1 A Minimal Methodology

> Yet school officials here and in several other places said laptops had been abused by students, did not fit into lesson plans, and showed little, if any, measurable effect on grades and test scores at a time of increased pressure to meet state standards. Districts have dropped laptop programs after resistance from teachers, logistical and technical problems, and escalating maintenance costs.
>
> Such disappointments are the latest example of how technology is often embraced by philanthropists and political leaders as a quick fix, only to leave teachers flummoxed about how best to integrate the new gadgets into curriculums. Last month, the United States Department of Education released a study showing no difference in academic achievement between students who used educational software programs for math and reading and those who did not.
>
> Hu Winnie, *New York Times*, 4 May 2007

In 2006 public schools in the United States had on average one computer per 4.2 pupils, which is equivalent to a total of more than 53 million computers (U.S. Census Bureau 2007, table 248). In 2006 Danish schools provided a new computer[1] for every 4.9 pupils (UNI-C 2007). Converted to monetary value, this amounts to an investment, in the United States, of more than $30 billion, which is almost $240 per American household. In addition to this amount is the cost of software, maintenance, training, Internet access, and so on. What has all this money been invested into? We know that it has been invested into materials, and according to the *New York Times* these materials failed to deliver the expected result. But what, then, did they deliver? What can we say about the educational practices that have been invested into? Which educational practices have come about? Not the ones imagined, obviously, but what then? After having invested so much money and so much effort into technology in schools, it is upsetting that the question of what practices these bring about is widely

[1] A "new" computer is defined as being less than four years old.

neglected. Such questions – and their answers – could teach us a lot, not only about the ways in which materials contribute to educational practice, but also about what was wrong with our initial expectations.

It may seem absurd that such questions are so rarely asked. However, these omissions are quite understandable. The blindness toward the question of how educational practice is affected by materials, beyond the expected results, can be found in the widespread humanist approach to education. I characterize as humanist approaches that start from understandings of the human, of human development, learning, and needs, and that typically ask how the world can be arranged to support one or another desired dimension of human life. Consequently, materials are typically conceived as instruments for educational practice, and the questions asked concern how such instruments can advance educational performances and well-being.

The concept of materials as instruments for humans distinguishes sharply between the human and the instrument the human is using. If the instrument does not deliver the expected result, it makes no sense to further scrutinize the educational practice into which it was introduced. We could however also take a posthumanist stance – which this book does – and place the human not above materials (as the creator or user) but *among* materials. These materials may be used by humans, but they may also use the humans and influence and change the educational practice, which then is no longer particularly human; instead it is *socio-material*. From this point of departure, the question of whether a technology meets human aims becomes overshadowed by questions of what practice takes place when a particular arrangement of social and material components is established. It makes us ask what practice is constituted through this socio-material arrangement, what knowledge comes about, what kinds of pupils and teachers are created, and what learning is achieved. This stance can provide us with some idea of what we received from our enormous investments into educational technology. And it may teach us about the *materiality of learning*.

This book is an attempt to suggest an alternative to humanist studies of education. It studies school practices, but its starting point is neither in pupils nor in teachers, and neither in goals nor in needs. Instead it begins with a focus on materials and is fueled by the observation that humans are not entirely in control of school practices, that what happens in schools is not only due to the pedagogy, authority or style of teachers, children's motivations and abilities, modes of interactions, planning and structuring of school practices, educational culture, or the societal function of

education. This book is supported by the assumption that new as well as already established technologies take part in and contribute to forming school practices, and from this point of departure it asks what practices occur and how they are formed.

The question of what and how such technologies contribute to school practice is, however, only secondary to the investigations presented in this book. Due to its humanist tradition, educational research lacks a methodology for the study of learning that does not begin with humans, their aims, and their interests. The question I therefore seek to answer through this book concerns how to account for how materials participate in school practices and for what is performed through this participation. In other words, this book addresses how to account for the materiality of learning from a posthumanist stance.

