The future of the classroom is an issue that essentially concerns many of us as students, parents, taxpayers, policymakers, teachers, design professionals, or researchers. A glance at the history of pedagogical practice reveals, however, that despite rapid developments in the outside world, classrooms have evolved very little over the years. While our understanding of learning and favourable learning environments has substantially improved and technological innovations are offering a variety of new possibilities, it still seems that most of today’s schools and universities remain more or less unaffected by these developments.

This book brings together the perspectives of researchers, architects, technical designers, and teachers on emerging theoretical and technological developments pertaining to the classroom of the future.

Innovative ideas are offered on how new technologies and learning approaches can be integrated into schools. It challenges us to think of learning spaces in a new way. Classroom of the Future is of interest to researchers and students, designers and educators across various disciplines including education, cognitive, social and educational psychology, didactics, computer science and design as well as to parents and policymakers.
Classroom of the Future
TECHNOLOGY ENHANCED LEARNING
Volume 3

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Scope
The rapid co-evolution of technology and learning is offering new ways to represent knowledge, new educational practices, and new global communities of learners. Yet the contribution of these changes to formal education is largely unexplored, along with possibilities for deepening our understanding of what and how to learn. Similarly, the convergence of personal technologies offers new opportunities for informal, conversational and situated learning. But this is widening the gulf between everyday learning and formal education, which is struggling to adapt pedagogies and curricula that were established in a pre-digital age.

This series, Technology Enhanced Learning, will explore learning futures that incorporate digital technologies in innovative and transformative ways. It will elaborate issues including the design of learning experiences that connect formal and informal contexts; the evolution of learning and technology; new social and cultural contexts for learning with technology; novel questions of design, computational expression, collaboration and intelligence; social exclusion and inclusion in an age of personal and mobile technology; and attempts to broaden practical and theoretical perspectives on cognition, community and epistemology.

The series will be of interest to researchers and students in education and computing, to educational policy makers, and to the general public with an interest in the future of learning with technology.
Classroom of the Future

Orchestrating Collaborative Spaces

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1. THE CLASSROOM OF THE FUTURE –
AN INTRODUCTION

INTRODUCTION

Will classrooms still exist 20 years from now? Do we have traditional classrooms in a physical sense anymore? What is the classroom anyway? For most of us, a classroom consists of four walls, ‘closed’ doors, chairs, tables, perhaps a blackboard, and sometimes a desk - simple but efficient pieces of furniture. A quick glance at the history of pedagogical practices reveals that the classroom has scarcely evolved over a period of many years. Is the traditional classroom intrinsically outdated or has it rather survived the test of time because it is already self-reconfigurable and has been adapted in many different contexts of use? Do we even need a classroom anymore? Do we need a teacher in the classroom? What do we teach and what do we want pupils to learn? What kinds of knowledge and skills will be required in the future? These are some of the questions that we should bear in mind when thinking about the classroom of the future.

Over the last few decades, our understanding of learning and the conditions under which it is facilitated have substantially improved. In most contemporary theories, learning is conceived as a constructive and social activity, as a result of which the roles of the teacher and the learner within the classroom have been redefined. Development in technologies that can be used to enhance and support learning has been even more rapid. Nonetheless, it would appear that the majority of the classrooms in today’s schools and universities remain unreached by these developments. In our roles as students, parents, tax payers, policy makers, teachers, designers, or researchers, the future of the classroom is an important issue of concern to many of us. It is certainly an issue that has the potential to fire one’s imagination. It is also an issue that can unite people from various educational and vocational backgrounds or divide them even further. However, despite the wide range of ideas and perspectives on this topic, multi-disciplinary efforts to design the classroom of the future are scarce. Our presumptions surrounding the classroom are alive and well and for most of us, classrooms are something very physical. We therefore need multiple perspectives to shake up our own traditional way of thinking about classrooms and to stimulate a real discussion concerning what the classroom actually is. This volume can be seen as a step in the direction of bringing together researchers, designers, and teachers, providing a forum in which to share their experiences and ideas on emerging theoretical and technological developments related

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Classroom of the Future: Orchestrating Collaborative Spaces, 1–12.
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to the future classroom and in which to plan the future classroom in an innovative and imaginative way. The volume is mainly based on the contributions presented at an international workshop entitled “The Classroom of the Future”\textsuperscript{1}. In collecting the essays to form this book, we aim to open up the door to a wider audience and allow an examination of the classroom of the future from the various perspectives included. At the same time, we hope to set the ball rolling and encourage people from different fields to share their ideas on the classroom of the future.

A closer look at the front cover of this book, for instance, reveals how Gollifer Langston Architects\textsuperscript{2} imagine the classroom of the future. Depicted is the interior of a prototype expandable mobile classroom which was funded as part of the UK governments’ Classroom of the Future initiative that sought to stimulate thinking about future school environments. Since education concerns our desires and hopes for the future, it may be argued that educational thinking is always strongly connected to utopian thinking (see Peters & Freeman-Moir, 2006). In the chapters of this book, however, you will not be confronted with science fiction but with technologies and devices that are predominantly available and ready for use.

TOWARDS COLLABORATIVE SPACES IN CLASSROOMS

New ways of viewing learning and the development of technology challenge us to think of learning spaces in a different manner. Given its impact on the way in which people behave (Graetz & Goliber, 2002; Tanner, 2000), environmental psychologists claim that the physical environment can no longer be seen as a neutral setting. In the field of educational psychology, Lave and Wenger (1991) similarly note that learning is situated in a particular context and embedded within a specific social and physical environment. The work of these researchers clearly indicates that the physical environment sets constraints and possibilities by influencing a learner to act in a certain way in a certain place. Of relevance in this context is the concept of “built pedagogy” introduced by Torin Monahan (2002). Built pedagogy refers to the notion that physical environments reflect and generate values through their constraints upon social activity and interaction. Consider, for example, a classroom in which the teacher generally assumes a frontal position. This kind of arrangement and architecture potentially creates an expectation according to which pupils should remain quiet and listen to their teacher, who alone has the right to talk and pose questions. Such an environment fails to enhance interaction between students and the teacher or among students. While this environment sharply contrasts with the majority of prevailing theories on contemporary learning, Resnick (1987) pointed out back in the late eighties that school environments differed from most everyday environments in continuing to highlight individual work. In hospitals, for example, decision making in emergency room medical teams is distributed among different expert members, each of whom shares their knowledge in order to identify the best solutions for the treatment of a patient. Twenty years after Resnick’s observation, educational spaces continue to provide little support for more student-centred processes of teaching and learning such as collaborative learning (see, for example, Schratzenstaller, in this volume; Law, Pelgrum, & Plomp, 2006; SITES 2006 study).
Collaboration is described as an active process and a coordinated effort by which learners pursue joint goals, solve problems, and build a mutual understanding of a particular issue (Littleton & Häkkinen, 1999). Collaborative learning crucially depends on the existence of appropriate instructional, physical, and social conditions. Simply putting people into groups and asking them to solve problems or perform tasks does not necessarily induce the kind of interaction that makes learning more likely. Collaboration should rather be comprehended in a wider sense. Learning can include collaborative as well as individual and collective activities, distributed across multiple places (physical, virtual, or a combination of the two), and can be supported by multiple tools. According to Dillenbourg and Fischer (2007), three different dimensions of distributed collaborative learning should be taken account: cognitive, pedagogical, and technological dimensions. Teaching and learning are thus seen as context-sensitive activities (see also Lave & Wenger, 1991).

In the early stages of designing technological applications for learning purposes, a focus was mainly placed upon the individual needs of the learner. As technological applications became more developed, the internet increasingly gained in popularity as a communication channel, and different virtual learning environments were designed, the focus of attention switched to social interaction and its relevance for learning. By engaging in knowledge-building communities and social interaction, the learner came to be seen as an active constructor of knowledge (see Scardamalia & Bereiter, 2006). Research thus began to focus on enhancing interaction between learners in asynchronous and synchronous situations. In the process, different kinds of tools and environments for sharing, distributing, and building information were designed. Moreover, technological development began to expand beyond standard computers to mobile technology and intelligent walls, ceilings, and furniture. If used appropriately, the use of technology and new media has great potential for enhancing learning. There is, however, also a need for deeper understanding on how different kinds of technological features constrain and afford interaction and learning. The central question concerns how to trigger the kind of interaction between learners which makes learning through collaboration more likely. Learners need a reason to collaborate and a simple tool is sometimes sufficient to grab learners’ attention and enhance the natural interaction that occurs between them; in the best of cases, this in turn results in learning. Innovative technology can motivate students to learn and make learning more fun. Recent research focuses on the ways in which technologies can be used to design interactions, creating, for example, the kinds of situations that force students to engage in effortful interaction (Fischer, Kollar, Mandl, & Haake, 2007).

