or situation. And we can thus begin to see the ways an entrenchedly differentiated distribution of access to tools, resources, and other helpful 'things' has been normalized, and to appreciate how educationally-advantageous forms of surrogate competence, and differentially-advantageous affordances of learning, have been overlooked in even our most 'objective' educational assessments of 'gifted' and 'challenged', 'able' and not.

ANT thus challenges invisible standards of self-sufficient 'normalcy', as well as whatever implicit entitlements go with such standards. ANT asks us to repudiate androcentric notions of capacity where sovereign actors act out the discrete contents of their proprietary self-sufficiency. Importantly, from the standpoint of educational theory, ANT casts its light outward to show that *all* accomplishment (and by implication, all learning) depends upon very broad networks of generous relations and supports—both human and non-human.

By demonstrating how radically populated *any* network of action or capacity is, it is possible to elucidate how emerging innovations—what Latour calls *mediators*—'authorize, encourage, permit, suggest, influence, block, render possible, forbid, and so on' (p. 72). As Latour continues, one of the reasons ANT focuses on technical innovation is because a novel mediator reminds us of, and critically re-sensitizes us to, the environment(s) at large. It is the study of innovation that opens up places where emerging actor-networks (and novel ways of doing) are thrown into perceptible relief, or become suddenly visible, before an innovation settles in to become a self-evident aspect of the given 'distribution of the sensible' (Rancière, 2004). ANT in this way takes seriously Postman's (1992) well-known axiom that a new technology 'does not merely add something, it changes everything', as well as Postman's cautionary note that even radical changes in technology quickly 'settle in' as ordinary features of the practical every day.

ANT's attention to *mediators* and technical innovation parallels, functionally, what McLuhan (1997) called a *probe*, that is, a novel technology that reminds us of the constructed, artefactually-populated, if seemingly 'natural', environments in which we are always already situated. ANT, by tracing the emergence of probes and mediators, helps make perceptible what McLuhan called an anti-environment. As McLuhan (1997) states, a novel probe 'makes the [extant] environment visible. … When an environment is new, we perceive the old one for the first time' (p. 119). A probe is an innovation—an experimental technique or 'form of symbolic action' (p. 119)—that opens up a critical counter-environment, one that displays as artefactual/artificial what was previously considered self-evident, autopoietically self-present, or not accounted for at all. In this sense, Mitra's 'Hole in the Wall' experiment can be recognized as a probe, a means of transforming the ecology of learning, and thus challenging conventional educational presuppositions, methods, and expectations about what bodies can do.

Latour's mediators and McLuhan's probes both function as 'anti-environmental means that enable us to see the environment. [As such], a probe enables means of perception that must constantly be renewed in order to be efficacious' (McLuhan, 1997, p. 119).[1] Paralleling, to some extent, avant-garde aesthetic challenges to well-ordered categories of experience (e.g., through aesthetic defamiliarization, or by self-referentially showing the medium of representation *as* a medium), it is in the area of technology studies, so Latour argues, the site of 'innovations and controversies', that probe-like mediators are continuously emerging, 'accountable' and in play (p. 80).

Yet unlike spectacular (and specialized) avant-gardiste gesture,[2] what ANT describes, and helps re-sensitize us to, is *how* countless everyday 'things'—pencils, steps, a level sidewalk, a door, the camera obscura or slide projector, the television

remote or computer mouse, the touch screen tablet or the Wii Wand, indeed transportational vehicles of any kind—all *support* goal-completion, *enable* aesthetic percept and/or *mediate* symbolic qualification. ANT demonstrates how all these subtle sets of things, including the performative power of words, serve as a cybernetic-ecological topography for accomplishments of *any* kind.

In simplest terms, one only truly appreciates the cybernetic mediation of a toothbrush when the artefact has been misplaced, modified by an improved model, or superceded by an innovative device, or when the artefact is being mis/used or experimentally repurposed in unofficial ways (say, by using the brush to clean a spark plug, or to deliver paint to a surface so as to exact a certain visual-textural result, or by placing the artefact between piano strings to modulate acoustical sound). In the lexicon of artistic practice, the association of ordinarily unrelated artefacts, or the unofficial use of a thing (by unauthorized actors)—is called an extended technique.

