View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by VBN

Aalborg Universitet

AALBORG UNIVERSITY
DENMARK

A Didactic Design Experiment

towards a Network Society Learning Paradigm

Levinsen, Karin

Published in:
Design for Learning

Creative Commons License
CC BY 4.0

Publication date:
2009

Document Version
Publisher's PDF, also known as Version of record

Link to publication from Aalborg University

Citation for published version (APA):
Levinsen, K. (2009). A Didactic Design Experiment: towards a Network Society Learning Paradigm. *Design for Learning*, *2*(2), 34-55. [4]. https://www.designsforlearning.nu/articles/abstract/23/

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

? Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
? You may not further distribute the material or use it for any profit-making activity or commercial gain
? You may freely distribute the URL identifying the publication in the public portal ?

Take down policy
If you believe that this document breaches copyright please contact us at vbn@aub.aau.dk providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from vbn.aau.dk on: November 30, 2020

DFL1_10:Layout 1 10-02-24 13.57 Sida 2

EVA INSULANDER & STAFFAN SELANDER: *Designs for learning in museum contexts*

JUDITH MOLKA-DANIELSEN, MATS DEUTSCHMANN & LUISA PANICHI: *Designing Transient Learning Spaces in Second Life - a case study based on the Kamimo experience*

KARIN LEVINSEN: *A Didactic Design Experiment - Towards a Network Society Learning Paradigm*

FREDRIK LINDSTRAND: *Interview with Staffan Selander*

DESIGNS FOR LEARNING

#2/09

A Didactic Design Experiment - towards a network society learning paradigm

By KARIN TWEDDELL LEVINSEN,
Danish School of Education, Aarhus University, Denmark

The ongoing transition from industrial to network society challenges educational practices and the process is characterised by opposing forces. At the political level, New Public Management initiatives oppose the general consensus that it is necessary to consolidate network society competencies. At the level of everyday educational practice we see a mounting tension between the quality of educational outcomes, in terms of genuine learning, and students' strategies for dealing with an increasing pressure of efficiency and time. This article presents a design for teaching and learning experiment that aims to navigate these turbulent waters, scaffold genuine learning, satisfy learning objectives and ease the strain on students. Due to the experiences and knowledge derived from the experiment, the paper argues that the model behind the experiment demonstrates qualities that may be developed and refined and contribute to the educational system's adjustment to the network society.

INTRODUCTION

The transition from industrial to network society generates new concepts and phenomena that address globalisation, education and competencies of the future (Castells 2000). During the process, these concepts and phenomena gradually become dialectic, constituting and constituted actors in the ongoing transformation.

In Castells (2000) famous trilogy *The Information Age: Economy, Society and Culture*, he analyses various dimensions of society and identifies certain characteristics, which have already emerged out of the transition from industrial to network society. In the important paper *Materials for an exploratory theory of the network society* (2000), Castells clarifies certain implications of his observations in *The Information Age* which are of relevance in this context. Castells describes (2000b, p. 10) the new societal structure – *New Economy* – according to three dimensions: *informational*, *global* and *networked*. The informational capacity for generating knowledge and processing information determine productivity and competitiveness. Development of a worldwide IT-infrastructure provides strategic activities with the capacity to work as a unit on a planetary scale in real time or chosen time. Globalisation as an organisational principle is highly selective and links to value anywhere, while discarding anything (people, firms, territories, resources) that has no value or becomes devalued. The technologically based connectivity of the global economy generates a new form of organisation, the *network enterprise* made from either firms or segments of firms. The unit of production is no longer the firm, but the business project (2000, p. 176). According to Castells, work and employment make up the New Economy, characterised by flexibility and mobility, and the people who work within this system are "fundamentally divided in two categories: self-programmable labour, and generic labour" (2000b, p. 12). Self-programmable labour is equipped with competencies for lifelong learning: the ability to retrain and adapt to new conditions and challenges. By contrast, generic labour is both interchangeable and disposable.

It is generally accepted that the transition challenges the educational system as the transformation produces concepts and phenomena that represent forces that pull in opposite directions and leave education and learning open for interpretation within at least two meta-discourses (Dyson, 1999). The *political-ethical discourse* is focused on the development of a new network society paradigm inspired by social constructivist theory, and on a general consensus that 'network society' competencies take time to mature. This is based on the idea that humanity is made up of whole persons or employees (Greve, 2000). On the other hand, the *economic-pragmatic discourse* rests on New Public Management (NPM). The term NPM was coined by Christopher Hood in 1991 and describes how administrative reforms of the public sector – including educational institutions – are based on target management, commercialisation and the quantifiable measures of output and effect (Pollitt & Bouckaert, 2000). While network society theory aims to describe a new paradigm, NPM represents an incremental adaption of the industrial paradigm to the challenges of the emerging network society. While the network society demands from its citizens, e.g. educators and students, the ability to navigate through chaos in a reality of fluidity and unpredictability, NPM demands fast, efficient, predictable and controllable productivity from educational institutions and from its actors. Horton (2000) argues that around 2000, internationalisation has led to a globalised situation where the rational economic paradigm tends to take over at the expense of the social constructivist learning paradigm. According to Dyson (1999) this process is characterised by a lack of acknowledgment of the paradigmatic incompatibilities of the discourses and the ambiguous use of concepts. Consequently, at the level of society development, the dominant political-ethical discourse on the fluid network society calls for a new paradigm: the new learner, formal and informal learning, and the *self-programmable* labourer/employee. On the other hand, the dominant economic-pragmatic discourse's call for commercialisation and globalisation tends towards an incremental improvement of the industrial paradigm through the implementation of New Public Management, at the risk of reproducing generic labourers/employees.

THE BACKGROUND

The Danish context

In Denmark the tension is at present stabilised through legislation, contracts and institutional structures and it is noticeable considering that the Ministry

DOI:http://dx.doi.org/10.16993/dfl.23

of Science, Technology and Innovation's implementation of NPM in Danish universities is at odds with the Ministry of Education's visions and plans of action regarding practices within universities, which are based on the definitions of future competencies in floating contexts (OECD, 2001; G8 summit, 2006).