Meaningful and efficient collaboration requires a specific place which formally or informally enhances collaborative learning. In opening up new channels for collaboration, technology is also stretching the limits of physical space. With the help of new technology, collaboration and community thinking are no longer limited to the inside of the classroom but can also occur in a number of other places. In contrast to the common assumption that the teacher of the future will play a more background role, future teachers will actually assume a major role in scaffolding
different processes, extensions, and functions within collaborative learning spaces. Dillenbourg and Fischer (2007) refer to this perspective as “orchestration”. Their idea highlights the complexity of teachers’ work and the importance of technology in the future classroom. Besides knowledge on how to use technology and content knowledge on particular subject matters, the teacher will also be required to come up with ideas on how to apply technology in teaching and in the respective subject area. In other words, the teacher should have adequate ideas concerning the pedagogical model which is best suited to prerequisites of the learners as well as concerning a particular topic and the technology available (Häkkinen & Mäkitalo-Siegl, 2007).

The contributions in this book include various pedagogical models comprising formal and informal collaboration in the context of individual, group-based, class-wide, or even school-wide activities. A variety of settings (classroom, online, fieldtrip, excursion) and modes of communication (face-to-face, online and offline, synchronous and asynchronous etc.) are described. Each of the chapters introduces innovative pedagogical models for collaborative spaces and the use of technology as well as highlighting advantages and further challenges in designing classrooms for the future in different educational environments.

FROM BUILDING DESIGN TO IMPLEMENTATION

This book is divided into five sections. The first section focuses on the design of classrooms and school buildings by exploring the history of school design and instruction as well as the influence of architecture in the creation of formal and informal learning spaces. In the second section, the authors present already-available technologies which can be embedded into objects and furniture and which have the potential to enhance learning in the classroom of the future. The third section discusses the role of knowledge-building communities in the classroom, and introduces how different experts from the outside of the classroom can support knowledge building in the classroom. In the fourth section, current designs and realisations of the future learning places are presented. The book concludes with a discussion of the challenges and the possible reasons why technology and new pedagogical models have yet to be widely adopted in today’s schools. The reader might, however, even consider starting with the discussion rather than proceeding through the chapters in the proposed order. The questions raised in the final chapter by Ingo Kollar may provide guidance and a wider perspective for approaching this book and its contributions.

Learning Spaces Shaped by Instructional, Classroom, and School Building Design

The first section of this volume prompts readers to think about classrooms and schools from both an instructional and an architectural perspective. Andreas Schratzenstaller goes beyond the design of the classrooms in highlighting major influences on education and the subsequent shape of the classroom as it is today. The influences he addresses include economy and economical thinking, parental
INTRODUCTION

involvement and demands, and politics. He subsequently takes the reader on a journey through the last 150 years, examining the changes that have taken place in the classroom with regard to both architecture and social context. Sch ratzenstaller argues that despite the critical demands of society, the classroom of the present still can not be viewed as anything other than antiquated. He concludes that the classroom of the present is clearly influenced by the structure of preceding classrooms and has finally reached a state of utter incompatibility between form and function. He underscores the urgent need for a resolution of this incompatibility and stresses the importance of an interdisciplinary effort in realising and implementing the classroom of the future.

In their contribution, Joanna and Rosamund Sutherland aim to create a framework for understanding the relationship between school design and learning. They point out ways in which the design of learning spaces can enhance or hinder informal and formal learning. Architecture itself sets limits and expectations with regards to how people behave in certain places. In this chapter, the individual perspectives of an architect and an educator form a dialogue in which different school designs are compared. The dialogue focuses on a discussion of the use of space and the usability of school designs as learning spaces, the role of information and communications technology (ICT) and users’ respective experiences (teachers and students), and differences between a school of the future and a school of the past.

Facilitating Learning Using Technology-Enhanced Objects and Furniture

While the previous section addresses the design of schools and classrooms as learning places, the second section presents technologies that can be embedded in different kinds of objects and furniture and used in the classroom. Paul Holleis, Albrecht Schmidt, Heiko Drewes, Richard Atterer and Petra Dollinger present several examples of technological innovations which aim to motivate learners to learn and make learning more fun. Embedding technology into familiar, every-day devices not only makes them easy to use but further turns them into tools for effective and motivating learning. The examples provided by Holleis and colleagues all have a common denominator: The innovations are available and easily used without in-depth technical knowledge. Additionally, an eye-tracking system which combines eye-gaze tracking and web-activity tracking is introduced. This system can be used as a reading assistant or to measure reading intensity and can prove valuable in the classroom, for example, in helping to find optimal ways to foster students’ reading abilities.

In the next chapter, Stefano Baraldi describes how technology with natural interaction features could change learning and teaching practices in the classroom and in particular how concept mapping integrated into innovative technology (e.g., interactive walls, tables) could enhance collaborative group learning processes (joint knowledge building). He argues that embedding new technology within objects that are already familiar to users allows objects to retain their basic affordance, so that less effort is required in concentrating on novel functions. The use of newly designed objects should not be limited to simple action-response mechanisms but should enhance the continuing dialogue between the user and the object. Baraldi
introduces several further principles which should be considered when designing new technologies for the classroom and explains how students can benefit from these elements in collaborative situations.

Giulia Gelmini Hornsby discusses the way in which technology can be designed to support innovative teaching in which teamwork is appreciated and flexible material arrangements are supported by particularly focusing on collaborative storytelling in primary education. The author presents StoryTable – a tool designed to support children in collaboratively creating stories. The idea underpinning the use of StoryTable is to provide structures within the collaborative story-making process. This additional structuring is provided with two important aims: 1) to enforce collaborative action and 2) to enhance ownership accountability. Gelmini Hornsby indicates specific design features which should be taken into account when developing technologies to support collaboration in primary school classrooms.

For the large part, the devices presented by Frederic Kaplan and Pierre Dillenbourg are already found in the classroom and include, for example, tables and lamps. However, the authors look to discover multiple uses for these common artefacts and focus on the presentation of an entirely “scriptable classroom”, where scripts and interactive furniture can be combined. Scripts are designed to scaffold interaction between learners and in doing so, ensure that fruitful learning takes place. Kaplan and Dillenbourg identify certain properties which each artefact should possess (e.g., bidirectionality, plane switching, dynamic group formation). A particularly important design feature is that these artefacts should be available for use in several educational situations and not just for a specific classroom assignment. Besides physical elements such as desks and lamps, Kaplan and Dillenbourg also illustrate data structures that can be used in the scriptable classroom. These structures can help teachers to track students’ assignments and observe classroom dynamics. Pairs or groups can, for instance, be formed on the basis of specific criteria derived from the collection of student profiles.

Towards Knowledge Building Communities in Virtual and Physical Learning Spaces

Knowledge-building communities can be located in both virtual and physical spaces. The following chapters discuss knowledge-building communities and technologies which support knowledge building. Nicolae Nistor presents an overview of the state of the art in research on knowledge communities and addresses the potential of knowledge communities as knowledge-building and knowledge-creating environments. Social and motivational (e.g., anticipated reciprocity, increased recognition, sense of efficacy) dimensions are presented in order to underline the popularity of these knowledge-building communities. Nistor characterises three levels which are typical for knowledge-building communities in the internet, namely information exchange, co-construction of knowledge, and collective memory. Finally, several ideas and developments for increasing understanding and designing knowledge communities in a future classroom are presented.
INTRODUCTION

Lily Diaz and Lotta Partanen introduce the CIPHER (Communities of Interest to Promote the Heritage of European Regions) project which constitutes a multidisciplinary community in the field of digital cultural heritage. The authors refer to cultural heritage as a form of “cultural and artistic expression from the near or distant past of a given country or cultural area” (p. 220). Nowadays, this can be referred to as digital cultural heritage because of the advanced technology and the digital tools applied in the creation, recording, and preservation of cultural heritage. The project presented here is particularly interesting, not only because of the tools and artefacts created but because of the way in which educational activities formed part of the research and design cycle. Collaboration took place between different groups and communities, such as universities, local schools, and museums. This chapter stresses the importance of online and offline learning and how these can be integrated in a meaningful way (e.g., not only an integration of different kinds of modes but also of different kinds of activities and settings as well as different subjects).

