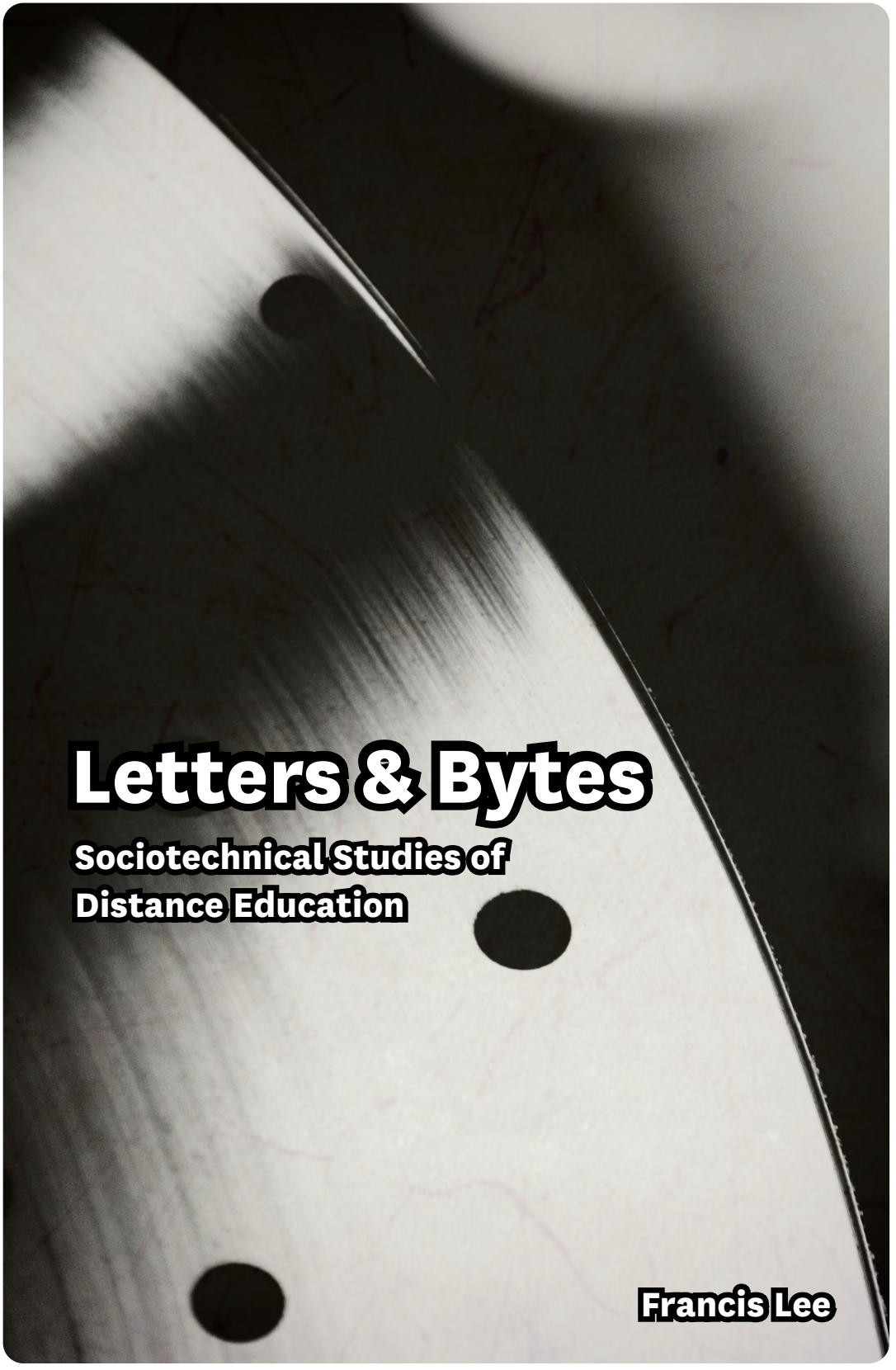

Letters & Bytes
Sociotechnical Studies of
Distance Education
Francis Lee

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Sociotechnical Studies of Distance Education

Francis Lee



Linköping University
FACULTY OF ARTS AND SCIENCES

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For R & J

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Stockholm, November 2009

Introductory Framework

1

Introduction

Technology is crucially intertwined with education. Classrooms depend on specific architectural features and furniture: a raised podium, a centrally located lectern, a blackboard, a projector for transparencies, and maybe some charts or posters. All these artifacts shape how education is practiced. Furthermore, educational evaluation systems depend on artifacts, such as tests or examinations, that produce knowledge about students' intelligence, performance, or aptitude. In these ways, and countless others, technology makes possible and constrains educational practices and assessments.

The focus of this text is technology in education, and specifically an area of education where technology has great consequences – distance education. The importance of technology in distance education can hardly be overestimated. Technology makes it possible to reach students that are far away or that could not attend classes at regular times. It provides the means with which to communicate, coordinate, teach, discipline, and motivate students at a distance. In distance education, every educational exercise hinges on technologies and artifacts to an even greater extent than face-to-face education. By its very nature distance education is intensely dependent on technology to bridge time and space. The heart of the matter is that distance education's reliance on technology makes it a

particularly thought-provoking case for exploring technology in education.[1]

The technology of distance education has changed immensely from the first large-scale correspondence schools that used printing techniques and mail, to today's online and mixed mode institutions that use streaming video, Internet chat rooms, mobile devices, and multimedia teaching materials.[2] Correspondence education methods are still alive in many parts of the world, where Internet connections and computer literacy are lacking. However, correspondence methods are being gradually supplanted by digital means as technology and education permits. Arguably historical correspondence education and contemporary distance education are both dependent on technology, albeit very different kinds of technology. In both cases, technology is used to bridge time and space, to coordinate, and to disseminate information. But they use very different material configurations to do so: one uses paper and printing, the other depends on computers and computer networks.[3]

In society at large, educational technology is often heralded as an enabler of educational betterment on all levels, from teaching materials, to learning, communication and geography. As described in a UNESCO document on information- and communication technology in education:

> The impact of information and communication technologies (ICTs) on teaching and learning has been steadily increasing throughout the past decade at all levels, providing new perspectives and opportunities for expanding traditional education processes and systems. ICTs are increasingly becoming an integral part of educational policies and strategies, providing greater flexibility in learning situations, promoting increased

1. In this I do not take distance education to being different in kind from regular education, however the dependence on technology is larger and more ingrained. On the pervasive dependence on technology in human society, and thus also on education, see Shirley S. Strum and Bruno Latour, "Redefining the social link: from baboons to humans," *Social science information* 26, no. 4 (1987).

2. See for example "Pre-conference bulletin: International Conference on Correspondence Education," (Lincoln, Nebraska, USA, August 22-24 1948), for a number of histories of correspondence education in various places of the world.

3. When I refer to the historical practices of using letters and mail to teach I use the term correspondence education, and when I refer to contemporary practices I use distance education.

> interactivity for learners and connectivity to people and learning resources in different parts of the world.[4]

The assumptions underlying this reasoning are that technological hardware, software, and infrastructures are seen as cure-alls for education's problems, and that access to more information through technology will lead to better-educated students. Several scholars are critical toward this enthusiastic view of technology, where more computers in classrooms are presumed to generate a superior education. According to the critics, the problem is that there has been no progress in academic achievement that could be positively credited to the increased use of computers.[5] Larry Cuban's conclusion, for instance, is that computers in education are 'oversold and underused.'[6]

A problem, which is related to the techno-enthusiastic perspective outlined above, is its treatment of technology as a black box, which hides all the work – social processes, technological histories, power plays, and beliefs – that has shaped it. This black boxing is reflected in the fact that educational administrators, politicians, and techno-enthusiasts often treat technology as a neutral tool for the facilitation of teaching objectives and goals. Thus, overlooking the fact that the organization of technical systems is shaped by social, material, economic and technological processes that can have momentous consequences for the application of technology to a particular situation.

This perspective, which can be labeled technological determinism, is widespread in education; and can lead to the treatment of technology as an external force that develops *ex nihilo,* and to which education must adapt.[7] This type of reasoning – i.e. 'schools must have computers or the nation will fall behind' or 'education and pedagogy will be renewed

---

4. "Major programme V: communication and information," (Paris: UNESCO, 2005), 205.

5. These criticisms have been expressed by several scholars, notably David Noble, *Digital diploma mills: the automation of higher education* (New York: Monthly Review Press, 2002), Douglas D. Noble, *The classroom arsenal: military research, information technology, and public education* (London: Falmer Press, 1991), Preface, Jörgen Nissen, "Säg IT – det räcker," (Stockholm: KK-stiftelsen, 2002), 22.

6. Larry Cuban, *Oversold and underused: computers in the classroom* (Cambridge, MA: Harvard UP, 2001).

7. For a discussion of technological determinism in society see Merrit Roe Smith and Leo Marx, *Does technology drive history? The dilemma of technological determinism* (Cambridge, MA: MIT Press, 1994). On technological determinism in education see Jens Pedersen, "Tekniken styr inte utvecklingen," in *IT i skolan mellan vision och praktik: en forskningsöversikt* ed. Ulla Riis (Stockholm: Skolverket, 2000).

through computers and multimedia' – has often been the rationale for introducing technology in schools. A consequence being the investment of huge sums of money in order to incorporate new technology in schools without a clear concept of how or why. This position is problematic, as technology is always constructed under the influence of a number of factors: social, technical, economic, legal, etc. Furthermore, it is far from established that investments in technology would automatically lead to better education.[8]

A related problem in the discussion of educational technology appears when technology is viewed by politicians and technology-pundits as a mere tool to be shaped in the hand of the teacher, i.e. 'we have given you an Internet connection and computers, now it's up to you to revolutionize the school system.' This expresses a social deterministic account of technology which is paradoxically often complementary to technological determinism in education. These two contradictory standpoints can have disastrous consequences. In education, massive 'necessary' investments in infrastructure, hardware, and software are often abandoned as soon as they are installed and the support-staff has moved on to other projects. The reason for this is that technologies are seen as both unavoidable investments, but also as mere 'tools' that educators can integrate on a whim with their educational practices.[9]

Technology, education, and STS

Important questions to ask in relation to determinism in education are: How can we move away from an understanding of technology in education seen as a necessary condition for bringing education to the next evolutionary level? Or as an infinitely flexible tool that can be wielded at the whim of a politician, educator, or administrator in order to modernize, future-proof, or move education into the next century? The answers to these questions are necessarily complex, as technologies are woven into education at every juncture – from administration, to teaching and learning.[10]

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8. On the inconclusive effects that technology have on education see Cuban, *Oversold and underused*, 188 ff, Noble, *The classroom arsenal*, xi, Ulla Riis, Lars Holmstrand, and Gunilla Jedeskog, "Visionär entusiasm och realistisk eftertänksamhet," (Uppsala: Uppsala Univ., 2000).

9. On other types of determinism see Donald MacKenzie and Judy Wajcman, "Introductory essay," in *The social shaping of technology: how the refrigerator got its hum*, ed. Donald MacKenzie and Judy Wajcman (Buckingham: Open UP, 1999).

10. Throughout this inquiry I treat education as a social practice. If the objective was to understand learning, a completely different approach would have been more ap-

As a way to start grappling with these questions, I turned to the long-standing discussion of determinism in the field of science and technology studies, STS.[11] As a field, STS grapples with how society, politics, and culture shape technology, and, conversely, how technology shapes society, politics, and culture. A key tenet being that technology is seen as intertwined with society, economy, and culture and consequently treated as political. This means that the neutrality of technology is often questioned and argued to be politics with other means.[12] Empirically this interest has been directed at many diverse areas ranging from microbes to subways, district heating, medical education, or clinical trials.[13]

Furthermore, several scholars have already drawn on insights from the STS-field in order to understand educational technology. These researchers, very broadly speaking, are clustered into two camps, on the one hand the group of researchers who attend to the *social construction of technology* (SCOT), and on the other hand the group that argues that technology is *constructed heterogeneously*.[14]

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propriate. However, there are compelling overlaps between the social theory of technology and educational theory, such as the concept of mediation. For mediation in Actor-Network Theory see Bruno Latour, *Pandora's hope: essays on the reality of science studies* (Cambridge, MA: Harvard UP, 1999), chapter 6. On mediation in sociocultural theory see Lev Vygotskij, *Thought and language*, 6 ed. (Cambridge, MA: MIT UP, 1962), and Roger Säljö, *Lärande i praktiken: ett sociokulturellt perspektiv* (Stockholm: Prisma, 2000). A complete discussion of these overlaps would be a worthwhile endeavor elsewhere. I have sketched some in Francis Lee, "Teknopedagogik: vad har teknik och pedagogik för relation egentligen?," in *Världens gång: teknikens utveckling*, ed. Per Gyberg and Jonas Hallström (Lund: Studentlitteratur, 2009).

11. On social determinism see Bruno Latour, *Reassembling the social: an introduction to actor-network-theory* (Oxford: Oxford UP, 2005), 84. On technical determinism see MacKenzie and Wajcman, "Introductory Essay."

12. On politics with other means see Bruno Latour, *The pasteurization of France* (Cambridge, Mass.: Harvard UP, 1988), 229.

13. On microbes, see Ibid. On subways: Vasilis Galis, *From shrieks to technical reports: technology, disability and political processes in building Athens metro* (Linköping: Linköping Univ., 2006). District heating: Robert Hrelja, *I hettan från ångpannan: vetenskap och politik i konflikter om tekniska anläggningar* (Lund: Arkiv, 2006). Medical education: Ericka Johnson, *Situating simulators: the integration of simulations in medical practice* (Lund: Arkiv förlag, 2004). Clinical trials: Petra Jonvallen, *Testing pills, enacting obesity: the work of localizing in a clinical trial* (Linköping: Linköping Univ., 2005).

14. On the concept 'heterogeneous construction' see David J. Hess, *Science studies: an advanced introduction* (New York: New York UP, 1997), 83.

Countering technological determinism

Researchers inspired by the social construction of technology perspective (SCOT) have focused on the ways in which social groups construct technology in accordance with their interests. In doing so, they aim to counter a technologically deterministic perspective by showing how technology is constituted in social relations. The essence of this argument is that technology could be constructed otherwise – suited to another agenda or another way of organizing education. Consequently, rather than seeing educational technology as affecting education from the outside, a social construction perspective sees it as being constructed within power struggles, and social, cultural, and political controversies.[15]

This perspective on technology has led to a number of studies concerned with how different social groups shape technological systems for educational purposes. One such researcher, Andrew Feenberg, has investigated how distance education technology can embody different pedagogical models depending on the concerns of different social groups. In his research, he has discerned two models of educational technology which reflects two pedagogical ideals and two different groups' interests. One, supported by educational administrators, which is based on economies of scale, automation, and little interaction. The other, endorsed by teachers, is based on frequent interaction between students and teachers and promises little or no cost-savings. His point being that economic and social concerns gain the upper hand in the construction of educational systems.[16]

Moreover, historian of technology, David Noble approaches distance education from the point of view of social interests.[17] He is, to a greater extent than Feenberg, polemical and dystopian about educational tech-

15. SCOT was originally presented in T. J. Pinch and Wiebe B. Bijker, "The social construction of facts and artifacts: or how the sociology of science and the sociology of technology might benefit from each other," *Social studies of science* 14, no. 3 (1984), the most complete articulation being Wiebe B. Bijker, *On bicycles, bakelites and bulbs* (Cambridge, MA: MIT Press, 1995).

16. See for example Andrew Feenberg, "Reflections on the distance learning controversy," *Canadian journal of communication* 24, no. 3 (1999), ———, "Whither educational technology?," *International journal of technology and design education* 11, no. 1 (2001), Edward Hamilton and Andrew Feenberg, "The technical codes of online education," *E-learning* 2, no. 2 (2005).

17. See David Noble, *Digital diploma mills*. Douglas (sic) Noble is another researcher who is interested in educational technology and has affinities to SCOT. He analyzes how military interests have shaped research into computer-based education. See *The classroom arsenal*.

nology, arguing that it is a vehicle for the commodification and commercialization of higher education. From his perspective the groups that stand behind this development are 'the vendors of the network hardware, software, and "content" [...] who view education as a market for their wares.' Noble's account paints a black image of distance education; in which a quest for financial gain has become directly harmful to educational quality and academic freedom.[18]

For my study of technology in education, the SCOT perspective shows that technology is a product shaped by social interests, struggles, and politics, and effectively counteracts a technologically deterministic understanding of technology. This indicates that I view the shape and functionality of educational technologies as neither given by nature nor neutrally technical. As a consequence of this argument, I see technologies of education, just as all technology, as being shaped by the circumstances of their creation.

Where did materiality go?

Although the SCOT perspective successfully counters technological determinism, it has come under increased criticism for excluding the material aspects of technology construction as well as black-boxing social groups and using them as an explanatory resource.[19] According to some detractors this approach leads to 'social determinism,' where the social determines the outcome of technical developments – removing the unpredictability of technology completely.[20] Social determinism is decisively connected to a view of technology as a mere tool, which can be used and adapted to any situation. Discontent with the SCOT perspective has led to a series of other approaches which emphasize the heterogeneous nature of the forces that shape technology, the most well known perspective perhaps being Actor-Network Theory, ANT.[21]

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18. Noble, *Digital diploma mills*, 29.

19. For lack of materiality see Andrew Pickering, ed. *Science as practice and culture* (Chicago: Univ. of Chicago Press, 1992), 2. For black-boxing of social groups see Latour, *Reassembling the social*.

20. On social determinism in science see Michel Callon and John Law, "On interests and their transformation: enrolment and counter-enrolment," *Social studies of science* 12, no. 24 (1982): 622, and Latour, *Reassembling the social*, 84.

21. Classic studies of technology using ANT are John Law, "Technology and heterogeneous engineering: the case of Portuguese expansion," in *The social construction of technological systems: new directions in the sociology and history of technology*, ed. Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge, MA: MIT Press, 1987), Bruno Latour, *Aramis or the love of technology* (Cambridge, MA: Harvard UP, 1996), Michel Cal-

ANT is a theoretically founded method that attempts to trace how actors are bound together in a network of material and semiotic things. The theory sees actors like matryoshka dolls, in that it assumes that every actor is simultaneously a network, an actor-network. For instance a car is seen as an actor, but simultaneously also as a network of spark plugs, axles, pistons, as well as engineers, ideas, or gas-stations. Thus, each actor-network forms a complex web of associations which shapes other actor-networks.[22] In relation to social and technical determinism, the advantage of this approach is that it attempts to deal with social determinism by reintroducing the shaping powers of materiality and technology, but without succumbing to the technologically deterministic view of technology as an external force. Educational technology, in this conception, would not only be a matter of the influence of social groups' interests, but also contingent on a network of other factors, such as materiality.

The heterogeneous perspective on education has been applied to a number of studies of educational technology with emphasis on how technology and learning are interwoven. Rather than focusing on the construction aspect of educational technology, these studies have emphasized the role of technology in various educational practices.[23]

Estrid Sørensen is one researcher who has applied a heterogeneous perspective to the use of technology in educational practice. In her study, *The materiality of learning*, she attends to the performance of presence, knowledge, and learning in the classroom, and how these can be understood using different spatial formations. She argues that education needs to take into account multiple spatial formations that are linked to multiple forms of knowledge, presence, and learning. Thus, rather than depending on the representational knowledge, which is tied to the prevalent spatial form in today's school systems, her analysis demonstrates how attention to *multiple* spatial formations can lead to a rethinking of educational practice. Her point being that we need to take into account different forms of

---

lon, "The sociology of an actor-network: the case of the electric vehicle," in *Mapping the dynamics of science and technology: sociology of science in the real world*, ed. Michel Callon, John Law, and Arie Rip (London: Macmillan, 1986).

22. The concept actor-network was introduced in Callon, "The sociology of an actor-network."

23. One example of a heterogeneous analysis is Frode Guribye who has investigated technical infrastructures for learning in the workplace. His dissertation discusses among other things how infrastructures can embody a pedagogical model, and how there is an inherent tension between the design and use of technology. See "Infrastructures for learning: ethnographic inquiries into the social and technical conditions of education and training," (Ph. D., Univ. of Bergen, 2005).

knowledge, presence, and learning in order to be able to choose which forms that are most conducive to our educational goals.[24]

Another researcher who has applied a heterogeneous stance to the study of education is Helen Verran. Using ANT she has demonstrated how Yoruba and Western quantification routines in education are combined in symbolic-material educational practices. The point being that quantification can be seen as a series of symbolic and material routines that can be translated between different cultural domains, rather than as an abstract concept which must be learned. In the case of teaching the concepts of length/distance, she shows how teaching can be based on multiple material and symbolic routines that resonate with different cultural understandings of the world, rather than trying to teach an abstract conceptualization. Thus, she argues that the learning of length/distance is produced in culturally situated symbolic and material practices, not in an abstract realm of concepts.[25]

For this study, the SCOT and ANT approaches outlined above have provided me with two insights into technology in education. Firstly, that educational technology must be seen as constitutively social; that it is always deeply implicated in social relations that can encompass social, political, and cultural ideas, controversies, or values. Secondly, that the material and technological aspects of constructing and using technology should not be disregarded, as they are decisive for how educational technology, education, and learning are organized and shaped, with significant consequences for pedagogy and educational practice.

Constructing a research design

Following the insights of SCOT and heterogeneous construction, the overarching purpose of this research project is to investigate how correspondence and distance education technology are both shaped by social concerns and ideas about education, but also how technical and other matters shape education and educational technology. As a result, questions relating to the techno-enthusiastic perspective outlined at the outset of this chapter, and several classical questions related to determinism become important, and are, as I will discuss throughout this text, related to issues of material agency and technological determinism. My overarch-

24. Estrid Sørensen, "The materiality of learning: technology, knowledge and presence in educational practice," (2009).

25. Helen Verran, "Staying true to the laughter in Nigerian classrooms," in *Actor-Network Theory and after*, ed. John Law and John Hassard (London: Routledge, 1999).

ing research questions are: How does technology shape educational practice? And how is the shape of educational technology decided?

In approaching this complex set of issues I attempt to provide a space for reflection on technology's role in education by splitting the empirical investigation into two parts, one historical and one contemporary. The motive for this research design is to use historical correspondence education, where the veil of technology hype is thin, to understand and reflect on contemporary and future developments in distance education. Furthermore, in order to avoid the unyielding nature of the contemporary, where the order of things is often seen as 'natural' or 'necessary,' I study an educational technology *in spe*, where the dust of the commonplace has not yet settled.

Hence, I employ a two-pronged approach, in which history, in the form of correspondence education, and a possible future, in the form of a novel technology for distance education, are employed to reflect on the sociotechnology of contemporary distance education. Using the duality history/future gives rise to a third overarching research question which is: Are there any similarities or differences between the historical and contemporary cases in how technology is conceived of and used?

As a consequence of this research design, I approach the study of technology in education in two ways: one, concerned with technology in educational practice, and the other, with the construction of a future technology.[26] In the case of correspondence education my studies are focused on how technology is used in the organization of a flow of letters, forms, and identities. How a 'machine' consisting of mundane and everyday technology became a crucial part in shaping historical correspondence education with decisive consequences for educational practice. By studying historical correspondence education, the organization, ideas, and roles of technology become distilled into their essential parts, without being concealed by the revolutionary promises of a novel technology. In the contemporary cases, I study a possible future of distance education through a technology which has not yet become stable and diffused. It is still under construction by a network of organizations, companies, visionaries, and engineers.

26. The line between these two sides is not as clear-cut as it is portrayed here. There are a series of recursions at work: technology shapes the construction of other technologies, and it is also constructed where it is used.

The organization of correspondence education

The historical articles in this dissertation analyze the role of technology in correspondence education. The focus is on understanding how technology becomes a part of teaching, handling students, sorting students, and creating student subject positions. These studies approach the use of technology in education, and are concerned with the organization of correspondence education. In line with the above-outlined objective, the reason for selecting correspondence education as the historical case is that it is the most technologically fundamental version of distance education. On good grounds, the techno-enthusiasm relating to letters, printing, and the postal service was non-existent in correspondence education's heyday in the twentieth century. Thus, the analysis is meant to show how even the most rudimentary technologies shape educational practice.[27]

In approaching the study of correspondence education I am interested in technology as restricting and facilitating education, how it produces distinct modes of organizing education and student identities. Here, it is the reciprocal relationship between technology and educational practice that is the center of attention. My way of approaching these matters is partly shaped by Foucault's attention to classification, normalization, and observation in education, and partly by the analysis of technology as classificatory and normalizing in the field of STS.[28]

The overarching purpose in my studies of correspondence education is to understand how educational technology in correspondence education is related to pedagogical thinking; how technology constrains and affords educational practice; and how student identities are formed through the combination of these.

In the first article treating correspondence education, *Technopedagogies of mass-individualization*, I attempt to understand how pedagogy and the technologies of correspondence education created a particular mode of organizing education that was connected to a figure of simultaneous industrialization and individualization.[29] The emphasis in this article is

27. If there was a hype around correspondence education, which can be argued, it was in relation to education as a means to a better life, not technology.

28. I will return to the connections between Foucault's work and ANT in the theory chapter. On classification, normalization, and observation see Michel Foucault, *Discipline & punish: the birth of the prison*, 2 ed. (New York: Vintage Books, 1995).

29. When I write *industrialization of education* I take it to mean the introduction of new technological means of production into education, which changes education so that the 'production process,' which was earlier under the control of the teacher, is adapted to a new mode of organizing production. When talking about industrialization in a larger economic sense this meaning of industrialization entails changes in the

to understand the 'machinery' of correspondence education and the tensions in it. Specifically, it seeks to explain how a web of technology, ideas about education, ways of measuring knowledge, and student identities resulted in what I call a mass-individualized mode of organizing correspondence education.

In the second article, *Learning in nowhere*, I investigate the production of individualistic pedagogy and the notion of the 'independent learner' in correspondence education. The focus is on the ways in which individualistic ideas, practices and student identities developed in correspondence education. In this, I attempt to answer how individualism was to be achieved: Who was the legitimate teacher? What were the desired identities of the students? And how were students' material circumstances understood?

The construction of Learning Objects

The contemporary studies, *Lego learning* and *Coding copyright*, are both concerned with the construction of standardized digital educational material, or so called Learning Objects. The aim of creating a standard for Learning Objects is to achieve interoperability between computer systems so that they can utilize any educational material that conforms to the standard. As an educational technology project, Learning Objects is an attempt to create a market for standardized, reusable, and atomic bits of educational material that are designed to facilitate economies of scale through reusability.

A Learning Object can be likened to a standardized container for learning material which includes metadata or rights-protection schemes. For instance a Learning Object could contain a text on guitar playing, a video lesson about how to play a song, and a rendition of the same song of a master guitar player. These media files would be wrapped in standardized metadata that describe the contents of the Learning Object; and furthermore, they could be protected by technology specifying who could use it, for what price, and for how long.

Learning Objects are not widely disseminated or implemented yet, but many governmental bodies, organizations, and companies are actively involved in different parts of their construction. The point is that Learning Objects have stirred the imaginations of many, and consequently might

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processes of production, in the increasing dependence on capital, and the forms of organization and ownership. On this meaning of industrialization see Lennart Schön, *En modern svensk ekonomisk historia: tillväxt och omvandling under två sekel* (Stockholm: SNS förlag, 2000), 78.

enroll enough support for becoming real. And this is also what makes Learning Objects an interesting case: it is not a stabilized technology, but still manages to paint a picture of the future, which creates interest and attracts investors.[30]

Empirically, my studies of Learning Objects are inspired by the concern for standards, infrastructures, and code in the field of STS. The argument is that standards, as other technologies, embody social, political, cultural values, as well as controversies.[31] Through the creation of a background infrastructure, the programming code that constructs Learning Objects is slowly entering the educational arena.[32] Accordingly, I see the development of Learning Objects as creating an information infrastructure that could form the basis for digital and online education.

As Learning Objects are not yet widely disseminated or utilized, the contemporary articles studies the heterogeneous construction of a technical object in a web of technical solutions, organizational pressures, and economical calculations. The technology in question is not yet widely implemented and used: it has not yet been utilized by users, subjected to redefinition by systems designers, or coerced to work. It is still a dream of a possible future. Accordingly, my concern is with a technology in the making; a technological project that is on the winding road to perhaps one day becoming a technological object. The argument for studying the construction of Learning Objects is that they simultaneously shape the technical and the educational: 'because the social runs throughout the technical and thus cannot be separated from it. We cannot, and should not wish to, avoid the technical.'[33]

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30. The list of interested parties is long. Some organizations from the members list of IMS Global, which works for the standardization of Learning Objects, can serve as examples. National governments and government bodies: US Dept of Defense, the Australian government, and the Canadian government. Software companies: Microsoft, IBM, Moodle, and Blackboard. Distance universities: Athabasca University (Canada's OU), the Open University UK, and the Open University of the Netherlands. Regular universities: University of California, the Universities of Cambridge, and Michigan. Also, publishers like Elsevier and Haughton Mifflin Harcourt have shown an interest. See, IMS GLC, "Contributing members," http://www.imsglobal.org/members.html.

31. A central study approaching classification, standardization and infrastructure is Geoffrey C. Bowker and Susan Leigh Star, *Sorting things out: classification and its consequences* (Cambridge, MA: MIT Press, 1999).

32. On the social study of code see Adrian Mackenzie, *Cutting code: software and sociality* (New York: Peter Lang, 2006).

33. John Law and Michel Callon, "Engineering and sociology in a military aircraft project: a network analysis of technological change," in *Ecologies of knowledge: work and politics in science and technology*, ed. Susan Leigh Star (New York: State University of New York, 1995), 282.

In the third article included here, *Lego learning*, my purpose is to investigate the construction of a hypothesis for Learning Objects and how this hypothesis is imprinted in a technical metadata standard. The focus lies on the ways in which Learning Objects translate economy, education, pedagogy, and knowledge, and link them in a chain of translations. Here I show how an interest in economies of scale become translated to epistemic atomism. The fourth and ultimate article, *Coding copyright*, investigates a standard for protecting intellectual property in Learning Objects. Here, I examine how a technical project for education attempts to redefine property in relation to Learning Objects. The point being to show how the embryo of a market for educational material is created through a technical infrastructure, and how this infrastructure translates novel business models from other domains.

A brief outline

This dissertation is organized in three parts. The first part is this introductory framework which contains the present introduction; a theoretical chapter, which goes into more theoretical depth than possible in an article; and a methods chapter, which also attempts to provide space for a more substantial examination of methodological choices and considerations. The four articles, outlined briefly above, follow the introductory section. The final part contains the closing discussion, which attempts to examine a number of common themes stemming from the four articles, as well as an epilogue that highlights a tendencies in educational technology which could be a compelling case for further study.

2

Assembling theory

Theory has been an important part of this dissertation in many ways: it has shaped my questions and perspectives, it has generated metaphors for understanding, and it has molded my interpretation of the empirical material. This chapter develops a theoretical discussion that attempts to temper a social/technical deterministic understanding of technology in education. An important insight when approaching an analysis of technology is that technology is used in a myriad of ways, in different places, practices, and situations. It can be argued that technology is part of almost every human encounter.[1] As a result, this theoretical framework needs to be able to take into account the many roles and forms that technology can have in an educational setting, and to take seriously the pivotal role that technology can play in shaping educational practice and knowledge.

Here, I first present a general introduction to what I call association-analysis and how this can be applied to education, second I present two theoretical metaphors that I have used in my articles to analyze technology in distance education. The objective is to go into more depth than has been possible in the article format, and thus to provide a more detailed

1. For a discussion of technology's ubiquitous influence on society see Shirley S. Strum and Bruno Latour, "Redefining the social link: from baboons to humans," *Social science information* 26, no. 4 (1987).

description and analysis of the concepts. These metaphors are *dispositif* and *translation*.[2]

Technology, associations & non-human agency

In analyzing technology in distance education I have employed multiple and affined analytical tools with strong connections to different theoretical perspectives.[3] To varying degrees, Actor-Network Theory, Gilles Deleuze, Michel Foucault, and Michel Serres have been important in shaping my understanding of society and technology. In this, several concepts have become momentous: the notion of the *actor-network* in ANT; Gilles Deleuze's and Félix Guattari's contemplations on the *rhizome*; Foucault's deliberations on *dispositifs*; and, to some degree, Michel Serres' treatises on *translation*. Consequently, my perspective on technology in education is akin to several related theories dealing with technology in society.[4]

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2. This way of treating theory implies that I accept the use of other vocabularies and tools. From my point of view, the most important judge for if theory is valid, is if it is fruitful. My hope is that that the application of theory in the different studies will convince the reader of their usefulness. However, there is a tension between multiplicity and unity here. Like I have drawn on several theoretical vocabularies, it would have been possible to draw on other ontologies, or even other theoretical traditions. The vocabularies bring out certain aspects of technology and education; undoubtedly other ontologies or theories do the same.

In the same way that I draw on multiple analytical vocabularies I feel that I have affinity toward several theoretical descriptions of technology. These multiple affinities are sometimes visible, and produce tensions within the analyses and between the studies. For an extended discussion of multiplicity and ontology, see John Law and Annemarie Mol, "Situating technoscience: an inquiry into spatialities," *Environment and planning D: society and space* 19, no. 5 (2001). See also Michel Callon, "Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay," in *Power, action and belief: a new sociology of knowledge*, ed. John Law (London: Routledge, 1986), where it is advocated to choose between different vocabularies, but sticking to a number of principles.

3. I have struggled with describing myself in relation to this nebulous approach to technology studies. Am I part of a conversation? A field? An approach? I have used the labels post-foucauldian studies of materiality, material-semiotics, or posthumanist to categorize this nebulous theoretical framework, but rather than assigning a label, I will let the problems and theories speak for themselves.

4. The text that allegedly introduced the concept actor-network was Michel Callon's "The sociology of an actor-network: the case of the electric vehicle," in *Mapping the dynamics of science and technology: sociology of science in the real world*, ed. Michel Callon, John Law, and Arie Rip (London: Macmillan, 1986). On rhizomes see Gilles Deleuze and Félix Guattari, *A thousand plateaus: capitalism and schizophrenia* (London and New York: Continuum, 1987). On dispositifs see: Michel Foucault, *Power/knowledge: selected in-*

These theories have contributed different ideas to my analysis, but most concretely they have inspired an analytical sensitivity to the associations that technology is intertwined with: they affirm that an analysis of society is obliged to attend to the multiple ways in which technology, humans, laws, standards, ideas, etc. can accept, resist, shape, or be shaped by each other. The analysis of associations is connected to a specific understanding of society, in which the separate associations are seen as shaping the aggregated whole and vice versa. There are several iconic examples of this type of analysis, ranging from Foucault's analysis of the Panopticon to Callon's analyses of electric cars, or Latour's discussion of door closers.[5]

For me, the point of this type of analysis is that it traces how assemblages of heterogeneous things, through their associations, constitute specific versions of humans, society, technology, science, or, in this case, distance education. The essence of this move is that it effectively counteracts both technological and social determinism. Thus, instead of taking as starting point either society or technology, each empirical case must trace the associations that are involved in the co-evolution of both the constitutive parts and the whole. In this text, I use *assemblage* to denote a conglomeration of associations when not referring to a specific theory.[6]

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terviews and other writings 1972-1977 (New York: Pantheon, 1980), 194. On translation: Steven D. Brown, "Michel Serres: science, translation and the logic of the parasite," *Theory culture society* 19, no. 3 (2002), Michel Serres, *The parasite* (Minneapolis: Univ. of Minnesota Press, 2007).