To this end, I compare how newly implemented technologies participate in school practice with the way in which established technologies do so, using ethnography. Ethnography is a suitable method for studying practice, and for finding answers to open questions about the nature and formation of these practices. Doing an ethnography of new and established technologies means studying them in practice (Hine 2000, 2005; Miller & Slater 2000). The established technologies we encounter in this study include a blackboard, chalk, a chalk-holder, a one-meter ruler, songs, bodies, notebooks, a bed-loft, sheets of paper, chairs, and a bell. The new technologies include an online 3D[2] virtual environment, a weblog[3] (more commonly know as a "blog"), and a conference system. An online 3D virtual environment is a computer program that can be accessed on the Internet. It creates the illusion of a landscape in which the user can move around a graphic character – called an avatar – and create graphic scenarios. The user can meet other people online in the virtual environment, and she can communicate with them electronically through chat and by way of the avatar's gestures. Figure 1 shows the interface of the Active Worlds virtual environment that I discuss throughout the book.[4] A blog is

[2] Commonly, virtual environment technology such as Active Worlds is described as "three dimensional," even though it is based not on 3D graphics but on the so-called 2½D images, which are digital images that appear to be three dimensional and that can be rotated on the screen.

[3] http://www.blogger.com.

[4] Other online 3D virtual environments available at the time of my research – 2000 to 2001 – include Blaxxun Contact (http://www.blaxxun.de) and Onlive! Traveler (http://www.onlive.com). The latter allows users to speak to each other when a microphone and speakers are connected to the computer. Active Worlds was one of the most used and most promising graphic virtual environments. It however never succeeded in achieving

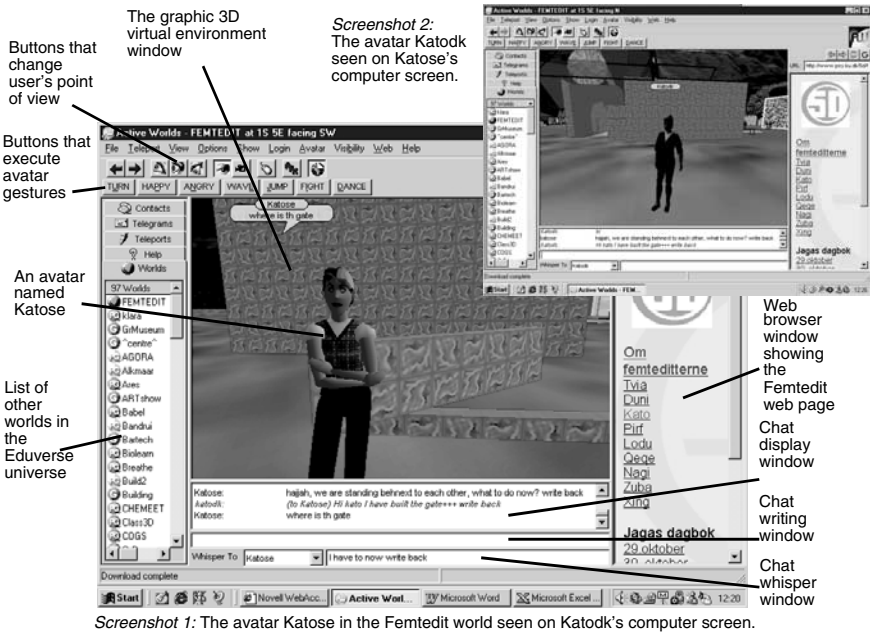

Figure 1. Screenshots of the Active Worlds interface, showing two avatars (named Katose and Katodk) confronting each other in the virtual world, called Femtedit, discussed throughout this book.

a journal-style interface on the Internet in which users can enter messages that are automatically organized chronologically, so the latest message is on the top of the page while older messages move down one place each time a new message is entered. In the study we used an online discussion forum system that was similar to a blog. Unlike a blog, however, it was a closed user group, and it was set up such that users could organize messages in a string system whereby discussions could take place in separate spaces. By opening a new string, a user would open a new discussion separated from the one taking place in the source string.

broad popularity. After three years in beta, Adobe launched new graphic virtual environment Atmosphere (http://www.adobe.com/products/atmosphere) in February 2004, accompanied by great expectations. Ten months later the program was discontinued due to "market conditions, customer feedback and research done by Adobe," according to their website. Linden Lab's Second Life graphical virtual environment was launched in 2003. It was not until 2006, however, that a sudden rise in the popularity of Second Life (from 100,000 residents in January 2006 to more than 4 million residents a year later) gave rise to a broader use and especially to a broader public awareness of virtual environments. In 2005 a separate teenage world was launched by Linden Lab.