Joint Efforts for Designing and Implementing Future Places of Learning

The chapters in this section offer prime examples for integrating different modes of learning and present current designs and realisations of the future learning places. In the first chapter of this section, Andreas Lingnau provides examples of how innovative technology can enrich traditional classrooms. He presents three different projects (NIMIS, SEED, and LMMP) in which technology was designed around already existing good practices. This chapter illustrates how existing pedagogical practices can be transferred into computer-supported learning scenarios bringing added value for both the teacher and the learner. Lingnau states that intensive collaboration between experts from different fields is essential in successfully designing future learning spaces. He goes on to present “complementary action design”, a co-development process in which teachers, with the support of researchers, play a crucial role in contributing ideas as well as informing and advising designers (e.g., software developers) throughout the entire design process.

Based on long-term research collaboration with schools, Jim Slotta explores the idea that poor exchange of learning and instruction innovations within international research communities represents one restriction when it comes to evolving and realising classrooms of the future. He discusses the benefits and constraints of supporting the exchange of innovations between researchers in a ten-year research program on designing technology environments for scaffolding science inquiry projects (WISE). He further describes new technology environments which support various kinds of activities (information and material sharing, collaboration) among researchers. Slotta takes a step next to the future by presenting the SAIL Smart Space -a system comprising several distinct layers and a range of devices and approaches that can be applied in smart classrooms and with rich pedagogical scripts. This innovative system enables the flow of people, roles, goals, materials, and devices to be managed in the classroom.
Using semantic data on content or student interaction data, many different pedagogical operations can be performed by, for example, influencing the learning materials that are provided to the students or grouping students.

FROM THE CLASSROOM OF THE FUTURE TO THE CLASSROOM OF THE PRESENT

In the final chapter, Ingo Kollar opens a critical discussion on the purpose of conceptualising the school or the classroom of the future and claims that there are many challenges to be mastered before new ideas can be realised. In his essay, he aims to answer the following three questions: 1) What are the educational goals and 2) the instructional approaches for reaching these goals in the envisioned classroom of the future and 3) what obstacles need to be overcome in transforming the classroom of the future into the classroom of the present. In the process of answering these questions, Kollar identifies a variety of approaches driving the innovations and designs presented in the chapters of this volume. These include technology-driven, practice-oriented, and theory-based approaches. Major obstacles in realising the classroom of the future are identified on three different levels: the level of school, educational research, and political systems. Each of these systems carries individual as well as a shared responsibility in continuing to develop schools into future places of learning. On the one hand, the political system should offer schools more freedom and opportunities to experiment with different pedagogical models as well create the kind of infrastructure that encourages collaborative efforts between practice and research. On the other hand, teachers themselves should be more open to new pedagogical models and the development of technology as well as be willing to regularly update their knowledge by participating in in-service education and reading current research literature.

CONCLUSION

Rather than just being about school and classroom design, this volume is also meant to offer some innovative ideas on how both new technologies and learning approaches can be integrated into schools. It marks a first step towards real interdisciplinary approaches (see, for example, Sutherland & Sutherland, in this volume) and aims to inspire and encourage collaboration between different fields with the ultimate goal of producing a well-designed classroom of the future which is suitable to become the classroom of today. In the future, a second step should look to deepen this interdisciplinary approach and disassemble our traditional thinking surrounding the classroom and school in order to create flexible spaces with flexible practices for flexible users. The real challenge is to create a space which can be adapted in the case of unexpected changes and which takes the specific learning needs of different student populations and different communities into account (see Monahan, 2002). Based on the contributions in this volume, some central ideas can be identified that might prove useful when it comes to considering classroom space or hybric
learning space. In the future, learning spaces might be designed in such a way as to encourage students to collaborate with one another, with teachers, and also with people outside the confines of the classroom, not only in physical but also in virtual spaces. As Baraldi (in this volume) suggests, a learning space might be described as a social meeting place. This is not necessarily a place with four walls and closed doors in which a single class community meets but might rather be an open physical and virtual place for different communities. The design of the future hybric space might be more user-centred (both from the view of the learner and the teacher), functional, usable, and appealing. Functionality entails flexible and mobile learning spaces, furniture, and technology which enable users to easily change between learning spaces according to their learning goals and needs and which support individual, small group, or whole-class activities and even outside-of-the-whole-class activities. Hybric space should motivate the user to actively restructure the learning space in accordance with the learner’s needs. Several chapters also emphasise that learning spaces are to be usable, which means that furniture and tools have a clear learning purpose and that already-existing objects in the classroom are equipped with some novel functions. Familiar and already-existing furniture or objects providing novel functionalities require less effort on the part of the learner when accessing new functions. Clear instructions on using these novel technologies, however, serve to support the attitude and ownership of the users with regard to the learning space as well as enabling them to focus on learning and not the use of the tools. Today’s learning spaces should be designed to be more inspirational (see Cornell, 2002) as well as to offer “wow” and flow-experiences (Csikszentmihalyi, 1990) to users. These kinds of experiences easily arise when, for example, playing computer games (Inal & Cagiltay, 2007). In helping to stimulate users to engage in activities that result in learning (e.g., Holleis et al., in this volume), computer games may thus form a key element in future classrooms. Nonetheless, offering “wow”-experiences and inspirations should not lead to future classrooms becoming high-tech entertainment parks; learner activities should rather be connected to both the content of the respective subject and the real world. Therefore, we should ask ourselves in the process of designing these hybric spaces, that what do we want the pupils to learn? What are the kinds of knowledge and skills that are needed in the future?

Most chapters in this book clearly emphasise the crucial role played by the teacher in the classroom without any hint of a replacement by machines. To a certain extent, this contrasts with the prevailing view that the teacher is to become increasingly passive or even just a guide. Based on the chapters in this volume, it is strongly assumed that there is only one teacher in a classroom. We might, however widen the “borders of the classroom” by suggesting that several different professionals could serve as a “teacher”. This means that, when needed, several teachers might be available for different learners in the future hybric space. Nonetheless, from a learner’s point of view, there should be one person who is responsible for orchestrating the complex learning and teaching situations in the future hybric space (see Dillenbourg & Fischer, 2007) and who keeps track of overall learning and teaching processes; this could in part be achieved with the help
of technology. The availability of new technologies and the possibilities the contributions of this book offer to the teacher in the classroom of the future are of course accompanied by an increased responsibility to use them in a sensible way. Sensors and tracking devices provide detailed information that may help the teacher to better understand what is going on in the classroom and to make corresponding adaptations. In order for this and other technical possibilities to become real innovations within the classroom, we need comprehensive programs of teacher professional development as well as professional integration approaches. At the same time, various authors in this volume indicate the relevance of privacy issues and the limitations of freedom for the individual learner that are connected with the use of such tracking technologies. This discussion clearly extends far beyond the classroom - a large number of objects currently used in our daily lives are capable of collecting data. Most mobile phones can record audio or video files and there are digital cameras that are even capable of detecting whether a person is smiling (indicating happiness) or not. However, this issue further emphasises the need to embed respective technologies into a reasonable pedagogical concept.

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NOTES

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REFERENCES


INTRODUCTION


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PART I: LEARNING SPACES SHAPED BY INSTRUCTIONAL, CLASSROOM, AND SCHOOL BUILDING DESIGN
2. THE CLASSROOM OF THE PAST

“Tis all in pieces, all coherence gone”  
(An Anatomy of the World: The First Anniversary by John Donne, 1611)

INTRODUCTION

In the course of the late 20th century, “a period of significant educational change” (Lawn & Grosvenor, 1999, p. 385), pedagogic practice came under increasing scrutiny – in the sense of “a growing concern from governments and the general public about the adequacy and quality of education and training” (Rychen, 2001, p. 1). Situated at the precarious intersection of conflicting discourses, the classroom became a pedagogic dispositif, predetermining, it appears, more than ever in educational history, the future of the individual (e.g., Reese, 2007; Smit, Driessen, Sleegers, & Teelken, 2008) and consequently of society in general. This social power naturally attracts the attention of numerous social groups, each of which has their own very specific notion of what should be achieved in the classroom. In the domain of education, there may be nothing as ambiguous as today’s classroom with respect to both its role as an important path into the future and an object of disposal. For a project that visualises the classroom of the future, an examination of these external influences proves instructive in identifying the societal processes which shape, form and lay claim to the classroom and in revealing the relevance of these processes for an educational project that addresses the classroom itself rather than the external forces impacting it.

There are at least three major forces to be considered: the economy, parents and politics. Yet before focusing on these influences in more detail, let us agree that, of course, one classroom or one school does not resemble another. Exceptions, alternative modes, specific patterns and optional designs are always to be found. It is therefore more to the point to focus on influential paradigmatic structures and changes rather than becoming entangled in the snare of individual differences and controlling for discontinuities which in any case would not refute but only add to the discursive formations outlined in this chapter. So, let us begin. Let us enter the classroom of the present and view it in the light of the educational expertise of economy, parents, and politics.