5. The affinities between Foucault's analyses and ANT are many. John Law and Ingunn Moser go so far as to state that ANT is a foucauldian theory. See Moser, *Road traffic accidents: the ordering of subjects, bodies and disability* (Oslo: Oslo Univ., 2003), or Law and Singleton, "Social science and the technical: ANT and heterogeneity," in *Lecture at the Ph.D. course in science and technology studies* (TIK, Oslo Univ. 2005). This sentiment is also repeated by Bruno Latour in T. Hugh Crawford, "An interview with Bruno Latour," *Configurations*, no. 1.2 (1993), 253:

> Panopticon is the very sort of intellectual technological dispositif which interests me. In that sense, the dissemination of laboratories, their ability to reverse scale, to completely reverse micro and macro order, is very much a confirmation of Foucault's tradition.

On the Panopticon, see Michel Foucault, *Discipline & punish: the birth of the prison*, 2 ed. (New York: Vintage Books, 1995); electric vehicle, Callon, "The sociology of an actor-network."; door closers, Bruno Latour, "Mixing humans and nonhumans together: the sociology of a door-closer," *Social problems* 35, no. 3 (1988).

6. Apparatus, assemblage, collectif, dispositif, network, and rhizome have all been used in different but akin traditions to denote a conglomeration of entities and relations which constitute each other.

The hallmark of association-analysis is its attendance to non-human entities. This analytical imperative, dubbed generalized symmetry by Michel Callon, was intended to overcome an increasing focus on the social as an explanation of scientific and technical work. He insisted that a symmetrical vocabulary should be developed to analyze the co-evolution of nature, technology, and society. From this point of view, neither of these could be seen as determining the other.[7] An important point of emphasis in Callon's generalized symmetry is that each entity adds a certain momentum to the assemblage, and the sum of these associations can create an impetus in a certain direction. This signifies that there is a type of agency in an aggregate of associations, which is sometimes called non-human agency or distributed agency. This suggests that agency does not necessarily indicate an act of human intentions, but rather that an assemblage of associations can gain a certain momentum that has agential effects.[8]

As with all academic approaches, the development of the association-analysis approach has not taken place without dispute, and a number of criticisms have been leveled at the more concrete branches. Particularly ANT, which has been somewhat of a figurehead and entry point for tracing associations, has generated many critical remarks and has been the subject of long and fierce disputes. In some cases, the battle lines were drawn in the early 1980s.

One line of critique, closely related to the questions of determinism, originates from a disagreement over whether the explanation for phenomena is to be laid on the side of humans, on the side of science and technology, or somewhere in-between – social determinism, technical determinism, or a middle ground. The 'social realist' critique, coming from those emphasizing the determining powers of the social, suggests that the granting of agency or autonomy to non-human actors effaces the difference between action and behavior, thus, re-granting to science a particular epistemological status. According to the critics, this could lead to a conservative description of science and technology without radi-

7. Callon, "Some elements of a sociology of translation," 200, ———, "The sociology of an actor-network," 20.

8. On intentions, language and non-human agency see Michel Callon and John Law, "Agency and the hybrid collectif," *South Atlantic quarterly* 94, no. 2 (1995). For a humorous critique of non-human agency, see Malcolm Ashmore, "Behaviour modification of a catflap: a contribution to the sociology of things," *Kennis en methode* 17, no. 2 (1993).

cal potential. Thus, they argue that an account of associations essentially echoes the conservative narratives of traditional history of science.[9]

One manner of answering this critique has been to divorce intentions from agency by analyzing to whom agency is imputed: traditionally agency is granted to those who speak and express intentions, while the quiet masses of technological artifacts are treated as non-determining entities. If one divorces language, intentions and agency one can conceive of agency as a composition of heterogeneous forces rather than as intentional actions.[10]

The point of tracing associations is thus to show that nature, technology, and humans co-evolve – that the boundaries that separate nature and technology from society are part of the problem of determinism. According to this perspective, instead of asking if society determines technology or vice versa, one should ask empirically what entities – regardless of ontological domain – shape the momentum of an assemblage. Conceptualized in this fashion, agency becomes a question of grounding the analysis in empirical work, rather than deciding in advance where explanation should be located.[11]

Therefore, in the practicalities of my research the question of agency ultimately becomes a methodological and empirical question. For me, the problem of agency is first and foremost a question of epistemology – how we can know about the source of action?

Technology and associations in education

For my analysis of educational technology the above outlined perspective contains a number of important qualities that help me stress the com-

9. The sociology of scientific knowledge (SSK), which the social construction of technology stems from, held that social negotiations should be used as explanation for scientific knowledge. Their line of reasoning was that the attention to social negotiations managed to counter the 'independent power of the natural world' and the scientists' 'privileged access' to this realm. In this perspective, social negotiations are seen as determining the outcome of knowledge. Essentially the justification is that they counter a natural determinism, just as SCOT outlined in the introduction to this chapter counters technological determinism. Harry M. Collins and Steven Yearley, "Epistemological chicken," in *Science as practice and culture*, ed. Andrew Pickering (Chicago: Univ. of Chicago Press, 1992).

10. On the attribution of agency see Callon and Law, "Agency and the hybrid collectif."

11. Michel Callon and Bruno Latour, "Don't throw the baby out with the bath school! A reply to Collins and Yearley," in *Science as practice and culture*, ed. Andrew Pickering (Chicago: Univ. of Chicago Press, 1992).

plexity of technology in education. This framework moves my analysis firmly out of technological and social determinism by highlighting the shaping of technology in heterogeneous associations. The importance of this point relates to the uncritical view of technology in education that I outlined in the introduction. Rather than seeing technology as a necessary condition for the development of education (technological determinism), or as a tool to be wielded at the educator's whim (social determinism), I conceive of technology as a non-human actor in an assemblage. As a result I see technology in education as an active but non-determining entity. It does not determine the practice of education, but it is not a malleable tool that can be wielded in any way that the teacher sees fit.[12]

More concretely, a mundane report card isn't just a neutral tool for the educator to use as s/he sees fit. It is tied to a certain way of thinking about knowledge and education, to a way of assessing students' performance, as well as to material practices of filing, reporting, and consolidating knowledge about the student. The report card stands in relation to both material and social entities that shape its design, use, and effects. It cannot be seen as a technology developed *ex nihilo* because it is steeped in specific social practices and knowledges, and furthermore its practical use is shaped by its material characteristics.

In a high-tech educational situation, the same logic applies: A learning management system is constructed through an amalgamation of heterogeneous associations. Programming languages, technological standards, and the engineers' understanding of educational cultures, as well as ideas about pedagogy and knowledge are inscribed into a technical system. And later, in use, teachers and students employ the technological system in various foreseen and unforeseen ways. Accordingly, technology shapes educational practice, but is not the only determining entity.

As I stated in the introduction to this chapter I utilize two conceptual metaphors, *dispositifs* and *translation*, in order to underline the role of technology in education and to investigate the empirical case of distance

12. See Donald MacKenzie and Judy Wajcman, "Introductory essay," in *The social shaping of technology: how the refrigerator got its hum*, ed. Donald MacKenzie and Judy Wajcman (Buckingham: Open UP, 1999), for a discussion on determinism and the shaping of technology. For a more associationist conceptualization of the construction of technology, see for example Bruno Latour, *Aramis or the love of technology* (Cambridge, MA: Harvard UP, 1996), Callon, "The sociology of an actor-network," John Law, "Technology and heterogeneous engineering: the case of Portuguese expansion," in *The social construction of technological systems: new directions in the sociology and history of technology*, ed. Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge, MA: MIT Press, 1987).

education. In the following two sections I develop these concepts in relation to education generally, and my material specifically.

Metaphor 1: dispositif

The purpose of the historical articles, *Learning in nowhere* and *Technopedagogies of mass-individualization* has been to show how a specific mode of organizing education was built with everyday technologies – paper, typewriters, duplication machines, and forms – with specific consequences for identity, knowledge, and observation. My principal theoretical departure point here is Foucault's analysis of the *governing* of subjects using the concept *dispositif*.[13]

The concept of *dispositif* was first used in its theoretical sense by Foucault in *History of sexuality*. The aim was to develop his early notion of épistème into a more inclusive analysis of associations that, as he argued, included 'a thoroughly heterogeneous ensemble consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral and philanthropic propositions [...] The [dispositif] itself is the system of relations that can be established between these elements.'[14] In developing the concept of dispositif, Foucault aimed to expand his analytical framework and more distinctly stress the heterogeneity of practice and the associations that constitute it.[15] This model of analysis allows diverse and heterogeneous elements to be included in the analysis: technologies, humans, scientific knowledge, practices, and methods of observation.

For my analysis of education, attending to a dispositif means to attend to a system of associations in order to bring out the way in which power, knowledge, observation, and subjectivity circulate. Valerie Walkerdine, who draws on Foucault to investigate the relationship between pedagogic

13. In French, the concept dispositif means a device, mechanism, measure, apparatus, or arrangement. It has been translated in various ways into English: apparatus, social apparatus, assemblage, and regime of practice. It is also used sometimes used by Bruno Latour to describe an actor-network. To avoid the confusion of different translations I will, like Gomart & Hennion, use the original French concept. See Foucault, *Power/knowledge* 194, Gilles Deleuze, "What is a dispositif?," in *Michel Foucault: philosopher* (London: Harvester Wheatsheaf, 1992), Emilie Gomart and Antoine Hennion, "A sociology of attachment: music amateurs, drug users," in *Actor-Network Theory and after*, ed. John Law and John Hassard (Oxford: Blackwell, 1999).

14. Foucault, *Power/knowledge,* 194. See also Michel Foucault, *The history of sexuality* (London: Allen Lane, 1979).

15. Paul Rabinow, *Anthropos today: reflections on modern equipment* (Princeton: Princeton UP, 2003), 53.

thought and the organization of the classroom, provides an example of such an analysis. She makes the point that if the school subscribes to an individualized and active way of organizing education – which is perhaps the modus operandi today – there are probably different spaces geared for different activities in the classroom: reading in one corner, painting in another; perhaps groups of tables set in patterns for facilitating group work or discussion in a third corner. If the school subscribes to another mode of organizing education, which focuses on transmission of knowledge, one might find a lectern up at the front of the classroom, perhaps on a podium, and rows of tables and chairs set up for listening to a lecture.[16]

To analyze correspondence education in a similar manner, I have utilized a heuristic framework developed by Gilles Deleuze in relation to Foucault's concept of dispositif. This heuristic framework has allowed me to examine correspondence education in relation to four distinct levels: thought, observation, subjectification, and action. These levels are intertwined, but are not reducible to each other. They allow for a classification of the heterogeneous entities that comprise the dispositif and an analysis of their associations.[17] In my study they afforded a matrix with which I could come to grips with the seemingly mundane nature of the correspondence education system, and produced an analytical sensitivity to the correspondence education letters, forms, tests, leaflets, and other educational paraphernalia.

The first Deleuzian level of the dispositif, *thought*, directed my analysis toward the milieu of knowledge in which correspondence education existed, as well as toward the knowledges that were created in and transformed the dispositif. This level moves on what Foucault called the epistemic level, on the level of *énonciation*, in utterances or affirmations. The analysis of thought shows that there are forms of knowledge and expertise that are constitutive of the dispositif. These exist as segments of thought that both inform – and are transformed by – the dispositif. By attending to this level in my study of correspondence education I demonstrate the ways in which correspondence education was associated with pedagogy and psychology. Specifically, I show that progressive thought, inspired by the psychology of individual differences and IQ-testing, which emphasized the individual student's needs, had a great influence. Furthermore,

16. Valerie Walkerdine, "Developmental psychology and the child-centered pedagogy: the insertion of Piaget into early education," in *Changing the subject: psychology, social regulation and subjectivity*, ed. Julian Henriques, et al. (London: Methuen, 1984).
17. Deleuze, "What is a dispositif?," See also Mitchell Dean, *Governmentality: power and rule in modern society* (London: Sage, 1999), who also applies Deleuze's levels to an analysis of governing.

I show that the venture to organize education individually met with an attempt to automate and industrialize correspondence education.[18]

The second heuristic level that I apply to correspondence education is the level of *observation*. This level directs my analytical attention toward a grid of perception. Foucault's perhaps most famous examples of grids of perception are the Panopticon that made every movement of the inmate visible and 'the medical gaze' that entered the body into a field of knowledge.[19] By analyzing the grid of perception I can understand which objects are constituted and acted on in correspondence education, and consequently which objects become available for thought and action.

While the grid of perception can be understood preeminently through architectural drawings, diagrams, or flowcharts, the grid of perception is not always a question of visibility in the physical sense. Rather, it has guided my attention toward analyzing perception in a metaphorical sense, sometimes in the realm of physical visibility, but more often in the realm of knowledge about something. For my analysis of correspondence education, attending to the grid of perception showed the different ways in which 'learning' was constituted as an object of knowledge, and consequently made visible for intervention. By analyzing the level of observation, I could show that the grid of perception in correspondence education was exceedingly geared toward illuminating students' written learning and knowledge development, and how the object 'learning' was entered into the field of thought and became possible to act upon.

Attending to the third level, *subjectivity*, allowed me to glimpse the ways in which individual and collective subjectivities were produced in correspondence education. By probing the ways in which dispositifs 'elicit, promote, facilitate, foster and attribute various capacities, qualities and statuses to particular agents,' I could observe the way in which the dispositif delineated appropriate manners for student conduct and aspirations to certain human qualities.[20] It became evident that the production of subject positions was not something that could be chosen freely or presented according to one's own predilections, but was part of a heterogeneous dispositif of associations. In correspondence education, I investigated the level of subjectivity in order to show how the dispositif constantly produced subjectivities that ordered students in relation to their characteristics and gave them their 'correct' educational and vocational position.

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18. See *Technopedagogies of mass-individualization,* for a complete discussion.
19. Foucault, *Discipline & punish*, Michel Foucault, *The birth of the clinic: an archaeology of medical perception* (London: Routledge, 2003).
20. Dean, *Governmentality*, 32.

The last of Deleuze's levels, the level of action or *power*, in which the technological and material are included, was also crucial for my analysis. This level directed my study toward heterogeneous 'means, mechanisms, procedures, instruments, tactics, techniques, technologies, and vocabularies.'[21] In analyzing the role of power, I examine two types of technologies: disciplinary technologies and technologies of self.[22] Rather than being something which someone can possess, this Foucauldian conceptualization of power stresses actions and effects: that power is both productive, in the sense that it makes possible certain actions, but also constraining in that it can inhibit or block certain actions. Power connects the other levels of the dispositif. It is the force that moves between observation and knowledge, between observation and identity, and between knowledge and identity. In analyzing correspondence education, awareness of the level of power drew my attention to technology. The ways in which certain artifacts, methodologies, and instruments, like an everyday test, a form, or the system of grades became implicated in producing a larger system of associations.

In analyzing correspondence education through the levels of the dispositif, it became apparent that these categories were productive in understanding correspondence education. However, they also gave a highly static understanding of the role of technology. In order to remedy this immobile analysis and better understand the effects and associations between the levels, I needed a metaphor that stressed movement, association, and process; for my analysis this concept became translation.

Metaphor 2: translation

Some of the points of sketching the associations in an assemblage are to circumvent technical and social determinism, and to highlight the point that technology can become an actor in shaping the direction of education. The heart of the matter being that the tracing of associations can analytically demonstrate which actors are important and how they shape the assemblage under scrutiny. In my studies of distance education I have employed the conceptual metaphor *translation*, which is one of ANT's pri-

21. Ibid., 31.

22. Foucault, *Discipline & punish*, ———, "Technologies of the self " in *Technologies of the self: a seminar with Michel Foucault*, ed. Luther H. Martin, Huck Gutman, and Patrick H. Hutton (London: Tavistock, 1988).

mary analytical tools, to describe the associations between technology, nature, and society.[23]

The translation metaphor allows me to describe associations between different entities and emphasizes the exchange of characteristics, forces, and properties. In my empirical studies I have applied translation to accentuate how ideas, practices, and technologies are combined and shape each other. For example, I employ translation to describe the ways in which written exams are used to translate students' performance into test results in correspondence education, or the ways in which object-oriented programming shapes the standardization of Learning Objects. By following a number of translations, it becomes possible to show the ways in which seemingly unrelated things could shape each other and the collective direction of an assemblage.

In its original meaning, translation was derived by Michel Callon from Michel Serres' work on interference/noise as a productive force in the transmission of information, in which it 'appears as the process of making connections, of forging a passage between two domains, or simply as establishing communication.'[24] Translation in its original meaning in ANT focused on the associations that shape an assemblage, and how

23. ANT in many cases defies simple description, and has come to encompass a plethora of concepts related to technology, science, and society. A common way chronicling ANT's many concepts has been to divide it into ANT I and II. The dividing line is often drawn with John Law's and John Hassard's *Actor-Network Theory and after*, (Oxford: Blackwell, 1999). The first version of ANT produces a profusion of concepts that attempt to describe the intermingling of human and non-human actors, was developed from the early 1980s to the late of 1990s. ANT I has made a number of philosophical points in relation to science, technology, epistemology, and non-human agency. This version of ANT can be exemplified with classic ANT studies such as Law, "Technology and heterogeneous engineering," Callon, "Some elements of a sociology of translation," Bruno Latour, *Science in Action* (Cambridge, MA: Harvard UP, 1987). The second version of ANT has attempted to shed the overabundance of concepts developed in ANT I in order to inhibit analytic reification, and has also attempted to answer to a number of critiques against ANT I. This version stresses the performative dimensions of producing multiple realities, and argues for an attention to empirically founded concepts, rather than an apparatus of prêt-à-porter concepts. ANT II has also entailed a move from studying epistemology to examining ontology. ANT II studies include Marianne de Laet and Annemarie Mol, "The Zimbabwe bush pump," *Social studies of science* 30, no. 2 (2000), John Law, "Objects and spaces," *Theory, culture & society* 19, no. 5-6 (2002), Annemarie Mol, *The body multiple: ontology in medical practice* (Durham: Duke UP, 2002).

24. The quote is from Brown, "Michel Serres," 5. The concept of translation in ANT was first introduced in Michel Callon, "Struggles and negotiations to define what is problematic and what is not: the socio-logic of translation," in *The social process of scientific investigation*, ed. Karin D. Knorr (Dordrecht: D. Reidel, 1980).

actors try to change its direction so that it suits their interests. Nevertheless, it is also stressed that a translation can also be a simultaneous transformation or betrayal of the original intention, as each association brings with it consequences that could be unfaithful to the original intent; therefore a translation must be seen not as a complete transfer, but as modifying the original in some way.[25]

By way of illustration, a researcher translates by creating references to research papers in order to strengthen his argument, an engineer by linking his product to a standard, or a policeman by using traffic-cameras to influence drivers' behavior – all these activities are intended to increase stability of a certain set of associations. In education, the tracing of translations could include, for example, ideas translated into writing on the blackboard, pedagogical theory translated into certain arrangements of furniture, an essay translated into a grade, or a questionnaire into a number.

Translation is used in at least three related manners in ANT. The common denominator for all three ways of applying translation being their emphasis on the building of a stable assemblage of associations.[26] I stress the different meanings of translation through applying a number of subconcepts, which emphasize these different versions of translation.

The first meaning translation took on was the mobilization of a set of human and non-human actors toward a common goal. Here it is used to describe the process of enrolling support for research projects, and how society, nature, and technology 'co-evolve' in the process of doing so. A translation in this first sense signifies mobilizing support in order to build a stable research assemblage.[27] To denote this version of translation, I utilize the concepts *problematization* and *obligatory passage point*. These terms stress how actors attempt to define a problem, the identities of actors, and their interests in building momentum for a certain project. In doing this they endeavor to construct themselves as mandatory, or obligatory passage points, on the road to solving a particular problem. The essence of this first meaning of translation is that the establishment of associations can strengthen the momentum of an assemblage, change

25. John Law, "Traduction-trahison: notes on ANT," http://www.lancs.ac.uk/fss/sociology/papers/law-notes-on-ant.pdf.

26. See Steven D. Brown and Rose Capdevila, "Perpetuum mobile: substance, force and he sociology of translation," in *Actor-Network Theory and after*, ed. John Law and John Hassard (Oxford: Blackwell, 1999), 33-34, for a discussion of the three versions of translation.

27. Callon, "Struggles and negotiations to define what is problematic and what is not," ———, "Some elements of a sociology of translation."

its direction, or, if it fails, can betray and destabilize it.[28] In the sense of mobilizing a set of actors toward a common goal, translation is employed in my last article *Coding copyright*, to show how support was enrolled for a technological project; how a problematization and obligatory passage point were constructed to enroll support for digital property rights technology.

The second sense in which translation has been used in ANT, is to describe how facts, intentions, or ways of organizing move to material objects and back again. Here the concept stresses that knowledge can be inscribed in more durable forms to increase stabilization, or that intentions can be inscribed in a technology to prescribe certain actions. The focus lies on moving between ontological domains.[29] This type of translation, in which 'an object stands in for an actor,' emphasizes the intentional folding of a *hypothesis* about the world into an assemblage.[30] A number of expressions have been developed in order to describe this meaning of translation. The most important ones for my analysis have been the duality *inscription* and *prescription*. I take inscription to be defined as follows:

> A general term that refers to all the types of transformations through which an entity becomes materialized into a sign, an archive, a document, a piece of paper, a trace. Usually but not always inscriptions are two-dimensional, superimposable, and combinable. They are always mobile, that is, they allow new translations and articulations while keeping some types of relations intact.[31]

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28. Problematization and obligatory passage-point are defined in Callon, "Some elements of a sociology of translation."

29. For this interpretation of translation see Bruno Latour, "Mixing humans and nonhumans together: the sociology of a door-closer," in *Ecologies of knowledge: work and politics in science and technology*, ed. Susan Leigh Star (New York: State Univ. of New York Press, 1995), Madeleine Akrich and Bruno Latour, "A summary of a convenient vocabulary for the semiotics of human and nonhuman assemblies," Madeleine Akrich, "The de-scription of technical objects," both in *Shaping technology building society: studies in sociotechnical change*, ed. Wiebe E. Bijker and John Law (Cambridge, MA: MIT Press, 1992).

30. It is sometimes called delegation. Bruno Latour, "A collective of humans and nonhumans: following daedalus's labyrinth," in *Pandora's hope: essays on the reality of science studies* (Cambridge, MA: Harvard UP, 1999), 189.

31. ———, *Pandora's hope: essays on the reality of science studies* (Cambridge, MA: Harvard UP, 1999), 306-307.

For me, inscription indicates a process of materialization where a thought, a fact, or a hypothesis about the world is translated into a durable form that allows it to travel. For my analysis, the essence of inscription is that it describes the shaping of technologies and artifacts for specific purposes, thus embedding programs of action or prescriptions into a more persistent incarnation.

Prescription is the mirror image of inscription and describes the way in which non-human actors shape the direction of an assemblage. Akrich and Latour define it as: 'What a device allows or forbids from the actors – humans and nonhuman – that it anticipates; it is the morality of a setting both negative (what it prescribes) and positive (what it permits).'[32]

In the historical articles I have used translation in the sense of inscription and prescription to underline the ways in which technologies in the form of exams, tables, or questionnaires translated students' tested progress and learning into subjectivities like 'gold dust' or 'dead timber;' or an individualistic ideal into the possibility of choosing from thousands of courses. I also employed it in both the contemporary articles *Lego learning* and *Coding copyright* to show the ways in which technical standards were inscribed with hypotheses of an educational organization. Here the emphasis lay on the construction of educational technology – and the surrounding chains of translations.

The third, most philosophical way of understanding translation in ANT, is to see it as the forging of an ontological association between two elements. This interpretation of translation describes the most generalized process of establishing associations.[33] In this sense, I employ translation to describe how ideas from other domains are associated with the construction of new educational technology. Here, the starting-point is that intentionally formed hypotheses or problematizations are not the only type of translations which shape technology. There are also associations between other already-existing technologies, and translations from other domains of practice, which importantly mold technological objects and projects. The point being that the introduction of a solution or idea from another domain brings with it a complex series of other associations that shape the direction of an assemblage. As an ontological association, I employed translation in both *Lego learning* and *Coding copyright* to show the ways in which ideas travel between different domains and shift

32. Akrich and Latour, "A summary of a convenient vocabulary for the semiotics of human and nonhuman assemblies," 261.

33. According to Steven Brown and Rose Capdevila, this ontological meaning of translation is close to the relational and combinatorial philosophies of Leibnitz and Spinoza. See Brown and Capdevila, "Perpetuum mobile," 33-35.

the direction of an assemblage; for example, an analogy between object-oriented programming and Learning Objects, brings with it a number of other ideas and modes of organizing that shape the construction of a technical standard.

As I have already argued, translation enables me to analytically highlight the associations between thought, observation, and subjectivity in the historical articles. The goal here was to complement the static levels of the dispositif with a concept that highlighted doing and process, thus emphasizing the always already ongoing processes of stabilization. In the contemporary cases, my core rationale for making use of translation was to show how educational technology standards were shaped in a chain of translations stemming from social interests, technological solutions, or other domains.

Conclusion

The longstanding specters of technological and social determinism are challenges that are not easily overcome – whether they are expressed in relation to education or other empirical fields. Technology in education is bound to be implicated in so many different configurations that such an exploration would be rendered meaningless by the sheer diversity of educational practice. Therefore, rather than trying to find a definite answer to the ways in which technology becomes part of education, I have focused on the associations that educational technology is part of, and used the concepts of dispositif and translation to understand their shape and dynamics.

This analytical point of departure has been productive in its most empirical sense – the articles highlight a number of roles for technology in distance education; they show that technology is part of producing certain modes of organizing education; and that educational technology is indeed constructed in specific heterogeneous associations.

Foucault's dispositif and Deleuze's levels have helped me to analyze how technology makes it possible to observe certain characteristics of learning, thereby constituting 'learning' as an object of knowledge that feeds back into the dispositif. They also help to show how certain ways of thinking inform and shape these observations, and how these associations produce certain subject positions for students. The use of the metaphor brought out specific associations that constituted a certain pattern – a mode of organizing education – which underlined the contradictory movements of massification and individualization.

Translation, in its three senses, emphasized the processes of stabilization and the construction of associations. This brought out the way in

which a disparate assortment of things and forces change shape and affect each other when they are associated. In my cases, translation demonstrated how technology is used to intentionally shape education, but also how it brings with it unintended consequences. Accordingly, translation showed how each technological artifact brought with it knowledges, interests, ideas from other domains, and how the artifacts created a number of effects on other technologies, identity, access to educational material, or the treatment of knowledge.

In this study, the perspective of associations, and the concepts of dispositif and translation call attention to the heterogeneous nature of educational practice. By attending to translations in dispositifs, the role of technology is highlighted as always already being connected to a complex web of associations that shape every facet of our educational interactions. In this, I aim to show how student identities, the mode of organizing education, and the construction of technology are deeply implicated in an aggregate of associations, which can neither be reduced to a view of technology as necessary for bettering education nor to a flexible tool to wield as the teacher sees fit.

Coda: reflecting on theory as process

As will become apparent in the empirical articles, my application of these concepts has been more complex than presented in this chapter. The disparities between the articles and the framework presented here is the result of an ongoing theoretical process linked to the empirical investigations. As a result, the articles stress different aspects of the theoretical metaphors and highlight different aspects of technology in education.

In my first article, *Learning in nowhere*, which for pedagogical reasons is the *second* article in this volume, the analysis is tightly focused on the production of identity in correspondence education. Here, I focus on the Foucauldian and heterogeneous *governing* of students from the point of view of technologies of self and technologies of power. My application of the concept of dispositif and the discussion of dispositifs, agency, and materiality in STS are not particularly apparent, neither in the analysis nor in the theory section. However, I discuss dispositifs briefly in a long footnote, and I refer to a number of STS studies as 'post-Foucauldian perspectives.'[34] This is a crucial weakness in the article, as the role of materiality and technology becomes highly inconspicuous, rendering the ac-

34. See *Learning in nowhere*. See also the footnotes 3, 5 and 6 in this chapter for a brief justification of 'post-Foucauldian.'

count closer to a social construction perspective, than to a heterogeneous analysis.

In my second article, *Technopedagogies of mass-individualization*, which is the *first* presented in this volume, dispositif and translation are visibly applied, and are productive in highlighting the role of technology in organizing correspondence education. The empirical focus is clearly the sociomaterial dispositif of correspondence education. In this article, the levels of the dispositif clearly guide the analysis, and have also provided the organization of the presentation. Translation also becomes productive in showing how the Deleuzian levels are connected to each other through technology.

However, there are two concepts in the historical articles which have been carefully banished from my discussion in this text: co-production and technopedagogy. The first concept, co-production, was an attempt to discuss the relationship between technology and pedagogy, and led to my development of the concept technopedagogy. I developed this concept to show how pedagogy and technology stood in constant relation with each other in educational practice and theory. Nonetheless, upon further reflection, it seemed that technopedagogy and co-production were ill conceived to describe my studies of technology and education, as co-production demands an attention to a process unfolding over time. I believe that applying a co-productive analysis of technopedagogy – the science of pedagogy, technological artifacts, and educational practice – would be a worthwhile endeavor elsewhere and could show important associations between technology and pedagogy.[35]

The theoretical apparatus of the contemporary articles, *Lego learning* and *Coding copyright*, includes the concepts of translation in order to understand the way in which technology is shaped in heterogeneous associations among humans, hypotheses, visions, and ideas from other domains. As I outlined in the introduction, the focus here is on the *construction* of technology rather than on the use of technology in practice. So rather than using the levels of the dispositif, which are more effective in analyzing practice, I employ translation here.

35. A fertile analysis of the relation between technology and pedagogical theory is Nikolas Rose, "The gaze of the psychologist," in *Governing the soul: the shaping of the private self* (London: Routledge, 1989), who shows how the development of mental stage theory was linked to development of laboratory technologies of observation and documentation. Walkerdine has linked the material practices of education to educational theory in Walkerdine, "Developmental psychology and the child-centered pedagogy."

The differences in my applications of theory reflect my research process, but also the nature of the material that I have studied and the focus of my empirical inquiries. They also highlight the long research process, which lay the groundwork for the articles, and the way in which different metaphors are useful for analyzing different sets of empirical materials. Regardless of the differences in my application of conceptual metaphors the association-analysis perspective outlined above has crucially guided my research from the outset of this dissertation.

3

Material and methods

The purpose of this chapter is to outline and discuss the material and methods in further detail than has been possible in the individual articles, as well as to provide a space for reflection on my practices of analyzing and theorizing. To do this, I first examine both my historical and contemporary empirical material in some detail: its characteristics, its context, and its status. Secondly, I discuss my perspective on texts in relation to technology, and how I can study heterogeneous associations and non-human agency through text. Ultimately, I turn my attention towards a discussion on qualitative coding, analysis, and theory.

Material on correspondence education

In order to study the historical practices of correspondence education, the first two articles in this study are based on the conference proceedings of the International Conference for Correspondence Education (ICCE).[1] This conference, founded in 1938, is still in existence today. The ICCE-conferences are important in many ways, as they were the first international conferences in distance education and also one of the biggest are-

1. This empirical approach was inspired by Katherine Hayles' treatment of the *Macy conferences*, which constructs a history of the seminal ideas of cybernetics through the lens of a series of conferences. See N. Katherine Hayles, *How we became posthuman: virtual bodies in cybernetics, literature, and informatics* (Chicago, IL: Univ. of Chicago Press, 1999).

nas for international collaboration and exchange of ideas in the distance education field. The primary objective of the ICCE conferences was to facilitate meetings and knowledge exchange, with the aim of bettering educational practices in correspondence education.

The idea of an international conference for correspondence education was proposed in 1936 at a conference for supervised correspondence study at Columbia University in New York, USA by the director of High School Correspondence Instruction for British Columbia in Canada, J. W. Gibson. In New York, Gibson presented his knowledge about correspondence education in several different countries and suggested the organization of an international conference. This suggestion was met with acclaim by the delegates, and the first ICCE conference was held in 1938 in Victoria, British Columbia, Canada.[2] At the first ICCE conference it was decided that a second conference was to be held in 1940 at the University of Nebraska at Lincoln, USA, but, due to World War II, the second conference was postponed until 1948. The third conference was held in 1950 in Christchurch, New Zealand.[3]

The attendants at the early ICCE conferences were mostly from the countries in which the conferences were held and their neighbors, making 'international' a manner of speaking rather than an actual conference practice. At the six first conferences, held between 1939 and 1958, as much as 91-97% of the delegates came from the US or Canada. The exception being the conference held in 1950, in New Zealand, when 89% of the delegates came from the host country or neighboring Australia.[4]

The conference proceedings that are analyzed for the historical articles, *Technopedagogies of mass-individualization* and *Learning in nowhere*, are from the first conference in 1938 and the third conference in 1950. The 12 year gap between the conferences is due to two circumstances: firstly, as I stated above, the second conference was postponed from 1940 to

2. Ellen L Bunker, "An historical analysis of a distance education forum: the International Council for Distance Education world conference proceedings, 1938 to 1995" (Ph. D., Pennsylvania State Univ., 1998), 33.

3. Subsequently conferences were held in 1953 in Pennsylvania, USA; in 1957 in Alberta, Canada; in 1961 in Oregon, USA; in 1965 in Stockholm, Sweden; in 1969 in Paris, France; in 1972 in Virginia, USA; in 1975 in Brighton, UK; in 1978 in New Delhi, India; in 1982 in British Columbia, Canada; 1985 in Melbourne, Australia; 1988 in Oslo, Norway; in 1990 in Caracas, Venezuela; in 1992 in Bangkok, Thailand; in 1995 in Birmingham, UK. Ibid., 34-35.

4. In 1938, 84 of 87 delegates came from the US or Canada; in 1948 111 of 116; in 1953 59 of 65; and in 1958 72 of 76, while in 1950 (when the conference was held in New Zealand, 81 of 91 delegates were from New Zealand or Australia. See Ibid., 377.

1948 due to the second word war; and secondly I was unable to obtain the proceedings from the second conference that was held in 1948.[5]

These early conferences were chosen as the object of study as they provide insights into correspondence education in its heyday, when thousands of students around the world gained access to education. Furthermore, the conferences in 1938 and 1950 were held in different continents, broadening the perspective of the study somewhat. However, I have not studied the whole series of conferences, as the purpose of this study is not to construct a sequential history of the development of distance education practice, but rather to understand the capacity of technology in education by juxtaposing the history and a possible future of distance education.