By bringing novel mediators and extended techniques into view, ANT helps us discern where learning actors are improvisationally performing in ways that are not, as it were, in the 'instructional manual', and in ways that depart from traditional developmental schooling, curricular scripts, and conventional educational role-positions. In what follows, we will try to make visible the surprising events and dynamic relations that digital tools and emerging media(tors) may offer, and particularly those emerging media forms that enable learners to more deeply engage, and more directly embody, a learning that is more fully their own.

Virtual Short Cuts: Role Play and Production Pedagogies

While the term short-circuit has a fittingly disruptive ring to it, we are rather more interested in *short cuts*, that is, how new affordances and extended techniques reframe expectations about what bodies can do, about who is qualified to make, design or communicate, and how emerging media might interrupt traditional educational methods based in developmental schooling. Paradigmatically, Rancière (1991) has argued that developmental techniques of schooling *first* provide students with 'the measure of inability', that is, a calculated 'distance' to be gradually, and programmatically, reduced (on the way to future capacity, talent, or status). Traditional curricular techniques thus prefigure and enact what Rancière calls a method of explication: the mobilization of curricular forms, structures, and environmental contingencies where student bodies are progressively moved, in-sequence, from 'the simple to the complex', from incapacity to competence, from a 'novice' status to an 'expert' role (Rancière, 1991). However, in Rancière's argument, the distance to competency or full membership is continuously re-enacted, or re-emplotted, from stage to stage, from discrete outcome to outcome, throughout the protracted educational arc. As Pelletier (2009) summarizes, 'the perpetual re-making of incapacity, as the student moves up the educational ladder, is what the education system terms individual progress' (p. 144). Going beyond critiques of 'banking education' (Freire, 2006), Rancière (1991) interrogates developmental-progressive educational techniques where learning actors become trapped in the amber of predicted environments, scaffolded preparations, and regulated improvements. Here, even as students 'progress', learning actors

may not (ever) take roles as agents involved in critically re/framing, or productively remediating, their own lived worlds and situations. If the medium is the message, students may indefinitely occupy and practice novice roles and attitudes of relative incapacity (in relation to 'experts' or teachers). Students in this way may accrete, by degree, segmented 'skills' and knowledge about 'states of affairs over which they themselves have neither any agency nor any embodied competence' (de Castell et al., in press).

The term 'short cut', as a trope for circumventing this developmental technology, may imply, at first blush, a simple relation of *access* to new media. But the value of access is void, from the standpoint of ANT, unless larger ecologies are taken into account: What roles are being assumed (upon what kind of stage), and with what kinds of socio-technical supports? How do new media invite agentive role-taking, modes of sustained interaction? What new modes of agency are therein co-constituted or mobilized? And what, then, can the everyday actors who appropriate new production media teach educational theorists about their (the actors') own forms of significant learning?

As we will argue, if there are shorts cuts afforded by new media, they can and need to be described not only in terms of 'access', but also in terms of how learning actors are enabled to experimentally perform in 'the gap between accreditation and act' (Rancière, 1991). How might emerging media, and co-emerging social forms, enable un(der)qualified actors to engage design challenges, and to take positions of participation that, under the conditions of traditional curricular technologies, would be denied or deferred?

Below, we'll trace this notion of performing in 'the gap between accreditation and act' across two interrelated, and technologically-mediated, forms: role play and production pedagogies.

Role Play: Whereas the discourse of disruptive innovation typically focuses on multiple learning styles, self-directed exploration, and 'studentcentric' technologies (Christensen et al., 2008, Noer, 2012), what is left largely undisrupted are the *roles* learning actors take in relation to those tools, as well as corresponding divisions between those who make or distribute knowledge and those who are addressed to incorporate that knowledge or know-how.