SHAPING THE CONTEMPORARY CLASSROOM: MAJOR INFLUENCES ON SCHOOL EDUCATION

Economy, to start with, has been tremendously successful in the past few decades in penetrating other domains. Indeed, it has become common practice to gear domain-specific considerations towards economic concepts. Not surprisingly,
education also did not go unheeded in the alleged necessity for stock-taking cost-benefit analyses. There is ample evidence to suggest that we are witnessing a wide-scale “implementation of the economic market mechanism in education” (Smit et al., 2008, p. 73) and that this is a worldwide process. In America, the National Commission on Excellence in Education has explicitly reformed schools with respect to the needs of national economic competitiveness (Hanushek, Jamison, Jamison, & Woessmann, 2008). The same goes for China, where education is expected to “fit in the market economy” (Guorui, 2006, p. 18). Europe, in accordance with its Lisbon Strategy, conceives of knowledge as “a tool of positioning individuals on […] the labour market” (Magalhães & Stoer, 2003, p. 43) and aims to model the learner according to the demands of the knowledge economy (Brine, 2006). Even Finland, since PISA the shining beacon of education in and beyond Europe, is no exception in this respect (Häyrinen-Alestalo & Peltola, 2006), and the same discussion is being led in New Zealand and Australia (Casey, 2006) and, yes indeed, even in the Caribbean (World Bank Publications, 2007).

What does this mean for education and the classroom when they are at the receiving end of economic tuning? To begin with, economic demands on education are asserted on a rather dubious basis. In America, arguably one of the countries most open-minded for economic considerations, there is growing scepticism due to the fact that even strong advocates of the economic turn within education have not been able to produce empirical evidence for the alleged educational benefits of this development, although they continue to exert pressure upon educational institutions (Hanushek et al., 2008). In addition, the economic reign over education also carries content-related problems. Controversial at best is the main demand to foster key competencies (Kember & Leung, 2005), which are regarded to be highly important for productivity and competitiveness (Salganik & Stephens, 2003). Not only is the term utterly vague and not only are there “650 different key competencies […] suggested just in the German literature” (Weinert, 2001, p. 52) - which leaves school with a tremendous amount of work to be done - but a recent study by Hanushek et al. (2008) further suggests that it is cognitive skills rather than key competencies which impact a nation’s economic growth. Altogether, the economy thus interferes rather forcefully and self-confidently, although it becomes obvious upon empiric scrutiny that, with regard to the educational domain, it scarcely has more to offer than vague assumptions and unspecific concepts. Does it take one by surprise that schools experience considerable pressure as they inevitably fall short of what is expected of them as they are unable to deliver that which, economically speaking, the customer him/herself does not know?

Parents worldwide are currently gaining increasing influence on schools due to the discussed impact of the economy: “parents empowerment is […] endorsed and encouraged by the market ideology and consumer orientation that penetrate into schools” (Addi-Raccah & Arviv-Elyashiv, 2008, p. 395). Parents’ involvement represents one of the pillars of modern school reform. It is considered to have a substantial effect on - to name but a few educational outcomes - democratic values (Smit et al., 2008) and even academic achievement, however modest the latter effect may be (Nettles, O’Brien Caughy, & O’Campo, 2008). When it comes to
parental participation in school-life, approval is enthusiastically voiced. A closer examination of this success story beyond words of eager commendation, surprisingly quickly reveals, however, that this fervent excitement has remained “largely unexamined” (Ogawa, 1998, p. 397) over decades. This might explain why it has thus far “resulted in relatively few evidence-based lessons for effective policy” (Smit et al., 2008, p. 66). Again, we are thus faced with a discourse which, though self-confidently practiced, is by and large scarcely supported by evidence.

Moreover, a number of studies indicate that parents exert considerable pressure upon schools. On the one hand, parents expect schools to avoid any practices that might be seen as asking too much of their children, “who are not expected to overcome conditions not to [their] liking [and] are expected to achieve only if they have the Perfect Teacher, and teachers are expected to do it all” (Zoch, 2004, p. 71). On the other hand, schools cannot rely on parents as educational allies, regardless of compliant terms like participation, involvement, or particularly partnership which are used to characterise the parental role. The comparative study conducted by Smit et al. (2008) indicates that “in many countries, dissatisfied parents can make their schools accountable for their actions” (p. 74). The consequences of a partnership conceived of in this manner become apparent when parents – in their quest to foster democratic values? – go as far as forcing principals to exclude teachers whose educational practice is not to the liking of individual parents (Addi-Raccah & Arviv-Elyashiv, 2008). In this context, the demarcation-line of parental behaviour towards school seems to run along income-boundaries. It is well established that in particular parents of high socio-economic status claim involvement and use their considerable resources to simply “enforce their demands” rather than entering a partnership-based relationship (Addi-Raccah & Arviv-Elyashiv, 2008, p. 398). How very much at odds the interests of parents and schools can be characterised by Jacob & Lefgren (2007): parents of children who attend affluent schools demand teachers who “keep students happy” (p. 60) considerably more than teachers who aim to improve student achievement. It is thus no wonder that several studies have revealed that “parents’ participation in school decision making [has] the potential to turn schools into an arena of a battle over turf” (Addi-Raccah & Arviv-Elyashiv, 2008, p. 395). Attempting to balance the multitude of parents’ individual convictions and dealing with parents who insist that their specific interests be met must indeed induce a great deal of pressure within some schools. While it might be rather strong to speak of “war”, as Mawhinney (1998, p. 39) does, the examples he as well as Addi-Raccah and Arviv-Elyashiv (2008) provide vividly show the self-opinionated details with which schools are forced to struggle in the case of extensive parental involvement.

Politics clearly sides with both parents and the economy but does, in the wake of PISA, also stipulate the additional demand of high-quality education at the same time as reducing public spending on education. Economically streamlining education is a rather popular euphemism for serious financial deficits in the educational sector which are reflected in a lack of both material and personal resources. Indeed, for years, statistics from the Organisation for Economic Co-Operation and Development (OECD) have shown the political unwillingness of
many countries to financially live up to the high standards they quite naturally set for education. As recently as 2006, it again became evident that even – or perhaps in particular – economically powerful nations such as Germany invest less in their educational system than the OECD average, as far as both “annual expenditure” and “expenditure […] as a percentage of GDP” are concerned (OECD, 2006, pp. 170, 194). The rest is silence. So often has it been stated that political impetus for actively engaging in education has, to put it mildly, room for improvement that it is hardly an exaggeration when Jane McGregor understands “political inertia” (McGregor, 2004b, p. 355) as a major reason for the continuing staleness of education in general and the classroom in particular.

Yet, what does all this have to do with the classroom as a learning environment? Nothing! And that is exactly the point to be made here. The classroom as a learning environment is the precarious zero within the fault-lines of the popular discourse on education. In addition, countless suggestions, opinions, demands and convictions form a discursive reality that is charged with ambitious expectations but that is far too disparate and inconsistent to be realised. It is central to the argument to see that these expectations are based upon a physical void. As they strive to see through their interests the major influences on school education, the economy, parents and politics, are scarcely interested in the very space where they naturally expect their interests to be realised. They pretend to see it all, but their blind spot is the classroom itself; the touchstone which any educational aspiration, as high flown as it may be, will sooner or later run into. The greater the gap between the discursive reality of interest groups and the physical reality of the classroom, the more discontent is felt about that which schools can achieve and the more indignantly new demands seem to be expressed - a vicious circle that can all too easily spiral into wishful educational thinking.

One could say that the classroom of the present has become lost amidst the uproar of discourse and it is therefore no wonder that it has not changed for decades. It is remarkable how highly critical society is towards education at school, yet at the same time, how readily or indifferently it accepts that the learning environment of its children is simply antiquated. Jane McGregor (2004a, p. 13) puts it in a nutshell when she states that:

In a world increasingly characterized by change, diversity and complexity, with educational institutions […] aspiring to become ‘learning organisations’ and where the ‘knowledge economy’ is apparently crucial, schools as workplaces for learning […] exhibit physical, organisational and social arrangements that have changed relatively little in the last 150 years.