Within adult learning, the tension appears at the level of educational institutions as an increasing conflict between curriculum and learning objectives related to the political-ethical discourse, which opposes the economic-pragmatic discourse's focus on summative evaluations and economic measures of student-units. At the level of the students' everyday practice, the contradicting forces burden adult students, who are often in full employment and have a family, with heavy time pressures. Thus, for the individual, the tension appears as a personal cost-benefit analysis of the balance between deep learning (political-ethical discourse) and passing a given course within the time limit (economic-pragmatic discourse). A substantial body of literature confirms that students react with stress due to time pressures. Additionally, empirical studies demonstrate that students' strategic choice under stressful circumstances conform to the economic-pragmatic discourse at the expense of deep learning (Biggs, 2003; Lawless & Allen, 2004; Levinsen, 2006; Orngreen & Levinsen, 2007). In everyday practice, the tension appears phenomenologically, as students who have not read the theory before they engage in learning activities. Students either hope for, or expect that the teacher presents a digested version of the core curriculum. At the base-line, the paradigmatic struggle constitutes a battle between the production of quality and the increasing time pressure stemming from the demand for efficiency in terms of time reduction and cost-effectiveness.

The tension must be considered a basic condition that leaves the educational system with a major challenge in terms of a dilemma: on one hand, we cannot get rid of the opposing paradigms and we cannot remove the time pressure, and on the other hand, we cannot accept a substantial loss of educational quality.

Dealing with the dilemma

So far, incremental efforts of dealing with the changes in society have turned time into a scarce resource and made stress the most prevalent disease in the Western world. The incremental efforts can be described through Argyris' (1977) and Dirckinck-Holmfeld et al. (2002) concepts of single- and double-loop learning. In short, single-loop learning is reflection in action, while double-loop learning is reflection on action. Thus, efforts to do more and more of the same at a higher speed reflect single-loop learning. In contrast, efforts to change strategy without changing the basic assumptions, e.g. the idea of filling the *skill gap* (Horton 2000), reflect double-loop learning. Both single- and double-loop learning can be considered as reactive strategies according to Ackoff (1976). Rather than to try to resolve the dilemma through incremental adaption and assimilation, we can – as Hastrup suggests (1999, p.103) – exploit the inherent power of contradicting forces. This implies a change from a reactive to a proactive and interactive strategy (Ackoff, 1976) and triple-loop learning (Hauen et al., 1998, Yuthas et al., 2004) – in short, reflection on reflection on action. Triple-loop learning corresponds to Jean Piagets' *accommodation*, Yrlö Engeström's *expansive learning* or Gregory Bateson's *Learning III*. Triple-loop learning moves the focus from incremental improvements to genuine or radical innovation. It involves a wider scope on the practice and context, and implies a radical change of the involved parties' mental models. In other words, proactive and interactive strategies may change the current situation from a *Catch 22-situation* into a *thinking-out-of-the-box-situation*. In conclusion, the challenges have to be met by radical innovation, and that was what the author intended. The aim was to explore whether an innovative design for teaching and learning may facilitate the specific course required to bypass the negative consequences of time pressure, and fulfil learning objectives. The experiment was not envisioned as a research project from the beginning, but as it rapidly developed in that direction, the collection of data demanded a choice of methodology. Due to the author's role as developer, participant and researcher, the choice of data collection methods is inspired by action research and anthropology.

The article is structured such that section one presents the outline of the experimental design and describes how the model, in its transition from theory to practical application, passes through three phases of construction: Phase 1) *Conceptual modelling* is based on Lotte Darsø's Edge of Chaos Model (2001); Phase 2) *Orchestration*, where the conceptual model is transformed into a script that stages the subject matter in a complex framework of practice, based on Bohr's Complementary Principle (1957); and Phase 3) *Operationalisation*, the specific, but also contingent directions for the students' performance that apply the conceptual model to the specific context. Section two presents the work of two groups during the performance, and the final section discusses a number of indications that the model provides a supporting scaffold to students and enables them to maintain progress in their ongoing learning processes. Accordingly, it is argued that the model contributes to the innovation of the network society's design for teaching and learning. But first, the Master Programme and the current case are introduced.

The case - Masters in ICT and Learning (MIL)

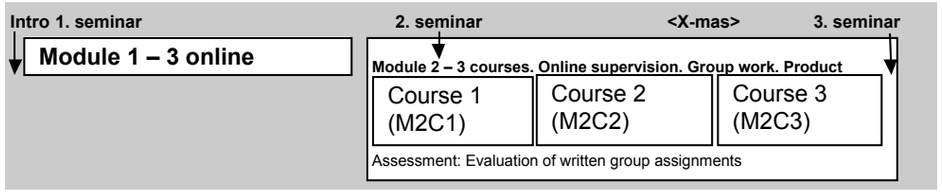


Figure 1. Timetable for MIL, first semester.

The Danish Masters programme in ICT and Learning (MIL) is an established programme of two years' duration. MIL is designed as blended mode with online activities and seminars, based on variations of social constructivist and constructivist pedagogy. The current MIL design of workflow and progression (Figure 2) rests on the assumptions that students are well prepared, and that learning progresses as a linear process. The *productive frustration* which is necessary for a reflective learning process (Illeris 2006, p. 82, p. 104 and p. 181) is designed to occur and peak at the seminar.

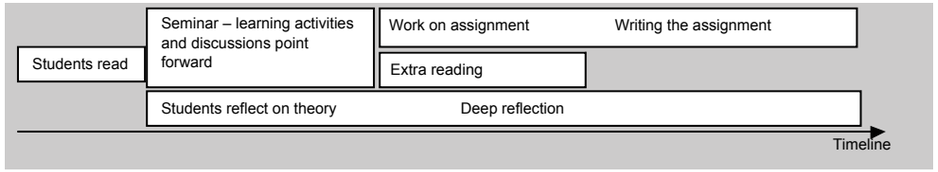


Figure 2. Current workflow model for MIL´s first semester.