To understand the educational workings of role play, Benjamin's (1928) description of 'proletarian children's theater' offers a fittingly actor-network staging to describe recent ecological shifts in educational experience. What links Benjamin's argument to present media ecologies is his exploration of a particular pathway to participation and involvement, where learners perform in 'maker roles', and think, make and do within the context of meaningful design challenges. But we need to be clear that invoking the theatrical is not intended principally to reference 'the dramatic arts' as a medium of educating (as developed in the work of Heathcote, 1985; Boal, 1992). Taking a cue from Goffman's (1959) dramaturgical theory of action, and drawing upon Latour's (2005) use of dramaturgical models, we argue that the significance of Benjamin's children's theater is not simply that learners assume, for a moment, the role of the teacher, or that they perform on stage for the adults, or that they take the 'mantle of expert' (Heathcote, 1985) as part of an artfully contained schooling drama. Rather, what we think is significant is the improvisational mode through which

learning takes place, the hands-on relations to authentic, multimodal objects and production contexts, and, more specifically, the mimetic means through which 'reality and play are so fused together' that pretended gestures and concerns may become 'real ones' (Benjamin, 1928; Walker, 1987).

In the performative art of the children's theater, the aim is not to instruct the children in adult knowledge and behavior as a stable and superior model to reproduce. Rather, the aim is to amplify the embodied capacities and productive gestures of actors who are already mimetically immersed in, and affectively invested in, the exploration, and reshaping, of an incomplete world of knowledge and practice. As Buck Morss (2002) states, Benjamin downplays privately-cognitive, 'in-the-head' forms of education grounded in propositional representation. What he valorizes, by contrast, are immersive experiences where learning actors improvisationally 'lay hold' to things, pictures, and words, 'releasing from them new possibilities of meaning' and function (Buck-Morss, 2002, pp. 262–265). As engaged imitators, learning actors both adopt and creatively re-mediate 'gestures, representational forms, and patterns of action', and make of them their 'own expressive forms' (Gebauer & Wulf, 1995, p. 286).

On one hand, Benjamin's pedagogical theater can be seen to challenge asymmetrical role-relations between those who know and those who don't, between specialists and unqualified novices. But to stop here leaves us with a facile version of carnival: a temporary inversion of stable identities and fixed roles (where 'the mantle of the expert' is dropped at the end of the act).

In terms of technology studies, Benjamin's discussion of a revolutionary children's theater describes not a momentary swapping of stable roles, but a sustained, cumulative and embodied demonstration that such roles—in relation to engaging meaningful challenges and productively 'doing things'—may be unstable, artificial, and, indeed, undecidable.

As Otte (1995) argues, when persons directly 'pretend' or playfully 'impersonate' roles of competency/talent, they in turn display literate and aesthetic competences that exceed what might have been traditionally expected or taught. Here, such unexpectedly competent performances by learning actors signal a challenge to developmental paradigms about what learning actors 'can do', and what talents they might be (en)able(d) to perform. But the important point, from the standpoint of actor network theory, is not just about 'theatrical improvisation', but about materially emergent stagings that abet, or 'co-produce', such unexpected effects. What kinds of subjectivities (agencies) co-emerge in relation to emerging media, and through human/material practice as *performance*?

In terms of human/material interaction, the notion that pretended acts, through the fusion of 'reality and play', might enact genuine competences has, for some time, been a concern of educational researchers working in the area of digital game-based learning and play environments (Bogost, 2011; de Castell, 2011, de Castell & Jenson, 2003, 2007; Gee, 2007; Squire, 2008).

As de Castell et al. (in press) trace out, innovations in gaming consoles signal emergent controllers that no longer simply 'simulate' actions or talents on screen (by way of abstract arcade-style 'button-pushing'). Rather, emerging consoles increasingly provide controllers/interfaces that afford a novel form corporeal interactivity, enabling

players to more directly embody the capacities they are supposedly just 'simulating'. The player's physical actions, gestures, and performances more directly correspond, mimetically and kinesthetically, to the action or performance displayed on the screen. Bogost (2011), for example, deploys the term 'proceduralism' to stress the 'process-intensive' (p. 13) mode of embodied 'doing' that characterizes the kinds of mimetic interfaces we are signaling here. So situated, learners more *directly* experience (through the game or play-based challenge) what it is *like* to engage in and performatively 'do' a practice (de Castell et al., in press).