Although it has been pointed out that new schools in America, and for sure not only there (see Sutherland & Sutherland, in this volume), do indeed incorporate the results of spatial research, which has led to “considerable improvements” (Earthman, 1999, p. 353), the architecture of most schools primarily lends support to McGregor's line of argumentation. All those endless discussions on education and all those numerous curriculum changes have not led to a substantial reform of the classroom. One cannot but conclude a societal disregard for the learning environment of its future generations.
THE HISTORICAL DIMENSION OF THE FUTURE CLASSROOM: REFLECTING UPON THE PAST TO UNDERSTAND THE FUTURE

This is where the Classroom of the Future comes in. As a worldwide interdisciplinary project, the Classroom of the Future aims to bring together theorists and practitioners from various domains who join efforts to adapt the classroom to that which it can be expected to resemble in the 21st century. The pressure of change is on the classroom; it is utterly unthinkable that it can continue to be built, structured and equipped as it has been for all these decades. It is rather grotesque that societies which essentially depend on and intently strive for innovation and progress should try to source the power and energy for their innovative and progressive future from the physical and conceptual conditions of the educational mills of the 19th century. The Classroom of the Future aims to bridge this gap and to actively fashion this process of change with the help of educational scientists, media scientists, architects, designers, and teachers, to just name a few of those involved. Theoretical, conceptual, and practical knowledge is combined with the aim of realising architectural and spatial prerequisites for implementing new media technology as well as constructivist and instructional state-of-the-art teaching into the classroom. The question arises, however, as to how these fundamental changes can be put into practice. How can this hopeful future of the classroom be developed out of its deficient present?

At the core of reforming the classroom into the classroom of the future is a double rationale. It places the physical spatiality of the classroom at the centre of considerations and is essentially aware of the historical disposition that shapes today’s classroom. Deeply rooted in the structures of its historical predecessors, the classroom of the present is very much a genealogical object, corroborating the notion of the “present as a mode of history” (Peim, 2001, p. 178). What has in this respect been claimed for English schools can be generalised for Europe: there are “deep continuities visible in the genealogy of the modern school, from the post-1870 elementary school to the overburdened contemporary post-comprehensive school” (Peim, 2001, p. 188). It would therefore be short-sighted to attempt to design a new future without understanding the present and in particular, the considerable extent to which this present is “predisposed […] to emulate past practices” (Jacklin, 2000, p. 4). This chapter attempts to retrace this genealogical line and in doing so, to reveal “how over time changes become sedimented […] in the system” (Lawn & Grosvenor, 1999, p. 385). It examines the development of the architecture and structure of the modern school and the modern classroom over time, triggers of change, and the interaction between the historical formation of certain characteristics and both the classroom of the present and its attempted transformation into the classroom of the future. Two questions thus emerge as a focus of interest:

(1) To what extent is there a correlation between architectural modifications of the school as well as the classroom and socio-semantic changes?

As cultural practices school and the classroom are expected to change in the course of socio-semantic shifts. One would assume that societies possess those schools and classrooms that correspond with general societal and particular educational
convictions. In dealing with school architecture and its modifications, it is thus necessary to view it as being enmeshed in the cultural practices of its time. It is therefore not the numerous and fine nuances emerging in various countries over the course of the past few centuries that are of interest here, but general developments which consolidated to form paradigms influencing the design of learning environments. Placing the classroom of the future in the context of its historical determinedness can hardly be achieved by “studying small incremental changes” (Sawyer, 2006, p. 568). The aim is rather to understand how the qualities of learning environments result from an interaction with their societal environment. Against the backdrop of these historical considerations, the question arises concerning the role which this interdependency currently plays in shaping the classroom.

(2) To what extent is the classroom of the present characterised by the structures of its predecessors and to what degree does this influence implementation of the classroom of the future?

When even conservative estimates maintain that the classroom of the present where pupils are currently being taught has not changed in decades (cf. McGregor, 2004a), is it then likely that the form of today’s classroom is appropriate for the tasks it is supposed to fulfil in a modern society? Is the intuitively felt discrepancy between form and function a historical constant that is attributable to certain continuing influences or is this discrepancy rather at odds with historical developments? If the latter is true, what lessons can be learned from history with regard to resolving this disparity? In other words: from which socio-cultural processes have present structures evolved and how can these be united with modern methods and concepts which support learning processes? It will be argued that the Classroom of the Future is situated in a historically well-known theory-practice divide and that bridging this divide represents one of the major challenges of this interdisciplinary project.

In its aim to retrace the genealogical line of the classroom of the present, this chapter focuses on two major and arguably most important semantic shifts of modernism, in the course of which extensive school reforms were implemented: (1) the rise of the disciplinary society in the 19th century and its factory-like school buildings, which brought a strict rank-and-file order into previously unstructured classrooms, (2) its reform in the course of progressive education, which led to classrooms that were considerably less structured and more adaptive to the individuals taught there. It will be shown how these two major developments in the history of school precariously merge again in the classroom of the present and how they produce a learning environment which does not correspond with its societal environment. For the Classroom of the Future, this juxtaposition is the tense ground upon which schools in the new millennium are supposed to be built.

SCHOOL ARCHITECTURE AND CLASSROOM DESIGN IN THE 19TH CENTURY

Schools in England must have been in a serious state when in 1870 the London School Board sent the architect Edward Robson on a tour of Europe and the US. His mission: to track down best practices of education. Serious improvements were
urgently called for due to a rapidly growing population which, particularly in urban areas, lead to overcrowded schools and which made a major building programme necessary (Filmer-Sankey, 2003). Indeed, the report of two observers - Jacques Demogeot and Henry Montucci - sent out by France to investigate secondary education in England only ten years prior to Robson’s tour was not especially flattering:

national education […] does not seem at first sight to follow any kind of system, to be the logical product of an idea or preconceived plan; rather it seems to be the bizarre result of diverse and often contradictory forces; it appears to have developed from a purely coincidental accretion of traditions […] and all of this is completely abandoned to individual initiative with the public authorities abstaining completely from any involvement (de Bellaiague, 2004, p. 108).

This report leaves hardly any doubt that the consequences of Robson’s *tour de l’éducation* would inevitably be far reaching, and so they were. Towards the end of the 19th century, England completely reformed its educational approach as well as considerably modifying its school architecture and classroom design. This can be understood as the introduction of a principle characterised by a new correspondence between method and space. Throughout the 20th century, this new correspondence was the determining but ever so discreetly operating undercurrent of classroom design. For the implementation of the Classroom of the Future at the beginning of the 21st century, an awareness of the fact that the source of this formative undercurrent is situated in the 19th century proves instructive. Understanding its ebb and flow can shed light upon the factors which shape today’s classrooms and upon the points at which changes can therefore effectively be made. The example of school reform in England serves to illustrate major developments in 19th century educational domain. It is worth the effort therefore to take a closer look at the results of Robson’s innovative impetus, how the concepts he encountered on his educational journey were implemented and what were forces working against this innovative process.

**School Reform in England – an Example of the Influence of the Disciplinary Classroom**

The classroom of the 19th century portrayed a pedagogic ‘*tableaux vivantes*’, which is the “first of the great operations of discipline […] which transform the confused, useless or dangerous multitudes into ordered multiplicities” (Foucault, 1995, p. 148). Previously, the classroom had in most cases been very poorly structured. Pupils would move freely around the room with the teacher working with one pupil or a small group, while the rest were left unattended. Particularly in rural areas, the classroom was not always part of anything like a school but was rather a private room provided for instructing children in basic skills. The Victorian school reform in England can serve as an instructive example of how this change materialised and how influential the disciplinary discourse was in the 19th century.
The institutionalised form of – compared to our contemporary understanding as well as the understanding of a disciplinatory society – fairly unstructured group tuition was formerly the traditional type of school in England and was exactly what Edward Robson must have known school to be like when he knocked on Europe’s classroom doors. What Robson was familiar with is depicted in the plan for English schools published by the Education Committee in 1856 (Figure 1). In a kind of open-space school, hundreds of pupils were assembled in a single spacious room – “mixed school” – with only one supervising teacher. With the help of curtains, it was possible to divide the school room into separate compartments in which older pupils could work as tutors and instruct younger pupils. In addition to a single spacious room also individual classrooms, like in this plan, could be included and were then set up in such a way that the teacher could supervise them and the “mixed school” room at the same time. This model was undoubtedly cost effective, allowing instruction of several hundred pupils with a minimum investment of resources. Yet while the Government’s Education Committee in 1865 continued to praise this model as being exemplary, criticism and concern about its educational as opposed to its economic effectiveness were growing fast (Filmer-Sankey, 2003). What Edward Robson saw, particularly in German classrooms which were at that time influential throughout Europe (Anderson, 2004), was an innovative spatial formation which transformed the classroom into a pedagogic ‘tableaux vivantes’ by placing it within the disciplinary semantics of the 19th century. In this context, the central structural mechanism was the rank, which had become a prevalent concept in the 18th century and which, in its regulative and classifying function, provided a serial organisation of space and thus replaced “one of the great technical mutations […] the traditional
system (a pupil working for a few minutes with the master, while the rest of the heterogeneous group remained idle and unattended)” (Foucault, 1995, p. 147). For adequately understanding what changes school and the classroom in the 19th century it is important to see this major cultural shift and to what considerable extent it triggers corresponding changes within specific discourses. It would hardly be accurate and indeed misleading to trace educational discipline back to the influence of machine production – as has been suggested (Markus, 1996) – despite the spatial and temporal proximity of the two. England was already a modern industrial power before it possessed a disciplining classroom structure and Germany’s classrooms were already highly disciplined before its industry was machinised. Disciplinary working conditions in machine production and disciplinary learning environments in the classroom of the 19th century represent different expressions of the disciplinary discourse, which has – as yet undisputedly – been shown by Michel Foucault to stem from the religious practices of previous centuries (e.g., Foucault, 1995).