Within the programme and during the course of this research, there were 32 adult students in full employment who also had family obligations. They had been out of the educational system for 5 to 10 years and their skills and competences differed widely. The class convened for weekend seminars twice a semester. At the first seminar, the class was divided into working groups. During the semester, groups participated in two subsequent modules; M1 and M2, each subdivided into courses; C1, C2 and C3 (see Figure 1). M2 - ICT and *Interaction Design* – that constitutes the current case, is the study of human-computer interaction, focusing on interface design and design of (virtual) learning spaces. The learning objectives are specified as intellectual, subject related, and practice competencies in relation to ICT, design and learning. The first course in the module (M2C1) is an introduction to a theoretical psychological frame and focus is on sense making. The second course (M2C2) focuses on visual communication and visual interaction as the basis for human-computer interaction (HCI). The third course (M2C3) is about HCI methods and techniques in design, test and evaluation.
The case is based on a four-hour session at the second seminar that aims to introduce M2C3 (Figure 1). Prior to the seminar, students had just finished M1 and prepared initial individual short papers for M2C1. At the seminar, all three M2 courses were introduced. Due to the heavy workload prior to the seminar, the teacher expected the students' personal cost-benefit negotiation to favour an economic-pragmatic attitude. Consequently, their knowledge of the course literature could be considered sketchy because:

- They have not read the literature at all before the seminar.
- They have read (some of) the literature and may be aware of main concepts, but they have had no time to digest or apply the content.

This actual situation does not fit to the assumptions of the current workflow model (Figure 2) and thus, the teacher could not expect students to be able to understand or operationalise important aspects of the theory. Furthermore, and more generally, they may find it difficult to reflect on the theory with regard to relations, contradictions, complexities and ambiguities (Biggs, 2003; Laurillard, 2002; Lawless & Allen, 2004; Levinsen, 2006; Orngreen & Levinsen 2007; Salmon, 2002; Salmon, 2003). According to Darsø (2001, p. 35), the basis for learning and construction of new knowledge is a clear set of concepts that can be used as a starting point for building a common ground and clarify concepts (Darsø uses the expression, to *clarify concepts* where other authors use the term *negotiate meaning*). However, when students are poorly prepared, there is no clear set of concepts with which to negotiate meaning or build knowledge. This is the missing link in the current case and the basic challenge for an alternative approach.

THE DESIGN FOR THE TEACHING AND LEARNING EXPERIMENT

In search of alternative approaches

The pragmatic and often used solution of the dilemma is to mediate a condensed version of the theory in order to establish the necessary set of concepts, followed by structured, closed exercises that aim to consolidate the concepts. This approach aims to fill the students' knowledge gap and provides a reading guide for the following online-period. However, the approach is incremental and reactive as it maintains the linear workflow and merely postpones the problem (see Figure 3). The students' choice of strategy may correspond to the current workflow model but the author's findings as both external examiner (Levinsen & Madsen, 2007) and as supervisor (Levinsen, 2006) are that they do not. On the contrary, students choose to start working on the assignment right away and spend time doing scattered ad hoc reading. Consequently, the productive frustration does not peak at the seminar but during the compressed workload when the assignment is almost finished, a situation that influences the quality of learning negatively.

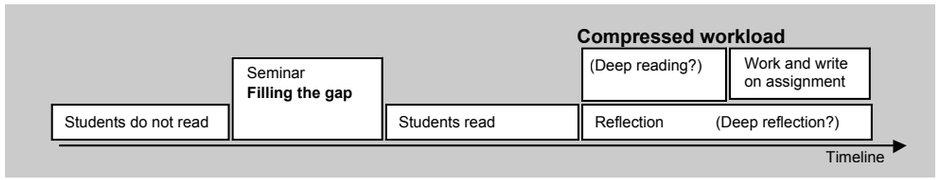


Figure 3. Traditional solution workflow model - filling the knowledge gap.

The challenge is to support the students' internalisation of the important and framing concepts of the subject matter, when they are not prepared. The challenge is to create a design for the seminar activities that dissolves the

compressed workload and allows the students to bridge the gap rather than have it filled, e.g. as a design that facilitates a workflow as shown in Figure 4.

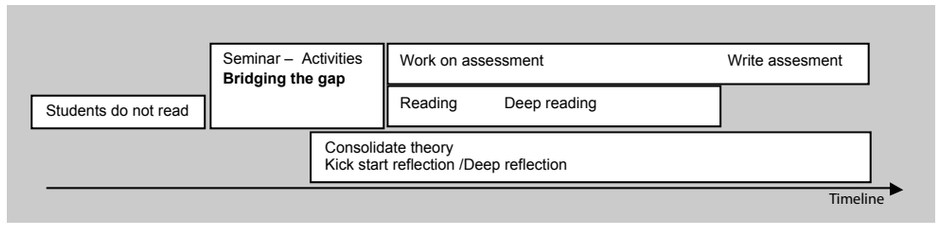


Figure 4. Alternative workflow model.

The workflow model aims to:

- Kick start students' productive frustration and reflection
- Bridge the knowledge gap and regain some lost time
- Kick start students' production of (new) knowledge
- Provide students with a scaffolding for approaching the theory and support their reading reflection and operationalisation of the theory during the online period after the seminar

Conceptual modelling

MIL is designed around group work and projects and therefore it makes sense to look into Lotte Darsø's theory on group dynamics and project management. In her book *Innovation in the making*, Darsø (2001) distinguishes three phases of a project's life-cycle: *Preject*, *Pre-project* and *Project* (Figure 5).

Preject	**Pre-project**	**Project**
Explorative	Identifying the goal	Goal oriented
Divergent	Divergent–convergent	Convergent
Non-linear	Linear	Linear
Time-frame	Deadline	Deadline
Process driven (innovation)	Product driven (specifications)	Product driven (final product)
No pressure on making decisions	General decisions are made	Modifications are made

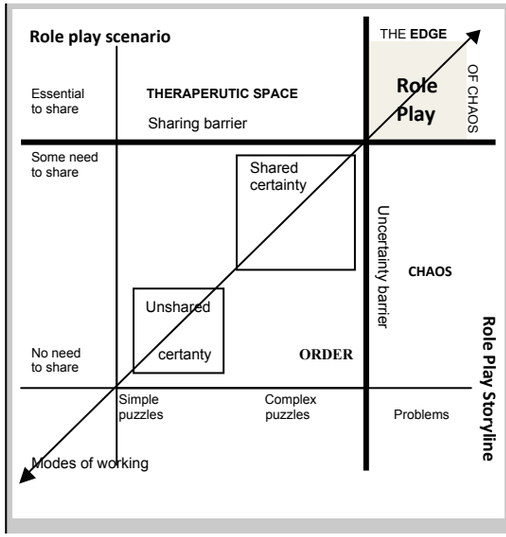
Figure 5: Darsø's phases and their characteristic attributes (2001: chapter 3).