My ethnographic studies of these new and established technologies took place in a Danish fourth-grade class. The book discusses how the materials and technologies took part in the school practice, and through these discussions it answers step-by-step the question of how to account for the materiality of learning.

I answer this question by doing it, by accounting for the materiality of learning. What is the materiality of learning, what is materiality, and what is learning? I reach a definition of materiality in Chapter 2. We however have to wait until Chapter 4 for a definition of learning, and until Chapter 6 for a definition of the materiality of learning. In most educational research, there is a strong preconception of learning as an individual achievement. Such a conception cannot be adopted by a posthumanist approach because it predefines learning as realized by humans, not as a result of a symmetric interplay of humans and materials. Many scholars have done important work to re-conceptualize learning as a social achievement (e.g., Lave 1988; Lave & Wenger 1991; Nielsen & Kvale 1999; Salomon 1993), but, as I argue in Chapters 4 and 5, the concept of materiality in these approaches is rather weak. On the basis of insights gained through approaches to learning as a social achievement I develop in this book a methodology to study learning as not social but socio-material. The endeavor of introducing a new dimension – social or material – into learning theory is not only a matter of taking an additional element into account. From the development of approaches to learning as a social achievement we have learned that such a step changes the whole methodology of learning and the understanding of learning as a whole. Consequently it is a crucial principle of this book to define learning not in advance of the empirical study but instead as a result of the study and the accompanying discussions on how to account for the materiality of learning.

The Study of Materials in Educational Research

Going Beyond Technology as a Means to an End

It would be wrong to say that materials are entirely neglected in educational research. There is a large body of literature on educational technology, which, in addition to studying humans in school practice, is concerned with technology. Some of the central questions of research in educational technology concern how technology makes learning more efficient and more meaningful and how collaboration can be supported by

technology (e.g., Koschmann 1996; Koschmann et al. 2002). These are good questions, and they are indeed important questions. But note how they limit the study of technology: When the focus is on learning efficiency, on motivation, on collaboration, and on other human or social phenomena, the only part technology is able to play in the research accounts is that of a means to social, psychological, or pedagogic ends. The answers tell us about the ways in which the technologies in question are or are not suitable for serving human aims. The diverse other ways in which materials take part in social interaction remain under-theorized and little examined. Human aims, interests, or consciousness play the leading part, and technology is relegated to the secondary part. In this book I let technology play the leading role, or at least I place it on the same footing as humans.

Consider this story from the history of technology: In the 1870s Graham Bell made public demonstrations of the telephone in which audiences would listen to Bell's assistant, Thomas Watson, reading the news in a nearby city. This early use of the telephone for broadcasting is very different from the two-way one-to-one communication that later became its primary function. There are several examples in the history of technology showing that the designer's original expectation of how a device would be used largely diverged from how the device eventually came to be used. Most often, this is explained with reference to social needs, organizational structures, culture, competencies, or economy and market forces. In other words, explanations point to social circumstances surrounding the technology, and less frequently to how the technology took part in the practices in question. For example, Larry Cuban (1986) lists the main obstacles for increased film use in the classroom:

- Teachers' lack of skills in using equipment and film
- Cost of films, equipment and upkeep
- Inaccessibility of equipment when it is needed
- Finding and fitting the right film to the class (p. 18)

These obstacles are all primarily social in the sense that they can be remedied by social rearrangements such as training, different economic prioritization, better organization, and more information. There is nothing in these four points that has to do with the specificities of film, that is, with the material in question. Cuban has not considered in which ways film may contribute to a different form of knowledge than textbooks do, for instance, or whether the use of film gave rise to new problematic forms of

interaction between the pupils and the teacher. Furthermore, he does not consider whether the form of learning to which films may contribute could in any way be an obstacle to increased use of film in the classroom. The way in which materials take part in interactions in educational practice is rarely considered in the literature.