The considerable impact of the disciplinary discourse on education becomes even more apparent when viewing the abandonment of the English open-space school of the 19th century in the context of the rise and fall of panoptism. When Jeremy Bentham conceptualised his famous Panopticon in 1787 and implemented it as a prison in Pentonville in 1821, he aimed to create a structure which made it possible to observe the various areas of the building from one central point. The image of a central tower surrounded by a ring-like building became, so to speak, the icon of the century of discipline (cf. Foucault, 1995, Chapter 3, Panoptism). Bentham’s panoptic concept was received with great interest in Europe and Foucault (2006) emphasises that Bentham explicitly intended the Panopticon design to be adopted for any institution and in particular for schools. The idea of a teacher supervising a multitude of individuals from a central point – possible and necessary in the mixed-school room depicted in the plan above – is very much in accordance with the panoptic realisation of control. In the 19th century, discipline was, however, differentiated further along a compromise. It was neither practical to supervise hundreds of individuals nor to have closed units for each and every single individual as originally envisaged in the pure concept of panoptism. When plans were made to teach 1,000 pupils in a single school (Filmer-Sankey, 2003), the old system could simply no longer be seen as appropriate. Just as the panoptic prison in Pentonville was finally demolished in 1903, the open-space school was replaced by the class system that Robson encountered particularly in Prussia.

What innovative spatial formations did Robson encounter and crucially bring back on his return to England? What, in other words, are the main features of the 19th-century school and classroom which so very much correspond to the general disciplinary semantics of their time?

Characteristics of the Disciplinary Classroom – a Case of Contemporary Form-Function Fit

In its societal function, the classroom of the 19th century was a disciplinary dispositif. As the smallest architectural unit, the core, as it were, of the pedagogical system, the classroom embodied all of those structures, mechanisms, orders and
ways of behaviour which made the pedagogical system of the 19th century one of the most momentous disciplinary systems of modernism. It can be conceived of as the climax of a modern process of differentiation, the origin of which can, according to Michel Foucault, be found in the discipline of the young in the 16th century – one of the first contexts in which the disciplinary system as such was applied and extended upon (Foucault, 2006). It was, however, not only a climax but also a starting point; a starting point with respect to a kind of spatial realisation of instruction which was still to be common practice in most classrooms more than 100 years later and on the eve of the new millennium, regardless of the many alternative approaches which particularly the end of the 20th century would have to offer. Thus, the argumentative juncture from where the classroom of the future is to be developed out of its present predecessor is situated really in the 19th century. It is the very historic dimension of a project so explicitly focused upon the future. So, how was the disciplinary classroom structured and what architectural and technological qualities did it possess?

The innovative spatial formation of the classroom becomes clear at a glance (Figure 2). Lecomte’s lithograph from 1818 has maybe become one of the most famous in school history. It was used by Michel Foucault to explain his pioneering and still topical studies on the disciplinary discourse of education in the 19th century. It shows that the cellular classroom of the 19th century – which will later also be the cellular classroom of the 20th century – was structured by fixed desks strictly arranged into ranks and files and thus signified a transformation from the heterogeneous distribution of individuals commonly found in previous classrooms into a formation that was far easier to control than the masses of pupils which characterised the English open-space school. Two major conceptual characteristics of this disciplinary classroom continue to show topical relevance in the 21st century regardless of variations in design.

Figure 2. Lithograph by H. Lecomte, 1818. School with mutual lessons (Foucault, 1995).
Pupils were banned to their single space which was for the first time standardised in size and exactly calculated. In German primary schools, for instance, each pupil was allocated 1m² of playground space in Munich and at least 1.5 m² but usually 3 m² in Prussia. Prussian classrooms had a standardised ground plan: a height of 3.2 m was calculated to compensate for air consumption and each pupil was allocated exactly 0.8 m² of working space (Schmidt, 1968). This measurement of space actually represented measurement of the individual and his/her behaviour. The classroom in this form embodied a secular standardisation and control of individuality, which only a few decades ago in the 18th century had celebrated emancipation from the suppressing force of religion and social class. Additionally, individual pupils were not randomly distributed within the rank-and-file structure of the classroom but were rather placed according to a variety of well-defined criteria such as their ability, their behaviour, or diligence. Tests and reports were applied to evaluate the correctness of the spatial distribution of individuals and turned the classroom into a codified “learning machine” (Foucault, 1995, p. 147). On top of this, furniture was designed to contribute to disciplining pupils’ bodies. It aimed to “dictate bodily postures” and, together with the classroom design and the architecture of the school building, was “irrespective of the will of the current occupants” (Margolis & Fram, 2007, p. 196).

The teacher, like each of his/her pupils, was also controlled by this new system. The clear spatial order and semantic definition of space introduced a new understanding of the role of the teacher by allocating him/her a fixed position. From this point onwards, lessons were exclusively taught ex cathedra and Lecomte’s lithograph, which shows the teacher positioned on an elevated platform in front of the class, is reminiscent of Reigeluth’s formula of the instructor as a “sage on the stage” (Reigeluth, 1999, p. 19). Just like the pupils the teacher behind his desk stopped walking around the classroom, ceased talking to individual pupils, and hardly geared lessons towards individual needs. In the majority of schools, neither the pupils nor the teachers were from this point onwards to emerge from behind their desks. Any activity on the part of the pupils was replaced by sitting still and obediently listening to the teacher’s elaborations.

Spatial design determines methodology or at least makes a specific method more likely. An exclusively instructional form of education is closely linked with a learning environment that guarantees control. This is, unequivocally, the historical lesson to be learnt from the classroom of the 19th century. The sustained influence of instructional teaching methods may be seen as stemming from the very organisation of classroom space and its paradigmatic foundation as lying in the disciplinary classroom of the 19th century. This strongly implies that instructional changes within classrooms - in particular those comprising the implementation of constructivist concepts - should be accompanied by a spatial modification of all those rank-and-file structures which still prevail in today’s classrooms. At this very juncture it more than clearly becomes apparent that in reforming the school and the classroom it is vitally necessary to cooperate with educational scientists and architects.

Yet, this design-method fit is additionally and essentially accompanied by a design-semantic fit. All of the changes which finally led to the development of the disciplinary classroom of the 19th century were enmeshed in the contemporary social
strategies of the 19th century. The disciplinary classroom was the classroom of a disciplinary society and the classroom of disciplinary pedagogy. There was obviously a perfect correspondence between the fundamental contemporary semantics of the 19th century and the concept which was at the heart of the classroom. Despite individual cases in which unfavourable conditions – such as classrooms which were too small – might be made responsible for a teacher resorting to a disciplinary approach (Linton, 1984), it would be inaccurate to give the impression that discipline was nothing but a secondary factor or the consequence, as it were, of adverse circumstances. In the 19th century, society clearly made school that which it wanted school to be: a place of obedience, drill and discipline; a place of clear instruction, clear form and clear structure. Given the continued prevalence of this type of classroom organisation, the significance of the Classroom of the Future becomes all too apparent. There is clearly no such correspondence between the fundamental contemporary semantics of the late 20th/early 21st century and its disciplinary classroom. Our society is no longer a disciplinary but a postmodern society and educational sciences no longer favour instructional scenarios which promote passive and controlled learners. Based on empirical evidence (e.g., Dochy, Segers, van den Bossche, & Gijbels, 2003) constructivist learning environments of the 20th century favour self-regulated, collaborative and social learning. In view of the historical development of today’s classroom, its roots, and the conditions of its origin, it becomes clear that that which once shaped the classroom is completely at odds with that which is today the social environment of our classrooms. It is this discrepancy within educational practice that must at least be brought to a compromise by any effective school reform. As was the case back in the 19th century, it seems to be high time that the 21st century has classrooms which are compatible with the zeitgeist in which they are situated. Inherent within the historical dimension of the Classroom of the Future is therefore a historical responsibility to rebalance educational and socio-semantic practice.