The alternative MIL M2C3 workflow (Figure 4) can be aligned with Darsø's project life-cycle. *Preject*: The body of knowledge is characterised by divergence and ignorance of the theory. The students begin to grasp and identify landmarks of the new subject through exploration, meaning negotiation, knowledge construction and innovation. The seminar situation and the first part of the online-period belong in the Preject. *Pre-project* is the phase that is characterised by focused goal-oriented research and refinement. The Pre-project gradually transforms into a structured project period; the *Project* is the phase where the assignment is actually takes form, is produced and finally delivered. The case design involves the seminar activities as a Preject.

In her book, Darsø examines Prejects and the complexity of innovation processes in heterogeneous groups, and offers a framework for the construction of a conceptual model for the alternative workflow. Preject participants bring whatever resources they posses into the process (Ibid., p. 321), and therefore the Preject draws on divergent knowledge in terms of conscious everyday knowledge, along with qualified and tacit knowledge. The Preject is also characterized by ignorance and emerging relations among participants. Based on her empirical studies (Ibid., p. 330), Darsø defines two dimensions or axes of major importance for the success of innovative and knowledge constructing group dynamics: the *relational dimension* and the *complexity dimension* (depicted as the *Dynamic knowledge* map, Ibid., p. 332). On the relational axis, group dynamics must pass beyond the sharing barrier where it becomes 'essential to share' rather than not to share. On the complexity axis, the group challenge must pass beyond the *complexity barrier* and change perspective from simple or complex puzzles where the problem is predefined, to deal with the identification and exploration of genuine problems. In the area of the model that Darsø calls *The Edge of Chaos*, participants in the Preject are challenged or even forced to negotiate meaning, explore, and construct new knowledge on the basis of their everyday knowledge, qualified knowledge, tacit knowledge and their realisation of ignorance. In this way, the Preject functions as a conceptual model for the present design that helps to bridge the students' knowledge gap and bypass the 'missing link'.

Based on Darsø, the conceptual model for the current design frames the seminar activities within *The Edge of Chaos* space, by staging their position on the axis through concrete tools (Figure 6). Instead of starting from zero, the basic idea is to activate the students' informal resources in terms of everyday and qualified knowledge through carefully designed, but also open, activities at *The Edge of Chaos*. When everyday resources are externalised through practice, they may constitute a basis for building common ground and clarify concepts. Furthermore, everyday resources may work as a vehicle for reflection and knowledge construction in relation to the subject matter, inasmuch as it is possible to align this to theory, e.g.: *the everyday activity of deciding what is practical to do when we want to know about something, aligns with the specialised activity of methodological data-collection design*; the everyday realisation

of ignorance aligns with the specialised activity of *formulating a research question.* Thus, the design aims to bridge the knowledge gap, to generate the 'missing link', and to provide a basis and scaffolding for meaning negotiation and knowledge construction theory during subsequent online-periods.



1 *Relational axis:* A role-play scenario frames the group work and confronts negotiation of a common ground and sharing. Thus, the activity is pushed above the sharing barrier.

2 *Complexity axis:* The role-play storyline confronts genuine dilemmas and problems and forces the participants to identify and explore problems. Thus, the activity is pushed beyond the uncertainty barrier.

3 *The Edge of Chaos:* The participants' assigned roles frame the scope of their actions in relation to the theory, while the problem actualises their qualified- and everyday knowledge, tacit knowledge and ignorance in a field of tension that may generate (for them) new knowledge and innovation. In the current case, new knowledge is understood as everyday knowledge that can be aligned with the theory.

Figure 6. Darsø's Edge of Chaos Model (2001: 330) adapted to the current case.

Apart from setting the stage and initiate the role-play, participants' practices also have to be facilitated during the activities. According to Darsø, participants must be aware of how they practice communication, e.g. whether they attempt to persuade or if they jump to conclusions, as these practices tend to push the Preject towards the Pre-project phase. In order to sustain the process in the Preject phase, it is important to maintain communicative practices such as explorative questioning and active listening. When participants are forced to negotiate and choose between options, the Preject's time trajectory becomes a path of bifurcation points "rather like 'forks in the road' leading to different futures" (Ibid., p. 326) where learning is linked to the participants' conscious awareness of the points of bifurcation, related contingent choices, styles of communication and the negotiation of decisions.

During the performance of the role-play, the challenge is of how to facilitate and balance participants' productive frustration between the opposites of static deadlock and destructive chaos as it is not possible for the teacher to be present and facilitate all the groups while they work. Therefore, the support principles of the conceptual model relate to the practice of supporting these processes:

- An explorative approach and a communicative practice is maintained through the description of the groups' task as open-ended and explorative;
- An awareness of points of bifurcation and choices is sharpened and maintained through the demand for and focus of the group's documentation of its work;
- An ongoing negotiation and structuring of the groups' collaboration is facilitated through a specific script for the groups' task.

So far, Darsø's Edge of Chaos Model has worked as a vehicle in the development of the conceptual model for the design. The next step is to orchestrate the conceptual model and the subject matter as an integrated time–space relation.

Orchestration

Orchestration means to transform the claims of a conceptual model into performable time–space relations, just like a musical score or a movie script. One major challenge for the design is the curriculum's complexity and volume. It is not possible for students to touch upon the entire curriculum and its implications in the course of four hours. As defined to this point, the conceptual model cannot deal with this challenge. This is where Bohr's Complementary Principle (1934/1961 & 1957) becomes relevant for the orchestration.

Bohr's Principle of Complementarity refers to quantum physics, but Bohr recognized its relevance for the Humanities and epistemology (Bohr, 1934/1961; Bohr, 1954/1957; Favrholdt, 1992; Favrholdt, 1994; Favrholdt, 2002; Faye & Folse, 1994; Levinsen 2005). According to Bohr, a material world exists independent of our consciousness. However, any observed phenomenon is a construction that cannot be separated from the observer, the position or the context, and consequently all phenomena are situated and relative to the observer and observation as agency (Barad, 2007). Bohr's epistemology bears strong resemblances to Heidegger's phenomenology and this is not accidental, as Heidegger was inspired by Bohr and Quantum Physics when he developed his phenomenology (Glazebrook, 2000). However, Heidegger did not elaborate on Bohr's Complementary Principle and Bohr's idea of the complementary image with regard to the Humanities and Social Science. Therefore, it is necessary to turn to Bohr's original writings (Bohr, 1934/1961) and present Bohr's Complementary Principle and the complementary image in order to explain the method of orchestrating the conceptual model.