The conferences in 1938 and 1950 sported 88 and 79 delegates respectively, drawn from various parts of correspondence education: some were principals of correspondence high schools, some worked at university extension divisions, some were correspondence teachers, and some were course-constructors. Others were part of the educational administration of US or Canadian states, or worked at libraries or periodicals. What all these different people had in common was an interest in correspondence education from either a political, democratic, practical, or economic perspective.

The conference proceedings consist of about five hundred typed pages (236 pages from the first, and 265 pages from the third) and include addresses and subsequent question sessions. Furthermore, they include discussion forums that were organized to consider different topics in a more open manner. The addresses, the question sessions, and the discussion sessions were transcribed by secretaries, thus providing me with a window into the discussions, questions, and worries of the delegates.

The speeches held at the ICCE conferences varied in character: they were heroic portraits of the pioneers of distance education, expositions on economic aspects, presentations focusing on various social problems (like unemployment, the migration from country to city, teacher shortages, or social exclusion), as well as on the problems and strengths of correspondence education pedagogy.

The discussion sessions were organized into topics such as, *The organization, promotion and accreditation of correspondence instruction*; *The work of the correspondence instructor – teaching, evaluating, and recording of results;* or *Course production* and provided forums for learning from each other's

5. I tried apprehending the proceedings for the second conference in multiple ways: the Linköping university library tried other institutions for several weeks; and I searched the Internet for clues.

practice. At these discussion sessions, different opinions were voiced on topics ranging from grading, organization, testing, organization of the mailroom, to the use of special envelopes.

To complement the texts from the ICCE conferences I also investigated a large archive of correspondence material that was collected by the Swedish state delegation for the use of correspondence education in the compulsory school system.[6] The archive, stored in forty-three semi-unsorted boxes, contains teaching material from correspondence schools in, for example, the USA, Canada, Australia, New Zealand, France, South Africa, and Norway. As delegates from the US, Canada, Australia, and New Zealand dominated the early conferences, my analysis of the archive focused on the eleven boxes from these countries. This choice excluded material stemming from other places which could have broadened the analysis to include other cultural spheres, like Russia or eastern Europe, and would have been an interesting investigation in the history of correspondence education in itself.[7]

The archive material is dated from the early 1940s to the end of the 1950s, thus, to some extent, overlapping the 1938 and the 1950 conferences that were also scrutinized. The archive included various diagnostic tests and self-tests, informational material about different schools, newsletters and bulletins, administrative and teaching guides, leaflets containing the course offerings, schedules that were sent to the pupils, as well as instructions on how to study efficiently. Also included were course 'letters' of various qualities: some were typed and mimeographed, some were printed and typeset beautifully. Many course letters were adorned with artwork by professional illustrators, but the majority were decorated by the correspondence teacher that constructed and typed the course.

The courses in the archive have an extremely wide range that reflects the breadth of the offerings available from correspondence schools. The material ranges from US high school courses in French, English, literature, history, geometry, or drivers education(!), to university courses (from USA, Australia, and New Zealand) in economics, income tax, litera-

6. The state delegation was called *Brevskoleutredningen*, the correspondence school inquiry, and was commissioned in 1957. Its final report was called correspondence education in the school system. "Korrespondensundervisningen inom skolväsendet (SOU 1962:16)," (Stockholm: Ecklesiastikdepartementet, 1962). The Archive is sorted under YK 1808 in *Riksarkivet*, the Swedish National Archives in Stockholm, Sweden.

7. In my examination of the archive I was unable to identify how the archive of correspondence material was formed. However, the secretary of the inquiry Malte Eurenius took part in the ICCE-conference in the beginning of 1960's and was probably involved in requesting correspondence education material from different schools around the world.

ture, history, statistics, horticulture, mining and mine surveying, radio repair, accounting, public administration as well as elementary courses in 'reading, 'riting, and 'rithmetics from New Zealand and Australia. The material also included a number of commercial vocational courses in for example transistors and their applications, or trade work.

The correspondence material and the archive material have different strengths in relation to understanding technology in education. The conference proceedings are texts that are produced by people involved in a series of events, and therefore often reflect the intentions and visions of correspondence education. In the conference proceedings, the delegates expressed visions, hypotheses, and rationales for correspondence education. The archive material, on the other hand, provides a large collection of relics that show how the material artifacts were inscribed with the visions of correspondence educators. Taken together these two types of material elucidate different aspects of correspondence education, and strengthen each other, as one provides a window into the lines of thought prevalent in correspondence education, and the other provides insights in how the materials looked that were used in correspondence education practice.

Taken together, the conference proceedings and the archive material provide a multifaceted understanding of the intentions of correspondence administrators and teachers, as well as of their struggles with translating their pedagogical visions into technologically mediated education.

Material on Learning Objects

The contemporary articles, *Lego learning* and *Coding copyright*, also have as their departure point the ICCE conferences, but in their present-day guise, after changing the name to the International Conference on Distance Education (ICDE). The collection of material for the contemporary study began in September 2006, at the 22nd ICDE conference in Rio de Janeiro, which I attended as participant/observer. The conference itself was held at a large hotel on Copacabana beach, and can be described as a mixture of trade show and academic conference. The conference area was littered with large showcases for multinational software companies and Brazilian distance education organizations.

What became apparent at this conference was the growth of the conference and the increased diversity in the distance education field. What started out as a small conference for correspondence education had grown to encompass previously unheard of numbers of people, machines, approaches, and countries. Over 1500 delegates from 73 countries were represented, and over 650 papers were accepted for presentation, of which

about 50% were from Brazil.[8] The delegates at the conference ran the gamut of distance education: from distance universities, like the Open University, UK or the Open University of the Netherlands; via international organizations, such as UNESCO; or NGOs, like the Brazilian Organization for Distance Education; to commercial software companies, like Blackboard or Moodle; as well as representatives of state administrations and politics, like the ministers of education from Norway and Brazil.

The empirical material for the contemporary articles started out with 279 papers from the conference in Rio de Janeiro that were published on the conference website. These were diverse, including theoretical discussions on distance education, case studies on courses, presentations of software, keynotes on the quality of distance education, presentations of universities, and talks on distance education for international aid. Authors, like those who participated in the historical ICCE conferences, were from all walks of distance education: teachers, researchers, aid-workers, and visionaries, providing a highly cosmopolitan picture of distance education.

In this diverse material the idea of Learning Objects – standardized and reusable digital objects of learning material – stood out as a distinct and unexpected figure of thought. However, the conference presentations were inadequate for a deeper study of Learning Objects, leading me to expand the selection of articles through a chain technique.[9] This entailed reading the reference lists of the original articles to identify further texts relevant for studying Learning Objects. The chain technique yielded a collection of 35 texts that added up to approximately 500 pages of material. Furthermore, I studied the first accepted standard on metadata for Learning Objects, which was produced under the umbrella of the well-established international standardization organization IEEE. This standard is dubbed the *IEEE standard for Learning Object metadata* (IEEE LOM).[10] This material is the basis for the article *Lego learning* in this volume.

In the second phase of my investigation into Learning Objects I switched empirical focus, to a sister report of the IEEE LOM. This report is dubbed the *IEEE trial-use recommended practice for digital rights expression languages (DRELs) suitable for elearning technologies* (IEEE DREL).[11] The IEEE DREL report seeks to identify properties of a suitable computer language

8. ICDE, "22nd ICDE world conference on distance education report" (ICDE, 2007).
9. Michael Quinn Patton, *Qualitative research and evaluation methods*, 3 ed. (London: Sage, 1990), 237-238.
10. IEEE, "IEEE standard for Learning Object metadata," (New York: IEEE, 2002).
11. IEEE, "IEEE trial-use recommended practice for digital rights expression languages (DRELs) suitable for elearning technologies," (New York: IEEE, 2007).

for describing permissions in relation to intellectual property in the educational arena, and is inscribed with a technological vision for instituting digital rights management (DRM) for Learning Objects. In order to better understand the vision inscribed in the IEEE DREL, I turned to Google Scholar for relevant texts treating DRM and Learning Objects. Like with the IEEE LOM, the original texts identified through Google Scholar were expanded through a chain technique that entailed scanning reference lists for texts on Learning Objects and DRM.[12] This yielded 29 texts that encompassed around 800 pages. The above analysis is presented in my article *Coding copyright*.

The studied standards are published and endorsed by the international organization IEEE, an acronym that used to stand for Institute of Electrical and Electronics Engineers, but now is just a name without further meaning. The aim of the IEEE is to 'to foster technological innovation and excellence for the benefit of humanity.'[13] The IEEE is a highly influential organization when it comes to electronics and computers, and has developed a number of ubiquitous standards in the computer and electronics industry, for example standards for: Firewire, USB, or Wi-Fi. The documents that I have studied in relation to Learning Objects have been developed under the auspices of the IEEE Learning Technology Standards Committee (LTSC).

For both the IEEE standards and the other texts on Learning Objects, a mixed, but small, circle of people are involved. Some are, or have been, members of standardization committees, others have contributed through submitting use-cases to the standardization process, and still others work with educational technology, attempting to gain momentum for their own products or standards. A number of the papers are co-authored by different circulating sets of people, showing that there are many professional affinities them, and quite a few of the authors have vested interests in Learning Objects through the companies they work for or have founded.

In hindsight, interviews with these representatives might have been a productive way of deepening my understanding of the construction of Learning Objects, as the actors themselves might have provided additional insights into the intentions, the differences in opinions, or the network of people involved in the construction. However, I believe that the studied texts can give adequate information for the tracing of a vision for Learning Objects, as they can be seen as inscriptions that attempt to

12. Patton, *Qualitative research and evaluation methods*, 237-238.
13. IEEE, "IEEE mission & vision," http://ieee.org/web/aboutus/visionmission.html.

enroll support for the project, and are in agreement on many of the broad lines of development for Learning Objects.

While all the texts are relevant for understanding the standardized technological object, Learning Objects, the texts have diverse goals and subjects reflecting the still unstable nature of the project. The common ground is that they attempt to broadly define Learning Objects as socio-technical object – technologically, theoretically, economically, educationally – and in relation to diverse entities – publishers, universities, vocational schools, course constructors, researchers, primary schools, etc.

Texts, translation, and non-human agency

The construction and use of technology implicates countless numbers of texts: standards documents, conference papers, journal articles, government reports, manuals, promotional materials, forms, tables, etc. Furthermore, texts accomplish things by forging associations to other things, like other texts, efforts, or organizations;[14] they can be a major path to gain reputation and status by enrolling, organizing, and creating interest;[15] they can make action at a distance possible creating centers of calculation;[16] and they can make certain things visible.[17]

In education for instance, using a written test as the basis for individualizing the curriculum implicates a number of translations and non human actors: the student inscribes knowledge on paper, it is then translated into a grade by the teacher, it can later be taken up by a student counselor, who in turn creates an individualized study plan. Here, every artifact becomes an actor which is part of a chain of translations that transforms student knowledge into placement and guidance. The forged linguistic translation produces effects on the assemblage's momentum.

Consequently, I see texts as crucially implicated in constituting technology and vice versa. For my study this means that I see linguistic associations as creating links between entities which constitute a specific mode of ordering distance education, an assemblage. Conceptualized in this fashion, texts are part of creating worlds by forming associations.

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14. Michel Callon, John Law, and Arie Rip, eds., *Mapping the dynamics of science and technology: sociology of science in the real world* (Basingstoke: Macmillan,1986).
15. Michel Callon, "The sociology of an actor-network: the case of the electric vehicle," in *Mapping the dynamics of science and technology: sociology of science in the real world*, ed. Michel Callon, John Law, and Arie Rip (London: Macmillan, 1986).
16. Bruno Latour, *Science in action* (Cambridge, MA: Harvard UP, 1987).
17. Cf. the grid of perception in Gilles Deleuze, "What is a dispositif?," in *Michel Foucault: philosopher* (London: Harvester Wheatsheaf, 1992).

As Callon and Law have argued, texts are crucially linked in chains of translation:

> There isn't a reality on the one hand, and a re-presentation of that reality on the other. Rather, there are chains of translation. Chains of translation of varying lengths. And varying kinds. Chains which link things to texts, texts to things, and things to people. And so on.[18]

This position suggests that analyzing chains of translation can entail studying texts, but can also include educational tables, computer interfaces, programming code, or diagrams. By seeing texts as being parts of chains of translation I see them as part of a heterogeneous assemblage. Thereby, I treat the linguistic as one form of association, but by all means not the only one.

A crucial aspect of the empirical material that undergirds these studies is that it abounds with human intentions. The texts that I have studied are crucially inscribed with visions, hypotheses and problematizations about distance education. When a human actor inscribes an intention in a text I see it as establishing an association to another practice, to another technology, or to another idea that is meant to enroll support for and stabilize an assemblage. Accordingly, texts can mobilize associations from other domains, like for example, object oriented programming or IQ testing. They can enroll support for a technological or educational project, using economy or technology as arguments. But texts can also shape other things, such as technological standards that define the characteristics of technological objects.

I argue that texts are crucial components in translating intentions, but also that these translations bring with them unintended consequences. The re-presented actor can become a trickster, a traitor, that shapes an assemblage in an unintended or unforeseen direction. In this manner translation can unexpectedly become trahison, betrayal, unfaithful translation. Accordingly, I see these processes of translation as involving non-human actors and non-human agency.[19]

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18. Michel Callon and John Law, "Agency and the hybrid collectif," *South Atlantic quarterly* 94, no. 2 (1995): 501.

19. On materiality as trickster, see Donna J. Haraway, "The actors are cyborg, nature is coyote, and the geography is elsewhere: postscript to 'Cyborgs at large'," in *Technoculture*, ed. Constance Penley and Andrew Ross (Minneapolis: Univ. of Minnesota Press, 1991). On translation/betrayal, see John Law, "Traduction-trahison: notes on ANT," www.lancs.ac.uk/fss/sociology/papers/law-notes-on-ant.pdf.

An example of unintended consequences in the construction of Learning Objects, is how a text that turns to object-oriented programming translates a non-human actor – in the form of a specific way of organizing code. This non-human actor shapes a hypothesis of education, which is inscribed in a standard for learning material, and starts to construct a technical object, Learning Objects. However, in including object oriented programming, the momentum and shape of Learning Objects are changed: the re-presented actor brings with it specific consequences from other domains. The same reasoning applies to correspondence education, where a vision of individualism and mass-education shapes how correspondence letters are designed, but the correspondence letters also shape how and what can be done.

In sum, the train of thought delineated above means that I study texts that attempt to accomplish things, and that these texts are inscribed with human intentions to shape the world in a certain manner. These linguistic translations carry with them characteristics from other domains, technologies, or organizations that shape both human intentions in the form of a hypothesis, but also, in turn, technological standards that shape what it is possible to do.

Analyzing, coding, and interpreting

The conference proceedings and the texts on Learning Objects were analyzed through a thematic coding technique that aimed to identify patterns in qualitative data. This approach to coding was primarily inspired by the analytical strategies developed by Strauss and Corbin, but does not aspire to fully be a grounded theory approach.[20] The work of coding and categorizing entailed an oscillation between coding excerpts, grouping them into more general categories, and making links between codes and groups of codes. Eventually the explorative coding process evolved into a detailed awareness of the passages that dealt with technology in distance education and the links that were made between them.[21]

The first phase of this coding process, what Corbin and Strauss call the open coding phase, entailed identifying recurring themes in the texts, grouping them together and labeling them with a descriptive name.[22] My application of the codes worked both deductively and inductively, creat-

20. Anselm Strauss and Juliet Corbin, *Basics of qualitative research: grounded theory procedures and techniques* (London: Sage, 1990).

21. Compare with Amanda Coffey and Paul Atkinson, *Making sense of qualitative data: complementary research strategies* (Thousand Oaks, CA: Sage, 1996), 27.

22. Strauss and Corbin, *Basics of qualitative research*, chapter 8.

ing a meeting point between my research interest and questions, theories, and the empirical material.[23] In the generation of codes I relied on identifying recurring patterns of thought or action that were salient to my research.[24] In the case of correspondence education, this initial coding was focused on how the delegates to the conference spoke about technologically mediated practice. In the case of Learning Objects, coding was focused on understanding the visions and hypotheses that were attached to Learning Objects as sociotechnical objects.

In the second phase, the axial coding phase, I aimed at finding groups of codes and links between them. This phase entailed grouping codes into larger categories, and trying to discern general patterns of organizing, defining, and doing. This coding process resulted in super-categories that were designed to organize and find patterns in the more concrete codes from the first phase. I formed these super-categories by looking for similarities and differences in codes and meanings. Due to the large number of possible themes in the material, I tended to focus on similarity and grouping, rather than on splitting themes.[25] This activity was part of a continuous process of working with codes, sometimes by merging different codes, sometimes by renaming them, and sometimes removing them as too infrequent or as irrelevant to the research question.

In addition to the coding, I analyzed the IEEE standards and the historical archive material to understand how they translated a hypothesis of education. The technical standards and the correspondence letters had little rhetorical and visionary embellishment, but were, for the most part, dry technical reports or mundane texts that conveyed their associations with other things in terms of their design, in technical and semi-technical terms, or sometimes in terms of their intended use. In analyzing the technical standards and the historical artifacts it was highly fruitful to use the coded material as a sounding board to connect the technical terms and correspondence letters with different visions of education, i.e. the coding of the conference proceedings and the texts on Learning Objects provided additional support in interpreting the technical standards and the correspondence letters.

The last step of the analysis, the application of *translation* and the levels of the *dispositif*, highlighted certain aspects of my material. Here the metaphors outlined in the theory chapter shaped my interpretation of links

23. Coffey and Atkinson, *Making sense of qualitative data*, 27.

24. On repetition as a way to identify themes see Gery W. Ryan and H. Russell Bernard, "Techniques to identify themes," *Field methods* 15, no. 1 (2003): 89.

25. On the process of cutting and sorting, as well as the strategy of lumping together see, Ibid.: 94-95.

and categories – they became tools for thinking and writing about the relations between technology and education.[26] One fashion of describing this meeting between theory and coding is to describe these theoretical concepts as *sensitizing concepts* that form a backdrop to the overall research questions and problems. These sensitizing concepts often stem from the field of research or disciplinary propensities, and can work to heighten awareness of certain phenomena. However it could be argued that they can only serve as a point of departure, and never as an end-point.[27]

My coding and identification of themes bore an important relation to a number of theoretical notions, like the concepts tied to translation – inscription, prescription, hypothesis, problematization, and obligatory passage point – or to the Deleuzian levels of the dispositif – thought, observation, subjectivity, and power. I also tried other theoretical metaphors and concepts, such as *technological zone*, *posthumanist*, *co-production*, or *technopedagogy* against the material, with unsatisfactory results, and discarded them. In the final analysis, the levels of the dispositif fit better with correspondence education, allowing me to categorize and analyze educational practice, while the concepts of translation fit with both the analysis of correspondence education and Learning Objects.

Furthermore, one of my most important analytical themes, *mass-individualization*, was an 'indigenous' concept which I happened across in a European Union call for research and development in technology-enhanced learning. It managed to capture the tensions I was struggling with in my empirical material, and pinpointed how different empirical themes were in fact fragments indicating the same mode of organizing education. Subsequently, I have employed this concept to highlight the tensions between industrialization and individualization in distance education.[28]

Thus, the meeting between theories and empirical material can be seen as a negotiation of an analytical space where one stands in reciprocal

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26. Compare with George Lakoff and Mark Johnson, *Metaphors we live by* (Chicago: Univ. of Chicago Press, 1980).

27. For a discussion of sensitizing concepts see Glenn A. Bowen, "Grounded theory and sensitizing concepts," *International journal of qualitative methods* 5, no. 3 (2006). See also Ryan and Bernard, "Techniques to identify themes," 93-94, on theory related analysis.

28. The concept of mass-individualization was found in European Commission, "ICT – information and communication technologies: a theme for research and development under the specific programme 'Cooperation' implementing the Seventh Framework Programme (2007-2013) of the European Community for research, technological development and demonstration activities," (2007), 36. On 'indigenous' categories see Ryan and Bernard, "Techniques to identify themes," 89.

relationship to the other. The disciplinary emphasis of these concepts, as well as my strong affinities with the field of STS made certain themes, like those involving technology or knowledge, stand out in my analysis, but naturally also led to the de-emphasis of other facets of the material. However, the empirical material also shaped how I understood and applied concepts, and led to the generation of a descriptive metaphor, mass-individualization, for how my studies related to each other as well as to larger trends in education. In the analysis, the coding process, the practices of sorting and grouping, the sensitizing concepts, the empirically founded analytical concepts, and the final writing of the analysis all affected the end result to varying degree, but every part lent its crucial characteristics to the whole process.

Conclusion: homogeneity and difference

The above-outlined process emphasized identifying general patterns of meaning and organization. The strength of this approach was that it allowed me to find patterns that are general for distance education. However, the texts and the objects stemmed from various practices: from different countries, different levels of education, and different schools. Here I was forced to make a choice. Should I emphasize homogeneity or should I emphasize difference and heterogeneity? In this, I chose to attend to common patterns and similar uses of technology, thus producing a monolithic picture of distance education. This approach has undoubtedly glossed over a number of national and local differences, however I believe that the relational perspective on distance education, the juxtaposition of different time periods, and the use of different theoretical metaphors to some extent counter this homogenization.

A central problem in this research process has been the cosmopolitan and multifarious nature of conferences. This has generated contextual and epistemological concerns that I had not foreseen when choosing to base my studies on the ICCE conferences. In hindsight these challenges have been both a blessing and a curse. They have made it possible to look at distance education as a truly boundary breaking practice (in the geographical sense), that has heralded a globalization and homogenization of the educational system; but they have also generated problems.

To handle this conundrum I have attempted to situate the historical case in an English-speaking pedagogical tradition, where certain manners of thought and action were strongly dominant in terms of Deweyian pedagogical progressivism, the psychology of individual differences, and developmental psychology. The contemporary case, on the other hand, exists in a context of multinational standards, companies, and educa-

tions, and therefore could be said to exist, in a stronger sense, in what is sometimes called globalization. However, there is a strong dominance of actors from Canada, Australia, and the USA which connects the historical and contemporary cases.

My ambition is that that the insights generated from the study will help in understanding the role of technology in shaping ideas and practices in one of the most important and prominent social institutions: education.

The Historical Articles

4

Technopedagogies of mass-individualization[1]

Material artifacts embody and change both pedagogical theory as well as educational practice: they enable the testing of students' knowledge – producing particular knowledges about student intelligence, talent, or motivation; make possible seating arrangements – reflecting specific paradigms of educational theory; or make possible mediated expositions of school subjects – actually transmitting knowledges about education. Material artifacts are crucial for how education is organized, practiced and understood.

This article is interested in technologies as enablers of education, but also as producers of an educational situation with particular pedagogical and didactical discourses on students, learning, and education. Consequently, the article is interested in how technology is co-produced with pedagogy. The interest in the interminglings of knowledge and expertise with material artifacts and technology stems from Foucault's brief engagement with the material practices of classification, normalization, and observation in education.[2] On a more mundane level the interest stems

1. Francis Lee, "Technopedagogies of mass-individualization: correspondence education in the mid 20th century," *History and technology* 24, no. 3 (2008).
2. Michel Foucault, *Discipline & punish: the birth of the prison*, 2 ed. (New York: Vintage Books, 1995).

from the increasing interest in computerized educational technology today, which promises to make education cheaper, more efficient, more individual, freer, or simply better.

The purpose of this article is to understand how the relations between technology and pedagogy produced a certain mode of organizing correspondence education that led to, what I have chosen to call, mass-individualization.[3] The concept of mass-individualization captures the basic tension that exists in correspondence education between the ambition to industrialize and streamline education (through a machinery consisting of teachers, printing presses, the postal system, and students) and the progressive ambition to individualize and adapt education to the individual student's talents, aptitudes and needs.[4]

These questions become particularly visible in distance education, which always depends on technology for the educational interactions, and especially historically in correspondence education where the veil of technology hype is thin. This article is about the co-production of knowledge and technology in correspondence education in the early 20th century.

Theoretical framework

Taking the interaction between technology and pedagogy as the departure point for analyzing education generates a number of crucial questions about how pedagogical knowledges are imprinted in the material artifacts of education, but also how the material artifacts feed back into our understanding of intelligence, learning or education. Consequently, the article stresses that an analysis of the practices and knowledges of pedagogy cannot be separated from technology. Thus, the article moves in a co-productive idiom that treats technology and pedagogy as crucially interwoven entities, and introduces the concept of *technopedagogy* to stress

3. According to *A dictionary of the Internet*, mass-individualization refers to 'large scale development of products which are customized to buyers. [...] network technology has provided the infrastructure for a major expansion in companies offering mass individualization.' Thus, mass-individualization is a concept which is closely tied to technology, mass production, and customization, and, as I show below, is a useful and accurate way of depicting correspondence education. See 'mass-individualization' in Darrel Ince, *A dictionary of the Internet* (Oxford: Oxford UP, 2001).

4. Cf. David Noble, *Digital diploma mills: the automation of higher education* (New York: Monthly Review Press, 2002), Chapter 1, for a discussion of the industrialized characteristics of correspondence education, and *Learning in nowhere* for a discussion of individualization in correspondence education.

this interrelation.[5] The concept technopedagogy emphasizes that technology is crucially fused with pedagogy: the prescribing powers of technology impressing certain modes of organizing education, and pedagogy making a decisive impact on how practice is shaped.

This article situates itself in a post-Foucauldian strand of research that has taken an interest in the interaction between technology and knowledge in education, thus it is located in a tradition of 'material semiotics' or 'heterogeneous construction.'[6] In this strand of research there have only been a few works taking an interest in the interaction between knowledge, technology, and education. These works have focused on the classroom's technology as source for analyzing discourse, or technology's role for the emergence of child development psychology.[7] Within science and technology studies (STS) the interest in the interactions between knowledge and technology has been much larger: for example in laboratory studies, studies of subjectivities, health care, or standards.[8]

To operationalize an analysis of the co-production of educational discourse and educational technology this article employs a materialist analysis of social apparatuses, *dispositifs*, which has been inspired by Michel Foucault and Gilles Deleuze.[9]

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5. Cf. Sheila Jasanoff, "The idiom of co-production," in *States of knowledge: the co-production of science and social order*, ed. Sheila Jasanoff (London: Routledge, 2004).

6. John Law, "Technology and heterogeneous engineering: the case of Portuguese expansion," in *The social construction of technological systems: new directions in the sociology and history of technology*, ed. Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge, MA: MIT Press, 1987), ———, "After ANT: complexity, naming and topology," in *Actor-Network Theory and after*, ed. John Law and John Hassard (Oxford: Blackwell, 1999).

7. For classroom technology see Valerie Walkerdine, "Developmental psychology and the child-centered pedagogy: the insertion of Piaget into early education," in *Changing the subject: psychology, social regulation and subjectivity*, ed. Julian Henriques, et al. (London: Methuen, 1984). For child development psychology see Nikolas Rose, "The gaze of the psychologist," in *Governing the soul: the shaping of the private self* (London: Routledge, 1989).

8. Lab studies, see Bruno Latour, *Science in action* (Cambridge, MA: Harvard UP, 1987), John Law, *Organizing modernity* (Oxford: Blackwell, 1994). Subjectivities, see Emilie Gomart and Antoine Hennion, "A sociology of attachment: music amateurs, drug users," in *Actor-Network Theory and after*, ed. John Law and John Hassard (Oxford: Blackwell, 1999). Health care, see: Annemarie Mol, *The body multiple: ontology in medical practice* (Durham: Duke UP, 2002). Standards, see Geoffrey C. Bowker and Susan Leigh Star, *Sorting things out: classification and its consequences* (Cambridge, MA: MIT Press, 1999).

9. The French word *dispositif* means device, mechanism, measure, apparatus or arrangement and has been employed by Michel Foucault to discuss biopower, and is translated into English in different ways. It has been translated it as apparatus or social apparatus, assemblage or regime of practice, and has also inspired theories based

A dispositif is 'a thoroughly heterogeneous ensemble consisting of discourses, institutions, architectural forms, regulatory decisions, laws, administrative measures, scientific statements, philosophical, moral and philanthropic propositions – in short, the said as much as the unsaid. [...] The [dispositif] itself is the system of relations that can be established between these elements.'[10] In sum it can be said to be the institutionalized (routinized and ritualized) way something has been organized at a particular historic and geographic moment in order to control and manage different aspects of society.[11]

The concept of dispositif stresses the discursive as well as non-discursive aspects of practice and the varied processes and relations by which particular practices are constituted.[12] By employing the concept of dispositif the article aims to connect an analysis of thought or discourse with an analysis of material semiotics, which means that it analyzes the relationality of all things.[13] Consequently, an analysis of dispositifs is materialist in that it focuses on the relations between particular modes of ordering material practice and certain ways of thinking and knowing.[14]

Following Deleuze, this article analyzes dispositifs in four discrete but intertwined levels:[15]

The first level addresses the specific *forms of knowing* that make intelligible the dispositif. In this, questions are posed about different forms of knowledge and expertise that inform, produce, and modify the dispositif, such as medicine, pedagogy, psychology, or social work. The knowledge and expertise help define the objects of the dispositifs, codify suitable ways of handling the objects, and define the proper institutional location of knowledge and expertise.[16]

The second level directs our attention to the *grid of perception* of the dispositif, and seeks to understand the constitution of objects of knowl-

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on networks or heterogeneous collectifs. In this article I wish to avoid these different translations, and therefore use the original French concept. See Gilles Deleuze, "What is a dispositif?," in *Michel Foucault: philosopher* (London: Harvester Wheatsheaf, 1992), Gomart and Hennion, "A sociology of attachment," Paul Rabinow, *Anthropos today: reflections on modern equipment* (Princeton: Princeton UP, 2003), Mitchell Dean, *Governmentality: power and rule in modern society* (London: Sage, 1999).

10. Michel Foucault, *Power/knowledge: selected interviews and other writings 1972-1977* (New York: Pantheon, 1980), 194.

11. Dean, *Governmentality*, 21, Rabinow, *Anthropos today*, 50.

12. Rabinow, *Anthropos today*, 53.

13. Law, "After ANT."

14. Dean, *Governmentality*, 18.

15. Deleuze, "What is a dispositif?," Dean, *Governmentality*.

16. Dean, *Governmentality*, 22, 31.

edge through techniques of perception and observation. An analysis of the grid of perception makes possible an understanding of how the techniques of observation constitute the objects of thought. In education this often entails different ways of measuring and controlling learning.

The third level directs our attention to the possible *subject positions* that are constructed in the dispositif: the collective or individual subjectivities that are produced in relation to the grid of perception, forms of knowledge, and relations of power and force.[17] Thus, the dispositif defines suitable ways of living, desirable characteristics, and modes of governing oneself. In education this can entail identities of citizenship, ideals of human capital, as well as positions of intelligence or class.

The fourth level pursues the aspects of *power*, or the actions, techniques or technologies that impose limits and create possibilities for action. This fourth level is crucial, as the lines of power or force that crisscross the dispositif link the grid of perception, forms of knowing, and the subject positions. The analysis of the fourth level of the dispositif is operationalized through the use of Actor-Network Theory's concept of *translation*.[18] Translation emphasizes the role of technology for our thought, perception and practice, and allows the article to move closer to the specific lines of force that the non-human elements produce between the grid of perception, forms of knowing, and subject positions. The concepts that will be used for this purpose are *inscription*, *delegation*, *prescription*, and *folding of time and space*. Inscription is used to describe the translation from ephemeral knowledge to a more durable form; delegation to describe the process of transferring a role to a non-human actor; prescription for analyzing where material things make possible at the same time as they constrain action; folding of time and space is used to describe the process where non-human elements make knowledge and action work over distance in time and space.[19]

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17. Deleuze, "What is a dispositif?," Dean, *Governmentality*.

18. Bruno Latour, "Where are the missing masses? The sociology of a few mundane artifacts," in *Shaping technology building society: studies in sociotechnical change*, ed. Wiebe E. Bijker and John Law (Cambridge, MA: MIT Press, 1992), 229.

19. Inscription, delegation, and prescription, see Madeleine Akrich and Bruno Latour, "A summary of a convenient vocabulary for the semiotics of human and nonhuman assemblies," in *Shaping technology building society: studies in sociotechnical change*, ed. Wiebe E. Bijker and John Law (Cambridge, MA: MIT Press, 1992). Folding of time and space, see Bruno Latour, "A collective of humans and nonhumans: following daedalus's labyrinth," in *Pandora's hope: essays on the reality of science studies* (Cambridge, MA: Harvard UP, 1999). Cf. also Latour, *Science in action*, Chapter 6.

Material

To investigate the co-production of technology and pedagogy of distance education this article uses the proceedings of two conferences on correspondence education and a pre-conference proceeding from the same series of conferences. The analyzed conference proceedings are part of a series of international conferences, the International Conference for Correspondence Education (ICCE) that started in Victoria, Canada in 1938 and still run today.

The participants and members of the ICCE included organizations and individuals who were interested in improving correspondence education, and the primary objective of the ICCE conferences was to improve correspondence education through facilitating exchanges between correspondence educators from different countries.[20] The first six conferences were extremely dominated by Anglo-Saxons, with 91-97% of the delegates coming from the US or Canada, except for the third conference, held in Christchurch, New Zealand, where 89% of the delegates came from Australia and New Zealand.[21]

The ICCE conferences were proposed in 1936 by J. W. Gibson – the director of high school correspondence instruction for British Columbia, Canada – at the US National Conference on Supervised Correspondence Study (CSCS) at Columbia University in New York. The idea was supported by the chair of the CSCS conference, Rex Haight from Montana. Haight served as the president of the first ICCE conference and Gibson as the chairman of the program committee with assistance from Earl T. Platt, the director of supervised correspondence study at the extension division of the University of Nebraska.[22]

The conference proceedings are comprised of complete transcribed addresses, as well as transcribed discussion sessions on varying topics relating to correspondence education. These transcribed discussions have been particularly valuable for understanding distance education practice as the discussions were organized topically for the exchange of ideas on educational practice, and provided a window both into how educators organized their correspondence schools and how they understood this organization.

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20. Ellen L Bunker, "An historical analysis of a distance education forum: The International Council for Distance Education world conference proceedings, 1938 to 1995" (Ph.D., Pennsylvania State Univ., 1998), 36-39, 41.
21. Ibid., 377.
22. Ibid., 33.

In this article I draw on an analysis of the conference proceedings from the first and the third conference, which were held in 1938 in Victoria, B.C., Canada and 1950 in Christchurch, New Zealand, as well as the pre-conference bulletin for the second conference that was held in Lincoln, Nebraska in 1948.[23] The three studied conferences are important for understanding a period when correspondence education had its largest spread, and gives a clear picture of the ideas that were formative of distance education at the time.