Researchers in educational technology can learn from the observation made by scholars of science and technology (STS) that technologies often are unfaithful (Akrich 1992; Latour 1988) to their designers, users, and researchers. The fact that educational technologies may contribute to educational practice in ways that are different from the expectations of their creators, implementers, users, and investigators is generally neglected. We find descriptions of technologies failing to deliver the expected educational outcome (e.g., Boyd 2002), but researchers rarely ask what was performed by and through the technologies in place of the expected outcome. Some may consider that an irrelevant question. They may maintain that if technologies do not achieve what is desired, then these technologies are of no interest, and consequently further inquiry is irrelevant. There are at least three reasons why I do not subscribe to this position.

First, it makes sense to ask how specific technologies contribute to practice without focusing on what we would like them to do, because they might contribute to performing forms of learning and collaborating that are unexpected but that may be fruitful if developed further.

Second, studying technology beyond the focus of educational aims makes us aware that even when technologies do support our educational aims, they also always produce other effects. When technology is treated as an instrument, questions about the exact role of technology remain unanswered, as does the question of whether changes in the design of technology or modifications in the interaction with technology could turn the practice in other (more desirable) directions.

Finally, the emphasis on technology as a means to educational aims establishes an intellectual division of labor, which puts educational theory and conceptualization of educational aims above the understanding of technology in educational practice. Researchers first consider how children learn and develop and what characterizes good interaction, and only after that they ask how technology can be applied to create these conditions. Researchers rarely consider that it may be the other way around: that we theorize about learning the way we do because we have certain learning materials in mind when we account for learning, or at least that the learning materials in use influence the formation of learning and affect our thinking and theorizing about education in general. I argue that this is the

case and consequently that we should place a stronger emphasis on materiality in educational theory in general.

Through empirical analyses of the school practice of a Danish fourth-grade class in the classroom and in a computer lab working with a 3D virtual environment, this book shows how digital and traditional learning materials influence educational practice in general, and how they contribute in particular to shaping different forms of knowledge and varieties of presence.

Paths Toward the Study of the Materiality of Learning

As a consequence of my previously mentioned disagreements with the human-centered approach to research in education, I have found inspiration for the work presented in this book outside the field of educational theory. My analyses are mainly inspired by STS, which is an interdisciplinary approach that has not yet been given much attention by the educational research field.

STS originates in studies of the sociology of science (e.g., Merton 1973), the history of science (e.g., Kuhn 1970), the philosophy of science (e.g., Popper 1963), and the anthropology of science (e.g., Traweek 1988). These disciplines all focus on the study of science and the production of knowledge. As a result of empirical studies of science, science studies scholars started to see technology as an intrinsic aspect of science and knowledge production (e.g., Knorr Cetina 1999; Latour & Woolgar 1986; Traweek 1988). Consequently, some scholars started referring to their work as studies of science, technology, and society,[5] and STS was born. STS scholars seek to understand the relationships among technology, science, political systems, social relations, and human values and to describe how these relationships are influenced by science and technology and, in turn, how these relationships affect science and technology (e.g., Sismondo 2004). Because technologies – and materials in general – have been (and still are) broadly neglected as part of the constitution of

[5] There is no consensus about whether STS refers to "studies of science, technology, and society" or to "science and technology studies." Some scholars insist on the first option, emphasizing that we study science and technology not as isolated areas but as crucial and influential aspects of society. I subscribe to the view that society is a crucial aspect of STS, but, like many others, I use the phrase "science and technology studies" in everyday communication simply because it is linguistically less clumsy than the former. I think it is more important to show the presence of an awareness of society in the work we do than to use the right labels.