Bohr's epistemology recognises that some objects and events cannot appear as phenomena and can only appear indirectly as index signs, as they evade both observation and language – they are inexpressible. The classic example deals with the object of *light.* From one position, *light* appears as the phenomenon of waves, while from another position, it appears as particles.

Bohr argued that in order to express the complex and inexpressible object of *light*, we have to accept that *light* (though we can never know what light is), can be both but cannot be observed as both at the same time. According to Bohr, it is possible to know something about objects which we can never observe as phenomena. Bohr argues that we have to specify the conditions of observation and be precise in our use of language and that the use of metaphors allows us to construct complementary images, which may serve as a vehicle to communicate about and explore inexpressible objects and events (e.g. black holes). In current Social Science and Humanities, *complementarity* is generally understood holistically as the construction of a whole out of complementary elements or perspectives, similar to the Yin-Yang Principle (see e.g. Wenger 1998, p. 232). Figure 7 illustrates the fundamental difference between a holistic interpretation and Bohr's complementary image.

Figure 7. Complementarity – the difference between the holistic YinYang-complementarity and Bohr's Complementary Principle in terms of the constructed complementary image.

According to Bohr's Complementary Principle, there will always be blank areas in the image (Honner, 1994, p. 152). Some of these gaps may be filled with new knowledge as in the holistic interpretation of complementarity. Other areas are inexpressible and can only be bridged through interpretations and constructions. According to Bohr, the complementary perspectives do not have to be logically consistent, compatible or even measurable. Thus, unlike other approaches, the different pieces or perspectives in a Bohrean complementary image cannot be expected to fit as the Yin-Yang principle or as a jigsaw puzzle (Lemke, 2000). Bohr stresses that the only language we can use to share and explore our complementary images of the inexpressible and the knowledge gaps, is the everyday language. We have to be precise in our use of language in order to share the conditions of observation and the use of metaphors. In this sense Bohr's Complementary Principle offers a dimension to Darsø as a metaphor for the construction of meaning and the use of everyday language in the construction of knowledge at the Edge of Chaos.

In the Humanities and Social Sciences, dynamic objects and events such as life, learning, thoughts, practice and competencies, possess qualities similar to Bohr's inexpressible objects – they are complex and they possess dimensions

that evade language and phenomenological appearance. Still, we can know something about these dimensions and negotiate their meaning. In the current MIL-case, objects such as HCI theory and interaction design possess inexpressible complementary characteristics. Consequently, rather than trying to expose all students to the entire curriculum, the idea is to orchestrate the time-space relations in a script that aims to distribute knowledge by exposing work-groups to different essential parts of the content. When the students need to share the distributed knowledge later in the course, they may all contribute to the shared construction of a complementary image of the curriculum and interaction design practice.

In the current case, the backbone of the time-space-relation-script is an iterative life-cycle model for Interaction Design (for details, see Sharp et al. 2007, p. 448). The iterations in the HCI life-cycle occur inside the phases and encompass four basic activities: research, conceptualisation, construction and evaluation. Iterations between the phases are rare. Each iteration produces an output that serves as input for the next iteration until a satisfying output is produced and the life-cycle proceeds to the next phase along the timeline (Figure 8).

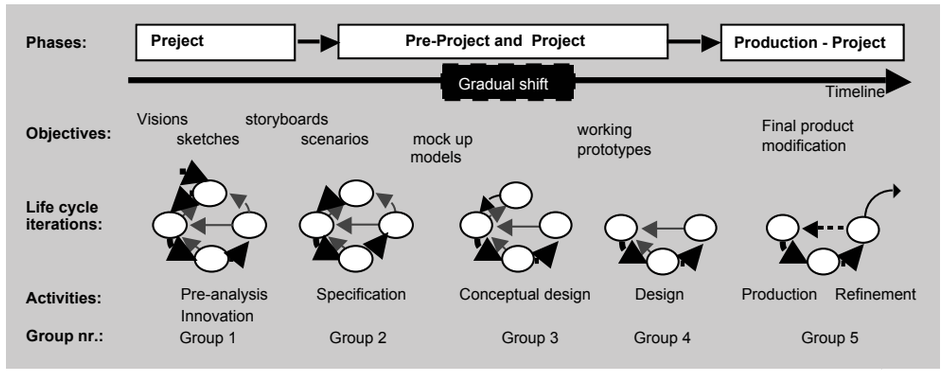


Figure 8. The script model for the group-work at the seminar. The Complementary Principle applied on the HCI life-cycle model.

The four basic activities and some of the HCI methods recur through the phases, but they are performed differently depending on the time-space relation to the life cycle. E.g. in the HCI Preject and Pre-project phases, evaluation means to explore: "Do we need to know more?", "What do we not know of yet?". In the HCI Project phase, evaluation means to test: "Does this work as intended?".

Operationalisation

At the seminar, the whole group received a crash course on the core issues of Interaction Design in order to facilitate meaning negotiation during the

role-play. A PowerPoint presentation, which was designed as a quick guide and summary, was posted to the virtual learning environment immediately after the crash course. After an introduction to the role play, students proceeded to the activities that were orchestrated on the basis of the Complementary Principle. To obtain the widest possible distribution of knowledge as complementary elements, students were divided into five seminar groups across the original semester groups, and each seminar group's task was related to a phase in the HCI life-cycle, and accordingly to specific parts of the theory (see Figure 8). In this way, the design embraced the full syllabus in both theory and practice as complementary bits of distributed knowledge. Additionally, all semester groups had a member in each of the seminar groups so that an individual part of the curriculum was familiar to at least one person in the semester group. As a further support for reflection and knowledge sharing, each seminar group documented their work through written notes, photos, sound recordings and videos using the process support principles from the conceptual model. These documentations were shared online after the seminar. The seminar groups presented their learning in a videotaped plenary session, which was also shared online afterwards, as streaming video.
The activities were staged in the operationalisation script that drew on classic role-play theory (Johansen & Swiatek, 1991). The storyline and the scenario of the role-play possess specific challenges and simultaneously constrain participants to act within certain limits that aim to force the role-play into the *The edge of chaos*:

> There are [problems] with X-firm's website. Users complain. Therefore X-firm has hired your team as HCI-experts. In order to explore the problem you use this [HCI method] to explore [a specific problem area].