In addition to the conference proceedings, a large quantity of correspondence material, brochures, and pamphlets from the United States, Canada, New Zeeland, and Australia, available in the archive of the 1957 Swedish National Committee on Correspondence Education, have been scrutinized.[24] This archive has been valuable as it retains a large collection (19 volumes) of correspondence course materials that were collected through contacts established at the ICCE conference. The analysis of the correspondence course material, brochures, and pamphlets has been used to validate the interpretation of the discourse on educational practice at the conferences, thus serving as a means of data triangulation.

What can be found in the above outlined materials are traces of practices from many different locations under many different circumstances, and consequently every analysis of the conferences will be a condensation of the complex arguments that take place there. Regardless of the multifariousness, these dispositifs are orderings of both language and action that speak of a common way of seeing, thinking, and acting.

Progressive individualism, individual differences & industrialization

In order to understand educational thought surrounding correspondence education – the first level of the dispositif – we must be aware of educational thinking of the first half of the 20th century. At this time educational thought was related to political programs that aimed at refining and developing the population; the formation of scientific methods of managing the population like statistics, the observation of children,

23. I have been unable to attain a copy of the conference proceedings for the second conference, but I have been able to obtain a copy of the pre-conference bulletin.
24. Brevskoleutredningen, "YK 1808," (Stockholm: Swedish National Archives), vol. 14-33.

mental measurement and child development psychology; but also to progressive ideas that saw education as a possibility for social change.[25]

Progressive thought had a great influence on society at the time, and 'tried to reform American democracy to meet the new challenges of industrialism, urbanism, and statism.'[26] One of the central arguments of the progressive educationists was that education should be organized on the interests of the children and their experiences, rather than on subject matters, or disciplinary blocks.[27]

The most important portal figure for the progressive movement, John Dewey, strove to emancipate education so that the abilities and talents of each child could develop in full and every individual's talents and resources could contribute to the development of a successful society and the common good.[28] In the progressive discourse it was argued that the individual's success would be determined by his/her talents and accomplishments rather than social status, thus connecting progressive thought with meritocratic ideals.[29]

As much as the progressives were focused on reforming education in a democratic direction, there was a great deal of respect for science, expertise and statistics within the progressive movement. Science and numbers were used as a way to organize, define, and master social change and provided direction and method for social reform programs.[30] In education, scientific thinking through the psychology of individual differences introduced statistical methods and measurements that sorted children into classes based on measurements of subnormal and supernormal intelligence, and were closely connected to bureaucratic needs of classifying the student. The most important of these technologies being the IQ

25. Walkerdine, "Developmental psychology and the child-centered pedagogy," Paula S. Fass, "The IQ: a cultural and historical framework," *American journal of education* 88, no. 4 (1980).
26. Fass, "The IQ," 434.
27. Ibid.: 436.
28. Ibid.: 435.
29. See for example Patricia M. Broadfoot, *Education assessment and society: a sociological analysis* (Buckingham: Open UP, 1996), 32-37, Adrian Wooldridge, *Measuring the mind: education and psychology in England, c. 1860-1990* (Cambridge, MA: Cambridge Univ. Press, 1994).
30. Fass, "The IQ," 437. See also Theodore M. Porter, *Trust in numbers: the pursuit of objectivity in science and public life* (Princeton: Princeton UP, 1995), for a discussion of the expanding use of statistics in society.

test, which combined the normal distribution curve with developmental psychology.[31]

The dilemma for this progressive philosophy was to 'translate an expansive liberal philosophy into a method of mass instruction which required organization, direction, and systematization.'[32] Several educational technopedagogies evolved in conjunction with the progressive call for the democratization of education, the widening of educational access, and the adaption of education to the individual. One answer to this problematisation was correspondence education which was to provide a semi-automated and individually tailored system for instruction that reached across barriers of time and space to include rural children, working adults, members of the armed forces, or the unemployed.

Apart from progressive individualistic thought, a discourse of automating education also exerted a strong influence on correspondence education, which was materially articulated in the division of labor between different specialized teachers, archival clerks, mailing clerks, and secretaries that many large correspondence schools had instituted. A part of the industrialization of correspondence education was the application of mass produced model answers and form letters, which were to automate the teacher's composition of individual corrections. Occasionally the belief in automation went so far that it was argued that encouragement and guidance could be transferred from teachers to the correspondence course.[33] In many cases, especially in the commercial schools, when the Fordistic ideal was taken to the logical conclusion, teachers were employed on a piece work basis and the correspondence school largely became a center of administration, coordination, and logistics that funneled correspondence letters between teachers and students, coordinated the work, recorded the grading of pupils, and marketed the school products.[34]

As I show below the co-production of progressive individualism, the psychology of individual differences, and automation of education with the devices of correspondence education developed into specific techniques and technologies that tried to bridge the inherent tensions in a mass-individualized correspondence education.

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31. Wooldridge, *Measuring the mind*, Nikolas Rose, *Governing the soul: the shaping of the private self* (London: Routledge, 1989), 137-142, Leon Kamin, *The science and politics of IQ* (Potomac, MD: Lawrence Earlbaum, 1974), Rikard Eriksson, *Psykoteknik: kulturell fabricering av personlig identitet* (Stockholm: Carlssons, 1999).

32. Fass, "The IQ," 435.

33. "Report of the first International Conference on Correspondence Education," (Victoria, British Columbia, Canada, August 22-24 1938), 191-192, 175.

34. Noble, *Digital diploma mills*, Chapter 1.

The organization of correspondence education

During the studied period, correspondence education was most commonly organized through a systematic flow of educational materials between the student and one or several teachers. Books, comments, personal letters, and assignments flowed back and forth between the correspondence school and the student's home.[35] In the majority of cases a study unit was concluded with the submission of a test, or 'required response' that was corrected and returned with a new study unit. Thus, new knowledge was imparted using books and/or technically reproduced study units, while the teacher taught through the corrections on these required responses making correspondence education resemble an assembly line.[36] Correspondence education also entailed a higher dependence on mass produced course materials, like the pre-printed model answer or the study unit, which tried to automate teaching through delegating the teaching actions and knowledge to technology.[37]

This was an attempt to standardize and streamline correspondence education, and was argued to be valuable for several reasons. The model answers were argued to relieve the teachers from the drudgery of corrections, and enabled efficiency and mass teaching on an individual level: they were likened to the blackboard that enabled the teacher to communicate with many students, but were not uncontroversial as they occasionally were seen as stereotyped and too much like a cross-word puzzle.[38]

The written test as a technology of perception, thought, and action

Two of the most important technologies in correspondence education were the test and its attached required response. In correspondence education the students were evaluated through the constant required responses on a variety of tests: essays, intelligence tests, study habit questionnaires,

35. The organization of correspondence work was generally similar in different schools, but with some variations. See the various examples of how correspondence work was organized in "ICCE 1," "Pre-conference bulletin: International Conference on Correspondence Education," (Lincoln, Nebraska, USA, August 22-24 1948), "Proceedings on the third International Conference of Correspondence Educators," (Christchurch, New Zealand, April 18-27 1950)..

36. See the Brevskoleutredningen, "YK 1808," vol. 14-32, for a large selection of correspondence courses that use required responses as a means for communicating with the students.

37. Cf. Noble, *Digital diploma mills*.

38. "ICCE 1," 60, 68, 69, 111, 112, 153, 156, 157, 169.

achievement tests, 'standardized tests of attainment,' examinations, 'Lets get acquainted' tests taken at enrollment, and reading questionnaires.[39] A typical correspondence student was tested at enrollment for his/her specific level, in every exchange with the teacher, as well as in examinations at various intervals throughout the course. The tests served several essential functions in correspondence education: they were used for promoting students, as a method of teaching, a means of measuring learning, a preparation for outside examinations, and as an evaluation of course efficiency and school results.[40]

The constant testing of students' abilities was believed to produce a highly sensitive diagnostic instrument that would make it possible to correct and guide the student. It was argued that failures and successes needed to be collected, analyzed and diagnosed to create the most favorable learning situation for the student. In the summary of the discussion session on *The preparation of correspondence courses* in the first ICCE conference, which was presented by Fred T. Wilhelms, Director of Secondary Course Construction, Extension Division, University of Nebraska it was stated that:

> Only such materials should be submitted for evaluation [...] which will enable the correspondence instructor to diagnose the causes of any failures and prescribe *corrective measures*. [...] Great care and ingenuity should be exercised to make the *total of the pupil responses* on any unit into a comprehensive and *highly sensitive diagnostic instrument* which will give the correspondence instructor a real basis for teaching.[41]

As assessment was delegated to the test, the test became the basis for pedagogical diagnosis which in turn led to corrective action on the student.

I argue that the test was an important node in the co-production of pedagogy and technology. The test was closely connected to progressive thoughts in that each educational exchange between student and teacher was individual, which was stressed as one of the main advantages of correspondence education.[42] Furthermore, the test was closely related to thoughts on industrialization through the changes it brought about in the teacher's role: from a role that included verbal expositions, drawings on the blackboard, collective questioning sessions, etc, to a more correc-

39. Ibid., 155, 175, 177-178, 209, "ICCE 3," 13.
40. "ICCE 1," 131, 132, 150, 151, 152, 183, 199.
41. Ibid., 189. My emphasis.
42. See *Learning in nowhere.*

tive and automated role which included the use of model answers and pre-printed study material. Thus, the test was a centrally located technology that stood in the intersections between the levels of thought and action. It co-produced progressive individualism, individual differences, and automation with pedagogic technologies and techniques, and was crucial for the mass-individualization of correspondence education.

I also maintain that the test translated students' results into the object learning, becoming a constitutive part of the second level of the dispositif, the grid of perception, which made the students' learning observable and cognizable. This had very specific consequences for correspondence education when it was complemented with other technopedagogical measures. Importantly the object learning needed to be translated into lines of power, which would allow the test scores and grades to form the basis for a functional, efficient, and mass-individualized educational situation.[43] To accomplish the translation of the object learning into pedagogic and administrative power, to translate from the level of perception to the level of power, correspondence educators formalized and materialized the knowledges wrought from the tests. Thus, to successfully sustain a mass-individualized mode of organizing correspondence education over a period of time it was necessary to maintain detailed records of the students' results as they progressed through their correspondence courses.[44] This was accomplished through the inscription of the knowledges about students into material records.

Record keeping: extending knowledge over time and space

The extensive use of tests entailed the utilization of a multitude of *inscriptions* of the students' abilities and performance: in New Zealand 'student passports' were utilized to accumulate records of the 'progress and abilities' of each student, in other countries so called personality cards, 'accumulative records' or indexed student cards were employed.[45] It was thought that the educational situation could be adapted to a 'real' knowledge of the student's abilities and performance through use of the students' accumulated scores on tests. In the session *Post primary education by correspondence* of the third ICCE conference, J. Nicol, the Principal of the Technical Correspondence School in New Zealand argued that:

43. C.f. immutable mobiles and centers of calculation in Latour, *Science in action*.
44. "ICCE 1," 188.
45. Ibid., 194, 197, 198, "ICCE 2," 44.

> The only apparatus that the teacher needs, apart from his pen, pencils and paper, is, for each pupil, a convenient and sufficiently roomy form of record sheet or record card where he can jot down the pupil's personal particulars, record his incoming and outgoing scripts, enter a summary of the comments made on each script and the marks awarded to it (if marks are given), and keep a note of any incidental correspondence that he has with the pupil and of changes in the latter's circumstances. The fuller his knowledge of the pupil, the more effective his teaching is likely to be.[46]

The records inscribed the object learning into more durable forms like comments, marks, notes, and correspondence. The record keeping was a device that translated the knowledges generated by constant testing into lines of power: a device for linking pedagogical and administrative action with knowledge about the student. In distance education the records had a more important role to play than in regular education in that they made possible action at a distance, and thus the existence of organized distance education.[47]

One form that the records took was the progress diagrams that sometimes were utilized to organize the work of the students. These could take the form of a rough schedule for the handing in of assignments, instructions outlining what a normal pace of study was, a detailed schedule mimicking the school day of a regular school, or a simple progress check-list.[48] For example, in Alberta, the cards used for supervised correspondence study had personal characteristics on one side, with name, address, school attended, grade XI examination results, classroom subjects taken, credits taken, and room for notes. On the other side there

46. "ICCE 3," 95.

47. To to know the students performance, abilities, and characteristics through examinations and records did not differ considerably from regular school practices where records played an important role in the collection of data on student's progress as well as the communication of the student's strengths and weaknesses to parties outside of school. Patricia Broadfoot, "Profiles and records of achievement: a review of issues and practice," in *Profiles and records of achievement: a review of issues and practice*, ed. Patricia Broadfoot (London: Holt, Rinehart and Winston, 1986), 3.

48. Merle Simpson, "A course in plane geometry (Mathematics IIIX): manual for the supervisor including form a tests," (University Extension Divsion, University of Nebraska, 1955, YK1808, Vol. 27), "Course B, form 3, girls: English, Social studies, Core mathematics, General science, Health education," (Wellington, New Zeeland: Correspondence School, YK1808, Vol. 14). See the also large number of Bulletins from different US universities in Brevskoleutredningen, "YK 1808," vol. 29.

was a grid with subjects on the vertical axis, and completed lessons on the horizontal. In New Zealand a similar device was utilized where a schedule of a school week was sent out with a grid for completed assignments on the backside.[49] These different recording devices translated various test scores into forms that were essential for the functioning of correspondence education, and which made it possible to track students' learning, development, and progress over time and space. The records functioned as a translating device in the dispositif which made it possible to effect a folding of time and space through making the object learning durable over a distance and at different times.[50]

The durability of the records were used primarily for tracking students progress so that they could be reminded, enticed, and motivated into handing in work. This motivational action was undertaken through withholding work from the students, classifying and grading students' work with color coded slips to discipline them, sending reminders to get students to submit their work, warning students that they were about to be marked as inactive, or trying to encourage them through distributing birthday cards to them.[51] For example J. S. Noffsinger of the National Home Study Council, an organization of for-profit correspondence schools, told the session on *The preparation of correspondence courses* at the first conference that his member schools regularly sent pre-printed form letters as well as birthday cards to stimulate the student regardless of the flow of lessons.[52] Thus, the folding of time and space, that the durable records facilitated, made possible an automation of education through mass-produced motivational letters and model answers. Also, the records made it possible to act at a distance on the individual student through automated means.

Additionally the records and their durability over time and space made possible a practice peculiar to correspondence education: the division of labor between different teachers working on a piece work basis. This job was often taken on by teachers or university staff needing to supplement a meager salary, and who worked with corrections in their spare time. This was often low paid and low status work which was contracted out to temporary employees without job security. This system was problematic for correspondence education, which was sometimes criticized for

49. See YK1808.
50. Cf. immutable mobiles in Latour, *Science in action*.
51. "ICCE 1," 172, 197, 203-204.
52. Ibid., 171.

making promises of individual tutoring that could not be fulfilled in an educational system built on division of labor.[53]

The use of records brought out the essential tension between progressive individualism and automation which was inherent in correspondence education: the use of records, and the records themselves materialized the tension between action on the individual student and a standardization and industrialization of the educational process, and embodied the tension between industrialization and individualization.

But, the records were also important in another way: through the translation of learning into durable form they made it possible to hold one student record next to the other, effecting an efficient classifying apparatus.

Classification & guidance: translating knowledge into placement

For some delegates to the conferences, the belief in the importance of mental levels was so strong that it was argued that education that progressed from the wrong stage could harm the educational outcome. In the third ICCE conference E. D. Pridgeon, Headmaster of Melbourne Correspondence School in Australia argued that:

> Tests are used very carefully to determine the classification of a new pupil, and every effort is made to find the child's standard of attainment. It is common to find that this is overrated by the child and his parents. Unless the correspondence tuition proceeds from a stage that is quite definite in the child's mind, harm – not good – will probably be the result.[54]

Thus, the object learning was translated back into the domain of thought, and knowledge, but also into the domain of a subject position, the third level of the dispositif. These groupings and classifications of students constituted a very specific form of understanding the students' minds and learning abilities.

A result of this formation of testing, recording, and classifying was different practices of guidance. The point of guidance was to find the correct educational, and thus social, placement of the student. It was argued that the individual student's needs, interests, abilities, talents, native endowments, intentions for the future or human personality should be the basis

53. Cf. Noble, *Digital diploma mills*, Chapter 1.
54. "ICCE 3," 46-47.

for teaching and guidance.[55] Through the practices of guidance it would be ensured that the student would achieve the optimal educational and vocational placement.

In the first ICCE conference, Sydney C. Mitchell, the Superintendent of Schools, Benton Harbour Michigan, and also the originator of the *Benton Harbour plan*,[56] argued that the guidance would lead to correct placement in education and work: 'boys who did not fit into the established educational groove' were to be given specialized training that fit their interests and abilities better, and consequently find 'entrance to their chosen fields more readily.'[57] The beliefs about intelligence and academic prowess were frequently associated with thoughts of an untapped talent reserve that could be developed using education.[58] This was vividly expressed when metaphors comparing intelligence and academic ability to natural resources like timber and gold were used: talented students were described as nuggets or college timber, and laggards as gold dust or dead timber.[59] The technologies of testing, recording and classification thus created specific subject positions for the student. The dispositif of correspondence education had made possible the translation of a multitude of actions by and on the students into specific subject positions that affected their educational trajectories, and hence their possibilities for working and living.

The practices of guidance in correspondence education were primarily data driven, which connected them to a progressive trust in numbers, and was dependent on the data that had been collected through required responses, tests, and examinations rather than on personal knowledge of the student's characteristics. The collected and recorded data built a map of student characteristics that would be the basis for guiding the student into the most fitting educational channel. In the summary of the discussion session *The work of the correspondence instructor – teaching evaluating and recording of results* in the first ICCE conference which was chaired by J. H. Straka, Supervisor of Correspondence Instructional Staff, Extension Division, University of Nebraska and W. G. Carpenter, Director of Technical Education for the Province of Alberta and Principal of the Institute of Technology and Art, Calgary, Alberta it was stated that:

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55. "ICCE 1," 94, 95, 108, 175, 194, 197.

56. The Benton Harbour Plan was a instructional system where correspondence education techniques were used in regular high schools, so called supervised correspondence study, which gained widespread use in the US for a period. See Michael G. Moore, "Editorial: the Benton Harbour plan," *The american journal of distance education* 16, no. 4 (2002): 201.

57. "ICCE 1," 101.

58. Ibid., 20.

59. Ibid., 33, 36, 104.

> A student who is registered for several subjects over a period of time becomes the source of much valuable information to all teachers concerned with his work. It is through personal letters, knowledge of interests, personal characteristics, progress in various subjects, environment, etc., that the educator is furnished with the data necessary to guide the pupil into the correct channels [...] Guidance cannot be possible if data are not collected and records of them kept within easy reach of the teacher.[60]

Through the guidance of the students into different ability streams the tested, recorded, and classified mental level of the student was articulated in the gentle steering of the student into the course optimally fitted for his/her mental developmental position.

The classification of students' minds was closely related to the type of thinking that was prevalent in the psychology of individual differences and progressive individualism, and had a decisive impact on correspondence education, which made it desirable to adapt education to the student and emphasized an education adapted to individual interests and needs: an individualized correspondence education.

Differentiating: making a course for every student

The psychology of individual differences and progressive individualism were affirmed continually in correspondence education. In the summary of the session on *The preparation of correspondence courses* in the first conference Fred T. Wilhelms, Director of Secondary Course Construction, Extension Division, University of Nebraska argued that 'every lesson should be adapted to meet precisely the interests, talents, and needs of the individual pupil,'[61] and in the third conference M. H. Kellerman, Headmaster, Blackfriars School, New South Wales, Australia contended that 'supervision and correction must be adjusted to the needs of the pupil' and his/her 'intellectual, emotional, social, and moral differences' as well as his/her IQ.[62] Thought on progressive individualism was so entrenched in correspondence education that correspondence courses from the University of Nebraska in the 1950's had the subtitle 'A series of instructional materials developed to meet individual interests and needs.'[63] These arguments mirrored closely the progressive individualistic thoughts of the

60. Ibid., 200.
61. Ibid., 191. See also "ICCE 2," 75.
62. "ICCE 3," 39.
63. Brevskoleutredningen, "YK 1808," vol. 27.

time, and constituted a milieu of thought for the differentiating practices that were adopted in correspondence education.

Differentiating the students in accordance with their abilities was particularly compatible with the individualistic mode of examining, recording, classifying and communicating with the students, especially through the use of the letter as communicative device. But there were problems with individualizing correspondence education as well. One of the problems lay in the thinking on automation, and the mass produced and standardized course material that made it hard to give students an individualized curriculum adapted to their individual characteristics. Another problem, also related to standardized mass production, was the model answer that provided the student with the desirable and correct solution, but which was antithetical to an individualized instruction.

The clash between automation and progressive individualism posed a striking problem for correspondence educators. On the one hand mass production of course materials inscribed automation and efficiency in correspondence education with specific prescriptions for the educational practice. On the other hand individually differentiated education was demanded by educational thought, and highly compatible with the individual technopedagogic devices. The solution for correspondence educators lay in the adaption of the course materials to the individual. Consequently, correspondence educators focused their attention on how to adapt the mass produced course units to the students' individual talents and needs. An example of the progressive scientific individualism was provided in the summary of the session on *The preparation of correspondence courses*:

> If much is to be accomplished in the adaptation of the course to an individual it will be necessary to have a considerable body of information about the individual. It is the feeling of the majority of the group that objective measures of pupils' intelligence, reading ability, etc. ought to be used much more extensively than they have been used.[64]

The methods for achieving individual adaption of the courses entailed several different methods for revising the course content and flexibility in providing for the students' abilities. Loose leaf systems that allowed for constructing each course on demand, mimeographing that allowed for frequent revision, or adaption of projects and required responses to the

64. "ICCE 1," 191.

individual were argued to be methods that could adapt the course to the students' needs. [65]

Another way that correspondence education was to be adapted to mass-individualism was through the choice of courses. The courses that were developed in correspondence education had a vast spread, and ranged from courses in horticulture and home economics, to textile fabrication, refrigeration and the history of European civilization.[66] Correspondence schools developed a veritable flood of courses in subjects aimed at professionals, workers, school children, university students, military men, housewives, and seamen.

Conclusion

This article has shown how the thinking, acting, seeing, and forming subjects in correspondence education resulted in a particular dispositif of mass-individualization. In this dispositif, the right to education and freedom of choice met the harsh realities of state finance, teacher shortage, lack of time, long distances, sparse populations, and last, but perhaps most important, technology. The article has demonstrated how the co-production of progressive individualization, an ideal of scientificity, and automation as well as specific technical devices resulted in a specific mode of organizing education. In a manner of speaking one can say that correspondence education was a particular solution to the problematisation of progressive educational modernity – equality of educational access, democracy, scientificity, and individualism – and that this solution embodied the inherent tensions that existed in the welfare state's educational system.

In correspondence education, the co-production of pedagogy and technology created an educational dispositif with specific problems and possibilities. On the level of thought, this was a struggle between progressive individualism, scientific thinking, and automation. On the level of power, this was a rupture between distance, time, motivation, loneliness, individualism, mass-production, and technology. On the level of perception, it was a matter of technical translation, where inscriptions constituted the student's learning as an individualized object, and subsequently a coordination and action at a distance. On the level of subject positions the dispositif produced a number of possible alternatives, ranging from nuggets, to gold-dust, to dead timber. Accordingly, correspondence education was a specific configuration of technologies, humans,

65. "ICCE 3," 48, 68, "ICCE 1," 173, 176, 178.
66. Brevskoleutredningen, "YK 1808," vol. 14-32.

actions, ideas, ideals, identities, objects, and seeings – a dispositif – which was constructed to bring about progressive individualism on an industrial scale.

The mass-individualized correspondence education dispositif was a technical fix for the tensions of educational modernity, and was very suggestive as such. One testimony to its suggestive power was its spread outside the traditional domains of correspondence education. For example, the particular practices of mass-production, testing, and individualization were also implemented in regular schools. In the US this was called 'supervised correspondence study' and it soon gained widespread use in high schools all over the US. This practice was so evocative of a solution to educational modernity that it even spread to the educational system in Sweden.[67] In supervised correspondence schools, just like in correspondence education, each course was produced to fit each student's needs and aptitudes, and was followed in the student's own pace and according to his/her own interests. Supervised correspondence study promised to meet the 'individual student needs which inevitably [arose] in many high schools' on a massive scale.

I argue that mass-individualism in correspondence education was a historical premonition of a dispositif which is still in the making. There are several facts that point in this direction: For example, the European Union's research policy calls for proposals to develop educational technologies that are hoped to result in mass-individualization on a massive scale.[68] This fact is illustrative of all the conferences, papers, and development money that are poured into making a reality of mass-individualization in education.[69] The belief in mass-individualization is also reflected

67. This was pioneered in Benton Harbour in 1923 through the work of Sydney C. Mitchell. "ICCE 1," 99-101. In Sweden this method of teaching was used by both the largest correspondence schools, NKI-skolan and Hermods. See Brevskoleutredningen, "Korrespondensundervisningen inom skolväsendet (SOU 1962:16)," (Stockholm: Ecklesiastikdepartementet, 1962), 15, 19, 22, 34-36.

68. European Commission, "ICT - information and communication technologies: a theme for research and development under the specific programme 'Cooperation' implementing the Seventh Framework Programme (2007-2013) of the European Community for research, technological development and demonstration activities," (2007), 36.

69. See David Sewart, "SCOP meeting in Cologne," http://www.icde.org/oslo/icde.nsf/id/132DC4A2C7DB09E5C125704B00330E13?OpenDocument, Fred Mulder, "Mass-individualization of higher education facilitated by the use of ICT," http://www.delfi2005.de/sites/programm/keynotes.htm, IT Strategic Advisory Council Miami University, "IT Strategic Advisory Council minutes," http://www.units.muohio.edu/mcs/advisory/ITSAC/Agendas&Minutes/2006-2007/ITSAC%20Minutes%20May%2007.pdf, European Association of Distance Teaching Universities, "Conference

in the growing e-learning market, which has seen business driven educational ventures start up at several universities.[70] Furthermore, correspondence education is an emblematic forerunner for the pedagogy of testing, which is reflected in today's school with its attached focus on national and standardized testing – 'the move to constant feedback which is killing education today' – and which, as I have shown above, is a prerequisite for distance education.[71] I argue that the tensions that existed in correspondence education are a forewarning of the tensions that will exist in the future educational systems that focus on technology as a solution to educational inequality, democracy, and pedagogy.

What I have shown to be the basic tension in correspondence education can be seen as an epitome of the modern educational problematisation, but also as a study of the genesis of a specific type of educational dispositif. What we must always be aware of is how the technopedagogical dispositif of mass-individualization translates tensions, ruptures, and fissures intrinsic to the modern educational project into a specific reality which we will hand down to coming generations.

2004, mass-individualisation of higher education for the knowledge-based society," http://www.eadtu.nl/conference-2004/.

70. David L. Kirp, *Shakespeare, Einstein, and the bottom line: the marketing of higher education* (Cambridge, MA: Harvard UP, 2003).

71. I want to thank the anonymous reviewer for *History and technology* for this comment.

5

Learning in nowhere[1]

> [In correspondence education] there is no class work in the ordinary sense. Each pupil's course is his own. The subjects that comprise it can be chosen to suit the individual pupil alone. The emphasis can be laid where it is most needed. The pupil proceeds at his own pace, independently of other pupils of the same grade. Pupils of higher than average ability can and do make faster than average progress; those of less than average talent may make slower than average progress [...] The use of individual assignments develops a sense of responsibility, initiative and self reliance.[2]

A. G. Butchers, quoted above, was the headmaster of the New Zealand Correspondence School in Wellington in the mid twentieth century. He was a most vocal proponent of individualistic learning in correspondence education. His words illustrate several fundamental facets of the peda-

1. Francis Lee, "Learning in nowhere: individualism in correspondence education in 1938 and 1950," *History of education review* 38, no. 1 (2009).
2. "Report of the first International Conference on Correspondence Education," (Victoria, British Columbia, Canada, August 22-24 1938), 60. This statement is repeated in the foreword to the third conference, which Butchers was the chairman of. See the "Proceedings on the third International Conference of Correspondence Educators," (Christchurch, New Zealand, April 18-27 1950), xxviii-xxix.

gogic individualism that was prevalent in correspondence education at the time. Correspondence education was argued to be tailor-made for the individual who studied at an individualised pace. The student was to become an independent learner who developed 'a sense of responsibility, initiative and self reliance' through the use of individual assignments.

Individualism in correspondence education was, like other individualistic understandings of pedagogy and the human, connected to specific practices of producing knowledge and ordering society.[3] Individualism in education, including the correspondence variant, was intimately intertwined with educational progressivism, the psychology of individual differences, and developmental psychology.[4]

This article seeks to investigate the individualistic ideas, practices, and student identities that developed in correspondence education in the mid twentieth century. In doing so, a number of questions about the individualistic pedagogy and identities in correspondence education are posed. How was individualism to be achieved? What pedagogic practices were used? Who could students learn from? What was the desired identity of the students? How were the student's material circumstances understood? In attempting to answer these questions the article aims to increase understanding of the individual pedagogy and the construction of the 'independent learner' at work in correspondence education during its golden age.

Theoretical framework

The article draws on the post-Foucauldian materialist tradition of research, which has earlier been applied to a wide range of phenomena including laboratories, hospitals, or disability, as well as psychology and the child centred curriculum.[5] In doing so, it emphasises the interaction of

3. Mark Olssen, "Science and individualism in educational psychology: problems for practice and points of departure," *Educational psychology* 13, no. 2 (1993).

4. Ibid, Valerie Walkerdine, "Developmental psychology and the child-centered pedagogy: the insertion of Piaget into early education," in *Changing the subject: psychology, social regulation and subjectivity*, ed. Julian Henriques, et al. (London: Methuen, 1984), Kevin J. Brehony, "Montessori, individual work and individuality in the elementary school classroom," *History of education* 29, no. 2 (2000).

5. Developmental psychology: Nikolas Rose, "The gaze of the psychologist," in *Governing the soul: the shaping of the private self* (London: Routledge, 1989). Disability: Ingunn Moser, *Road traffic accidents: the ordering of subjects, bodies and disability* (Oslo: Oslo Univ., 2003), Vasilis Galis, *From shrieks to technical reports: technology, disability and political processes in building Athens metro* (Linköping: Linköping Univ., 2006). Hospital practices: Annemarie Mol, *The body multiple: ontology in medical practice* (Durham: Duke UP, 2002).

knowledge and materiality, thus paying special attention to the 'architecture of the school and the seating arrangements of the classroom to the curriculum materials and techniques of assessment.'[6]

This article approaches individualism in correspondence education from a *governmentality* perspective by analysing the *conduct of conduct* or *governing*, i.e. the shaping, guiding, correcting, and modifying of individuals by themselves and others.[7] In this article I accentuate the heterogeneous nature of governing by analysing it as both a practice and a mentality. A principal aspect of the conduct of conduct is the construction of identities and its role in governing humans. Consequently, a keystone of the article is the analysis of the individualistic subject position of 'the independent learner.'[8]

Furthermore, the *governmentality* perspective prescribes a concern for the technologies that are employed to modify behaviour and thought. Moreover, as correspondence education is geographically dispersed, the article emphasises the technologies that make it possible to *govern at a dis-*

Laboratory studies: John Law, *Organizing modernity* (Oxford: Blackwell, 1994). Child centred curriculum: Walkerdine, "Developmental psychology and the child-centered pedagogy."

6. Walkerdine, "Developmental psychology and the child-centered pedagogy," 155.

7. In analysing correspondence education this article follows Gilles Deleuze and Mitchell Dean in scrutinising four discrete but entwined levels of a practice. The first level analyses the *discursive* level, the level of thought or rationality that makes the practice intelligible; the expertise and knowledge that informs and modifies it – for instance pedagogy, psychology, or sociology. The second level, the grid of perception, attempts to understand the processes by which objects of knowledge are constituted through statistics, testing or examining. The third level directs the research effort toward the formation of subject positions, such as suitable way of living, acceptable conduct, or ideas of intelligence. The fourth level analyses the lines of power, the *techne* of the practice, for instance the disciplinary modes of organising, or the technologies of the self. Gilles Deleuze, "What is a dispositif?," in *Michel Foucault: philosopher* (London: Harvester Wheatsheaf, 1992), Mitchell Dean, *Governmentality: power and rule in modern society* (London: Sage, 1999). See also *Technopedagogies of mass-individualization*.

8. Michel Foucault, "Governmentality," and Colin Gordon, "Governmental rationality: an introduction," both in *The Foucault effect: studies in governmentality*, ed. Graham Burchell, Colin Gordon, and Peter Miller (Chicago: The Univ. of Chicago Press, 1991), Graham Burchell, "Liberal government and techniques of the self," and Ian Hunter, "Assembling the school," both in *Foucault and political reason: liberalism, neo-liberalism and rationalities of government*, ed. Andrew Barry, Thomas Osborne, and Nikolas Rose (London: UCL Press, 1996), Thomas S. Popkewitz and Marie Brennan, "Restructuring of social and political theory in education: Foucault and a social epistemology of school practices," in *Foucault's challenge: discourse, knowledge, and power in education*, ed. Thomas S. Popkewitz and Marie Brennan (New York: Teachers College Press, 1998), see also Dean, *Governmentality*.

tance.[9] Technology in this sense is treated as a social apparatus consisting of a heterogeneous array of things that shape practice and knowledge.[10] These technologies can be of two major types: *technologies of discipline* and *technologies of the self*. The former denotes the technologies that are employed to shape others' actions – the original examples being examination, surveillance, and normalisation.[11] The latter refers to moral technologies that are employed to problematise and shape one's own conduct – for example a self-produced workout or diet regime could be seen as a technology of self.[12] Thus the two types of technologies work in different ways, one shaping the conduct of others, and the other shaping the conduct of oneself.

In line with the above outlined perspective on correspondence education, the article investigates individualism as a result of a specific formation of educational practices and knowledges as well as to the construction of a subject position of 'independent learner.' For example, it analyses the design of courses in flexible modules; the presupposition that it was an individual student that would work with the correspondence material; the motivational tactics that were employed; as well as the calculating apparatuses of grading and differentiating.

Material and methodology

The proceedings from the first and third international conferences on correspondence education provide the source material for the analysis. These conferences, held in 1938 in Victoria, Canada, and in 1950 in Christchurch, New Zealand, were part of the International Conference for Correspondence Education (ICCE) series that continue till today. J.W. Gibson, director of high school correspondence instruction for British Columbia, Canada, proposed the conferences during a USA national meeting on Supervised Correspondence Study held at Columbia University in New York. The aim was to deepen international exchange and collaboration between distance educators.[13] The participants were mostly

9. Peter Miller and Nikolas Rose, "Governing economic life," *Economy and society* 19, no. 1 (1990): 9-10.
10. Cf. Deleuze, "What is a dispositif?"
11. Michel Foucault, *Discipline & punish: the birth of the prison*, 2 ed. (New York: Vintage Books, 1995).
12. ———, "Technologies of the self," in *Technologies of the self: a seminar with Michel Foucault*, ed. Luther H. Martin, Huck Gutman, and Patrick H. Hutton (London: Tavistock, 1988).
13. Cf. Ellen L Bunker, "Gaining perspective for the future of distance education from early leaders," *The american journal of distance education* 12, no. 2 (1998).

professionals involved in correspondence education or educational administrators with correspondence schools in their geographical areas. Five of the first six ICCE conferences were dominated by Canadian and USA delegates, who accounted for more than 90 percent of the participants, except in the third conference, held in Christchurch, New Zealand, where 87 percent of the delegates came from New Zealand or neighbouring Australia.