The Rise of Economic Influence on Education – a Lesson to Be Learned from the 19th Century

Upon returning to England from his extensive travels and initiating an architectural implementation of the German disciplinary school, Robson conceptualised a project which we today would refer to as a Classroom of the Future. Back in the 19th century and today in the 21st century, the main impetus for the Classroom of the Future was and is the conviction that contemporary educational practice falls short of new societal challenges. It was Edward Robson who uttered the remarkably modern formula which can be considered to be at the very heart of school reforms in general and the Classroom of the Future in particular: “the plan of school buildings depends on the method of tuition” (Filmer-Sankey, 2003).

Yet as Filmer-Sankey (2003) clearly points out, Robson’s project of reforming the English educational system was far from being an unproblematic success story. Instead, it rather unpleasantly reflects the social and political influences on school reform which, in the many decades following Robson’s initiative, would continue to hinder an adaptation of education to new challenges and thus an appropriate
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education of future generations. More explicitly: historically tracing educational reform back to the beginning of the 19th century reveals that whenever such reforms came under the influence of economic considerations, it generally entailed at least serious modification which basically removed innovative elements, if not the end of the educational reform. Indeed, this was exactly what Robson had to experience. Regardless of the obvious success achieved at the Experimental School in Stepney, general implementation of Robson’s new concept was strongly opposed for financial reasons. In the end, Edward Robson succeeded in reforming English education and educational considerations were weighted more heavily than opposing economic considerations which would have preferred to see pupils taught ineffectively but far more cheaply by maintaining the old system – for details see Filmer-Sankey (2003). The bitter lesson which Robson was forced to learn, though, was that empirical evidence of the effectiveness of educational innovations does not seem to be sufficient for these innovations to be implemented. This discrepancy between educational and economic considerations was to become even more serious in the 20th century, with the economy proving more efficient in asserting its interests. One gets the impression that the Classroom of the Future will have to address this attitude and, in light of the far-reaching impact of the economy on education outlined in the introductory pages, the Classroom of the Future may very well also prove to be a touchstone for political and societal declarations in the wake of the PISA studies.

SCHOOL ARCHITECTURE AND CLASSROOM DESIGN AT THE BEGINNING OF THE 20TH CENTURY

The 20th century looked for alternatives. While the disciplinary classroom and in particular the imposing architecture of late 19th-century school buildings (Becker, 1961) were there to stay, the turn of the century generally marked the beginning of a new era characterised by the experience of plurality as well as of possible and available alternatives. This indeed was the very signature of modernism which was manifest in the juxtaposition of a new vitality on the one hand and a profound scepticism on the other; a juxtaposition which was so very characteristic of the zeitgeist at the turn of the century. It is in this ambivalent area of conflict that those pedagogical considerations which motivated a thorough revision of the architecture of school buildings and classrooms in the first decades of the 20th century are to be found.

So, let us first examine this socio-semantic context before turning to the way in which schools and classrooms were designed according to relevant criteria in this context and finally to the factors which determined the success of this architectural reform and the conclusions to be drawn with respect to the Classroom of the Future.

The Socio-Semantic Context of the Major School Reform Movement in the Early 20th Century

Scepticism particularly resulted from adherence to a belief in unambiguous knowledge and perception; a belief which was ubiquitous throughout the 19th century. Counter movements which opposed formerly undisputed regularities and practices
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began to exert their influence in various domains and within the context of this semantic shift, pedagogy also modified its approach. The wave-particle-dualism in modern physics, Freud’s psychoanalysis, twelve-tone music, atonality, post-impressionism, cubism, and modern forms of narration are just a few of the more prominent examples of this semantic change which, in the domain of pedagogy, led to serious doubts about the appropriateness of the instructional paradigm of 19th-century tuition. In discharging the disciplinary knowledge-drill which pupils were required to obediently and passively endure, modern pedagogy focused on the active learner who acquired knowledge in a self-directed manner by cooperating with fellow-learners and the teacher. In order to achieve this, schools actively engaged in imparting competencies and attitudes which were necessary for self-government and respectful cooperation. The “child’s imagination, creativity, sensibilities, or the capacity to act independently” (Lamberti, 2000, p. 33) were to form the core of educational activity which aimed to counterbalance the exclusive and traditional focus upon the child’s intellect at the cost of imagination. It is intuitively plausible that a practical realisation of such educational considerations was not possible within the rigid structures of the 19th-century classroom. This would have been at odds with any form-function-fit. While it is therefore not all too surprising that pupils were to be released from the rank-and-file discipline, it is rather remarkable – in particular with respect to potential implementation strategies for the Classroom of the Future – how consequently and thoroughly conceptual changes were put into practice.

A new vitalism is the driving force behind this shift from an instructional to a constructivist scenario. Progressive education, new pedagogy as it was appropriately called, was about to replace disciplinary education and infuse teaching with child-centred and active learning approaches. To a certain degree, this new development was due to democratic school reforms which conceptually centred upon the individual rather than the obedient masses. The educational result of this process was an awakening concern for the psyche of the child, which found its way into schools via teachers’ general interest in the “’new’ science of psychology” (Lamberti, 2000, p. 24). Newly founded publications such as The Child (London, 1900) or Child Study (London, 1908) reflected an interest in developmentalism which directed away from a disciplining of the body and towards the child’s psychological development upon which curriculum and instruction were based. Developments were thus taken up which had been initiated in and discussed since the 18th century but which had not been accompanied by systematic or sustained pedagogic practice in the 19th century. Christian Gotthilf Salzmann’s philanthropic school in Schneipenthal near Gotha in Germany is a case in point. Built in 1784, its main aim was to foster self-directed learning and to base tuition on sensual experience gained via contemplation and vivid experience (Schmitt, 2003) – not too much of which was to be found in the disciplinary schools of the 19th century. Neither is it easy to imagine Rousseau’s Emile in one of these rigid institutions. Innovative educational concepts had been on the agenda of pedagogical modernism since the 18th century and while they were quite well disseminated, they generally did not make much of an impact on the planning and building of 19th-century
schools. On the contrary, an industry and society focusing on economic growth as a priority readily accepted child poverty and a high death rate among children due to appalling working conditions.

While progressive education activated the child-centred discourse at the beginning of the 20th century this did not directly lead to educational reform. Of relevance for the Classroom of the Future is that despite the existence of elaborate theoretical foundations for potential educational reforms, it was once again primarily economic considerations which motivated both the implementation of a completely new educational paradigm and the consideration of a new school architecture and classroom infrastructure. The reasons for this economically motivated development are twofold: first, an increasingly modern industrial society could not afford to neglect the rising new generation; ultimately high mortality rates and incidence rates were the basis of the physical demise of entire nations (Cruickshank, 1977). Nations were aspiring to become world powers and thus needed a healthy population (Linton, 1984). Second, instruction itself proved inefficient in cases where pupils were too ill and showed too many symptoms of deficiency to be taught adequately: “On grounds of capital investment, money spent on education was not bringing in adequate returns” (Cruickshank, 1977, p. 63). At the turn of the century, states took steps beyond the mere philanthropic efforts which had previously been common practice in superintending the poor. Against the backdrop of an economically motivated discovery of the child, it was necessary to modify schools in such a way as to compensate for deficits in the maintenance and physical condition of children, to take preventive action against such deficits, and to prepare the rising generation for the challenges of the working world.

*School and Classroom Architecture of the Modern Reform Movement – a Case of Contemporary Form-Function Fit*

Progressive education had an impressive impact and was a prevalent international concept (Röhrs & Lenhart, 1995) as well as in America where it has continued to play a central role in shaping the educational system even to the present day (Labaree, 2005). As these changes were of a rather fundamental nature, it is not surprising that comparatively radical conceptual and architectural reforms hit the traditional school building and classroom of the 19th century. The central idea of this new architecture was to adapt buildings to the individual needs of the child rather than forcing the individual to adapt to rigid structures. Architects and pedagogues were thus supposed to cooperate closely and although this was not always the case and in actual fact led to architects setting out on their own, the first decades of the 20th century saw – as described above – a considerable amount of innovative educational theory upon which architects could sketch their blueprints. Indeed, contemporary architects showed a great deal of interest in educational theory and – as was the case for example in Germany – a considerable pedagogical impetus in their vocation (Kemnitz, 2003). How then, did these changes impact the school building and the classroom?
As far as the school building was concerned, architects and pedagogues wanted to move away from imposing, multi-storey buildings which were suited to the urge and claim for power prevalent in the 19th century. The school building was no longer to be prestigious but rather comfortable and at the same time to functionally conform to new pedagogic concepts. This basically entailed modifying the typical layout of school buildings which were formerly characterised by series of identical rooms monotonously strung together along an endless corridor. A second aim of the new school architecture concerned hygienic considerations and an improvement of children’s health. How thoroughly this represented the zeitgeist can be seen in the open-air schools, which represented “a new chapter in preventive medicine” (Cruickshank, 1977, p. 65). These became popular once the Charlottenburg Open-Air Recovery School had successfully began its educational work in 1904 and even traditional schools began to integrate single open-air elements into their concept in order to address the serious social problems associated with the children’s appalling state of health. Schools for children who did not suffer from an ailment due to low living standards were, however, also planned in accordance with health considerations. Particular care was taken to provide enough light within both the whole building and the individual classrooms. No less important was fresh air, with architects ensuring that classrooms provided sufficient ventilation.