All activities were fictitious, yet realistic cases, related to public train service. The script drove the role-play through three phases and forced participants to collaborate and move above the sharing barrier, while they had to move beyond the complexity barrier in order to invent/innovate relevant actions and interpretations as they explored and negotiated meaning:

1.	You design the specific use of the [HCI method], e.g. you produce a paper interface prototype and explore it using the Think-aloud method (groups were provided with quick guides to the methods).
2.	You perform the method (evaluation) on real users (students from another group) while collecting data in the form of written notes and video (special attention to communication style and bifurcation points).
3.	You analyse the data, the quality of your design and your data collection, and evaluate the use of the method. For the plenary discussion, you prepare a presentation of what you have done and what you have learned (Bohr, 1964).

The demand for reflected data collection further forced the participants beyond the complexity barrier and to be aware of their communication style, points of bifurcation, as well as their decision making. This awareness supports deep reflection on arguments, choices and actions.

In order to utilise the Complementary Principle even further, participants rotated during step 2 of the activities. The rotation followed a pattern based on the jigsaw method (Aronson et al., 1978; Slavin, 1991; Clarke, 1994) and allowed every semester group to end up with members that had either taken on the role of leader, evaluator/tester, user/test-person, or observer, from both the owner and guest perspectives.

At the seminar – report from two groups

In the following, two of the five group-activities will be presented in detail.

Group 1 - Image tagging

The fictitious task was to identify foreigners' and immigrants' special user needs, as the Danish Rail wishes to develop their website to serve this growing costumer group. The HCI Preject team – Group 1 – explored how users think about travelling by train and what the concept of 'travel' means to them. The first task was to choose 12 Tag-related images from Flickr using the Tag = *travel* (Lapham, 2007). The second task was twofold: 1) Present the chosen images in a way that generates and supports an explorative conversation with the user about what it means to travel by train; and 2) Design the session with an emphasis on collecting useful and valid data. Group 1 chose to arrange the images as a linear PowerPoint presentation and let the user interact with the images during a video-recorded conversation.

The group found that the method provided a useful frame for an explorative conversation. However, they realised that their choice of presenting the

images as a linear PowerPoint presentation became an obstacle for collecting useful and valid data. The user perceived the PowerPoint as a linear narrative and consequently the explorative conversation on *travelling by train* became a controlled step-by-step interview. In the plenary presentation, the problems were described in everyday language, but their findings were easily adjusted to basic methodological requirements for qualitative research and the core issues of HCI theory and methodology. Group 1 forgot to identify what exactly they wanted to explore and find out about. This lack of focus in the preparation of the data collection led to weaknesses in their whole process from data collection to analyses. The group became aware of this when they analysed their collected data and retraced their process and choices through the points of bifurcation. The results were presented in the plenum:

- The search for and choice of images was not optimal for a meaningful explorative conversation.
- It became difficult to introduce the test-user (a guest from Group 5) to the purpose of the session and what was expected from the user.
- The group found that a pilot run may be a useful way of refining the test-material and a script, before running the data collection session.
- The limits for the test-leader's interference became unclear.
- The user became insecure and felt uncomfortable.
- It became unclear whether the user tried to please the test-leader.
- The group found that it is of great importance to prepare the session and create a pleasant atmosphere where the roles and expectations are clear.

Group 1 also found that the presence of a test-leader/interviewer affected the situation, the user and the quality of the collected data. They realised that the repertoire of competencies in the group influenced the process and outcome. They found they had applied their own ideas of what it means to travel and how to use the Danish Rail's website to the test the design, and unintentionally, had biased the data collection and the analysis and thus, they began to grasp the difference between hypothesis-driven and explorative research approaches. In addition, they found that it is important to define criteria for selecting informants or test-users. The group had chosen to video record the computer screen and the user's hands. They found that a camera covering the total situation might be a useful addition, as a total take would document the interaction between the test-leader and the user along with the user's non-verbal reactions to the test-material.

Group 4 - Thinking Aloud (TA)

Group 4's fictitious task was to perform a user-test of the Danish Rail's existing website in order to identify usability problems (test) and determine the need for a re-design (explore). The group was asked to choose an area of the website and design 1-3 tasks for the test-user in a Thinking Aloud test (Boren & Ramey, 2000). Again, the group's task was twofold: 1) Design tasks that are experienced as relevant from the user's perspective and at the same time challenge the user's meaning construction and interaction with the website, and 2) Design the session placing an emphasis on collecting useful and valid data. The data was collected as a combination of a web-cam documentation of the user, Camtasia screen-recording of the user's interaction, and written notes on the process, communications styles and bifurcation points.

Figure 9. A group member writes the task, for the test-person to read.

After reading the task, the group discussed the website and decided on various relevant tasks. The tasks were formulated as scenarios and in the first, a woman and three children aged 2, 5 and 13, with a bicycle and a pram were to travel from Copenhagen to a small town in Jutland. The woman wanted to find the shortest travel route with a preference for family seats. This task was then written on the blackboard for the test person to read.

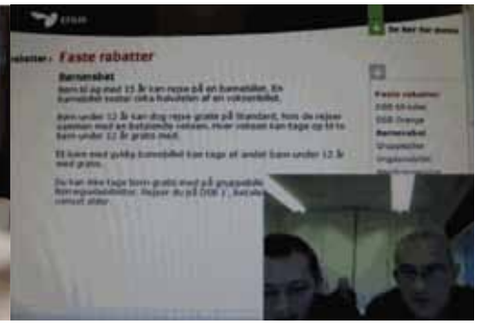


Figure 10 (to the left). The test-person and the test-leader sit by the computer. One observer is seen in the background. Figure 11 (to the right). Example from the Camtasia screen-recording.

The test-person and the test-leader then sat by the computer. One observer is seen in the above image, as remaining in the background (see figure, 10).

A Camtasia screen-recording of the user's interaction with the website is illustrated above. The synchronous web-cam recording of the user and the test-leader can be seen in the lower right corner of the screen (see figure, 11).