I have analysed the proceedings from the first and the third conference, as the proceedings from the second conference were unavailable to me at the time of analysis. The two studied conferences provide a fascinating window into correspondence education in its heyday, and give a clear picture of the ideas and practices that were shaping distance education at the time. The analysed proceedings comprise about 500 pages of transcribed addresses and discussions on varying topics relating to correspondence education. It is important to note that the proceedings consist not only of prepared addresses by the delegates but also transcribed discussion sessions on how to organise and carry out correspondence education. The discussion sessions taken together with the formal presentations provide a rich source for analysing how educators understood and wanted to organise their educational practices.

Successive sessions of coding, categorising, and analysing the conference proceedings were carried out in order to discern patterns in the practice and in the manner of speaking.[14] In the first pass through the proceedings, the open coding phase, I identified themes or terminology that could be grouped into more generalised categories. The open coding generated a number of analytical concepts, such as *guidance*, *differentiation*, *motivation*, etc. that were grouped into categories such as *education in a changing society*, *student handling*, etc.[15] The preliminary concepts and categories from the open coding phase were then analysed in a secondary or axial coding phase looking for patterns in the practices and organisation of distance education. Bringing the characteristics of the correspondence education process to the fore led to a focus on different types of educa-

14. In the article coding techniques developed by Strauss and Corbin have been utilised, but the article does not attempt to be a fully-fledged grounded theory approach. What has been in the foreground is the methodology for finding patterns in qualitative data. Anselm Strauss and Juliet Corbin, *Basics of qualitative research: grounded theory procedures and techniques* (London: Sage, 1990).

15. To guard against cherry picking each analytical category was supported by multiple subcategories with a number of utterances. The utterances chosen as an illustration in this article are not always typical of the utterances, but are chosen for their illustrative character in bringing out the general pattern of the analytical category or concept.

tional actions (like motivating, measuring, sorting, supervising, etc.). An important pattern that emerged during the coding was the individualistic ways of thinking about and organising correspondence education.

Individualism, expertise, and the progressive movement

Correspondence education in the early twentieth century came into being in societies in which the development of national educational systems was seen as necessary for dealing with a changing society and for the refinement of nation's population.[16] Education was seen as indispensable for dealing with a number of issues: migration from country to city, increasing need for labour with basic technical education, mass unemployment in the wake of the great depression as well as a route for meritocratic social climbing.[17] One can argue that education was an important part of the modern state that saw the preservation of national interest, or *raison d'état*, as its primary goal.[18]

Due to both a lack of teachers as well as a sparse population the development of national educational systems in countries like Australia, Canada, New Zeeland, Norway, Sweden, or the USA was problematic. In these countries correspondence education was developed as an attempt to remedy these difficulties. The first large organised correspondence schools were founded at the very end of the nineteenth century and in the first decades of the twentieth century.[19]

A momentous influence on education at this time was the progressive movement, which aimed to reform society in a democratic direction and to come to grips with industrialism, urbanism and statism.[20] In this movement it was argued that education should be organised on the child's own experiences rather than on subject matters or disciplinary blocks.[21] John Dewey, perhaps the most influential figure in the progressive movement, strove to organise education so that each individual child's talents and aptitudes were used for the betterment of society and the public good.[22]

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16. See for example Adrian Wooldridge, *Measuring the mind: education and psychology in England, c. 1860-1990* (Cambridge, MA: Cambridge Univ. Press, 1994), Hunter, "Assembling the school."
17. "Pre-conference bulletin: International Conference on Correspondence Education," (Lincoln, Nebraska, USA, August 22-24 1948).
18. Hunter, "Assembling the school."
19. "ICCE 2."
20. Paula S. Fass, "The IQ: a cultural and historical framework," *American journal of education* 88, no. 4 (1980): 434.
21. Ibid.: 436.
22. Ibid.: 435.

In the progressive vision, meritocracy played a significant part underscoring that the individual's talents and aptitudes rather than social standing would lead to success.[23] An important facet of the progressive movement was its reliance on expertise, numbers and statistics. These bureaucratic tools of knowledge were often used to direct and define social reforms as well as to master social change.[24]

Two aspects of expertise were pivotal in individualistic pedagogy: developmental psychology and the psychology of individual differences. The first, developmental psychology, divided children into different stages depending on their physical and mental development, and brought about a standardisation and normalisation of children's behaviour and growth.[25] The second, the psychology of individual differences, entailed a combination of normal distribution statistics and developmental psychology to produce the Binet test, which was the first IQ-test.[26]

Progressive individualism, developmental psychology, and the psychology of individual differences had, as I will show empirically below, a decisive impact on the organisation of correspondence education according to individualist and child-centred principles. This context provided correspondence education with a milieu of thought that influenced the development of a specific individualistic pedagogy. This milieu made the individuals' learning, development and classification the cornerstone of educational thought and practice.

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23. Patricia Broadfoot, "Profiles and records of achievement: a review of issues and practice," in *Profiles and records of achievement: a review of issues and practice*, ed. Patricia Broadfoot (London: Holt, Rinehart and Winston, 1986).

24. Fass, "The IQ," 437, Hunter, "Assembling the school," 154-155.

25. Rose, "The gaze of the psychologist," 142, Walkerdine, "Developmental psychology and the child-centered pedagogy."

26. The Binet test was the first administrative tool that was designed to connect academic performance to age and an idealised normal performance. The statistical visualisation of the Gaussian curve played a central role in the development of the psychology of individual differences and was related to human intelligence, cognitive abilities, and eugenics through Francis Galton's 1869 work *Hereditary genius*. Galton's work opened up for the field of measuring human intelligence: which was materialised in the IQ test that was developed by Alfred Binet in France and brought to popularity in the rest of the world through various networks of actors. See Leon Kamin, *The science and politics of IQ* (Potomac, MD: Lawrence Earlbaum, 1974), Rose, "The gaze of the psychologist," Wooldridge, *Measuring the mind*, Rikard Eriksson, *Psykoteknik: kulturell fabricering av personlig identitet* (Stockholm: Carlssons, 1999).

The independent learner

At the ICCE conferences delegates often argued that correspondence education shaped the pupil into a successful citizen through its ability to develop independence and autonomous thinking. Initiative, concentration, independent judgement, self-dependency, and responsibility were traits that defined a successful correspondence student. These traits were thought to be the hallmarks of a successful citizen and an important part of the legacy of a pupil's correspondence education are the defining characteristics of a subject position that I call the *independent learner*.

An example of how the independent learner was articulated came from G. M. Weir, the Minister of Education in British Columbia. He argued that, in comparison to regular schools, correspondence education developed 'initiative, independent habit of study and mental resourcefulness that carry the pupil forward.'[27] A similar sentiment was expressed by the Headmaster of Melbourne Correspondence School in Australia, E. D. Pridgeon, who maintained, by quoting the Editor of *The Hospital Magazine*, the character shaping virtues of correspondence education. He argued that it could turn 'seemingly hopeless little lives into self-dependent, self-respecting citizens.'[28] Also H. R. Thomson, the Head of Languages Department of Correspondence School in New Zealand, contended that correspondence courses developed 'qualities of initiative, of concentration, and of independent judgement far in advance of those for whom the way is made easier.'[29]

In correspondence education the independent learner was contrasted with the pupil that could not think for himself. It was maintained that individual instruction, individual pace, personal corrections, and individual assignments were to develop 'a sense of responsibility, initiative and self-reliance.'[30] This contrast was made especially visible by L. W. McCaskill, Associate Professor of Rural Education at Canterbury Agricultural College in New Zealand who quoted a prominent educator in Australia, J. McIlraith:

> Your very isolation is, in many respects, both a protection and an aid; it saves you from mingling too often with the crowd and

27. "ICCE 3," 51.
28. Ibid., 15
29. Ibid., 75.
30. Ibid., 23.

> developing that herd instinct which tends to make you an unimaginative slave to the ideas of others.[31]

Being an independent learner emphasised the student's ability to think autonomously, and it was argued that in the large classes in ordinary school too few pupils thought independently and that the rest were 'willing to adopt the ideas and solutions of the few. The correspondence child must intellectually stand on his own feet.'[32] In his speech at the first conference Butchers contrasted the correspondence student and the regular student with each other:

> [There is] not enough quiet in the ordinary school, not enough time for reflection and thought. Things are always moving. The correspondence school pupil can put down his pen at times and indulge in day-dreams, or get up and have a scamper outside with his dog, and resume his studies the better for the interlude. He is a human individual, not merely a unit of a flock, moving or stopping just as the drovers and dogs direct.[33]

The independent learner was the desired student and represented the idealised subject position of the correspondence student. The creation of the student of initiative, concentration, independent judgement, self-dependency, and responsibility was connected to a specific understanding of learning and of human beings. The emphasis on independence and initiative connected the ideal image of learning, which was best undertaken alone, to the ideal human being – independent, free, and individualistic.

This individual pedagogy was closely connected to the traditional liberal philosophy of the seventeenth century,[34] and I argue that the independent learner was articulated in line with the idea of a traditional liberal subject in which two basic premises coexisted 'What makes a man human, is freedom from dependence on the wills of others' and 'The individual is essentially the proprietor of his own person and capacities, for which he owes nothing to society.'[35] In the case of education the student

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31. Ibid., 15
32. "ICCE 1," 61-62.
33. Ibid.
34. Cf. James D. Marshall, *Michel Foucault: personal autonomy and education* (Dordrecht: Kluwer, 1996), Olssen, "Science and individualism in educational psychology," Mark Olssen, "Foucault, educational research and the issue of autonomy," *Educational philosophy and theory* 37, no. 3 (2005).
35. Crawford B. Macpherson, *The political theory of possessive individualism: Hobbes to Locke* (Oxford: Oxford UP, 1967), 263.

was seen as learning freely without 'becoming a slave to the ideas of others' – thus connecting a specific understanding of humanness to that of the subject position of the independent learner.

The subject position of independent learner was a crucial element of correspondence education. This subject position was closely tied to an idealisation of individual work and independence. The vision of the ideal human being and student was pivotal for the individualism of correspondence education and underpinned many of the pedagogical practices that were developed. Of course this subject position needed to be internalised by students in order to become effective.

Technologies of self-discipline and self-assessment

A key aspect of producing independent learners was the development of self-discipline and self-assessment skills. In correspondence education, students were encouraged to develop a motivation to discipline themselves a sense of their own performance through self-checking exercises. It was argued that students' character would be shaped using 'the fostering of pride in achievement, and the development of concentration and self-denial.'[36] It was stated that

> The children strive to excel, not for the sake of reward or for the satisfaction of beating their classmates, but for the sake of the work itself, and for the satisfaction derived from self-activity. Pride of personal achievement is the main incentive [for the student]. Self-discipline, rather than discipline from without, is an important aspect of character-training.[37]

Another example of the perceived advantages of self-discipline was expressed thus by M. S. Pitt, Senior Primary Assistant at the New Zealand Education Department's Correspondence School:

> An attempt is made to create learning situations whereby the pupil identifies himself fully with the task in hand. This involves the best of all disciplines, a self-imposed discipline, as well as the cultivation of initiative and self-reliance. The sturdy independence of the Correspondence School pupil in general is well known [...] assignments [...] are written to create and maintain

36. "ICCE 1," 28.
37. Ibid., 29.

> the interest of the child, to develop a self-imposed discipline and to cultivate initiative and self-reliance.[38]

The correspondence student was to be fostered through the use of individual assignments that developed self-discipline and it was argued that self-discipline was the best discipline. It was by placing responsibility completely on the student that they would become self-motivated and self-directed learners.[39] Another example from A. G. Butchers, the Headmaster of New Zealand Correspondence School in Wellington, showed how self-discipline was articulated:

> [O]ur attitude has been one of establishing the direct relationships between the correspondence teachers and the correspondence pupils, with the object of throwing the onus on the pupils entirely [...] We desire to have the student motivate his own work. We desire to do away with the direct supervision; we wish children to work alone.[40]

Motivation, supervision, and learning were described as individual activities. It was argued that individual work created its own socialising grid of self-evaluation and self-discipline. Self-evaluation was to be accomplished by creating self-checking exercises and by encouraging the students to set their own standards and evaluate themselves.[41] It was stated that 'The students are sometimes more critical about their own work than the teachers are.'[42] Another delegate expressed an idea that 'the initiative of the pupils is reflected in the manner in which they give helpful suggestions regarding the way their work could be improved.'[43] In a summary of one of the discussion sessions it was stated that 'Tests in such cases [of self evaluation] are of greater benefit to the student since he learns to gauge his own mastery.'[44]

The self-discipline and self-assessment practices in correspondence education built on a long tradition of technologies of the self in education, which were designed to develop self-reflective and self-assessing capacities in the students.[45] But the development of the self-assessing ca-

38. "ICCE 3," 18-19.
39. "ICCE 1," 201.
40. Ibid., 195.
41. Ibid., 170.
42. Ibid., 29.
43. Ibid., 200.
44. Ibid., 13.
45. Cf. Hunter, "Assembling the school."

pacities in the student also depended on disciplinary technologies like tests, examinations and reminders that were brought to bear on the student in order to help them problematise themselves and their morals and behaviour. This problematisation was to aid in the development of their self-reflective capacities and make their conduct available to intervention and governing both by the school and by themselves. Through correspondence education practice the student was to learn to problematise his/her own behaviour and become an independent learner. Thus, through a combination of technologies of self and technologies of discipline the correspondence school governed the students at a distance, shaping both their behaviour and morals through interpellating them to a subject position.

In order to organise a pedagogy that was in harmony with the independent learner and the practices of self-reflection and self-assessment a number of particular practices developed in correspondence education. These practices were closely connected to the subject position of the independent learner and the individualistic and scientific progressivism that were dominant at the time. These practices aimed to free the students from the herd, to tailor the courses to the student, and to provide individual tutoring for each and every student.

Freeing students from the 'lock step' of the class

In correspondence education the individualistic understanding of the student was inspired by the progressive trust in expertise and numbers. In line with educational progressivism in general, and the psychology of individual differences in particular, correspondence education stressed that it was crucial to identify the student's characteristics like IQ, talent, interest, motivation or needs in order to organise an individualised learning situation. M. H. Kellerman, the Headmaster of Blackfriars School in New South Wales, Australia, argued that by 'the very nature of our work, teaching of this type must be individual [... and] must allow for as many variations as there are pupils on the roll.'[46] He also attested that 'supervision and correction must be adjusted to the needs of the pupil' and his/hers 'intellectual, emotional, social, and moral differences' as well as his/her IQ.[47] It was argued that 'every lesson should be adapted to meet precisely the interests, talents, and needs of the individual pupil.'[48]

46. "ICCE 3," 37.
47. Ibid., 39.
48. "ICCE 1," 191.

The individualistic understanding of learning entailed an extreme version of student differentiation, attained by disposing of the class system. This differentiation was sometimes understood as freeing students from the 'lock step' of the class and was based on a completely individualised work-pace. Nancy J. Fitch the Headmistress of Adelaide Correspondence School, Australia expressed it thus in the third ICCE conference:

> Full advantage should be taken of the possibilities which correspondence instruction affords in the way of flexibility of grading and promotion. In a carefully worked out system of individual instruction, it is possible to make a child's rate of progress in any subject independent of any considerations except his ability in that subject and his industry.[49]

The advantages of an individualised progress rate were argued to be several. Through freeing the student from the lock step of the class the talented student would be freed from the tyranny of the underachievers, and the subnormal student would be allowed to progress at his/her individual pace without developing an inferiority complex.

Individualising through differentiation

Another scheme for making correspondence education individual was to divide the courses into different ability levels. K. O. Broady the Director of the Extension Division of the University of Nebraska, USA, maintained that 'correspondence courses seem much better adapted to the pupil of high or at least average ability than to the individual at the lower end of the scale' and that this could be remedied by introducing different levels of instruction by introducing optional units and adapted syllabi.[50] It was argued that courses should be organised on a minimum assignment basis so that different teaching techniques could be used at different levels; or that there should be different courses for different student ability levels.[51] It was also proposed that mastery work percentage or mastery tests could be used or that the course could be adapted to different levels through the addition of special leaflets, omission of certain sections, or the introduction of 'at least three educational streams in which pupils will be able to develop according to their needs and ability.'[52]

49. "ICCE 3," 12.
50. Ibid., 68.
51. "ICCE 1," 178.
52. "ICCE 3," 40.

The adaption of the course to individual talents, needs and desires was to be achieved through several different means: some argued for providing 'specific sets of work' or 'revision sets,'[53] some argued for mimeographed special material or revision of courses[54] while others maintained that short flexible units of teaching, such as those already in use in private correspondence schools, were most adapted to individualisation.[55] It was asserted that a well-prepared syllabus could provide the course with adaptability to the student.[56] '[F]lexibility for the individual,' was to be achieved by phrasing questions and building projects so 'that there might be a selection that would tend to fit almost any student.'[57]

An individualised organisation of education was to make up for the deficit of classroom discussions, face-to-face socialisation, lack of schoolroom, as well as school materials like laboratory material and visual aids. The advantages of individualisation were argued to be so great that they would compensate amply for the considerable lack of socialisation in correspondence education.[58]

The adaption of courses to the individual student articulated two important aspects of individualism. First, the student was understood in terms of his/her individual qualities such as IQ, talent, interest, motivation or needs – an understanding closely connected to progressive expertise in developmental psychology and individual differences. Second, the adaption of courses articulated that the student would be best served by learning individually by studying tailored course content. Thus, the subject position of the independent learner was built on an understanding of student's characteristics according to the then prevailing dominant knowledge and expertise, and individualist learning practices were organised in accordance with this.

The unobstructed teacher-pupil relationship

Although the ideal student was to learn independently it was understood that the student needed guidance and help. This was to be achieved through an individual and unobstructed teacher-pupil relationship. As expressed in the proceedings of the analysed conferences correspondence

53. Ibid., 48.
54. "ICCE 1," 173.
55. Ibid.
56. "ICCE 3," 68.
57. "ICCE 1," 176.
58. "ICCE 3," 75, "ICCE 1," 58.

learning was understood to be an individual pursuit in which the pupil was guided by means of dialogue with the teacher. It was said that the

> [R]elationships arising from close contact of pupil with teacher and pupil will alter greatly the necessity for 'handling' a pupil in correspondence teaching. The teacher-pupil relationship is the point of contact vital to the successful conduct of correspondence instruction.[59]

Another example of the importance the teacher pupil relationship came from K. O. Broady, and also shows how the interaction between student and teacher was a focal point of correspondence education:

> [C]orrespondence courses may be as effective as courses studied in residence, since learning depends more on the student and on the teacher, absent or present, than on the classroom or lack of one. [60]

The teacher pupil relationship was the seemingly natural route to educating students in correspondence education. This unobstructed relationship was deemed so important that it was seen as a compensation for material factors like the lack of a classroom.

The route of communication between teacher and student was deemed so vital that it was emphasised that it had to be kept unobstructed, undistorted, and free of interference. It was argued that parents had to be restrained from doing most of the thinking; that it was of utmost importance to keep the teacher-pupil relationship clear, and to realise that the correspondence teacher was the real teacher.[61] It was also stated that the supervision of correspondence pupils by supervisors or parents should not '[...] obstruct in any way the pupil-teacher relationship.'[62] There were also delegates who maintained that the teacher-pupil relationship had to be safeguarded against outside disturbing influences from parents or tutors, and that it would build friendship and trust.[63] For example:

> All visitors to the school are surprised by the evidence to be seen in every teacher's record book of the extent and depth of the per-

59. "ICCE 1," 199.
60. "ICCE 3," 62.
61. "ICCE 1," 95.
62. Ibid., 201.
63. "ICCE 3," xxix.

> sonal relationships that are developed between individual teachers and pupils. With the coming and going of every set of work letters pass to and fro. Snapshots are exchanged and real friendships are established which naturally have an excellent bearing on the work of both teacher and pupil.[64]

The communication and relationship between teacher and student were seen as paramount to teaching and motivating the correspondence education students. It was seen as the vital point of contact and stressed the importance of the friendship between teacher and pupil. The import of the relationship between the student and the teacher was deemed so considerable that material factors like the classroom or collaboration with other pupils were deemed unimportant in comparison.

Parallel to the acknowledgement of the importance of guidance and friendship, the teacher pupil communication excluded and idealised the relationship between teacher and student to such a degree that help from parents was seen to be detrimental to the learning process. Thus, the idea of the teacher pupil relationship emphasised the contradictory pattern of guided as well as individual learning, where the connection between the teacher and student was seen as more important than material circumstances, and excluded other influences than the ones sanctioned by the correspondence school.

The teacher-pupil communication pattern was problematic for the independent learner. Although the student, it was argued, was to rely on his/her own capacities and judgement the student was seen as crucially dependent on the teacher and correspondence school for help and guidance. Thus the individualistic understanding of the student as independent and autonomous was the desirable way of acting, but at the same time the actions of guiding and teaching show how the organisation of correspondence education stands in stark contrast to the subject position of the independent learner. The rupture between the independent learner and the organisation of correspondence education shows the contradictions inherent in the liberal ideal of independent learning, and that independence crucially depended on a grid of governing technologies that created independence.

64. "ICCE 1," 69.

Learning in nowhere: the social, cultural, and material disembodiment of the student

Correspondence education individualism exhibited quite specific practices that aimed to individualise education and produced a certain educational apparatus, outside of which it was extremely difficult to think and act. Progressivism, developmental psychology, the psychology of individual differences formed a library of knowledge and expertise that helped define individualism in correspondence education. The 'independent learner' was shaped through a number of educational practices that emphasised individualism in different ways.

The individualistic practices that developed in correspondence education were a combination of technologies of discipline that coerced the students to work in the desired manner, and technologies of the self that encouraged the students to problematise themselves. These two types of technologies constituted a grid that aimed to govern students at a distance through multiple vantage points: through the development of morals of self-motivation and self-assessment, friendship, as well as the skill to choose between a plethora of individualised courses. The independent learner was thus assembled through an apparatus of technologies that stressed autonomy, independence, and self-reliance. Thus, through the combination of technologies it was stressed that the independent learner was independent of the wills of others, independent in time and space, in the choice of courses.

I argue that in correspondence education the independent learner was treated as a disembodied free agent – a free-floating *cogito* that was to learn through the materialised flow of friendship and knowledge between the teacher and student. I argue that the independent learner was understood as existing outside of the structures of society, in a state of nature, and that this understanding was built on a liberal humanist subject position similar to that of seventeenth century liberal philosophy, in which the individual was essentially seen as the 'proprietor of his own person or capacities, owing nothing to society for them.'[65] Consequently, the student was constructed as existing in a context-less nowhere in which his/her social, material, economic, or cultural situation was obscured.

The individualism that was prevalent in correspondence education along with its educational practices were extremely influential for a time and reached far beyond the confines of traditional correspondence education. Correspondence education was used, for example, both in Sweden

65. Marshall, *Michel Foucault*, Olssen, "Foucault, educational research and the issue of autonomy," Macpherson, *The political theory of possessive individualism*, p. 3.

and the USA to enrich the educational offerings of small schools in programs called supervised correspondence study. This phenomenon was argued to offer freedom of choice to the student, while still maintaining an individualised rather than social emphasis.[66]

It can be contended that correspondence education and the independent learner developed into a highly liberal educational apparatus that attempted to realise the progressive dream of a child-centred curriculum for each and every child. But it can also be argued that this liberal ideal failed to account for the actual idiosyncrasies of each pupil's educational situation. In essence the practical failure to account for individual differences can be said to be the constant failure of the child-centred curriculum under the pressure of democratic mass education.

66. "ICCE 1," 30.

The Contemporary Articles

6

Lego learning[1]

Technological standards permeate our lives in a number of visible and invisible ways. We make use of standards when we use electricity (think about the electrical plug in different countries), cars (imagine putting one together without standardized nuts and bolts – nothing would fit), or when we shop for clothes (the sizes are standards). When we make use of standards they make possible and constrain our actions in both subtle and unsubtle ways. Their shaping powers can give form to both concrete things (like the fact that nuts and bolts fit together) as well as intangible things (like the fact that an email is sent around the world).

Technological standards are a matter of control and politics – a standard is shaped with a specific technical and social future in mind. For example, the struggle over Betamax vs. VHS was a struggle of economic dominance through technology – and so was HD DVD vs. Blue Ray. Technical standards are crucial for economy, power, and the usefulness of things, and hence they are the locus of intense political and economic interest for companies, countries, or other interest groups. However, sometimes technological standards escape political attention even when they are highly influential. This article is about such a standard. It is about an emerging technical standard for the exchange of digital learning mate-

1. Francis Lee, "Translating educational economy into epistemic atomism: Learning Object standards in education," *Science as culture* (Forthcoming).

rial, which aims to create packages of standardized learning material – so called Learning Objects.[2]

What is a Learning Object? Simply put, a Learning Object can be likened to a 'package' that wraps digital educational material of different forms and sizes in a standardized format. One of the important differences between regular educational material and Learning Objects is that a Learning Object 'package' also includes descriptive data, so called metadata, encoded in a computer readable format that makes it easy to catalogue, index, and, perhaps most importantly, find digital learning material that match certain criteria. The contents of a Learning Object can range from an image, a sound clip, or a diagram to a more complex digital file that encompasses different types of media, interactions, assessments, etc. For example, an image of the Mona Lisa combined with some text, a video, some learning exercises, or a test could constitute the content of a Learning Object. In short, a Learning Object is digital learning material packaged with metadata in accordance with a technical standard.

For primary education, the sale of Learning Objects is a growing business. For example, in Singapore there is an e-learning portal providing

2. A central point of departure for this article is the longtime engagement with classification, standardization, and infrastructures within STS, which treat standards and infrastructures as deeply political. See Andrew Barry, *Political machines* (London: Athlone, 2001), Geoffrey C. Bowker and Susan Leigh Star, *Sorting things out: classification and its consequences* (Cambridge, MA: MIT Press, 1999), Ole Hanseth, Eric Monteiro, and Morten Hatling, "Developing information infrastructure: the tension between standardization and flexibility," *Science, technology, & human values* 21, no. 4 (1996), Susan Leigh Star, "Power, technologies and the phenomenology of conventions: on being allergic to onions," in *A sociology of monsters: essays on power, technology and domination*, ed. John Law (London: Routledge, 1991), Susan Leigh Star and Karen Ruhleder, "Steps toward an ecology of infrastructure: design and access for large information spaces," *Information systems research* 7, no. 1 (1996). In this line of inquiry, infrastructures and standards are seen as political in several ways. For example they contain complex encoded histories, which are folded into both the inscribed data and into its classificatory mechanisms and often forgotten. Also, that which is not deemed as being of 'economic, aesthetic, or philosophic importance' is often excluded from the information infrastructure and rendered invisible Geoffrey C. Bowker, "Biodiversity datadiversity," *Social studies of science* 30, no. 5 (2000): 659. Thus, infrastructures and standards operate normatively to favor certain narratives and understandings of encoded data ———, "The kindness of strangers: kinds and politics in classification systems," *Library trends* 47, no. 2 (1998), Bowker, "Biodiversity datadiversity." An important point is that infrastructures tend to become increasingly obdurate and irreversible as they are diffused. Thus infrastructures and standards hold the power to distribute ideas and practices in both time and space Michel Callon, "Techno-economic networks and irreversibility," in *A sociology of monsters: essays on power, technology and domination*, ed. John Law (London: Routledge, 1991).

Learning Objects for primary education called LEAD that has 250.000 subscribers. It has recently been purchased by Time Warner. In Australia and New Zealand, there is a governmental collaborative project called The Le@rning Federation, which develops free digital educational material for all Australian and New Zealand schools. The company behind the well-known learning management system Blackboard has also recently announced that they will work to make their products compatible with Learning Objects standards. However, Learning Objects are still a technology in the making and has not yet been implemented widely or diffused into a large amount of learning platforms. There are many efforts under way to implement and develop Learning Objects further, but it remains to be seen if they will gain widespread use or have far-reaching effects on distance education globally.[3] Thus, as any technical object that has not yet been fully completed, Learning Objects are still a chimera – a vision.

The purpose of this article is to analyze how the vision of Learning Objects is configured and inscribed into a technical standard. In other words, I ask which the initial intentions of developing Learning Objects were and how these intentions got configured and materialized in a technical standard. I show that the visions of, and standards for, Learning Objects are not only about technology, but also carry with them visions and standardizations of economy, education, pedagogy and knowledge.

It is crucial to ask questions about the nature of this standard, since if it takes root, and spreads over multiple educational institutions around the globe, the configuration of Learning Objects can come to shape the way online education is practiced for a long time. The design and functionality of a computerized educational infrastructure can facilitate different types of educational landscapes that can either make education better for students and teachers, or become, in the words of Bowker and Star, 'a franchised, dully standardized infrastructure.'[4]

Theoretical perspectives

In order to analyze the visions tied to Learning Objects and the inscription of this vision into a technical standard this article draws on the Actor-Network Theory tradition, which works with the notion of *translation*. The concept of translation emphasizes the movement of processes, knowledges, and competencies between different entities in a network

3. Chris Barlas, "Digital rights expression languages (DRELs)," (London: Joint Information Systems Committee, 2006).
4. Bowker and Star, *Sorting things out*, 308.

comprised of both human and non-human actors.[5] It attempts to describe how translations between entities transform the whole network at the same time as they modify the member entities.[6] The concept of translation stems from the French philosopher Michel Serres, who used it to denote 'an act of invention brought about through combining and mixing varied elements.'[7] Accordingly, a translation is a 'displacement, drift, invention, mediation, the creation of a link that did not exist before and that to some degree modifies the original two.'[8] The processes of translation always run the risk of betraying, or changing, the direction of the network in unforeseen ways, and accordingly the translation is not always a straightforward matter.[9]

In this article, translation is used to emphasize how visions of different things are combined and shift direction – are translated – in relation to Learning Objects: an idea from one domain is combined with another and this creates something new. In this case, ideas of economy, object-oriented programming, education, and knowledge are combined, with specific consequences for the vision of Learning Objects and its subsequent inscription in a technical metadata standard.

A specific sub-concept to translation, *inscription*, is used to describe how something is translated into more durable form, or how 'an entity is materialized into a sign, an archive, a document, a piece of paper, a trace;' how it crosses between signs and things.[10] Inscriptions are closely tied to the work of innovators and engineers:

> [...] when technologists define the characteristics of their objects, they necessarily make hypotheses about the entities that make up the world into which the object is to be inserted. Designers thus define actors with specific tastes, competences, motives, aspirations, political prejudices, and the rest, and they assume that morality, technology, science, and economy will evolve in

5. Bruno Latour, *Pandora's hope: essays on the reality of science studies* (Cambridge, MA: Harvard UP, 1999), 174 ff.
6. ———, *Reassembling the social: an introduction to actor-network-theory* (Oxford: Oxford UP, 2005), 106-108.
7. Steven D. Brown, "Michel Serres: science, translation and the logic of the parasite," *Theory culture society* 19, no. 3 (2002): 6.
8. Latour, *Pandora's hope*, 179.
9. John Law, "Traduction-trahison: notes on ANT," www.lancs.ac.uk/fss/sociology/papers/law-notes-on-ant.pdf, Michel Callon, "Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay," in *Power, action and belief: a new sociology of knowledge*, ed. John Law (London: Routledge, 1986).
10. Latour, *Pandora's hope*, 306-307.

> particular ways. A large part of the work of innovators is that of 'inscribing' this vision of (or prediction about) the world in the technical content of the new object. I will call the end product of this work a 'script' or a 'scenario.'[11]

The 'script' or 'scenario' in the case at hand is a technical metadata standard concerned with Learning Objects, which, as I will show below, is inscribed with dreams of educational economy, modularization, and knowledge.[12]

Analytically, the vocabulary of translation is used to describe a chain of shifts in the vision for Learning Objects. As we shall see, ideas about economy are realized in terms of modules that translate educational material into independent components. This translates Learning Objects into atomized entities. Inscription – as a form of translation – is used to describe how the vision of Learning Objects is formalized and translated into the dry and formal language of technical compromise of the Learning Object metadata standard. Hence, the article is concerned with the constitution of a vision for, and standardization of, Learning Objects and the chains of translations that that this entails from economy over technology to education and knowledge.

Method & material

Data selection & material: Selecting the analyzed data for this article started with five articles from the 2006 International Conference on Distance Education (ICDE) in Rio de Janeiro, which had Learning Objects as their main focus.[13] This set of articles was subsequently expanded through a

11. Madeleine Akrich, "The de-scription of technical objects," in *Shaping technology building society: studies in sociotechnical change*, ed. Wiebe E. Bijker and John Law (Cambridge, MA: MIT Press, 1992), 207-208.

12. There is an important caveat that must be made in relation this point: the users of Learning Objects are still to interpret and subscribe to the script, which might be significantly changed in practice. Nevertheless, the script that is inscribed in the standard will be an actor in determining how online learning will be practiced, and as such is important to understand in its own right.

13. The ICDE conferences are a series of conferences which were commenced in 1938 under the name of International Conference on Correspondence education, and have been a partner organization to the UNESCO since the 1960s. The ICDE conferences are a meeting place for distance educators, distance education companies, as well as governmental bodies from all over the world. The conferences started out small in 1938, while today's conference is a large event involving hundreds of participants, simultaneous translation, visits by ministers of education, as well as large exhibits rented out to educational technology companies.

chain technique, where the reference lists of the original five texts were inspected for articles that contained Learning Objects in the title, in order to identify further texts for qualitative coding.[14] This method yielded 35 texts in total that were relevant to understand the vision of Learning Objects. In all, the 35 texts amounted to approximately 500 pages of material. The selected texts were chiefly written by educational technology engineers, educational technology researchers and educational visionaries that have been involved in developing, implementing, or using Learning Objects.