In our view, haptic and subsequent gesturally-responsive digital games like ROCK-BAND, GUITAR HERO, Kinect SPORTS, and the Wii Wand, herald a distinct, if still nascent, modal shift from 'button-pushing' (simulation environments) to interactive/mimetic technologies (that employ infrared sensors, balance boards, sophisticated motion-detectors, and hand held controllers which, in both appearance and functionality, procedurally emulate, and sensationally parallel, the 'real' instrument/object of use). Increasingly, these corporeal gaming interfaces (and their community-supported play environments) enable learning actors to mimetically perform *'just like'* musicians, visual artists, composers, and athletes, etc., and in ways that *'support players' embodied competence rather than just the ability to simulate such competences*' (de Castell et al., in press). In ANT terms, this elucidates how unexpected capacities are 'co-constituted' through novel shifts in human/material interaction.

The (educational) question, here, to paraphrase Cervantes, is to what extent players/actors, if performing 'with such unusual and convincing effect', might be 'transformed by the very parts they are playing'? If a procedural, mimetic engagement becomes a part of the technical equation, what epistemological shifts are taking place in these emerging contexts? What procedural pathways to participation/agency might be mobilized? What kinds of fresh agentive identities are co-produced, or come into play?

Production Pedagogies: In what follows, we transport this specific conception of actor role play to production pedagogy contexts, and to emerging design media. We examine the opportunities afforded by current and emerging design and production media where the making of 'meanings' and the making of 'tangible artefacts' (Squire, 2008) come concurrently into play.

A production pedagogy is one in which learning actors are enabled to engage (multi)literacy, artistic, and/or practical design challenges and aptitudes *through* the making of authentic cultural artefacts—and with correspondingly real audiences similarly enabled to witness such acts of art and knowledge production. Of particular interest are the means and support-interfaces (both social and technological) through which learners engage cultural texts, images, and objects, producing 'things' as valid cultural artefacts in their own right, and in so doing, demonstrating not only self-efficacy, but participative status.

Production pedagogies connect situated design practices (New London Group, 1996) and the conditions for 'knowledge-in-the-making' (Ellsworth, 2005) with the above mentioned modes of role play: modes of situated performance that challenge established roles and predetermined expectations/classifications for bodies. Production pedagogies stage environments where learning actors, immanently engaged with/in an

extended, open-ended, real-world 'curriculum', inhabit sustained roles as *artists, composers, writers, game-designers,* and/or *researchers*—that is, as cultural (re)Designers. What matters, dramaturgically speaking, is the specific pedagogical staging, that is, the material-social ecology that buoys the ongoing activity of production, enabling actors to deconstruct and reconstruct, interpret and refigure, and to make both meanings and 'things' within the context of appreciably meaning*ful* cultural/aesthetic interventions.

Here, new media—highly-interactive, multimodal, feedback-rich media—aid and abet situated production practices where learners are enabled to explore, copy and quote, assemble and remix, unlink and recombine figures, patterns and relations into new forms of art and knowledge. If new corporeally-activated game controllers make it possible for learners to more fully embody competent 'subject positions' (and their respective modes of performance), then new design media—from all-in-one digital music studios to video production platforms—might better position actors to engage with, and to seriously re/mediate, forms of knowledge, and to compose visual culture, video artefacts, music/soundworks, or engage, in-depth, in richly multimodal research challenges.