Group 4 also presented their reflections in everyday language, and again, it was easy to correlate their conclusions and concepts to the theory during the plenary discussions. The group knew about the TA-method in advance, as it is the most frequently used HCI method. Therefore they had thought it easy to adopt. They found TA useful but realised that it calls for a careful design of performance and purpose. When they analysed their data and retraced the points of bifurcation, they found that they had focused on discussing the test-scenarios as narratives and had entirely forgotten to develop a frame and purpose for the actual test-session. In plenum, they said:

> *We were not good at defining the test. What is it we want the test-person to do? What is the purpose of the test? It's the website that has to be tested, not the test-person!*

The group reflected on the consequences of the bad design and found that the test-scenarios had worked in the sense that the user could identify with the scenarios. However, the scenarios did not produce useful and valid data, e.g. the group could not distinguish between problems stemming from the user's (lack of) ICT-literacy and problems related to usability or the website's visual support of the user's meaning construction. The group also reflected on the relation between test-leader and test-person, and found it important to create a pleasant atmosphere where the test-person relaxes and focuses on the task rather than on the situation. They realised that the quality and timing of the test-leader's interventions are crucial and based on professional competencies as well as sensitivity and experience. It is not easy to decide when to be silent

and how to cue the test-person. As they said in the plenary session:

> *You should not be ironic and say things like 'Actually, this was the easy task, ha ha!'*

They had expected TA to be easy to use and they were very surprised to experience how their setup affected the test-person's emotions, and that even fellow students experienced their test as a personal and unpleasant examination.

DISCUSSION

The objective of the experimental design was to kick-start productive frustration and reflection, to bridge the knowledge gap, to regain some of the lost time and provide students with a sturdy scaffold for the online-period. I recognise the problem of being designer, teacher and researcher in this experiment. However, during activities, materials were produced by students, independently of the author. Accepting this premise, the video-taped presentations at the plenary sessions, along with the students' written documentation of their work, confirm that the experimental design succeeded at least in the plenary context. The data demonstrates that all groups had encountered, identified and discussed challenges and problems that are pivotal to core issues of the HCI theory and practice, e.g. the design process, the HCI practice, conceptual modelling, prototyping, as well as the quality of data collection and analysis. The problems and reflections were described in everyday language, but most of the findings were easily correlated to basic methodological requirements for qualitative research, core issues of HCI theory, and scientific methodology.

Some of the findings may seem trivial. However, when the groups discussed the relation between test-leader, design of the test, test-person and collected data, the discussion reflects an emerging understanding of the difference between the objective positivist position and the correspondence principle on the one hand, and on the other, the phenomenological position where subject–object–phenomenon are inseparable and bound to agency. This is a theoretical understanding that usually is very difficult both to convey and to grasp. Another example is that the groups became aware that they were biased in their views of their own data collection and how this affected the quality of their analysis. Here, they demonstrated an emerging understanding of the concept of *preconceptions* and began to discuss how to confront and promote an awareness of preconceptions in order to avoid unintended bias – that is, they touched upon Husserls' concepts of *Epoché* and *Reduction* which are also difficult to convey and to grasp. This is one of the big challenges for the validity and reliability of qualitative research and the issue is subject to continuous negotiation and discussion in the constructivist theory of science. Finally, all groups identified these complex challenges by retracing their documentation from bifurcation point to bifurcation point. Again, what may appear trivial

in the everyday presentation at the plenary reflects the emerging acquisition of basic scientific methodology (Latour, 1999) through the experience of its immediate advantages. Students at the seminar displayed a competence level in relation to these dimensions matching Dreyfus & Dreyfus' third stage *Competent* (1986), while usually we see that students, even at master's level struggle at the *Novice* or *Advance Beginners* stages. In this sense, the experimental design managed to kick-start a relevant knowledge-construction and reflection, which may be expected to work as a pathway into the theory during the subsequent online-period.

Two months after the seminar, the original semester groups collaborated online on their written M2C3 assignment. During online supervision sessions, it became clear that they had remembered and were able to reflect on and use difficult aspects of the theory. They were still conscious about the design of data collection and bias. On their own initiative, a group raised a discussion on the ambiguity of parts of the HCI vocabulary and struggled to distinguish between difficult concepts as *mental model* and *conceptual model*. Previously, I have experienced that students had not even noticed that these concepts were not identical. A few groups collected data in unpredictable environments and by their own initiative, were able to modify their data collection design accordingly. Finally, the written assignments demonstrated a high initial level of HCI knowledge, the generation of empirical data as well as reflective and critical uses of the theory. All groups were conscious of their way of communicating and precise about the distinction between explorative and hypothesis-driven research. In conclusion, they seem to be able to utilize the Complementary Principle and construct complementary images of the curriculum and to navigate at the edge of chaos.

On the basis of these results, I find that the suggested approach to conceptual modelling and orchestration offers a contribution to the development of a theory of design for teaching and learning. In the meantime, I continue the research and the improvement of the conceptual modelling and orchestration in various contexts.

Acknowledgements

I thank the students at MIL for letting me turn their seminar into a research experiment and allowing me to use their written and visual documentation in this paper.

• • •

References

Ackoff, R. L. (1976) *En ny fremtid formes*. Copenhagen: Nyt Nordisk Forlag

Argyris, C. (1977) "Double-loop learning in organisations", *Harvard Business Review*, 55 (Sep-Oct): 115-125.

Aronson, E., Blaney, N., Stephan, C., Sikes, J. & Snapp, M. (1978) *The Jigsaw Classroom*. Beverly Hills: Sage.

Barad, K. (2007) *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Duke University Press, Durham, North Carolina.

Biggs, J. (2003) *Teaching for Quality Learning at University,* Open University Press. McGraw -Hill Education, UK.

Bohr, N. (1934/1961) *Atomic theory and the description of nature*. Cambridge University Press, Cambridge UK.

Bohr, N. (1954/1957) Kundskabens Enhed. In Bohr (Ed.) *Atomfysik og menneskelig erkendelse*, Copenhagen: Schultz.

Bohr, N. (1964) Kvantefysik og filosofi – Kausalitet og komplementariet (1958). In Bohr (Ed.) *Atomfysik og menneskelig erkendelse II*. pp. 11-18. Copenhagen: J.H. Schultz Forlag.

Boren, M. T. and Ramey, J. (2000) Thinking aloud: Reconciling theory and practice, *IEEE Transactions on Professional Communication*, 43(issue 3): 261-278.

Castells, M. (2000) *The Information Age: Economy, Society and Culture*. Updated edition, Oxford: Blackwell, 3 volumes.