In addition to these texts, the *IEEE standard for Learning Object metadata* (IEEE LOM) was analyzed in order to investigate how the vision of Learning Objects was formalized in a technical standard.[15] I analyze the IEEE LOM standard as it was the first accepted metadata standard for educational purposes, and as such is indicative of the goals and ways of thinking in the early efforts for creating Learning Objects.[16] The analyzed IEEE standard is a technical description of the characteristics, properties, formats, and definitions that pertain to the metadata 'packaged' with a Learning Object. The heart of the IEEE LOM standard document is a table of named metadata properties, for example 'aggregation level.' with descriptions as to what they describe and how they can be formatted.[17] To understand what a metadata standard is, think about a library record for a book, this record is metadata about the book. A standard for metadata specifies which fields should be present in the metadata record and how they should be formatted. For example an ISBN number is formatted in a certain way (13 digits in order to be compatible with bar-codes), or the

14. Michael Quinn Patton, *Qualitative research and evaluation methods*, 3 ed. (London: Sage, 1990), 237-238.

15. IEEE, "IEEE standard for Learning Object metadata," (New York: IEEE, 2002).

16. Mikael Nilsson et al., "Harmonization of metadata standards," (Prolearn: Network of Excellence in Professional Learning, 2008). Various earlier projects that tried to define a metadata standard for education were incorporated into the IEEE LOM: the EU financed ARIADNE projects, the IMS industrial consortium project, as well as the work by the Dublin Core group, an early implementation of learning material metadata, were all integrated into the work with the IEEE metadata standard. IEEE, "IEEE LOM," iii.

17. Important standardization organizations involved in the development of standards for an educational infrastructure are the IEEE Learning Technology Standards Committee (IEEE LTSC); the European Committee for Standardization, Learning Technologies Workshop; the ISO/IEC Standards for Learning, Education and Training; the Dublin Core Metadata Initiative (DCMI); as well as the IMS Global Consortium ———, "Collaborating organizations," http://www.ieeeltsc.org/about/collaborating_organizations. The standard that is analyzed here is the *IEEE 1484.12.1 – 2002 standard for Learning Object metadata*, or IEEE LOM for short ———, "IEEE LOM."

type of material might be chosen from a pre-compiled list of available types (book, journal, audiovisual, dissertation). The metadata standard for Learning Objects specifies a number of properties that a Learning Object can be described with, and thus shows what parts of the vision are deemed important enough to standardize and diffuse globally.

Method: The qualitative coding of the 35 texts was executed through an oscillation between two different analytical techniques with a focus on understanding the vision of Learning Objects. The first technique was to study the texts for passages that articulated the intentions, rationales, problems, and solutions connected to Learning Objects. In this, my focus lay on understanding the hypothesis about the world that was tied to Learning Objects, rather than utterances that considered technical subtleties of implementation (like server design, or XML details), theoretical discussions of Learning Objects (like how they could be understood using Pierce's theory of signs), or matters of tangential importance for the general vision (like the semantic web). The second technique involved the generation of codes and categories that classified and grouped the relevant passages. Many concepts, and groups of concepts were generated from this process, like standardization, classification, flexibility, efficiency, personalization, or interoperability. In my interpretation, the most important categories for the understanding of the general vision of Learning Objects were *reusability*, *interoperability*, or *economies of scale*.[18]

Finally, to elucidate how different aspects of Learning Objects were combined and linked – translated – I followed how the actors linked key aspects of their vision, i.e. how the primary reason for implementing Learning Objects was expressed as being reusability and economy, and how this vision was linked to a particular way of achieving it. Furthermore, to analyze how this vision of the world was translated into more durable form and inscribed in the technical content of Learning Objects I scrutinized the IEEE LOM standard in order to identify how, and if, the vision of Learning Objects found its way into a technical standard. This process entailed reading and understanding the technical specifications of the standard in light of the results from the qualitative analysis. Through this move, I could for example discern the link made between a technical metadata property in the IEEE LOM called 'granularity' and a vision for modularization and granularity in the qualitative material.

18. These techniques were inspired by the coding techniques outlined in grounded theory, but do not constitute a full-fledged grounded theory approach. Anselm Strauss and Juliet Corbin, *Basics of qualitative research: grounded theory procedures and techniques* (London: Sage, 1990).

Through the combination of materials it became possible to analyze both the vision of Learning Objects, as well as its inscription into a metadata standard. In the article, I have chosen a number of illustrative quotes in order to demonstrate how these visions were expressed, and for elucidating the general vision that I brought out in the analysis.

What's the problem? Cost efficiency and reusability

The first step in understanding the vision of Learning Objects is to understand the intentions that are expressed in relation to them. This section outlines the purposes that are attached to Learning Objects. What are they expected to do? What are the problems to be solved? What are the rationales to develop Learning Objects?

The primary reason for developing Learning Objects is to increase the efficiency by sharing the high development costs for digital educational material among a larger number of institutions and users.[19] The vision of producing Learning Objects is closely connected to economy, as Stephen Downes, a specialist on online learning from the National Research Council of Canada, expresses it:

> We can lower the cost of learning. Imagine a multimedia company spending a million dollars on such a [multimedia Hamlet] production. Assume that *Hamlet* is taught in 10,000 schools, colleges or universities around the world (hardly a stretch). Assume 20 students per class (an underestimate, to be sure!). At $5 per student, the company would make its million dollars back in one year! The economics are very good, and this excellent resource would be cheaper than even the book alone.[20]

Consequently, the intentions that are attached to Learning Objects includes a vision of economies of scale in which educational content is seen as a commodity that can be reused in different educational 'market sectors, localities, cultures, or educational levels' through their possibility for reuse and adaptation.[21] Rory McGreal, who is the Associate VP of Research at Athabasca University and in charge of implementing the IEEE's Learning Object Model in Canada, expresses the idea like this:

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19. Stephen Downes, "Learning Objects: resources for learning worldwide," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004).
20. Ibid., 24.
21. Martin Weller, "Learning Objects and the e-learning cost dilemma," *Open learning* 19, no. 3 (2004).

'[...] the world does not need tens of thousands of similar learning topics. [...] a dozen well designed multimedia [Learning Objects] could be used in thousands of courses.'[22] According to Griff Richards, Marek Hatala, and Rory McGreal, who are distance education technologists with a long standing interest in technology and education, the perceived key to achieving economies of scale is to design the educational information infrastructure so that Learning Objects are reusable:

> The promise of digital LOs [Learning Objects] lies in reusability. If constructed appropriately, warehoused wisely and catalogued accurately, then a LO might find usage beyond its original audience and instructional context. Given the relatively high cost of developing good LOs, the promise of reusability receives considerable attention from administrators and publishers trying to amortize the cost of production and maximize the potential return for each of these digital investments.[23]

The purpose of the information infrastructure is the exchange of materials and student profiles in a digital marketplace for educational material. As Wayne Hodgins, the former chairman for the IEEE Learning Technology Standards Committee on metadata and a pivotal actor in the Learning Objects field puts it:

> Just as we have created grocery stores to provide us with the raw materials (and sometimes more) for our meals, and these stores are carefully geared to meet the predictable demands of their customers, so in the future we will receive Learning Objects as our needs arise, based on the predictability of those needs as determined from past behavior. The dramatic efficiencies of automation, such as bar codes and scanners that have assumed the functions of price tags and cash registers, will be mirrored in the learning arena by metadata standards, collaborative filtering of information, etc., all of which require standardization just as

22. Rory McGreal, "Introduction," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004), 3.
23. Griff Richards, Marek Hatala, and Rory McGreal, "POOL, POND and SPLASH: portals for online objects for learning," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004), 236.

> grocery stores require standard labeling and coding of the products they sell.[24]

Hodgins' vision of having a grocery store for educational material that will stock the relevant material based on predicting student needs and matching them against the metadata of educational material, is not only a dream of a visionary, but has started to become materialized through the development of a technical standard for Learning Objects. As I have outlined above, the dominating intention behind the development of Learning Objects is *economy* and *reusability*, and thus, these concerns are constitutive of the organization and development of Learning Objects standards.

Translation I: economy and reusability

In June 2002, the IEEE LOM standard became the first accepted IEEE standard for educational technology. It aimed to produce a standard for classifying and cataloging Learning Objects.[25] This standard defines a basic framework for classifying Learning Objects – and specifies a number of important attributes that are to be used to assemble new courses – in the search for suitable Learning Objects, or in the cataloging of Learning Objects in large databases.

The intentions behind the development of the metadata standard is to make it possible to search, evaluate and acquire Learning Objects.[26] The IEEE LOM framework contains vital information about where to find the Learning Object: who authored it, what version it is, what language it is authored in, to what subject it pertains, etc. Consequently, the IEEE LOM standard specifies how educational content should be classified and described so that computer systems and humans can 'manage, locate, evaluate, or exchange Learning Objects.'[27] Norm Friesen, the Canada Research Chair in E-learning Practices at Thompson Rivers University, Susan Hesemeier, working on the Canadian standardization project CanCore, and Anthony Roberts, from the Telecampus repository for TeleEducation in Canada, argue:

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24. Wayne H. Hodgins, "The future of Learning Objects," http://reusability.org/read/chapters/hodgins.doc, 7.
25. IEEE, "IEEE LOM."
26. Ibid., 1.
27. Ibid.

> Careful and coordinated implementation of the LOM standard is the linchpin of many of the visions of discoverable, accessible and reusable educational objects.[28]

Accordingly, the accomplishment of reusable Learning Objects is seen as being dependent on propagating a technical standard, the IEEE LOM, that allows economies of scale through the reuse of digital educational resources between different technical systems. The chain of translation has started with a shift from *economies of scale* → *reusability*. How ideas of reusability and economies of scale are translated into a standard for metadata, and the chain of translations that leads from economy to epistemic matters are the concerns of the remainder of this analysis.

Translation II: reusability through modularization

In the Learning Objects field, it is argued that the maximum reusability of educational material will be achieved through splitting educational material up into modules. Modularization means that each course is metaphorically seen as being constructed of a multitude of parts, or digital media components, that are combined to form a whole course. Consequently, the purpose is to construct an online course that is comprised of several Learning Objects. The course constructor only needs to select a number of Learning Objects and assemble them into a series that the student uses to learn. The argument is that large chunks of material are seen as unsuitable for reuse and remixing into new courses, as they are not flexible enough. Therefore it is seen as desirable to divide the courses into parts taking the form of Learning Objects:

> Courses themselves are *not* suitable candidates for sharing. [...] So, we will share *parts* of courses. What needs to be shared may be best described as parts of courses, or more accurately, course *components*.[29]

In this vision, a high degree of modularization is claimed to enhance the ability to reuse a Learning Object. As Mohamed Ally, the Director of the Centre for Distance Education at Athabasca University in Canada, expresses it: 'Programmes and courses of instruction need to be de-

28. Norm Friesen, Susan Hesemeier, and Anthony Roberts, "CanCore: guidelines for Learning Object metadata," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004), 235.
29. Downes, "Learning Objects: resources for learning worldwide," 26.

signed into smaller units in the form of LOs to make them flexible and reusable.'[30] The idea of modularization of educational material draws heavily on computer science and object oriented programming, which has developed a number of strategies for dealing with reusability. Stephen Downes discusses the relation between object oriented programming and Learning Objects as follows:

> An online course, viewed as a piece of software, may be seen as a collection of reusable subroutines and applications. An online course, viewed as a collection of LOs, may be seen as a collection of reusable learning materials. The heart – and essence – of online course design is the merging of these concepts, of viewing reusable learning materials as reusable subroutines, applications and documents assembled by application specialists in a computer-assisted software environment.[31]

So, the chain of translations now starts with economies of scale and reusability which are subsequently translated into an idea of modularization, which stems from object orientated architecture in computer science. Here two ideas from previously unconnected domains meet and translate a shift in direction in the vision for Learning Objects. Through the idea and practice of object oriented programming, the vision of Learning Objects becomes slightly altered from being an economic matter of reusability into a technological solution built on modularization.

The most important characteristic of technical modularization is the possibility to use each Learning Object as a building block for constructing a new course. Accordingly, educational concerns with course-development costs are – through the idea of modularization in object-oriented programming – translated into a specific technical solution. I maintain that Learning Objects are the result of a translation of economies of scale, reusability and object oriented programming into a technical mode of organizing educational material, which is modularization. The chain of translation has become *economies of scale* → *reusability* → *modularization*. The question now becomes how to translate technical modularization into a Learning Object. What is to be modularized? How is modularization to be achieved? How big should a module be? What consequences

30. Mohamed Ally, "Designing effective Learning Objects," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004), 94.
31. Stephen Downes, "Learning Objects: construction and creation," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004), 99.

does technical modularization have for the standardization of the Learning Object?

Translation III: the ideal size of a Learning Object

In the argument for modularizing learning material, there is a consensus that Learning Objects should be smaller than a course so that they can be used as building blocks for new courses. However, there is also agreement that the Learning Object cannot be so small so as to encumber development or become unmanageable. The most economically beneficial size is still an uncertain matter for the proponents of Learning Objects. The 'size' of a Learning Object can range from a raw media object, e.g., a digitalized image, a sound clip, or a diagram, to a set of complete courses consisting of raw media, interactions, assessments, etc. The size of the Learning Object is often referred to as granularity, or granule size.

This vision of granularity is deemed so important for the standardized Learning Object so that it is in inscribed in the IEEE LOM through the definition of a specific metadata property that divides Learning Objects into different levels of granularity. This property is called *aggregation level*. In the aggregation level property, ideas about economy and modularization have become an inscription in the IEEE LOM. The aggregation level property classifies the 'functional granularity' of the Learning Object: the first level of granularity equals 'raw media or fragments;' the second, a lesson; the third, a course; the fourth, 'a set of courses that lead to a certificate.' So although the vision of Learning Objects expresses an aspiration for small granules, this is not mirrored entirely in the IEEE LOM standard, a fact that reflects an uncertainty as to the most practical size of a Learning Object.

However, size is a crucial matter for reusability. With a large granule size (imagine a granule the size of a course) the possibility of reassembling courses flexibly diminishes greatly. With a medium granule size (imagine a granule the size of a chapter or an article) there is quite some leeway in reassembling the granules into courses, while still retaining a quite flexible way of reconstructing courses. With a small granule size (imagine a granule the size of a picture, a formula, or a video) the flexibility of repurposing becomes very high, but also the level of work needed to produce a coherent course rises. Thereby, not all levels of granularity defined in the IEEE LOM aggregation level property are compatible with a vision of reusability and economies of scale.

So, although there is flexibility inscribed into the IEEE LOM aggregation level property, the vision of a reusable and granular information infrastructure for educational purposes is tied to a certain understanding

of Learning Objects. In accordance with the economic vision of reusability it is argued that the Learning Objects need to be so small that the size facilitates flexible repurposing of content. Erik Duval, who is a professor at the research unit on hypermedia and databases from the Catholic University of Leuven, and Wayne Hodgins put the question of granularity as follows:

> Many actors in this research domain limit their vision of LOs to that of traditional documents or software applications (e.g. simulations). However, the current state of technology allows us to consider a much smaller level of granularity that enables more flexible and effective repurposing of content.[32]

Thus, in the vision of Learning Objects it is argued that the size is supposed to be of the smallest grain practically possible in order to facilitate maximum flexibility in the reuse and repurposing of the objects into new combinations that can be used in different courses and settings.

There are further translations at work here, which move the concern for economy through reusability toward the epistemic domain. Rather than basing a module on what is practical from an epistemic point of view, the argument is that the basis for decomposing the Learning Objects should be to lower the grain size in order to facilitate reusability. Hence, the economic intentions are translated into technical modularization via object-oriented programming. The chain of translation becomes *economies of scale* → *reusability* → *modularization* → *granularity*. Each move along the chain shifting matters subtly: from economy to technology, and from technology to epistemic matters.

Translation IV: self-contained, non-sequential, and contextless Learning Objects

With the quest for economies of scale and reusability, and in line with the technical emphasis on modularization, it is argued that Learning Objects should not be dependent on external resources. As I show below, the idealized modular Learning Object has three crucial characteristics associated with it: self-containment, non-sequentiality, and independence from an external context. These three characteristics are essential in order for a Learning Object to become increasingly modular and accordingly reusable, facilitating economies of scale.

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32. Erik Duval and Wayne Hodgins, "Learning Objects revisited," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004), 73.

The first characteristic, self-containment, emphasizes that the Learning Object should not be dependent on references to other components. In the vision for Learning Objects it is argued that they must only refer to resources that can be found within themselves: for example, Mohamed Ally argues that '[o]ne should be able to revise LOs without affecting other objects. [...] This requires that the LOs be independent and standalone.'[33] Consequently, it is argued that all information, exercises, assessments, and services utilized in the Learning Object must be contained within the Learning Object. Duval and Hodgins also agree on this point and argue that:

> Authors should *avoid explicit references* to other components, as these other components may not be available in the context of reuse. [...] a reference to 'chapter V' makes little sense if the context in which a component is reused doesn't include a 'chapter V'. [...] This is one example of an issue that needs to be considered when content is designed to be reusable.[34]

The self-containedness of the Learning Objects aims to allow the addition or subtraction of a Learning Object to or from a course, without affecting the course as a whole. The argument is that the breaking down of educational material into its fundamental parts will allow the reuse, remixing, and restructuring of Learning Objects. As a consequence, removing connections between different chunks of educational material and creating atomic units of learning material is extolled as being an ideal state for creating reusability.

The second characteristic of the atomic Learning Object that facilitates reusability through modularity is non-sequentiality. Monique Doorten et al., from the Open University of the Netherlands, argues that in order to maximize reusability resources cannot depend on prior or subsequent Learning Objects:

> In order to [... determine the smallest intrinsically meaningful parts] we need to check whether the distinguished objects meet the requirements of being reusable in the sense that they appear to be self-contained and ideally non-sequential [...] meaning that all concepts, principles, methods and so on are sufficiently explained within the object itself. [...] Non-sequential therefore means that objects should be without any references to any pre-

33. Ally, "Designing effective Learning Objects," 88.
34. Duval and Hodgins, "Learning Objects revisited," 78.

> sumed prerequisite prior knowledge, other than through the use of metadata.[35]

In the quote above, the translation from the economic vision of reusability into the epistemic domain becomes clear. It is not only a technoeconomic matter to modularize, but it also affects epistemic matters deeply. Hence, technoeconomically motivated modularization becomes translated into a modularization of knowledge.

This non-sequentiality of the atomic Learning Object is also inscribed into the IEEE LOM through a metadata property designated *structure*. This property defines a classification of Learning Objects into *atomic*, *collection*, *networked*, *hierarchical*, or *linear*. An *atomic* Learning Object is defined as 'an object that is indivisible' and as 'raw media or fragments;' a *collection* as a 'a set of objects with no specified relationship between them;' a *networked* Learning Object as a 'a set of objects with relationships that are unspecified;' *hierarchical* as a 'a set of objects whose relationships can be represented by a tree structure;' and *linear* as a 'a set of objects that are connected by 'previous' and 'next' relationships.' The *structure* property of the IEEE LOM is inscribed with a number of different ways of organizing Learning Objects, and translates specific epistemic relations and ways of learning into a technical standard. As a result, the IEEE LOM is inscribed with a number of characteristics with different degrees of compatibility with a vision of economies of scale through reusability, but also with different ways of traversing the Learning Objects, and working in the system.

The third characteristic of the modularized and atomic Learning Object is how context is understood. For the proponents of Learning Objects, educational and informational context in light of the wish for modularization becomes a problematic issue that needs to be addressed in order for the maximum reusability to be achieved. Robby Robson, Vice Chair of the IEEE Learning Technology Standards Committee and Vice President of the Eduworks Corporation, maintains:

> Context also affects reusability. Dependence on context diminishes opportunities for reuse, which acts as a disincentive to produce reusable objects in the first place. The degree of this diminution is a function of both the depth of dependence on context

35. Monique Doorten et al., "Transforming existing content into reusable Learning Objects," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004), 125.

> and the narrowness of the context. [...] A LO that makes sense only in a narrow context has less potential market size.[36]

Robson argues that the solution to the problem of epistemic context and economic reusability in Learning Objects is the implementation of technical metadata standards. Through providing an epistemic context in the Learning Object, like language, subject, student age, or educational level he argues that the reassembly of atomic Learning Objects will be less complex. His argument is that through implementing standardized metadata, the context of the Learning Object can be inscribed in the information infrastructure and thereby create preconditions for reusability. Through creating a technological framework for reusability, economy can be achieved:

> [...] LOs may not be as reusable as one would hope for. Context has been identified as being the culprit. The highly contextual nature of LOs adds significant cost to reuse. [But] standards [...] have the effect of preserving the context of a LO as it is handed off from person to person and system to system. [...] This makes reuse even more attractive and at the same time increases the inherent value of LOs. With standards in place, along with appropriate practice built around the standards, predictions of educational object economies [...] may well end up being correct.[37]

Through inscribing a context consisting of language, intended audience, subject matter, cultural context etc. in the Learning Object metadata, the 'context' is to be preserved in the Learning Object package. In this way, context is to be made available in every Learning Object through the inscription of metadata into its standardized package. The epistemic context of a Learning Object is translated into standardized technological and epistemic metadata in order to achieve economies of scale.

What I have shown above is how technical and economic concerns are translated into the domain of knowledge and information. What is an economically and technically motivated idea, modularization, becomes translated into a matter of handling epistemic matters. The chain of translation has become *economies of scale* → *reusability* → *modularization* → *granularity* → *the epistemic*. The technoeconomic has become the epistemic.

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36. Robby Robson, "Context and the role of standards in increasing the value of Learning Objects," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004), 160.
37. Ibid., 166.

As I have shown above, the IEEE LOM standard develops a classification of Learning Objects that allows a degree of flexibility as to how modular or granular a Learning Object can be, but there is also an attached hierarchy of desirability between these different classes of objects, where the modularized, non-sequential, contextless, and atomic Learning Object is the most desirable.

The new atomic and molecular science of education

Taken together, the stand-alone character and non-sequentiality of Learning Objects means that courses are to be materialized and broken down into building blocks that allow for the construction of new courses, and new content. Through freeing the Learning Objects from their context and from their sequentiality, universal reusability is to be achieved. Reusability has been translated into an atomic, contextless, epistemic project. Wayne Hodgins expresses the vision of a modularized educational information infrastructure as the new atomic and molecular science of education:

> I believe we are on the verge of a grand discovery in the areas of learning, content, knowledge, and objects. Just as revolutionary as our discovery of the atomic and molecular models will be our discovery of the equivalent of the periodic table for all content or data. [...] Similarly, an equivalent understanding of our data and informational world will give us a fundamental understanding and ability to manipulate, create, and build any substance possible. In the case of data, this model will be based on the ability to take everything down to fundamental units, understanding their basic structural makeup and components, the equivalents of their electrons, neutrons, protons that combine to form compounds.[38]

Hodgins vision is telling for how knowledge is understood in relation to the standardized Learning Object. What was once a matter of economy, and subsequently translated into technology, has now clearly become a matter of information and knowledge. Information and knowledge that are to be granularized and understood in their structural make-up so that 'the "rules" that govern what can be combined and how' can be discovered.[39]

38. Hodgins, "The instructional use of Learning Objects," 12.
39. Ibid.

Here I will stop following this chain of translations. Economies of scale have become translated into modular, contextless, one-size-fits-all Learning Objects. What started out as a dream of splitting production costs of educational material between a greater number of users and institutions has been translated into a dream of handling information and knowledge. In the vision of Learning Objects the economic became the technical and the technical became the epistemic.

What I have shown above is how Learning Objects are tied to a vision of economies of scale and technical reusability, and how this vision is translated through object-oriented programming and technically implemented through modularity. Accordingly, the standard for Learning Objects metadata, the IEEE LOM, is inscribed with a property that classifies the granularity of Learning Objects. These shifts between the intentions for Learning Objects and how knowledge is envisioned are examples of translations between the economic and the epistemic: a vision of economies of scale is translated into reusability, reusability into modularization, and modularization into the self-contained Learning Object. In the parlance of translation and inscription, what I have shown is how a specific *script* or *scenario* is created through a chain of translations and inscribed in the IEEE LOM. This script includes many different fictions, technological solutions, and visions about education, and is by no means yet stabilized – it is still in the making.

An important point to make about this series of translations is that epistemic atomism is not necessarily a mode which is supported by the human proponents of Learning Objects, but rather is a result of a heterogeneous assemblage of things that shape how Learning Objects are organized: human visions, economic rationalities, technical solutions, problem solving methods from computer science, etc.

This begs the question of what knowledges Learning Objects are compatible with. In line with the arguments made by Sørensen, Learning Objects can be seen as performing a representational knowledge-space, where knowledge is defined as stable reference points 'out there' which are transferred between knowing subjects, in contrast to, for instance, knowledge related to participation that is made in through performances and apprenticeship.[40] Accordingly, Learning Objects and their metadata standard can be seen as being compatible with a specific metaphor for knowledge that is quite strongly geared toward the acquisition of knowl-

40. Estrid Sørensen, "The materiality of learning: technology, knowledge and presence in educational practice," (2009). Anna Sfard, "On two metaphors of learning and the dangers of choosing just one," *Educational researcher* 27, no. 2 (1998).

edge.[41] The question is what type of pedagogy one would like the Learning Object infrastructure to be compatible with? It is quite clear from the vision of Learning Objects that it is not pedagogically neutral, but that it is geared toward a specific configuration of learning, thus perhaps excluding others.

Could it be otherwise? Could the vision for Learning Objects and the IEEE LOM standard be reconfigured to reflect a fundamentally different logic than economies of scale and epistemic atomism? Are global standardized technological objects at all compatible with the idiosyncrasies of knowledge and learning? Could a global standardized information infrastructure be adapted to a democratic, reflective, independent and contextual education? As Hamilton and Feenberg have argued it is quite possible to produce computerized learning platforms for collaboration, dialogue, and social learning, but such platforms are expensive to operate as they require large amounts of manpower.[42] Thereby, the economies of scale could be lost, but a social, contextual, and participant way of handling knowledge could be won.

These questions are questions of infrastructural politics that are crucial to reflect upon in order to imagine a desirable educational future. The vision of Learning Objects might seem an educational utopia to many, and it might hold great promise for harnessing technical developments for educational purposes – but arguably there could be a backside to such technical developments as well. The risk is that a large-scale implementation of an information infrastructure built on standardized Learning Objects will be strongly geared toward intensifying already strong tendencies toward educational homogenization in the global educational landscape. If the IEEE LOM standard becomes widely diffused and implemented this might create a landscape where atomization of knowledge in the form of Learning Objects is the default modus operandi. Is this what we desire?

41. Frode Guribye, "Infrastructures for learning: ethnographic inquiries into the social and technical conditions of education and training" (Ph. D., University of Bergen, 2005), 172 ff.

42. Edward Hamilton and Andrew Feenberg, "The technical codes of online education," *E-learning* 2, no. 2 (2005): 112.

7

Coding copyright[1]

In education and research, digital technology is increasingly starting to alter the search for, access to, and publication of research results, course literature, and other educational resources. Through online databases students and researchers can access an abundance of material that can be forwarded, duplicated, and shared infinitely. Databases, digital libraries, as well as the burgeoning market for digital learning material, are all part of an increasing digitalization of educational and scholarly material. In education, digital duplication, economy, and intellectual property are implicated on multiple levels, ranging from digital material in libraries or research databases, to the use of software or digital learning material in the classroom. Copyrighted material and intellectual property are crucially entangled with the core of the research and education system through financing, books, academic articles, supplementary materials, educational movies, or citation of sources.

For some copyright holders uncontrolled digital distribution is problematic as information can be reproduced with small to no cost without degradation of quality, and that this duplication is possible over computer networks spanning the globe. The replication of copyrighted digital information is so cheap and easy that it has become rampant in much

1. Francis Lee, "Coding copyright: the re-construction of intellectual property in education," *Social studies of science* (Submitted).

of the digitally literate world.[2] For copyright holders one solution to this situation has been to implement technologies for protecting copyright in the digital domain, so called digital rights management (DRM) technologies. These technologies lie at the heart of a specific vision of a digital publication landscape, and provide a way for publishers to increase control over digital material.[3]

Standardization of DRM in education is, like many of the educational standards for online distribution, at an embryonic stage in which large-scale implementation is still not a reality. Consequently it might change shape or form, or even become obsolete in the course of its design. Accordingly, I am concerned here with the visions of technologists, whose projects continually swerve in one way or the other, and which might remain projects in a filing cabinet, or in the end become technical objects. In line with this reasoning, I treat the hypotheses and standards of DRM in education as being important parts of a technological project that is progressing on a continuous scale toward a potential transformation into a technical object.[4]

Empirically, this article approaches DRM in education from the point of view of standards and infrastructure research in the science and technology studies field. In this strand of research a point of departure is that all standards, classifications, and infrastructures are strongly implicated in power struggles and politics. Accordingly, it becomes crucial to understand and problematize the politics that are inscribed in DRM, and to pay attention to the ethical and behavioral substrate that is inscribed in this information infrastructure before it becomes so diffused that the politics become lost from view.[5] Consequently, I do not approach DRM and intellectual property from a legal point of view; rather I attempt to

2. Cf. the case of *The Pirate Bay*, which has sprung to worldwide fame in the past few years.

3. An early article in the field of DRM is Mark Stefik, "Shifting the possible: how trusted systems and digital property rights challenge us to rethink digital publishing," *Berkeley technology law journal* 12, no. 1 (1997).

4. In this, I am inspired by studies like Bruno Latour, *Aramis or the love of technology* (Cambridge, MA: Harvard UP, 1996), and Michel Callon, "The sociology of an actor-network: the case of the electric vehicle," in *Mapping the dynamics of science and technology: sociology of science in the real world*, ed. Michel Callon, John Law, and Arie Rip (London: Macmillan, 1986).

5. See for example Geoffrey C. Bowker and Susan Leigh Star, *Sorting things out: classification and its consequences* (Cambridge, MA: MIT Press, 1999).

understand the construction of intellectual property through technical standards that define technical systems.[6]

In line with this perspective, the aim of this article is to understand how a vision of digital markets and distribution is inscribed in a standard for DRM protection of educational material. And furthermore, how these visions are elaborated in code and illustrations in a technical report. The specific questions are: what visions of education are tied to the construction of DRM standards for the educational sector? In what ways are these visions inscribed in a technical report and elaborated upon? In asking these questions, I aim to show how intellectual property is re-constructed through technical means and how a market for educational material is heterogeneously constructed through technology.

Translation: hypotheses, problematization, and inscription

Theoretically this article utilizes the concepts of *translation* to emphasize how visions of DRM are inscribed in a technical standard.[7] By using translation I emphasize that material and semiotic, human and non-human entities shape each other, and that conglomerations of human and non-human actors shape and reshape society as a result of their associations.[8] A basic presumption of this perspective is that an act of translation invariably includes the possibility of being unfaithful to the original, and consequently the chance of mutating a hypotheses or changing a materialization.[9]

In this article I use the concept of translation in three related ways.[10]

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6. On intellectual property from a legal and political perspective see Lawrence Lessig, *Free Culture: how big media uses technology and the law to lock down culture and control creativity* (New York: Penguin Press, 2004), ———, *Code: and other laws of cyberspace, version 2.0* (New York: Basic Books 2006). On a technological perspective on academic publishing see for example Ingemar Bohlin, "Communication regimes in competition: the current transition in scholarly communication seen through the lens of the sociology of technology," *Social studies of science* 34, no. 3 (2004).

7. The concept was introduced into science and technology studies, with inspiration from Michel Serres, in Michel Callon, "Struggles and negotiations to define what is problematic and what is not: the socio-logic of translation," in *The social process of scientific investigation*, ed. Karin D. Knorr (Dordrecht: D. Reidel, 1980).

8. Bruno Latour, *Reassembling the social: an introduction to actor-network-theory* (Oxford: Oxford UP, 2005).

9. John Law, "Traduction-trahison: notes on ANT," http://www.lancs.ac.uk/fss/sociology/papers/law-notes-on-ant.pdf.

10. On the three meanings of translation see Steven D. Brown and Rose Capdevila, "Perpetuum mobile: substance, force and he sociology of translation," in *Actor-Network Theory and after*, ed. John Law and John Hassard (Oxford: Blackwell, 1999).

First, I use translation in the sense of *inscription* to describe the act of materializing a *hypothesis* about the world into a technical object.[11] In this sense inscription signifies the materialization of a hypothesis of education into a technical object, and an appendant sociotechnical *script*, which could profoundly shape educational publishing.

Second, I use it to describe how a set of actors attempt to enroll support for a technological project. These types of translations are described using two sub-concepts: *problematization,* which describes how the definition of a set of problems is used to construct the project DRM in education; and *obligatory passage point*, which indicates an attempt to position DRM as a mandatory factor for the success of e-learning.[12] Here, the hypothesis and the problematization stand in important relation to each other: the hypothesis being the broad vision of the world, while the problematization and obligatory passage point are attempts to enroll support for this vision.

Last, I employ translation in a way close to Michel Serres' original meaning, where it describes a feat of creation through the blending and fusing of heterogeneous elements.[13] In this version of translation, I employ the concept to describe how ideas from other domains, or technologies stemming from different spheres shape the hypothesis of DRM systems in education. Here, the notion of unfaithful translation, trahison, is important as a productive force for the shaping of the technical project.[14]

In sum, I use translation and its sub concepts to describe the construction and attempt to stabilize a technical project tied to the DRM protection of educational material. That is, how the vision for DRM-protected learning material is constituted by inscribing hypotheses and problematizations in a technical standard, but also to describe how the hypotheses are elaborated on through ideas from other domains and visions of technology.

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11. On hypothesis and inscriptions see Madeleine Akrich, "The de-scription of technical objects," in *Shaping technology building society: studies in sociotechnical change*, ed. Wiebe E. Bijker and John Law (Cambridge, MA: MIT Press, 1992).

12. On problematization and obligatory passage points see Michel Callon, "Some elements of a sociology of translation: domestication of the scallops and the fishermen of St Brieuc Bay," in *Power, action and belief: a new sociology of knowledge*, ed. John Law (London: Routledge, 1986).

13. On translation and noise see: Michel Serres, *The parasite* (Minneapolis: Univ. of Minnesota Press, 2007), and Steven D. Brown, "Michel Serres: science, translation and the logic of the parasite," *Theory culture society* 19, no. 3 (2002): 6.

14. On trahison see: Law, "Traduction-trahision."

Acronymania: LO, DRM, and the IEEE LTSC DREL

This article is a continuation of earlier empirical research exploring so called Learning Objects in education.[15] A Learning Object is a standardized digital container that holds different types of educational material, allowing computer systems to combine and reuse information from different sources. A distinguishing aspect of a standardized Learning Object is the fact that it includes descriptive metadata about the educational material that make it possible to catalogue, index, and find material. A Learning Object can hold different types of material: images, audio, video, web pages, diagrams, or any combination of learning material. For example, the contents of a Learning Object might consist of a map of Tokyo and its subway system, combined with a text on urban development in Tokyo. This object might have a standardized set of descriptive data, so called metadata attached to it, and importantly for this article it might also be protected against unauthorized use by a computer system.

Learning Objects are an increasing trade globally which targets all levels of education. In Australia and New Zealand there are a multitude of projects on different levels doing research and distributing Learning Objects such as *The Le@rning Federation* or the *COLIS* project.[16] The Canadian federal government also has several projects investigating Learning Objects, and the US Department of Defense is sponsoring further standardization work in the field.[17] Furthermore, the popular learning management system Blackboard is also to be adapted to conform to Learning Objects standards.[18] However forceful the support for this project might seem, Learning Objects are still an emerging technology, and might turn out to be nothing more than a chimera, a fantasy, of a group of visionaries and engineers.