What is striking about new design media is that they do not address their users as non-competent novices, nor as 'student bodies'. Paradigmatically, the Tenori-On[3] is just one production affordance that enables learning actors to make music and 'do' (music) theory, *in media res*, through the immanent process of making and doing art. Through an intuitive touch-screen interface, actors activate or de-activate notes and tones, sample sonic textures or remix extant musical elements, select instrumentation, voices, and/or ambient textures, as well as navigate traditional key signatures, scales and musical modes. Actors are also enabled to sculpt sound gesturally, and 'draw' musical relations pictorially, and to then deconstruct and reconstruct musical figures and relations across inter-expressive scoring grids and editing interfaces. Through improvisational, hit-and-miss operations (additive and subtractive processes), players confront design challenges, and in so doing design musical artefacts, composing and recomposing 'loops' and 'layers' into multidimensional sound 'blocks': they then re/mix and re/assemble their various 'blocks' into a coherent artwork.

Further than being a production-pedagogy vehicle, each Tenori is quite literally a node in a social/material assemblage: each device is a networked window that opens onto real-time peer-to-peer collaborative sessions, technique-sharing, and peer tutorials. And each discrete device opens into authentic networks of aesthetic publication and visibility, where diverse aesthetic models, device 'mods', and extended techniques are shareable and in play.

In contrast to curricular forms that presuppose a determinate lack of 'know how' or 'know that' as the educational point of departure, emerging media like the Tenori-On act upon users differently, and act upon them in ways, we suggest, that invite learners to begin competent*ly*—and build competence from there. The medium suggests a particular *techne* of learning, one that renews, for digital contexts, what Cazden (1981) called, long ago, 'performance before competence'. Performance before competence, in our terms, signals a kind of 'short cut' to participative agency, a circumventing (*by other means*) of traditional suppositions that state that 'basic' literacy rudiments must

be meted out and mastered *before* actors can truly think or design, perform or take part in common.

Supporting this kind of 'part taking', traditional distinctions between specialized tools (designed for experts) and common tools (designed for no-one in particular) also appear to be eroding. Postmodern media like the Tenori—highly-interactive, multimodal, and feedback-rich—are, unlike their modernist predecessors, no longer being designed just for accredited specialists (Prior, 2010) As an example of a Latourian mediator, such media configure new ecologies of practice and performance, inviting unaccredited actors to do things that, formerly, were the purview of qualified actors (Latour, 2005; Rancière, 1991).

More than just about designing things, production-pedagogies unfold through widely seeable and shareable contexts of publication and use. While publication and public performance clearly come with their own ecologies of risk, and while new scripts and constraints on agency necessarily attend technical innovation, we think it is worthwhile to trace how emerging media may provide the social networks and the material vehicles for both 'serious play' and real-world design interventions—from learner-designed multimedia arts and literary/research journals to the co-creation of digital game-worlds, innovative apps and, indeed, the (re)design of educational technologies by learners themselves. That, we contend, is learner agency writ large.

Educational Technology Research

Whereas critical educational studies have long interrogated asymmetrical power relations embedded in traditional schooling forms, this article relies less on critique than on considering novel digital practices that performatively support relations of common agency. As Rancière (1995) and Latour (2005) emphasize, democracy and equality are less usefully grasped as formal aims to attain than as practical relations that can be mobilized, enacted, and verified in the material present.

In examining the popular discourses that surround the notion of disruptive innovation, we argue that, if there is something genuinely disruptive taking place within new online academies—and still more so within emergent, informal communities/assemblages of practice—it is that all varieties of knowledge, science, art, and aesthetic experience are freely offered up to anonymous actors: that is, they are presented to precisely nobody in particular. Here, the monological enclosures (discursive, institutional, and material) that have dictated the proper time, location, content, and progress of the modern curriculum are slackening, if not, to some extent, unraveling. In turn, creative capacities are being unlocked from these enclosures, and released from modern techniques of developmental management.