Castells, M. (2000b) Materials for an exploratory theory of the network society. *British Journal of Sociology*, 51, (Issue 1, January/March 2000): 5–24.

Clarke, J. (1994) Pieces of the puzzle: the jigsaw method. In Sharan (Ed.) H*andbook of cooperative learning methods*. pp. 34-50. Westport, Connecticut: Greenwood Press.

Dirckinck-Holmfeld, L. Danielsen, O. and Nielsen, J. (2002) Collaborative learning through multimedia in a community of geo-scientists. In Sørensen, Nielsen and Danielsen, (Eds.) *Learning and narrativity in digital Media*. pp. 53–66. Copenhagen: Forlaget Samfundslitteratur.

Darsø, L. (2001) *Innovation in the Making*. Copenhagen: Forlaget Samfundslitteratur.

Dreyfus, H. L. & Dreyfus, S. E. (1986) *Mind over Machine: the power of human intuition and expertise in the era of the computer*. Oxford. Basil Blackwell.

Dyson, A. (1999) Inclusion and inclusions: theories and discourses in inclusive education. In Daniels and Garner (Eds.): *World yearbook of education 1999: Inclusive education*. pp. 36-53. London: Kogan Page.

Favrholdt, D. (1992) *Niels Bohr's philosopical background*. Copenhagen: Munksgaard.

Favrholdt, D. (1994) *Fysik, bevidsthed, liv – studier i Niels Bohrs filosofi*. Odense: Odense Universitetsforlag.

Favrholdt, D. (2002) *Erkendelsesteori – Problemer, Argumenter, Løsninger*. Odense: Syddansk Universitetsforlag.

Faye, J. & Folse H. (Eds.) (1994) *Niels Bohr and contemporary philosophy*. (Series: Boston Studies in the Philosophy of Science, vol. 158.) Dordrecht: Kluwer Academic Publisher.

Gallie, W. B. (1956) Essentially Contested Concepts. *Proceedings of the Aristotelian Society*, vol. 56: pp. 167-198.

Glazebrook, T. (2000) *Heidegger's Philosophy of Science*. New York: Fordham University Press.

Greve, C. 2000. Contracts as Reinvented Institutions in the Danish Public Sector. *Public Administration*. No. 1.

Education for Innovative Societies in the 21st century. G8 Summit 2006 in St.Petersburg, [Data file] Retrieved April 2008 from http://en.g8russia.ru/docs/12.html

Hastrup, K. (1999) *Viljen til Viden. En humanistisk grundbog*. København: Gyldendal.

Hauen, F. van, Strandgaard, V. and Kastberg, B. (1998) *Den lærende Organisation*. Copenhagen: Peter Asschenfeldts Nye Forlag.

Honner, John (1994) Description and Deconstruction – Niels Bohr and Modern Philosophy. In Faye & Folse (eds.): *Niels Bohr and contemporary philosophy, Kluwer Academic Press*, s. 141-154.
Horton, S. (2000) Introduction – the competency movement: its origins and impact on the public sector. *The International Journal of Public Sector Management*, vol. 13 no. 4: 306-318.
Hood, C. (1991) A Public Management for All Seasons?. *Public Administration*, pp. 3-19.
Illeris, K. (2006) *Læring*. Roskilde Universitetsforlag.
Johansen, C. & Swiatek, E. (1991) *Rollespil*. Viborg: Bogfabrikken Fakta.
Lapham, A.C. (2007) Creativity through elearning: Engendering collaborative creativity through folksonomy. *Proceedings of the 6th European Conference on e-Learning*: pp. 379-387.
Latour, B. (1999) Circulating Reference: Sampling the Soil in the Amazon Forest. In Latour (Ed.) *Pandora's Hope: Essays on the Reality of Science Studies*, p. 24–79. Harvard University Press. Cambridge, Massachusetts.
Laurillard, D. (2002) *Rethinking University Teaching. A conversational framework for the effective use of learning technologies*. 2nd edition. RoutledgeFalmer. London.
Lawless, N. and Allen, J. (2004) Understanding and reducing stress in collaborative e-Learning. *Electronic Journal of eLearning*, 2 (issue 1): pp. 121-127.
Lemke, Jay L. (2000) Material sign processes and emergent ecosocial organization. In Andersen & Emmeche & Finnemann & Christiansen (Eds.): *Downward causation: minds, bodies and matter*. Århus, Sweden: Aarhus University Press, s. 181-213.
Levinsen, K. (2005) *Virtuel Uddannelsespraksis. Master i IKT og Læring – et casestudie i hvordan proaktiv proceshåndtering kan forbedre praksis i virtuelle læringsmiljøer*. Copenhagen Business School, PhD-Serie ISBN 87-593-8279-1.
Levinsen, K. (2006) Collaborative on-line teaching: The inevitable path to deep learning and knowledge sharing?. *Electronic journal of e-learning*, 4 (issue 1): pp. 41-48.
OECD (2001) *Meeting of the OECD education ministers*. Paris, 3-4 April 2001,[Data file] Retrieved April 2008 from http://www.oecd.org/dataoecd/40/8/1924078.pdf. Consulted April 2008.
Levinsen, K.T. Madsen, S. (2007) Barriers for Students' Learning of Holistic Systems Development. *Journal of Information Technology Education* vol. 6, pp. 425-439.
Orngreen, R. & Levinsen, K (2007) Acting against all odds. *Proceedings of the 6th European Conference on e-Learning*. p. 479-486.
Pollitt, C. & Bouckaert, G. (2000) *Public Management Reform. A Comparative Perspective*.
Oxford: Oxford University Press.
Salmon, G. (2002) *e-tivities, the key to active online learning*. Kogan Page.
Salmon, G. (2003) *e-moderating, the key to teaching & learning online*. Kogan Page.
Sharp, H. Rogers, Y. & Preece, J. (2007) *Interaction design: Beyond human-computer interaction* (2. ed.). Berkeley: New Riders.
Slavin, R. E. (1991) *Student team learning: a practical guide to cooperative learning* (3rd ed.), Washington DC: National Education Association.
Wenger, E. (1998) *Communities of Practice – Learning, Meaning, and Identity*.
Cambridge: Cambridge University Press.
Yuthas, K. Dillard, J.F. & Rogers R.K. (2004) Beyond agency and structure: Triple-loop learning. *Journal of Business Ethics*, 51 (May): 229-243.