Digital Rights Management (DRM) is a seminal technology that began being articulated and implemented in the mid 1990s as a way to 'shift the balance and put more power in the hands of publishers' in the emerg-

15. See *Lego learning*.

16. The Le@rning Federation Schools Online Curriculum Content Initiative, http://www.thelearningfederation.edu.au/default.asp. "About COLIS phase 1," Macquarie University, http://www.colis.mq.edu.au/about.htm.

17. On the Canadian government: Norm Friesen, Susan Hesemeier, and Anthony Roberts, "CanCore: guidelines for Learning Object metadata," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004). On the US Dept. of Defense, "What is SCORM," Advanced Distributed Learning, http://www.adlnet.gov/Technologies/scorm/SCORMSDocuments/What%20Is%20SCORM.aspx.

18. Ray Hendersson, "Openness and standards at Blackboard," http://www.rayhblog.com/blog/openness-and-standards-at-blackboard.html.

ing digital landscape. The foundation of DRM systems is that they adhere to rights holders' desires for their copyrighted material, and will only authorize certain users to operate on the material.[19] For example a system that is asked to make a copy, but which has no digital license to do so, will simply not do it. The purpose of DRM, generally, is to protect digital intellectual property, and to make control over digital material increasingly fine-grained.[20] This way of handling digital information essentially separates trustworthy and untrustworthy systems, so that publishers can control which computer programs, operating systems, or devices can be used to access DRM-protected material. In essence, DRM creates a sociotechnical script with highly constrained possibilities of action and shapes technical systems so that they will reflect the interests of rights holders and publishers.

Material and methods

An early effort to explore the standardization of DRM in education was undertaken under the auspices of the IEEE Learning Technology Standards Committee (LTSC), which has generated a number of influential standards for digital educational material. The empirical point of departure for this article is an IEEE recommended practice report on Digital rights expression languages (DREL) in e-learning.[21]

DRELs are an essential part of a DRM system. They are designed to unambiguously express rights and permissions so that the system carries out the intentions of the rights holders. They can for example state in a computer-readable form that all users that have paid €15 can access a digital book. The report under scrutiny here goes under the unwieldy name *IEEE trial-use recommended practice for digital rights expression languages (DRELs) suitable for elearning technologies*, or the *IEEE LTSC 1484.4-2007*, I

19. Stefik, "Shifting the possible."

20. Mark Stefik, "Letting loose the light: igniting commerce in electronic publication," in *Internet dreams: archetypes, myts, and metaphors*, ed. Mark Stefik (Cambridge, MA, USA: MIT Press, 1996). See also Lessig, *Code*, 178, for a critical discussion of DRM.

21. The working group that developed the LTSC DREL consisted of ten people working for various entities with stakes in DRM technology: software companies were represented by IBM, Click2Learn (now SumTotal), ContentGuard, and Microsoft; publishers were represented by educational publisher Scholastic; and the perspective of the nation state by the Australian ICT development agency for education, Education.au. See IEEE LTSC DREL Workgroup, "Call minutes," IEEE, http://ltsc.ieee.org/wg4/files/ieee_drel_minutes_030421.doc.

will call it the LTSC DREL report for short.[22] The report is a 128-page technological recommendation that expresses what permissions and conditions the actors found to be desirable in DRELs suited for education. The heart of the document is a list of 37 functional requirements, but it also includes annexes on three pre-existing DREL languages. These annexes were submitted to the LTSC working group by proponents for different DRELs in order to show that their DREL language satisfy the functional requirements.[23]

In order to investigate the hypotheses about DRM and Learning Objects in more detail, I expanded the material from the LTSC DREL report in two steps. First, I searched Google Scholar for articles that pertained to DRM and Learning Objects. Second, using a chain technique, I expanded this original selection of articles by scrutinizing their reference lists in order to find papers that dealt with DRM and e-learning until I found no new references.[24] This procedure yielded 27 articles, reports, or papers about DRM in education, encompassing about 800 pages. The majority of the selected texts were written by educational visionaries, researchers, or engineers that were involved in developing, implementing, or using DRM for educational puposes.

The 27 texts identified through the chain technique were qualitatively analyzed by identifying passages in which hypotheses of DRM in education were expressed. These passages were coded and classified under descriptive names, and subsequently grouped together under common headings, such as 'control,' 'create markets,' or 'modification and redistribution.'[25] These groups were then further interpreted and correlated with the LTSC DREL report, to generate an understanding of DRM in education. In analyzing this material I scrutinized the LTSC DREL report to understand how a hypothesis of DRM in education was inscribed in a technological recommendation. These methods allowed the linking of the dry and technical language of the LTSC DREL report with a vision for digital educational publishing.

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22. IEEE, "IEEE trial-use recommended practice for digital rights expression languages (DRELs) suitable for elearning technologies," (New York: IEEE, 2007).

23. These are the ODRL, the MPEG REL, and the OeBF DRELs

24. Michael Quinn Patton, *Qualitative research and evaluation methods*, 3 ed. (London: Sage, 1990), 237-238.

25. This technique was inspired by the coding strategies outlined by Anselm Strauss and Juliet Corbin, *Basics of qualitative research: grounded theory procedures and techniques* (London: Sage, 1990), but does not attempt to generate theory from data, and consequently does not aspire to be a grounded theory approach.

Hypothesis: networked marketplaces for reusable Learning Objects

In order to understand the hypothesis of DRM and Learning Objects I begin with the rationales, the purposes, and the intentions behind DRM in education. What are the actors trying to achieve with this technical project? What are their hypotheses about the world in which DRM protected Learning Objects will thrive? These hypotheses are critical to be aware of as they outline the intentions and purposes of DRM in education, and, as the article will show, also become inscribed in a technical standards report in education, the LTSC DREL.[26]

The intention behind introducing DRM for educational material is simple: to create a global market for distributing and marketing so called Learning Objects on a large scale through increasing the reuse of educational material. The idea is to create a technical system that would allow bits of information to be reassembled like Lego-blocks in order to avoid the duplication of thousands of Learning Objects.[27] The Vice Chair of the IEEE Learning Technology Standards Committee, Robby Robson, who is also the President of Eduworks Corporation, a developer of educational technology, expresses the rationale for developing a Learning Object market eloquently:[28]

> Every year, as summer turns to fall, thousands of faculty members across the United States will think about preparing a first-year calculus class. Thousands more will do the same for English literature. And most of them will not share their work. During the next year, tens of thousands of quiz questions will be written for introductory biology. Hundreds of Web sites will be developed for use by sociology classes. And virtually no questions and no Web sites will be shared. Those faculty members who do share their work typically find that they receive little or no official recognition or credit and retain little or no control over how their work gets used.[29]

26. On sociotechnical hypotheses and scripts see Akrich, "The de-scription of technical objects."

27. Cf. *Lego learning*.

28. Robby Robson, "Robby Robson homepage," http://www.eduworks.net/robby/.

29. Robby Robson et al., "Share and share alike: the e-knowledge transformation comes to campus," *EDUCAUSE review* 38, no. 5 (2003): 1.

According to this hypothesis, the essential idea is to break down educational material into atomic chunks of material – Learning Objects – so that they can be reused in many different configurations. The idea being that each Learning Object could form a building block for a new course, or even a new lecture. The proponents of the idea argue that this structure could facilitate the reuse and repurposing of Learning Objects so that learning material from different sources could be repackaged in new units. The ultimate goal being to create economies of scale for the expensive process of developing digital educational material.[30]

A further part of the hypothesis for rights protected Learning Objects is the idea of a computerized and automated marketplace, a so-called Learning Object Repository. It is envisioned that there will be several repositories that can collect material from publishers and resell it to the educational providers, teachers or students. Multiple repositories can then connect to each other in order to form a federation of repositories. In the material, this idea is for instance expressed by Stephen Downes who works with online learning at the National Research Council of Canada:

> A given provider of learning materials will work with one of many brokers who sell to multiple purchasers, and a given user may [use] one of many agents who conduct transactions with multiple vendors. Vendors and users may select from any number of brokering services, so that no single transaction agent controls the network. Vendors and purchasers may act as their own brokers. A vendor or purchaser may elect to employ multiple brokers. Brokers acting on behalf of, say, a provincial department of education [in Canada], may represent a given population, such as the students of that province. The purpose of this provision is to eliminate the need for the creation of multiple accounts, to allow users to user resources from multiple vendors, and to provide a choice of brokers, and therefore a greater likelihood of trust.[31]

The vision of federated repositories is crucial to the concept of reuse as one repository can include objects from different sources, and sell to other repositories, organizations, consumers, or a federation of repositories. According to the proponents, this would allow consumers to purchase

30. Cf. *Lego learning*.

31. Stephen Downes et al., "Distributed digital rights management: the edusource approach to DRM" (paper presented at the First International ODRL Workshop, Vienna, Austria, 2004), 113.

material from any repository and find material from different sources in one location.[32]

A synthesis of the hypothesis for reuse of Learning Objects, economies of scale, and federated marketplaces becomes a simple but compelling hypothesis of a technological future, in which information is available in multiple marketplaces that allow reuse and remixing of Learning Objects into new combinations. The purpose of the federated repository being to integrate knowledge from multiple sources so that it can be reused and sold.[33] This hypothesis describes the vision of a new technological marketplace for educational material through federated repositories, Learning Objects, and DRM.

Problematization: copyright, provenance, law, and duplication

However, the hypothesis of federated repositories is associated with a number of problems that position DRM as a technological system crucial for its realization. By defining and expressing these problems, the proponents of rights protected Learning Objects attempt to position DRM as an obligatory passage point on the way to the creation of a federated marketplace for reusable learning material. In this, one of the primary problems is the complexity of copyright management in a system of reuse involving multiple authors. How can Learning Objects that contain the works of different authors be tracked and paid for? A second set of problems is concerned with how digital material can be controlled in order to ensure proper attribution, and to prevent its unauthorized modification and duplication.

The first set of problems is related to the foundational idea of Learning Objects, in which they are to be put together from different objects, regardless of where they stem from, to form new objects, lessons, or courses. The difficulty, which is conjured up to enroll support for DRM,

32. On federated repositories see for instance Geoff Collier, Harry Piccariello, and Robby Robson, "A digital rights management ecosystem model for the education community," in *DRM whitepapers* (Content Guard, 2004), 12, Geoff Collier and Robby Robson, "Digital rights management for research and education," (Sidney: Macquarie Uni. E-learning Centre Of Excellence, 2004), 14, Stephen Downes et al., "Digital rights management in e-learning: problem statement and terms of reference" (paper presented at the World Conference on E-learning in Corporate, Government, Healthcare, and Higher Education, Chesapeake, VA, 2003), 1, Tim Hand et al., "Framework for rights enabled Learning Object exchange trial," in *New practices in flexible learning* (Brisbane, AU: Australian Flexible Learning Framework, 2003), 27.

33. See for example Robson et al., "Share and share alike," 2.

is the complexity of managing the provenance, copyrights, and royalties of thousands of Learning Objects. Especially as this task becomes increasingly complex as the number of authors increases. At the heart of the problem is that each course can combine multiple Learning Objects from any number of authors, publishers, or databases, with different prices or usage-rights associated with them. As Osvaldo Santos and Fernando Ramos, engineers from Portugal, argue:

> [...] even a simple eLearning module can have dozens of different Learning Objects, some of them from different providers, with different [intellectual property] rights. For example, the same Web page may contain text from one provider, a JAVA simulation from another and an image from a third provider, each one with specific rights and royalties.[34]

Accordingly, the problem, which is used to recruit support for DRM, is that the organization of federated Learning Object repositories would create a highly complex system of marketplaces in which payments are to be divided up between multiple authors and multiple vendors. The reuse of Learning Objects through federated repositories is portrayed as generating a plethora of micro transactions as each reuse generates the need for multiple streams of payments to different rights holders. The task of managing this complex organization is seen as gargantuan, and the 'obligatory' solution is constructed as the automatic handling of royalties, access, and rights through DRM.[35]

The other challenge which is used to define DRM as an obligatory passage point is the problem that a digital resource could be reused infinitely without control or rewards to the authors. By digitally publishing research or educational material in a system of federated repositories the possibilities of dissemination, use, and duplication become global and infinite. Problems that are associated with digital Learning Object publishing are the safeguard of 'proper attribution,' 'fidelity' of published documents, and the tracking of use. Accordingly, it is stressed that DRM control over research and educational information is needed to: (1) ensure proper attribution, i.e. Learning Objects can only be used as long as

34. Osvaldo A. Santos and Fernando M.S. Ramos, "Proposal of a framework for Internet based licensing of Learning Objects," *Computers & education* 42 (2003): 232.

35. On automation, see for example: Collier and Robson, "Digital rights management for research and education," 7, Downes et al., "Distributed digital rights management," 112, Hand et al., "Framework for rights enabled Learning Object exchange trial," 76.

proper credit is given; (2) hinder the unauthorized modification of published material; and (3) be able to track the use of the rights protected material, often in order to be compliant with legal requirements.[36] Using these problems, the proponents of Learning Objects position the protection of copyright and intellectual property as essential, and obligatory, for the 'success of e-learning:'

> As with other industries that rely on the digital content, a major obstacle facing e-learning is the vulnerability of intellectual property to improper and undesired use. Motives for ensuring proper use include avoiding adverse legal actions, ensuring payment, ensuring proper attribution, and ensuring the intellectual fidelity of content. [...] The ability to specify and enforce digital rights is crucial to the success of e-learning.[37]

The above-outlined problematization, where several interdependent problems are defined, connects DRM technology not only to control over the illicit duplication of intellectual property and compliance with regulations, but also to the specific demands tailored to research and education. Thus, the problematization creates a space for a technical solution that can control access to, provenance of, and remuneration for Learning Objects. As Renato Iannella, the creator of the Open Digital Rights Language, one of the DRELs submitted to the LTSC DREL report, puts it:

> In a thriving online learning and information environment, there will be extensive movement of learning and information resources and re-use, or repurposing, is integral to the way online learning takes place. The complexities of managing rights

36. On attribution, tracking, and modification see for example Collier, Piccariello, and Robson, "A digital rights management ecosystem model for the education community," 1, 7, Collier and Robson, "Digital rights management for research and education," 7, 11, Downes et al., "Digital rights management in e-learning," 1, Charles Duncan et al., "Digital rights management: final report," (Edinburgh: Intrallect Ltd., 2004), 31, Norm Friesen, Magda Mourad, and Robby Robson, "Towards a digital rights expression language standard for learning technology: a report of the IEEE Learning Technology Standards Committee Digital Rights Expression Language Study Group," (IEEE LTSC, 2002), 5, Hand et al., "Framework for rights enabled Learning Object exchange trial," 85, Robby Robson, "Digital rights management: a white paper for alt-i-lab 2004" (paper presented at the alt-i-lab 2004: Advancing learning technology interoperability, San Fransisco, CA, USA, 2004), 6.

37. Friesen, Mourad, and Robson, "Towards a digital rights expression language standard for learning technology," 2-3.

> in such dynamic environments are considerable and it is for this reason that DRM is of key importance to the online learning marketplace.[38]

In accordance with the problems defined to enroll support for DRM, the implementation of DRM for Learning Objects is to give course constructors and owners of educational content a large measure of automated and computerized control over their material. The argument being constructed is that DRM protection is an obligatory passage point for constituting a market for reuse of Learning Objects. The intention being to hamper the unauthorized digital duplication of published information, and solve the rights-complexities associated with the reuse of educational material.

The essence of the above argument is the fact that DRM for Learning Objects is constructed as an obligatory passage point through a specific set of hypotheses about the world and problems that need to be solved. I argue that the hypotheses and problems form a problematization which positions DRM technology as a necessary means for continuing on the path toward successful implementation of Learning Objects. In the following I show how this specific hypothesis and problematization is inscribed in a technical report and how this technical report not only elaborates a technical system, but also elaborates a number of new possibilities for doing business through translations from other domains.

Inscription: DRM constraints and the laws of the markets

The IEEE LTSC DREL report defines a number of constraints that are desirable to express in a digital rights expression language (DREL) geared toward education. This report begins to define a DRM protected information infrastructure by materializing the hypothesis and problematization of rights protected and reusable Learning Objects in a technical standards report. That is, a hypothesis of the world is inscribed in the report, which in turn forms a recommendation that is meant to shape the future of educational markets through technology. The point being that the dream of rights protected Learning Objects is slowly leaving the realm of hypotheses and problematizations and has begun meandering towards becoming a technical system. In the following the outlines of this information infrastructure are traced in order to show how these hypotheses and problematizations are inscribed in a technical report; how

38. Renato Iannella, "Digital rights management in the higher education sector," (Canberra, AU: Commonwealth Dept. of Education, Science and Training, 2002), v.

the envisioned market for Learning Objects is to be fashioned through a digital rights expression language, a DREL.[39]

At the heart of the LTSC DREL report there are a number of constraints and permissions that are considered to be crucial for an actual educational DREL. This list of constraints specifies 19 'conditions for use.'[40] For example, the report specifies that a digital rights expression language for education should be able to control how Learning Objects can be 'used, accessed, distributed, and/or replicated,'[41] or which devices or computers could use a certain resource – i.e. only computers at a certain university or only a trusted device. Furthermore, the LTSC DREL report states that an educational DREL shoud be able to specify from which sites a user can play content, for instance that a video could only be played from www.mit.edu. And that geographic constraints should be enforceable, so that pricing or control of access could be tailored to different geographical markets. Moreover, it defines time-based constraints, allowing DRM systems to flexibly price and restrict usage on the basis of time, whether it is arbitrary time intervals, or even metering time.[42] Essentially the numbers of rules that could be inscribed in a DREL are limitless, the only limitation being that it must be possible to specify in a standardized format.

However, in order to better understand how the LTSC DREL report constitutes a specific hypothesis of education, one must examine the concrete technical examples. These examples are not only inscriptions but are also translations from other domains that elaborate the hypothesis and problematizations connected to a Learning Object market. Here, new payment methods, business models, and markets are elaborated and inscribed in technical jargon and code. Tim Hand who works in the Technical and Further Education sector in Australia, echoes this sentiment:

> Good business models are the 'killer app' of the digital age. As music publishers struggle to see the need for new business approaches, so too should the education publishing community.[43]

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39. On the connection between markets and technology see for example James R. Beniger, *The control revolution: technological and economic origins of the information society* (Cambridge, MA: Harvard UP, 1986).
40. IEEE, "LTSC DREL," 4-5.
41. Ibid., 4.
42. Ibid., 4-5, 45-46.
43. Hand et al., "Framework for rights enabled Learning Object exchange trial," 86.

Thus, the report is not only about control, but also about elaborating new opportunities. Thereby, the report not only inscribes a hypothesis, but it also elaborates and betrays it. Cases in point are the many examples that describe how a global market for Learning Objects might function in the LTSC DREL report. The next section delves into a few business models that are elaborated in the report in order to explicate some of the sociotechnical scripts that can be created by implementing a DREL in accordance with the outlined hypotheses and problematizations. These show how the LTSC DREL report translates business models stemming from other domains like the music business, the movie industry, or the publishing trade. These illustrations provide insights into how the hypothesis and problematization are combined with business models from other domains, which are subsequently elaborated into novel sociotechnical scripts for the educational arena. Thus, translation becomes betrayal, but productive betrayal.

Elaboration: the grammars of business

A central hypothesis inscribed in the LTSC DREL report is that an educational DREL needs to develop a 'grammar' of basic building blocks of computer code for defining control and payment. The principal idea being that these basic building blocks could be used for elaborating new business models.

> For example, instead of defining pay-per-view, rent-to-own, and other such models, the core should provide the fundamental building blocks to link constraints (e.g. payment) to actions to allow constraints to repeat according to various criteria, provide metering syntax etc.[44]

This modular 'grammar' of coded control opens up for pricing models that make it possible to design many different structures of business and payment. Through the use of DRM, these basic types of control can be adapted according to different types of actions and to different types of users. Accordingly, the annexes to the LTSC DREL report include many examples of how the basic elements of control and payment could be organized in a DRM-protected educational system. These examples translate and elaborate a number of hypothetical modes of organizing the educational publishing business in a digital world. For instance, in Annex A of the LTSC DREL report a connection-constraint can be linked with a

44. IEEE, "LTSC DREL," 3.

copy-constraint, and a play-constraint, so that the prices for playing or copying educational material can be differentiated:

> The rights 'play' and 'duplicate' both are constrained to the software service http://www.universal.org/ but each right has different payment requirements. The party urn:univ:sguth has to pay € 1.00 for playing the video urn:iniv:lr-wuw-video-1 once and has to pay € 10.00 each time the video is duplicated.[45]

This is an example of how playing and copying become constrained and linked to different prices. To copy a resource to another device, or to redistribute the resource to another person would incur a fee. Likewise playing the resource, regardless of the previous payment for making a copy, would incur a fee. This provides an illustration of how a basic business model is constructed through combining technical constraints from a DREL.

An additional elaboration contained in the LTSC DREL report deals with 'renting' educational material. To achieve this, as I have outlined above, the report calls for the possibility of 'unambiguous specification of time-based constraints such as specific times, fixed intervals, sliding intervals, and metered intervals that can span across different time zones.'[46] By way of illustration, an appendix of the report shows in text and DREL markup language how time based constraints could be used to specify an interval between two dates, an arbitrary interval of time, or how many hours that a resource can be used:[47]

> The listing below shows the use of an asset with the 'accumulated' constraint. The right play may be performed to the asset urn:univ:lr-wuw-video-1 by the party urn:univ:sguth for an accumulated 30 h period.[48]

Restricting usage of a resource on the basis of time allows rights holders to extract payment not only for using content, but also for how long that content is used. For example, a combination of time based constraints and different prices makes it possible to apply different fees at different times: where a student could have to pay € 0.50 to play a video in the morning

45. Ibid., 50.
46. Ibid., 4.
47. Ibid., 45-46.
48. Ibid., 46.

and € 0.90 in the afternoon.[49] Instead of being limited to extracting payment for a specific specimen, like with books or DVDs, rights holders will be able to get paid in the same manner that owners of parking lots, bike rental companies, or real-estate owners get paid. Thus, through combining business ideas from other domains with the modular grammar of control, new payment methods and business models for education are elaborated. The hypothesis is not only inscribed in the report, the report also elaborates the hypothesis by translation from other domains.

A further sample of a translation from another domain in the LTSC DREL report is subscription. Subscription shows how different constraints can be combined to create pricing models based on geographic location and how different types of users can be automatically billed a different price:

> [an] online education magazine publisher offers its consumers the following subscription options:
>
> — A basic yearly subscription to the magazine.
> — Different subscription rates based on geographic location
> — Discounted subscription rates for schools and libraries.
>
> [...] Rather than purchasing rights to a specific issue (similar to buying an issue on the news stand), consumers may purchase a subscription for a flat fee and receive a one-year subscription.[50]

As this quote demonstrates, through combinations of different DREL constraints, different pricing models become possible. Subscribers could be given the right to play a video during a year.[51] Or all personnel in a specific organization or a specific range of computers can be allowed to access a resource.[52]

One thing that all of the above examples show is that, in a script constituted through DRM, the point of purchase is no longer the sole point of payment. Payment can be extracted at the point of purchase, for every copy made, for every use, for every hour and minute. Prices can also be adapted to different students, different times, different countries, and different organizations. The possibilities for creating a market of reuse and remixing through DRELs almost seem boundless. The above illustra-

49. Ibid., 51.
50. Ibid., 84, 120.
51. Ibid., 51.
52. Ibid., 52.

tions also show how certain hypotheses about business and education are translated from other domains and elaborated in the LTSC DREL report; how these technical constraints are used to construct a hypothetical market of reuse.

The point is that DRM-technology standards for education are inscribed with a hypothesis and problematization of how the global market for digital material should function, creating a script with the purpose of facilitating a certain way of handling digital educational material. But also that the code examples in the appendices to the report elaborate, expound on, develop, and expand the original hypothesis and problematizations to produce something qualitatively new. Thus, translation in this case crucially includes betrayal – traduction/trahison; but the betrayal is productive, it elaborates.[53]

The re-construction of intellectual property

This article has shown how a vision for digital educational publishing of so called Learning Objects is tied to digital rights management technology through defining a number of problems as essential to solve. In this manner proponents of DRM attempt to position DRM-technology as an *obligatory passage point* for the 'success of e-learning,' and a burgeoning Learning Objects market. Furthermore, the article demonstrated how a technical report, the LTSC DREL, is *inscribed* with this hypothesis for educational publishing. However, in the technical report, a number of business-models are elaborated through examples from other business domains. Through the *translation* of business models from other domains, new ways of constructing business, ownership and pricing of digital educational material can emerge, which thus creates the sociotechnical basis for a new market for educational material. The point is that through the heterogeneous combination of human intentions, ideas from other domains, and a technical object on the way to becoming real, a *script* for a new market for educational material can emerge.

The empirical point of the article is that DRM in general, and the LTSC DREL report in particular, is inscribed with and elaborates a logic which reshapes the ways in which we construct the future of digital distribution and ownership in education. If this reconstruction becomes stabilized in technical systems, it would mean that the purchase of educational material would no longer be tantamount to ownership or free use, instead a purchase would entail of a grant of rights. This can lead to

53. See Law, "Traduction-trahision." on the importance of translation and betrayal. For the productivity of parasites/static, see Serres, *The parasite*.

convoluted ways of thinking about copyright that seem illogical in light of traditional ways of constructing intellectual property. This translated re-construction of intellectual property can be argued to fit into an emerging shift from the current modes of paying and getting paid for educational material. Historically students and libraries have purchased their physical books or compendiums once; after this they have been free to use, copy, or read at will (although copying may have been illegal). A DRM protected system of publishing attempts to re-construct this situation radically. For instance, in a comment to a code-example from the LTSC DREL report, the following elaboration is made:

> The grant that the consumer may obtain. It grants the consumer the right to claim ownership of the property of being a subscriber for one year.[54]

Thus, in a DRM-protected educational computer system, the subscriber would no longer own the thing subscribed to, but would own the right of being a subscriber for one year. After that year, all access could be cancelled leaving the subscriber with no trace of the goods that would traditionally have been his or her property. Accordingly, with a DRM protected Learning Object, students no longer purchase copies of content, but the rights to use content in highly specified ways. By using techniques like this, DRM-systems can redefine essential aspects of how intellectual property is constructed. Precisely this effect has also been recorded with DRM protected books, in which Amazon.com, in one ironic instance, recalled George Orwell's *1984* from consumer e-book readers, leaving unsuspecting consumers wondering why their newly purchased books had disappeared, and why they had been refunded for the purchase.[55]

In context, DRM in education can be understood as one aspect of the increasing commercialization and commodification of education that is increasingly becoming a norm across the globe, in which the student is redefined as a consumer of education, and the educational process increasingly is imbued with an instrumental, measurable, and commodifiable logic.[56] Arguably, these developments have already begun to materialize in research databases, digital libraries, and learning management sys-

54. IEEE, "LTSC DREL," 86.

55. Brad Stone, "Amazon erases Orwell books from Kindle," The New York Times, http://www.nytimes.com/2009/07/18/technology/companies/18amazon.html

56. See for example David L. Kirp, *Shakespeare, Einstein, and the bottom line: the marketing of higher education* (Cambridge, MA: Harvard UP, 2003), who has shown these tendencies in the US higher education system.

tems. Despite the global dissemination of digital information and material the cost for access to digital scholarly resources is increasing steeply. Costs for journal subscriptions are rising across the board, and electronic versions typically cost between 10% and 25% more than their physical versions.[57]

It seems that the digital distribution of material for the educational market contains possibilities for at least two types of revolutions: one that makes possible low-cost dissemination and sharing of educational material over the Internet. In this version of digital distribution teachers and students share educational material on an open access basis, without requiring any economic compensation.[58] In the other version, presented in this article, publishers and copyright-holders attempt to create a rights protected market for educational material, through implementing technological measures that contain the possibility of fine-grained usage constraints, and are connected to a demand for economic compensation. Both of these versions of digital distribution are at the moment possible using similar sets of online digital technologies. One technology, DRM, is unequivocally tied to a vision of control and commerce.[59]

In sum, DRM standards for Learning Objects attempt to re-construct intellectual property by inscribing and elaborating a hypothesis of the future functionality of learning management systems and online learning platforms. Thus, technical recommendations for Learning Objects become non-human actors that assist a specific mode of organizing education, and are deeply implicated in an attempt to re-construct of intellectual property, digital distribution, and educational publishing.

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57. Carmen Luke, "Eduscapes: knowledge capital and cultures," *Studies in language and capitalism*, no. 1 (2006): 109.

58. Bohlin, "Communication regimes in competition," 375.

59. These two positions on digital distribution are decades old. For an introduction to the different sides see: Charles C. Mann, "Who will own your next good idea?," The Atlantic monthly, http://www.theatlantic.com/issues/98sep/copy.htm, and the following roundtable: Charles C. Mann et al., "Copyright roundtable," The Atlantic monthly, http://www.theatlantic.com/unbound/forum/copyright/intro.htm. For more contemporary takes on the issue see Bohlin, "Communication regimes in competition," 375, Heather Morrison, "Open access textbooks," http://poeticeconomics.blogspot.com/2005/12/open-access-textbooks.html.

Conclusion

8

Closing discussion

This chapter concludes this inquiry. It opens with a summary of the articles, and continues with a discussion of three different themes related to my articles. My objective in this discussion is to highlight some of the associations that exist between technology in distance education and the seemingly disparate topics of industrialization, individualism, atomic knowledge, and commodification. This entails a discussion as to how a particular mode of organizing education has had certain stability in the 20th century and how a number of developing technologies are formed.

The chapter is organized as follows: First, I outline the articles included in this volume. Second, I examine the figure of mass-individualization in distance education. Third, I turn my attention to how mass-individualization is connected to specific ways of understanding and treating knowledge. Finally, I discuss the role of non-human agents and responsibility in relation to technological and social determinism.

A summary of the articles

The first article in this volume is *Technopedagogies of mass-individualization*. The topic for this article is how technology and pedagogy shape each other in correspondence education. Here, I consider the ways in which educational thinking about individualism, scientific thinking, and the industrialization of education were combined into a specific educational assemblage in correspondence education. The focus of the article is to scrutinize this assemblage: how it worked, how its different parts inter-

acted, how students and teachers were viewed. The cornerstone of the argument is that a number of mundane technologies – in the form of tests, forms, and schedules – constituted an assemblage attempting to bridge pedagogical individualism and the industrialization of education. In conclusion, I ask whether or not mass-individualization in correspondence education can be regarded as the epitome of the desire for equality of educational opportunity, individually tailored education, and industrialized education: mass-individualization.

The second article is *Learning in nowhere*. Here I scrutinize the individualistic practices of correspondence education more closely. I study the thoughts, procedures, and student subjectivities that thrived in correspondence education. Attention is centered on the construction of student subjectivities through conditioning, mentoring, correcting, and adjustment of the students by themselves and others. The heart of the article is the construction of the subject position, 'the independent learner.' As in the first article, I pay particular attention to the heterogeneous assemblage of things that made this possible: the construction of flexible course modules; the assumption that the *individual* student should work with the material; the motivating schemes that were utilized; and the practices of classification, grading, and streaming. My argument is that 'the independent learner' was constructed through specific material practices: self-checking exercises, reminders, and examinations that were to help students develop self-reliance. These material practices were to free the student from the 'lock-step' of the class, but they also excluded the material, cultural, social, and economic aspects of learning.

In the third article, *Lego learning*, my concern shifts to the future of distance education and the technical project Learning Objects. I investigate how a number of intentions for Learning Objects are configured and materialized in a technical standard. The article demonstrates the ways in which ideas about economies of scale are translated into a vision of reusability of learning material, and how reusability is inspired by object-oriented programming and thus linked to technical modularization. Lastly the article shows how technical modularization is translated into epistemic atomism. This technical atomism emphasizes that every modular Learning Object must be independent of links to other material, independent of being in a specific position in a course, and independent even of being in a specific context. In closing, I ask with which epistemic norms and metaphors Learning Objects are compatible. Accordingly, Learning Objects are far from being purely technological; they are also steeped in hypotheses about economics, learning, education, and knowledge.

The fourth article, *Coding copyright*, continues the investigation into Learning Objects but now with emphasis on the technological systems

that are to protect Learning Objects from unauthorized duplication. In this article I analyze how the hypothesis of reusability is linked to the construction of DRM-technology as an obligatory passage point for the success of a Learning Objects market. This problematization attempts to define a number of essential roles for DRM in relation to standardized educational material: in assuring proper attribution; in hindering content modification; and in being able to track educational material. Furthermore, I trace how this hypothesis and problematization are inscribed in a report on the standardization of a specific DRM-technology, and are elaborated with influence from other content industries. In closing, I argue that this technical project is crucially linked to a commercialization and commodification of educational material and that it contains attributes which could change the definition of property.

These four articles highlight a number of themes relating to technology and education, and show some important tendencies in relation to technology in education: massification, individualization, commodification, and epistemic objectification. Taken together they call attention to the use of technology in education as well as to the construction of technology.

Mass-individualization

A concept crucial to the thrust of these articles is *mass-individualization*. This concept highlights two tendencies, industrialization and individualization, which complement each other in relation to educational technology. My point being that the combination of these two tendencies creates a particular mode of organizing educational technology which seems to run through much of the 20th century.

My first concern here is with industrialization, and the attempts to minimize the repetitive tasks in distance education through the application of technology. This tendency is visible in both my studies of correspondence education and Learning Objects, where it is routinely argued that the application of technology could render education and learning more efficient; the intention often being to minimize a perceived wasteful duplication of effort in teaching, production of educational material, or in correction of student work.

In correspondence education, this tendency becomes visible in the organization of education as an assembly line for sending and correcting letters. This assembly line depended on a 'machinery' of tests, forms, and 'model answers.' This mundane technological machinery of forms and tests made possible the materialization of student knowledge into grades that could be distributed to different teachers; the coordination

of teachers in different places; and perhaps most importantly the mass-production of correspondence lessons.[1] Also, in relation to Learning Objects, the attempt to industrialize is evident in the quest for standardizing digital educational material, the purpose being to achieve economies of scale through reuse and sharing of educational material. Thus, rather than developing a course for every subject at every educational department, Learning Objects are to be used like Lego blocks to assemble new courses in an efficient manner.[2]

The industrializing tendencies in my cases seem to be tributaries to a larger current of industrializing education through technology.[3] One of the most well-known portal figures in this stream is B. F. Skinner, who was concerned with the industrialization of education through the investment in behaviorist teaching machines seen as 'labor saving capital equipment,' and the possibility of creating efficient economies of scale by letting machines take care of the repetitive tasks of education. He writes:

> There are more people in the world than ever before, and a far greater part of them want an education. The demand cannot be met simply by building more schools and training more teachers. Education must become more efficient. [...] In any other field a demand for increased production would have led at once to the invention of labor saving capital equipment. Education has reached this stage very late, possibly through a misconception of its task.[4]

In Skinner's text the idea of industrializing the educational process is clearly articulated. The efficiency of education depends on labor-saving technology. Although most accounts of educational technology today are not as distinct, there are still distance education enthusiasts who dream of using 'star' professors, or even regular faculty, to construct reusable courses that could be given year after year without being forced to remu-

1. See *Technopedagogies of mass-individualization.*
2. See *Lego learning* and *Coding copyright.*
3. For a modern example that argues for the industrialization and streamlining of education through technology see Robert Heinich, "The proper study of instructional technology," *Educational technology research and development* 32, no. 2 (1984). See also Otto Peters, "The iceberg has not yet melted: further reflections on the concept of industrialization and distance teaching," http://www.fernuni-hagen.de/ZIFF/ICEBERG.HTM.
4. B. F. Skinner, "Teaching machines," *Science* 128, no. 3330 (1958).

nerate teachers.[5] As demonstrated, both in my cases, and in other places, the application of technology seems to be tied to ideas of efficient utilization of teaching resources, the mass-production of educational material, and attempts to organize education in labor saving ways.