We also caution that the recent popular trafficking in terms like 'disruption' and 'disruptive innovation'—often by technology specialists and industry leaders—may in fact conceal more genuinely transformative events that become perceptible when we attend to wider media ecologies, and to the many diverse actors who exert agency within them. Here, if new media (both technical innovations and extended techniques) can in these ways alter the old institutional/educational enclosures for learning bodies, they may also interrupt the pre-scripted forms of distinction, identification, and classification upon

which so much traditional schooling rests. In that case, these new ecologies of practice may powerfully challenge what Rancière (1991) has called the 'knowledge of ignorance', the disciplinary knowledge of the incapacity of bodies that subordinates them to a curricular place, and a corresponding developmental regime.

If there is a type of democracy enacted within the media/medium, it pivots less on the 'free access' to 'elite knowledge' (Noer, 2012) than on the absence of any pedagogical mode of address that would solicit classified bodies and bind them to their place: that is, interpellations (Althusser, 1971) that enroll bodies and progressively manage student 'growth' in preparatory, and predetermined, relation to an always-only *future* condition of ability, legitimate status, or formal equality (Rancière, 1995; Skrtic, 1995).

McLuhan (2003)—in this extent anticipating Latour—wrote that the 'art of remaking the world eternally new is achieved by careful and delicate dislocation of ordinary perceptions' (p. 510). One aim of this article has been to draw upon ANT to shift the focus from educational technology (as a means of enhancement) to a more ecological perspective that invites new ways of thinking relations between technology and education. However, merely dislocating ordinary perceptions does not, by itself, remake anything. What Latour adds to McLuhan's thesis is a specification of 'parts', and thence the possibility of a 'reassembling of the social' in all its heterogeneity, contingency and complexity. What ANT brings to McLuhan is the notion that 'standardized forces' and apparently 'immutable' role-relations can be re-cast, or mobilized into multiple assemblages (Fenwick & Edwards, 2011). By following networked actors, and by tracing emergent mediators, what is revealed is that apparently stable roles and standardized relations are in fact composed of a 'skein of weak ties, of constructed, artificial, assignable, accountable and surprising connections', a skein from which novel relations and techniques might be identified and articulated (Latour, 2005, p. 252).

In this context, ANT insists that we attend to the question of the performativity of our own discourses and methods. As Law (2004) and Latour (2005) have argued, methods and research practices do not simply represent social reality, or provide statements that describe 'the situation'. On the contrary, our methods and suppositions and discourse constitute the realities and situations we think we describe, such that 'to theorize is to intervene and experiment rather than to abstract and represent' (Fenwick & Edwards, 2011, p. 13).

In exploring relations between technology and educational theory, it is imperative that educational researchers consider the performativity of our theoretical gestures, and that we consider how our methods and words reproduce—or alternately re-figure—material situations, social realities, and curricular forms. For the point, as Latour reminds us, is not to critique a world of 'already standardized forces', but to engage actively and intentionally in the inescapably political 're-composition of its content' (p. 260).

Notes

1. In the 1930s, Benjamin (1968) presciently describes 'mediators' and anti-environments in terms of (then) novel 'optical' and 'acoustical' media: mechanical technologies and aesthetic techniques that instigated a 'deepening of apperception' in everyday experience that,

heretofore, 'floated along unnoticed in the broad stream of perception' (p. 235). This critical effect, for Benjamin, was an upshot of the material and symbolic innovations that arrived with 'the historical avant-gardes', and still more so with the proliferation of new broadcast media: film, photography, and radio; new image-editing techniques; new ways of inter-linking sound, visual, and diegetic elements; as well as new ways of deconstructing and reconstructing artistic conventions, narrative codes, and genre formulas.

2. For example, see Galloway's (2006) notion of 'countergaming', which examines recent 'avant-garde' digital game design, that is, modes of video-game art that aesthetically defamiliarize or explicitly disrupt the conventions and intuitive flow of digital game play (e.g., by designing media that, at the level of user experience, antagonize or disruptively conflict with mainstream expectations for how video games should be played).
3. Iwai, T. (2006). *Tenori-on* (Hardware); *Tenori-on/TNR-I* (for Ipad, iPhone, iPod Touch). (2006). Hamamatsu, Japan: Yamaha, Inc.

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