knowledge in particular, and of social processes in general, materiality came to be a central theme of one of the most theoretically sophisticated approaches to STS, namely actor-network theory (ANT). Over the past decade ANT has expanded the discussion of what is called socio-material practice from a narrow focus on science and the study of scientific (including medical) and engineering practices to a broad examination of other empirical fields such as financial markets (Knorr Cetina & Preda 2004), legal practices (Jasanoff 2007; Latour 2004b), the multiple identity of aircraft technology (Law 2002a), and the study of organizations (Elgaard Jensen 2001). From the perspective of STS this book is a contribution that expands its approach to yet another field: educational practice. Like science, school practices produce knowledge, and, like in science, materials are core participants in educational practice, or such is my claim.

There are other paths toward the focus on materiality in educational research. My journey to this field of study was also a personal one. In 1992 I went to college to study psychology. I had read Freud's *Interpretations of Dreams* (Freud 1994), and I found his attempt to explain the inner psychological life fascinating. I quickly learned that there is much more to academic psychology than psychoanalysis. I was particularly thrilled by the challenge of understanding the individual as socially embedded. I studied George Herbert Mead (1934) and ethnomethodology (Garfinkle 1967). I learned to criticize the way in which these interactional approaches bracket the societal dimensions of human life, and I turned to activity theory (Leontiev 1978; Vygotsky 1978) and critical psychology (Dreier 1993; Holzkamp 1995). I read the book *Situated Learning* (Lave & Wenger 1991), and I found its account of the person-in-the-world and of learning as a movement toward the (non-existing) center of a social culture very convincing, as did many other scholars. The book became a landmark for a new approach to learning as social. The more I studied and did empirical work, the more I realized that there was an absence of materials in these approaches' empirical analyses and that they had difficulty approaching materiality empirically. This was what turned me toward STS and especially toward ANT. Over the years, I have met many scholars whose stories are similar to mine. Many of these excellent researchers have a background in psychology, but only few of them work in psychology departments. They primarily work in more or less interdisciplinary departments and with interdisciplinary projects. Many call themselves "social scientists" or "STS scholars" because the "psychologist" label gives rise to associations that these scholars for years have worked to overcome. The discussion of materiality is a discussion on the boundary of the discipline of psychology,

just as it is a discussion on and of the boundaries of educational research. My personal story is far from private. Just as the person is embedded in a social and material world, my story – and this book – is the story of contemporary movements in social, psychological, and educational research.

Book Overview: Methodology and Empirical Work

The Chapters

The book is divided into six chapters. Chapters 2 and 3 concern materials, materiality, and how to study them. I investigate the question of how to account for materials in practice by studying the way in which the virtual environment technology became a subject of research, which, as I show, was a result of a process of a contingent practice. Methods books tend to be written from a management perspective, focusing on how the research process as a whole can be managed and directed toward an intended goal. This is indeed a common perspective when conducting a research process, but it is far from the only one. During the research project the researcher finds himself in the midst of data, appointments, documents, method guidelines, deadlines, informants, literature, colleagues, and institutional and disciplinary entanglements. In this position his attention is not only, and not foremost, on the research process as a whole, but very much directed toward how to attend to the variety of here-and-now practicalities with which he is confronted. Chapter 2 describes the initial phase of the method I applied from the perspective of being entangled in a complex research practice. It presents the method as contingent, which notably is different from being incidental. I account for the virtual environment by describing how it was constructed as a research object, and thus the discussion of how to account for a material melts into a discussion of the research method. I conclude Chapter 2 with a definition of material and of materiality.

Chapter 3 opens a Pandora's Box of sorts; a number of components are drawn in that undermine the description of the virtual environment in Chapter 2. This leads to a conclusion about the *multiplicity* of materials, and, more important, it leads to the conclusion that describing materials and other components as elements is misleading when accounting for the materiality of learning. I unfold instead a *spatial* approach that asks not about elements or relations but about the patterns of relations that social and material participants perform in practice. The spatial approach