However, the aspiration to industrially efficient production-processes is also tied to another theme in distance education: individualism. Through technology, distance education is argued to facilitate an adaption of the educational process to the individual student's knowledge, learning style, or other individual characteristics. The perceived problem is that a completely standardized and industrialized curriculum for mass education does not fit with each and every student.

In correspondence education, the attempt to individualize the educational situation was closely connected with measurements of student performance. These assessments were often linked to a belief in a scientific measurement of learning, which aimed to classify, guide, and place students according to their perceived 'aptitudes, desires, and needs.' In correspondence education, the thought of individualizing education through technology was an essential ambition.[6] Furthermore, in the 21st century, the idea of individualizing education through technology continues to thrive, for instance in relation to Learning Objects, where it is often argued that students and teachers can easily remix and recombine these 'Lego bricks' of content in order to individualize the learning experience.[7]

It appears, therefore, that the application and development of a number of educational technologies are tightly connected to two seemingly antagonistic ways of thinking about education. One is industrialization; the other is individualism. One interpretation of this assemblage could be that a particular type of distance education started down the mass-individualized path around the turn of the last century and continues along a similar path today.

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5. David Noble, *Digital diploma mills: the automation of higher education* (New York: Monthly Review Press, 2002).

6. See *Learning in nowhere*.

7. See for example Tim Hand et al., "Framework for rights enabled Learning Object exchange trial," in *New practices in flexible learning* (Brisbane, AU: Australian Flexible Learning Framework, 2003), 67, Peter E Higgs, Sam Meredith, and Tim Hand, "Researching Learning Objects and digital rights management technology for sharing," (Brisbane, AU: Australian Flexible Learning Framework, 2003), 10.

Knowledge as object: acquisition and representation

Another decisive aspect of technology in education is its relation to the epistemic, and an important aspect to consider in this is how the attempts to mass-individualize distance education have strong associations with an *acquisition metaphor* for learning.[8] According to Anna Sfard, this metaphor is a common way of thinking about learning in the 20th century, and is highly focused on knowledge as object:

> Since the time of Piaget and Vygotski, the growth of knowledge in the process of learning has been analyzed in terms of concept development. Concepts are to be understood as basic units of knowledge that can be accumulated, gradually refined, and combined to form ever-richer cognitive structures. The picture is not much different when we talk about the learner as a person who constructs meaning. This approach, which today seems natural and self-evident, brings to mind the activity of accumulating material goods. The language of 'knowledge acquisition' and 'concept development' makes us think about the human mind as a container to be filled with certain materials and about the learner as becoming an owner of these materials.[9]

According to Sfard's reasoning, the acquisition metaphor entails an understanding of knowledge as an object that can be acquired through learning and thus become the property of an individual: 'The idea of learning as gaining possession over some commodity has persisted in a wide spectrum of frameworks, from moderate to radical constructivism and then to interactionism and sociocultural theories.'[10] The acquisition metaphor can be contrasted with a participation metaphor for learning, which I argue stands in stark opposition to mass-individualization, and which is tied to an understanding of learning as a process of becoming, performance, and participation. In the participation metaphor for learning students are seen as learning in participatory practices, emphasizing the meetings and the social aspects of learning.[11]

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8. In this I build on Anna Sfard's discussion of two different metaphors for learning. See Anna Sfard, "On two metaphors of learning and the dangers of choosing just one," *Educational researcher* 27, no. 2 (1998).
9. Ibid.: 5.
10. Ibid.: 6.
11. Sfard exemplifies theories drawing on the participation metaphor with Jean Lave and Etienne Wenger, *Situated learning: legitimate peripheral participation* (Cambridge, MA:

From my point of view, a fruitful way of applying the acquisition metaphor to mass-individualization is to consider the relations between the technological and the epistemic in computer systems for learning. By analyzing with which metaphor a computer system is compatible it becomes possible to discern certain modes of organizing, certain technical solutions, and certain ideas about educational technology as being more or less compatible with different metaphors for learning.[12] In my cases, both correspondence education and Learning Objects seem to be primarily geared to facilitate acquisition of knowledge rather than participation and apprenticeship.[13]

A corresponding argument can also be made in relation to Edward Hamilton's and Andrew Feenberg's analysis of distance education, which shows that, 'learning management systems generally emphasise the representational rather than the relational potential of networked computers.'[14] Their argument is that certain systems highlight the representation of knowledge over the relational potential for meetings, discussions, and social learning. This means, that 'the technologies are conceived as essentially representational in nature, and it is as such that they are understood to relate to and remodel the education process according to a narrow pedagogy of information delivery and acquisition.'[15]

From my point of view there seems to be a strong link between Hamilton and Feenberg's analysis and Sfard's metaphors for learning. Systems that are associated with a participation metaphor for learning organize their educational process so that they emphasize the relational, while systems that are connected to an acquisition metaphor for learning emphasize the capability of educational systems to represent information.[16] I believe that these, the acquisition metaphor and the representational mode of organizing, are both firmly tied to mass-individualization:

Cambridge UP, 1991), and B. Rogoff, *Apprenticeship in thinking: cognitive development in social context* (Oxford: Oxford UP, 1990).

12. In this I was inspired by another application of the acquisition and participation metaphors to technology and learning. See Frode Guribye, "Infrastructures for learning: ethnographic inquiries into the social and technical conditions of education and training" (Ph. D., University of Bergen, 2005), 172.

13. There are other educational platforms that emphasize meetings, interaction, and participation. However, it seems that one strand of systems are closely tied to a mass-individualized metaphor.

14. Edward Hamilton and Andrew Feenberg, "The technical codes of online education," *E-learning* 2, no. 2 (2005): 114.

15. Ibid.: 107.

16. Here Freire's banking model of education also comes to mind. Paulo Freire, *Pedagogy of the oppressed*, 30th anniversary ed. (New York: Continuum, 2000).

First, in a mass-individualized mode of organizing education, learning is constructed in line with an acquisition metaphor for learning that focuses on the representational possibilities of technology. Thus, I argue that mass-individualization is closely related to a mode of organizing that treats *knowledge as an object* that can be represented by systems and acquired by the student. In this, knowledge becomes assembled in line with the physical things that represent it, rather than as something that is acquired in social participation.[17]

Second, the *industrialization of education* is crucially associated with the objectification of knowledge.[18] Through the construction of knowledge as an object, it becomes feasible to devise systems that minimize the duplication of knowledge objects; to conceive of the correction of student work as menial tasks that can be automated; and to comprehend the physical manifestations of knowledge as possible to own and sell. Here, technological systems facilitate representation, while the relational potentials of educational technology are excluded. In the case of Learning Objects, it becomes logical and desirable to industrialize education through atomizing the knowledge objects so that they can be reshuffled and reused infinitely.[19]

Finally, I maintain that the *individualization of education* is also tied to the construction of knowledge as an object. Here the individual learner becomes responsible for acquiring the right 'knowledge objects' and constructing his/her own knowledge. But it also becomes essential to measure individual 'learning,' manifested by the acquisition of the materialized bits of knowledge, and to adapt which 'objects' of knowledge that are most appropriate for this individual student. This aspect of mass-individualization can be considered a combination of Tayloristic scientific

17. In the constitution of objects of knowledge through technological means in I draw on Michel Foucault, *Discipline & punish: the birth of the prison*, 2 ed. (New York: Vintage Books, 1995), and Gilles Deleuze, "What is a dispositif?," in *Michel Foucault: philosopher* (London: Harvester Wheatsheaf, 1992), as well as Bruno Latour, *Science in action* (Cambridge, MA: Harvard UP, 1987). On different views on objectification in social theory and education see Webb Keane, "Modes of objectification in educational experience," *Linguistics and education* 19, no. 3 (2008).

18. Compare with Otto Peters, "Distance education and industrial production: a comparative interpretation in outline (1967)," in *Otto Peters on distance education: the industrialization of teaching and learning*, ed. Desmond Keegan (London: Routledge, 1994), 123.

19. See *Lego learning.*

management and an ambition to individualize education in line with a specific understanding of knowledge.[20]

Thus, I argue that mass-individualization is in many ways tied to an objectified construction of knowledge, an acquisition metaphor for learning, and representational educational technology. The mass-individualized mode of organizing education seems to be durable in time and space and is decisively associated with learning management systems that emphasize efficiency of education.

A crucial question which this analysis leads up to is: who is responsible for this mode of organizing? Who or what determines mass-individualization? Is it the proponents of correspondence education or Learning Objects? Is it a necessity of the technological organization of distance education? Here the discussion ties into the key questions of social and technical determinism that I posed in the introductory chapter.

Granularity, assemblages, and agency

One way of approaching determinism is through agency: who or what has the power to shape or change the direction of things? Technology determines education? Educators determine technology? In this section, I examine educational technology in the form of Learning Objects, first from the point of view of non-human agents, and second from the point of view of social interests. The critical issue is the way in which non-human agents, in the form of technological standards, can become powerful actors in shaping the future of distance education. Furthermore, I wish to discuss how different theoretical understandings of technology in education create different understandings of responsibility.

In the sense of shaping education, educational technology has agency in multiple ways: it can be affined with certain metaphors for knowledge or hypotheses about education; it can become an agent by constituting a background infrastructure that could gain power through its diffusion, or perhaps even become irreversible through the sheer force of its

20. The scientific management of education is also discussed in Peters, "Distance education and industrial production," 119.

associations;[21] or it could gain momentum by becoming a successful prototype which becomes a model for thinking and doing.[22]

Translating granularity

One decisive way in which educational technology is implicated in agential relations is through its translation of a hypothesis about the world. In this sense, educational technology is part of constituting an assemblage that gains an agential effect through the interactions of all its elements. The *granularity* of Learning Objects provides a clear illustration of these questions

Granularity is a word used by Learning Objects professionals to describe the size of a Learning Object. A highly granular Learning Object contains little data, for example only a picture of the *Mona Lisa*. Ideally Learning Objects should be highly granular so that the 'Lego' pieces can more flexibly be reused and reassembled in order to create new lessons. The reasoning is that the smaller the Learning Object, the more flexibility in reuse. The hypothesis of granularity is compatible both with a representational way of organizing educational technology and with an acquisition metaphor for learning, where ideally Learning Objects of atomic content are to be reassembled into new courses.[23]

This hypothesis about granularity and reuse is included in the IEEE LOM, which specifies several metadata properties for Learning Objects. One of these properties is *aggregation level*. The aggregation level property specifies a classification scheme for Learning Objects ranging from small, i.e. atomic, to large, i.e. a set of courses leading to a certificate. Accordingly, the aggregation level property defined in the IEEE LOM standard is inscribed with the hypothesis of granularity that underpins a vision for Learning Objects. Thus a hypothesis about education is translated into a metadata-property in a technical standard:[24]

> Aggregation level
> 1: the smallest level of aggregation, e.g., raw media data or frag-

21. On irreversibility, see Michel Callon, "Techno-economic networks and irreversibility," in *A sociology of monsters: essays on power, technology and domination*, ed. John Law (London: Routledge, 1991). On background infrastructures see Geoffrey C. Bowker and Susan Leigh Star, *Sorting things out: classification and its consequences* (Cambridge, MA: MIT Press, 1999).

22. On prototypes as agents see Adrian Mackenzie, *Cutting code: software and sociality* (New York: Peter Lang, 2006), 16.

23. This is discussed in detail in the *Lego learning* article.

24. See *Lego learning*.

> ments.
> 2: a collection of level 1 Learning Objects, e.g., a lesson.
> 3: a collection of level 2 Learning Objects, e.g., a course.
> 4: the largest level of granularity, e.g., a set of courses that lead to a certificate.
> NOTE—Level 4 objects can contain level 3 objects, or can recursively contain other level 4 objects.[25]

In the other IEEE standard which I have studied – the IEEE DREL report, which is concerned with protection of digital property – the hypothesis of granularity is also present. Here it is translated into a requirement for digital rights protection technology for Learning Objects, with the aim of protecting Learning Objects from illicit duplication. In the IEEE DREL report granularity is expressed in the dry language of technical expertise, as a desired property for an educational DREL language:

> 2.2.5 The DREL should allow specification of constraints associated with different levels of granularity in an aggregated Learning Object.[26]

This is a translation of granularity from a metadata property into a functional requirement for a computer language, a Digital Rights Expression Language. Another form of translation exists in the same document. Here granularity shifts modality, from technical prose to computer code. Through the code example, granularity is tied to a specific mode of protecting intellectual property. Hence, granularity is no longer only a matter of reuse, but also a matter of protecting the property of the author. The example expresses, in machine-readable code, permissions for using different assets in specific ways. The abbreviated DREL code example looks like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<rights>
  <agreement>
    <asset id="Asset-01">
      <context>
        <uid>urn:univ:lr-wuw-video-1</uid>
      </context>
    </asset>
```

25. IEEE. "IEEE standard for Learning Object metadata," (New York: IEEE, 2002), 10.
26. IEEE. "IEEE trial-use recommended practice for digital rights expression languages (DRELs) suitable for elearning technologies," (New York: IEEE, 2007), 4.

```
[…]
 <permission id= »forAsset01 »>
  <asset idref= »Asset-01 »/>
  <play>
 </permission>
[…]
 <permission id="forPackage">
    <asset idref="Asset-01"/>
    <asset idref="Asset-02"/>
      <duplicate>
        <constraint>
          <datetime>
              <end>2004-12-31T00:00:00</end>
          </datetime>
        </constraint>
      </duplicate>
    </permission>
    <party>
      <context>
        <uid>urn:univ:department-IS</uid>
      </context>
    </party>
  </agreement>
</rights>[27]
```

This passage of code exemplifies how a DREL-language can describe constraints and permissions regarding the use of specific parts of a bundled package of resources. Here, different aspects of control are encoded in machine-readable form in order to illustrate the fact that the DREL in question, Open Digital Rights Language (ODRL), can provide protection for aggregated and granular Learning Objects. This shows how code can translate the hypothesis of granularity into a specific version of Learning Objects.

All of the above translations transform in subtle ways the property granularity in Learning Objects, and are tied in different ways to each other. But the translations are also inscriptions of a hypothesis about the world. Through these translations, which add their own distinct flavor, granularity gains properties – it is slowly materialized. The IEEE LOM adds concerns for reuse, economies of scale, and an atomistic knowledge ideal. The IEEE DREL report adds concerns about property rights and markets. Every translation shifts the meaning of granularity slightly. By shifting the characteristics of granularity, every translation also shifts the distributed agency of Learning Objects.

27. Ibid., 36-37.

The above argument shows how technical standards, hypotheses about education, and code are associated with each other in an assemblage which gains properties and characteristics through multiple translations. Each technical feature adds social meaning, and each social meaning adds technical features. However, in order to understand how the agency in these translations could affect education it is crucial to take note of some further associations.

Diffusion and irreversibility

In the sense of melting into the background of an infrastructure that shapes educational practice, both correspondence lessons and Learning Objects standards have salience. Correspondence letters, on the one hand, are almost completely invisible as infrastructures. They are constructed with technologies that are so commonplace that their infrastructural role becomes almost immediately forgotten. Being so mundane, they melt into the background.

Learning Objects, on the other hand, is at the moment a very visible technology because it is under construction; it is, as of now, a chimera. It has not yet been backgrounded into the infrastructural substratum of digital education. However, if Learning Objects become commonplace, their specific codings of granularity as well as their treatment of knowledge and learning would become part of the technical background of education.[28]

A crucial aspect of making a Learning Objects infrastructure is its diffusion. If the assemblage of Learning Objects is diffused in multiple technologies, multiple systems, multiple educational institutions, it will gain a momentum through its diffusion; and it would become increasingly hard to reverse, perhaps even irreversible, through the sheer force of the assemblage's associations.[29] In this manner, Learning Objects could become a backdrop to education and with them would follow the assemblage of granularity. Thus, Learning Objects could become something which fades from educational consciousness like the black/whiteboard, overhead projector, or, increasingly, PowerPoint. Thus, Learning Objects could introduce 'algorithmic processes into the infrastructural backgrounds' of education, knowledge, and learning.[30] The software code of Learning Objects and granularity would hybridize itself with educational practice.

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28. On backgrounding see Mackenzie, *Cutting code*, 13.
29. On irreversibility see Callon, "Techno-economic networks and irreversibility."
30. Mackenzie, *Cutting code*, 13.

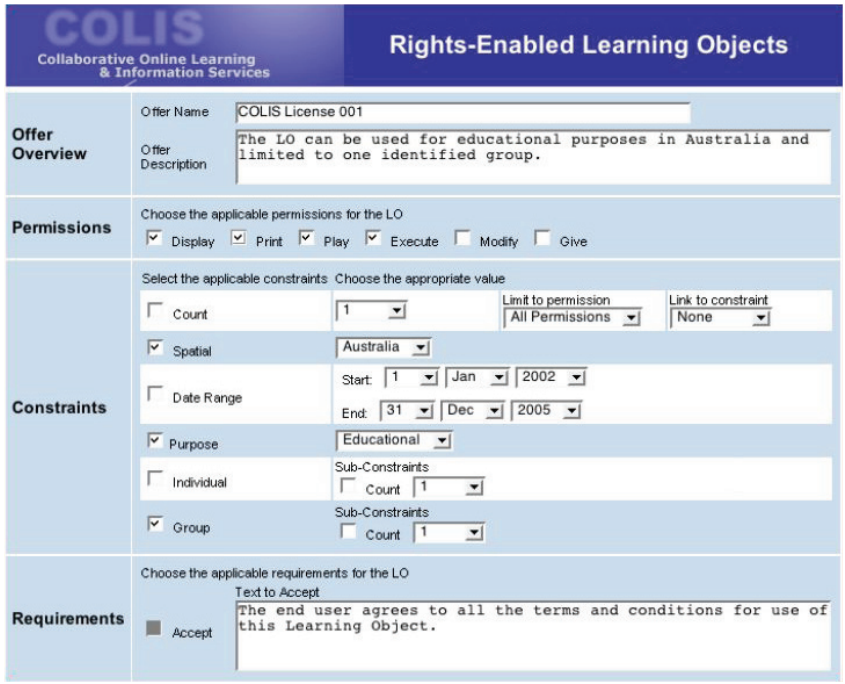
This scenario is becoming increasingly plausible as Learning Objects gain momentum. There are several events that point to this increasing momentum. For instance, CanCore, which is a Canadian technical recommendation and guide to the IEEE LOM, attempts to translate a global technical standard into a recommendation, or 'application-profile' in techno-speak, for the Canadian distance education sector. Furthermore, the IMS Global Consortium, which is an influential standardization consortium in distance education, incorporates the IEEE LOM in its standard called Common Cartridge. In addition, the educational technology company Blackboard has recently decided to support the Common Cartridge standard in its products; and the US Department of Defense builds on the Common Cartridge and the IEEE standard in its SCORM standard.[31] All these translations diffuse the IEEE LOM, and with it, a specific version of granularity.

Through these processes of translation, the IEEE LOM gains increasing momentum, every translation strengthening the assemblage, but also shaping its direction. Through these associations the sociotechnical features of the IEEE LOM become diffused into multiple systems, standards, and practices. These processes create an important non-human actor in the field of distance education, which, if it becomes backgrounded as infrastructure, would melt into the backdrop, and shape how distance education was practiced in both foreseen and unforeseen ways.

Another interesting way in which the hypothesis for granular Learning Objects is diffused is through the technical prototype called *COLIS*, which has become an influential model for thinking about and implementing DRM-protected markets for Learning Objects. The COLIS project is an Australian collaborative project that has developed a repository for learning materials which has become a proof-of-concept project for interoperability, standardization and DRM.[32] One of the goals of this project is to 'contribute more fully to the work of the Instructional Man-

31. On CanCore: Norm Friesen, Susan Hesemeier, and Anthony Roberts, "CanCore: guidelines for Learning Object metadata," in *Online education using Learning Objects*, ed. Rory McGreal (London: Routledge, 2004). On IMS: IMS Global Learning Consortium, "IMS GLC: metadata specification," http://www.imsglobal.org/metadata/index.html. On Blackboard: Ray Hendersson, "Openness and standards at Blackboard," http://www.rayhblog.com/blog/openness-and-standards-at-blackboard.html. On SCORM: "What is SCORM," Advanced Distributed Learning, http://www.adlnet.gov/Technologies/scorm/SCORMSDocuments/What%20Is%20SCORM.aspx.

32. COLIS is operated by Macquarie University, University of Newcastle, University of New England, University of Southern Queensland and the University of Tasmania. See "About COLIS phase 1," Macquarie University, http://www.colis.mq.edu.au/about.htm.



The indexical COLIS prototype screen-capture.

agement System (IMS) Global Learning Consortium.'[33] Consequently, the COLIS project links the hypothesis for rights protected learning material, the IEEE DREL report, and IMS Global Consortium in a functional computer system prototype.

The COLIS prototype is a powerful index for the collective hypothesis of DRM-protected Learning Objects. In several reports from my empirical material, a picture of the COLIS software on a computer screen becomes an emblematic example of DRM-protection in use, and shows how the hypothesis tied to the LTSC DREL can be translated into code and graphics. The computer screen shows how permissions can be attached to a Learning Object through a web-interface which encodes the choices of the user into DREL-code. The COLIS project is referred to, time and time again, in the material for the *Coding copyright* article, and becomes an index for a working Learning Objects market with DRM protection

33. Ibid.

in place – a powerful materialized fantasy which helps to construct and translate a hypothesis of Learning Objects into reality.[34]

What I have aimed to show with the empirical detour around granularity is the ways in which Learning Objects are assembled, and how they are diffused through standards, technological systems, and prototypes. The significance of this indirect route is to show how an assemblage of technical documents, code fragments, prototypes, organizations, and people are constructing a technology which is strongly linked to a mass-individualized version of distance education. Consequently, mass-individualization in Learning Objects takes not only the form of human intentions in the shape of hypotheses, but also the form of technical agents that shift matters subtly as they become connected to the project.

Responsibility and technology

However, as complex as the construction of granularity, Learning Objects, and educational technology might seem, the above-outlined processes are linked to questions about responsibility and agency. It is important to raise these questions as they are connected to the deterministic understandings of educational technology that I outlined in the introduction. They are: Is educational technology a flexible tool that can be wielded in any which way? Or does it determine certain ways of practicing education, learning and knowledge?

On the one hand it can be argued, as Feenberg and Noble do, that the link between technological systems and the organization of education is a matter of social interests where certain actors shape technological and educational systems so that they fit a commercial agenda. In this interpretation of educational technology the fiscal concerns of large corporations or university administrations dictate how technology evolves. The social and economic concerns shape how educational computer systems

34. See for example: Norm Friesen, Magda Mourad, and Robby Robson, "Towards a digital rights expression language standard for learning technology: a report of the IEEE Learning Technology Standards Committee Digital Rights Expression Language Study Group," (IEEE LTSC, 2002), Leah Halliday, "The JISC online repository for [learning and teaching] materials. JORUM scoping and technical appraisal study: volume VII. digital rights management," (Jorum, 2004), Hand et al., "Framework for rights enabled Learning Object exchange trial," Renato Iannella, "Trading Learning Objects" (paper presented at the Educause in Australasia Conference, Adelaide, AU, 2003), 385, Robby Robson, "Digital rights management: a white paper for alt-i-lab 2004" (paper presented at the alt-i-lab 2004: Advancing learning technology interoperability, San Fransisco, CA, USA, 2004).

are designed and how they also shape and organize the learning process.[35] This view, exemplified by Hamilton and Feenberg, can be expressed like this:

> How we design our new technologies is still an open question; the answer will decide which benefits and which limitations we end up with. Indeed, that choice will decide who the 'we' are that peoples the educational institutions of the future, since our models of computerized instruction will define the future identities and roles of students and teachers. If we can resist simplistic appeals to managerial efficiency and focus our efforts on sustaining the dialogue that has always been at the heart of the educational experience, then technology holds great promise; if not, then we face a great threat.[36]

Here we can see how a social-construction logic is organized: the human actors socially determine the shape of the technological systems. The underlying view of technology in education is a hopeful call to action in which the 'people of the educational institutions of the future' can choose which educational technology will be implemented.

On the other hand, as my cases show, not only human actors determine the contents of the technology called Learning Objects, but also a heterogeneous conglomeration of associations. Who is then responsible? Is it the IEEE LTSC standardization committee? Is it the visionaries behind the hypothesis? Is it the technology companies which implement standards in their products? Or is it the structure and grammar of the DREL code-languages? As I have shown, all of these actors shape Learning Objects. If all of these entities shape Learning Objects, the question of responsibility for them remains unanswered. The idea of an assemblage of things shaping the future of education is a worrisome thought. If we cannot assign responsibility, how can we then shape the future of educational technology, and by extension educational practice? Is the mass-individualized mode of organizing educational technology a feature which is neither determined nor rooted for? Is it just a matter of fatalistic acceptance of a distributed agential assemblage?

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35. Andrew Feenberg, "Reflections on the distance learning controversy," *Canadian journal of communication* 24, no. 3 (1999), ———, "Whither educational technology?," *International journal of technology and design education* 11, no. 1 (2001), Noble, *Digital diploma mills*.

36. Feenberg, "Whither educational technology?," 90.

The assemblage-analysis perspective has shown how complex the politics of educational technology can be, and how difficult it is to find a way to reshape an assemblage with many supporters. However, many of the powerful actors in the assemblage are humans with hypotheses, funding, organizational goals, and political agendas. Here the theoretical and metaphorical bases for studying technology in education become pivotal and deeply shape the results of the analysis. In line with the goals of introducing association-analysis, this analytical perspective has allowed me to efficiently reintroduce the shaping force of materiality and technology. The strength of this approach is that it can convincingly make a case for the complexity of technology. However, a weakness, related to making agency symmetrical, is that the technological responsibility and the democratic potential of the perspective become indistinct and even imperceptible.

But perhaps we can also learn something from this indistinctness? Technology, counter to its seeming obduracy and stability, becomes hazy and indistinct when analyzed from the point of view of associations. Rather, it seems malleable, unstable, and uncertain. The processes that shape technology in education are complex, and include technology companies, politicians, visionaries, teachers, students, standards, ideas from other domains, social scientific ideals, and computer codes. A process to successfully implement technology in an educational setting must take into account at least some of these complex factors.

Conclusion

In closing this dissertation, I would like to recapitulate some of the key arguments in this chapter and relate them to the issue of 'more computers in education.'

In my studies of distance education, the concept of *mass-individualization* stands out as a durable mode of organizing educational practice that has survived many different technological configurations of education. I believe that the concept of mass-individualization captures a basic tension in education at large: how do we educate as many as possible without losing sight of individual needs? In attending to mass-individualization through distance education a number of features of this mode of organizing education stand out. Here, I have discussed how it is tied to an objectified view of knowledge, an acquisition metaphor for knowledge, and a representational mode of organizing educational technology, with specific consequences for how technological systems are configured and designed.

Another matter worth recapitulating is related to agency and responsibility in educational technology. By viewing agency as situated in com-

plex assemblages of things it has been possible for me to follow associations between intentions, technologies and standards, painting a complex picture of human intention and technological artifact. But a key question to bear in mind when beginning such an analysis is where to place the responsibility for technology in education. With agency distributed among a number of things, responsibility for technology in education also becomes distributed. How do we implement such a perspective when choosing technology in schools? How do we evaluate it? Perhaps the best answer to this question is to call for a more heterogeneous examination of technology in education. Rather than paying attention only to the efficiencies, learning outcomes, or preparedness of teachers might one not also include a reflection on metaphors for learning, treatment of knowledge, and modes of organizing which are imbued in the technology?

As others have shown, educational technology is a complex issue which cannot be reduced to more computers in the classroom.[37] As I have shown, educational technology is shaped by concerns other than schools, teaching, and learning. Implicitly or explicitly, educational technology contains pedagogies, metaphors for knowledges and modes of organizing education, which could shape pedagogy in profound ways.

37. Larry Cuban, *Oversold and underused: computers in the classroom* (Cambridge, MA: Harvard UP, 2001), Jörgen Nissen, "Säg IT - det räcker," (Stockholm: KK-stiftelsen, 2002), Ulla Riis, Lars Holmstrand, and Gunilla Jedeskog, "Visionär entusiasm och realistisk eftertänksamhet," (Uppsala: Uppsala Univ., 2000).

Epilogue

The future of mass-individualization?

An interesting continuation of mass-individualization through educational technology is the European Union's interest in technology for mass-individualization. In an EU call for proposals, which aims to fund information technology development for educational purposes, the short-term objective is to create 'mass-individualisation of learning experiences with ICT,' with the long-term goal of creating:[1]

> Adaptive and intuitive learning systems, able to learn and configure themselves according to their understanding and experience of learners' behaviour. Cross-disciplinary research on the synergies between learning and cognition in humans and machines should lead to systems able to identify learner's requirements, intelligently monitoring progress, capable of exploiting learners' abilities in order to let them learn better [...] [2]

1. European Commission, "ICT - information and communication technologies: a theme for research and development under the specific programme 'Cooperation' implementing the Seventh Framework Programme (2007-2013) of the European Community for research, technological development and demonstration activities," (2007), 36.
2. Ibid.

Thus, the dream of mass-individualizing education through technology is to be amplified through the combination of artificial intelligence in computers and research into human cognition. The goal is to create computer systems that can automatically adapt to the behavior of the individual student. One compelling case of mass-individualization is a new 'learning engine,' which was awarded the *Most innovative new publishing solution* prize by the influential Learning Object standardization organization, IMS Global, in 2009.[3] This software was presented in a conference abstract detailing the thought of individualizing the educational process to each and every individual through computerized and mathematical evaluation of students:

> The central place of education in today's intelligence revolution necessitates the development of systems that fully understand, and cater for, the knowledge, skills, creativity and potential of each learner, while at the same time allowing for the measurement of progress against defined objectives and skills for the providers of education.
>
> The talk will describe a learning engine that allies advanced mathematical techniques with modern pedagogical and cognitive thinking. The system works across all subject domains, building a profile of the learner that allows for the most appropriate matching of learning materials, teaching methods and pace of learning, in order to provide the ideal learning pathway that will maximise the potential for learning of each individual.[4]

As an amplified and somewhat distorted echo of the individualizing machinery in correspondence education, the authors argue that the application of a computerized mathematical model could tailor the educational situation to the individual student. By using the 'learning engine,' education is to be automatically adapted to every individual student through measurements, profiling, and streaming. Thereby, a machine for industrializing education is endowed with the mathematical and coded ability to adapt the educational experience to the individual student. In the wedding of industrialization and individualization it seems that coded mathematical models are one way into the future. This new generation

3. CCKF, "Recognition for CCKF innovation," http://www.cckf-it.com/recognition-for-cckf-innovation/.
4. IMS Global Learning Consortium Newsletter, May 1, 2009.

of machines that are designed to mass-individualize education through mathematics, code, and cognitive research would be a fascinating case for further study.

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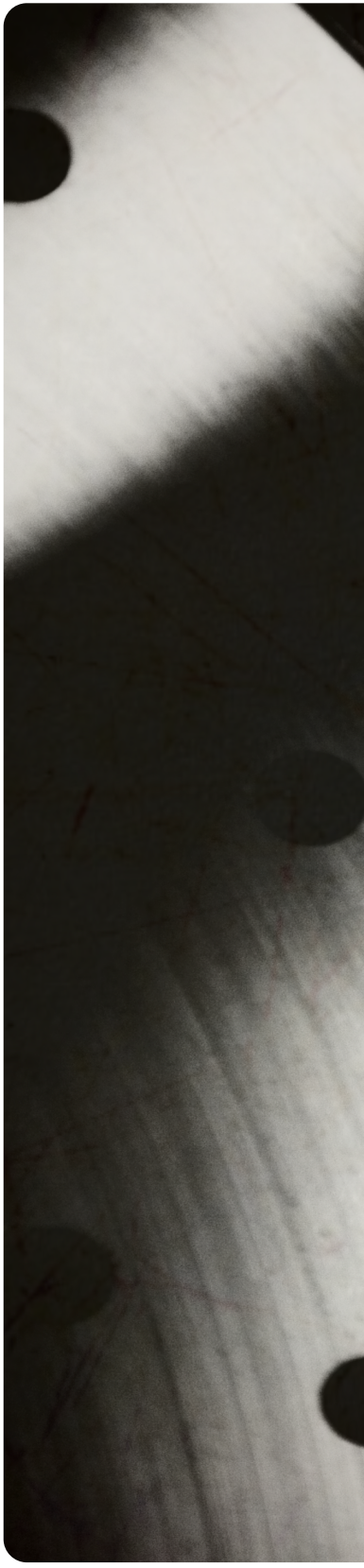
Letters & Bytes

Sociotechnical Studies of Distance Education
Francis Lee

Technology is everywhere in education: in the seating arrangements in the classroom, in the coordination of work, and in the delivery of lectures. In each and every educational meeting technology shapes interaction, pedagogy, and knowledge. However, technology is not a neutral tool that can be used in any way the teacher sees fit. Technology is permeated with hypotheses about its use, technological solutions, and social interests. Regarded in this manner technology becomes a complex and vital part of structuring educational practice.

Letters & Bytes uses distance education to explore technology as a powerful force that affects education. Through a number of cases the book investigates the history and a possible future of distance education. The historical case is correspondence education in the mid 20th century. The future illustration is Learning Objects, a developing standardized technology for reusing educational material. In exploring these cases the author emphasizes how technology not only shapes educational practice, but also how technology is steeped in economy, markets, education, knowledge, and other technological solutions.

In engaging educational technology, Letters & Bytes has both a theoretical and reflective motive. The point of departure being that techno-advocates often proclaim New Technology as a reformer that will reshape education. This rhetoric draws on two arguments. The first is that technology will reform education from the outside, and the second that technology can be used in any manner that the teacher sees fit. The involvement of technology in complex social and material processes makes these two positions untenable. This book seeks to sort out these fundamental misconceptions.



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