Classrooms were drafted as pavilions with the double aim of opening up tuition to the outside world and ceasing to block it off in a barrack-type way and of meeting the needs of individual pupils. At the very least, tuition could from now on do without its former rank-and-file structure. Classrooms were situated in one-storey, detached buildings and could be fully opened up on at least one side with the help of a sliding glass wall. Classrooms were sometimes planned in such a way that they could be opened up on various sides and lessons could then – like for example in the open-air school in Suresnes (see Figure 3; Schneider, 1998) – also be
conducted in the garden situated next to each classroom. All these measures are refreshingly straight-forward. In a simple and clear way they convert educational aspirations into architectural concepts.

Also the interior design of classrooms was planned according to the new paradigm of learner-centred tuition. Classrooms were square in shape, which gave them more depth and thus offered more freedom in placing desks and chairs and in turn differentiating forms of tuition by partitioning the room into different sections. To this end, furniture was no longer fixed to the ground, unmoveable, and static, but could instead be moved across the room, which was thus easily adjustable, for example, to group work. This introduced a kind of didactic classroom management which, from the perspective of both the teacher and the pupil, had been entirely inconceivable in the confines of the disciplinary classroom. How influential this new kind of classroom architecture became can be inferred from the fact that pavilion-like modifications were even attempted in areas in which the pavilion structure was not realisable due to a lack of space, like for example the Heinrich-Kromer-School near Frankfurt. New architectural concepts, which considerably modified the corridor structure of schools and partly even replaced it, made it possible to create classrooms in multi-storey buildings with daylight from two sides and to air these rooms accordingly (Schneider, 1998). An even more radical solution was implemented in Amsterdam where Johannes Duiker built a four-storey pavilion school by adding a fully glassed-in terrace to every classroom. These terraces were sheltered from the wind and could be used for open-air lessons even in poor weather conditions (Schneider, 1998). Duiker’s almost futuristic school building – at least compared to school architecture as it had been known so far – is an apt example of the fundamental international change in school design; the innovative power of which became a downright indicator of modernity in education at that time.

Success Factors in the Progressive Reform of School and Classroom Architecture

Europe at the beginning of the 20th century can thus be seen as having begun to plan and realise a new future for its schools – a classroom of the future, as it were. This process was influenced by two central factors, which may also prove important for the Classroom of the Future.

Cooperation between architecture and pedagogy was seen as particularly necessary due to a felt incompatibility of new educational concepts and the prevailing room design. Specifically, educational change was linked with architecture in order to guarantee structures which were appropriate for individual needs rather than individuals who had to adapt to given structures. Robson’s formula for 19th-century school architecture – “the plan of school buildings depends on the method of tuition” (Filmer-Sankey, 2003, p. 222) – is echoed in Taut’s explanation of the blueprint of the Dammweg School in Berlin. He points out that the school building should be “die passende Hülle für das pädagogische Leben […] und einzig und allein daraus ihre Formen herleiten” [a shell which is suited to pedagogic life […] and which should derive its form from nothing else]
This is the progressive aspect of pedagogy at the turn of the 20th century and can serve as a point of reference for the Classroom of the Future one hundred years later at the turn of the 21st century. Cooperation between pedagogy and architecture proved to be an eminently innovative impetus for school reform.

Extensive financing for the implementation of the new concepts was understood to be of vital importance if the attempted educational innovation was to succeed. New schools and classrooms were built; more and additional teachers were appointed; and material, equipment, and furniture were provided on a large scale. Considerable sums were spent and in Germany, for example, there were even genuine competitions between cities on who could best implement innovations at school (Linton, 1984). Yet, progressivism also had to experience that financial support was limited. At the end of the day, it had to be conceded that the large majority of schools had not been architecturally converted into progressivist places of education and that far too few schools had been built. It was of considerable symbolic significance that the Dammweg School in Berlin – one of the most prestigious projects of progressivist architecture in Europe – never made it beyond its detailed blueprints. At the same time, progressivism too readily allied with the economic considerations of American pragmatism, which in the course of time began to considerably influence school architecture and classroom design. Economic streamlining entered the process through the backdoor, as it were, and gradually took over to the considerable disadvantage of progressive impetus. In accordance with the contemporary economic discourse, school rationalisation became common ground for school reforms and gradually led to educational considerations giving way to economic rationale (Kemnitz, 2003). With reference to the situation in America, David Labaree pointedly puts into a nutshell what also applies for Europe: “[…] pedagogical progressives had the most impact on educational rhetoric, whereas the administrative progressives had the most impact on the structure and practice of education in schools” (Labaree, 2005, p. 280). From the beginning of the 20th century onwards, there has been a theory-practice divide which has separated that which is considered important by educational theory and that which is economically accepted by society and politics. History does indeed seem to repeat itself. The economic objections which Robson faced once again reared their head when new pavilion schools were to be built a few decades later. An examination of OECD-statistics from the past few decades further strikingly reveals that school reform hardly seems to be a matter of educational concepts but rather of monetary considerations. Given that this is an ongoing process, cutting down on the education of its children seems to be highly accepted by society.

An implementation strategy for the Classroom of the Future may therefore be to effectively bring together experts and practitioners from various domains which are important with respect to school architecture. The publication at hand, which is the result of a workshop related to the topic, might also represent an initial and important step in this direction. Guaranteeing the financing of new school concepts will, as history teaches, be pivotal. It is one thing to repeatedly point out that the present schools are clearly not suited to preparing our children for the 21st century.
and a vocational life that is characterised by rapid change (e.g., Dalin, 1998), but it is another to tackle this problem by actively working on possible solutions whose conceptual vision realistically stretches beyond the narrow cognitive confines of business management. The lessons to be learned from 20th century educational history are unpleasantly unequivocal: school reforms are all too rapidly held up by a profit-oriented rationale – in the 20th century, educational rhetoric and an actual willingness to invest in our children’s future proved to be seriously at odds.

BRINGING THE CLASSROOM OF THE FUTURE ON ITS WAY: CONCLUDING REMARKS TO START THE PROJECT OFF

The classroom of the present is by and large an unfortunate combination of the two developments described above. It is caught in the discrepancy between its discursive and its material quality.

As a discursive object, it is conceived of as a learning environment that is expected to foster self-regulated learning and enable the active learner to acquire knowledge and competencies by collaboratively working within a problem-based and technologically enhanced learning scenario.

As a material object, however, the classroom of the present is hardly designed towards translating this contemporary educational discourse into practice. Having “changed relatively little in the last 150 years” (McGregor, 2004a, p. 15), its structure still very much resembles the disciplinary rank-and-file design which has been prevalent since the 19th century.

Finally, the classroom of the present is characterised by a third parallel to its predecessors. Similar to the disciplinary classroom of the 19th century and the progressive educational classroom of the first decades of the 20th century, the classroom of the present is situated within a semantic shift; it is to be found within the coordinates of a digital and spatial turn, though neither of the two have thus far had any sustainable influence on classroom-design.

It is against the backdrop of these three characteristics of the classroom of the present – its discursive, material, and contextual qualities – that the following conclusions of this historical overview of classroom development are formulated:

There is a clear correlation between architectural modifications of the school and the classroom on the one hand and socio-semantic changes on the other.

The historical perspective adopted clearly reveals a considerable correlation in the past between the socio-semantic context of school and the classroom on the one hand and their respective design on the other. Historical societies had, or at least attempted to have, learning environments that corresponded with the zeitgeist of their time. Major educational changes – the two most important and influential changes of the past two centuries were presented here – were characterised by a striving for form-function fit. In contrast to this historical experience of the classroom, the contributions in this book show how great the gap is between the educational/societal discourse of our time and the current design of classrooms and schools. To date, it
has only occasionally, if at all, been possible to bring the digital age into schools. Andreas Lingnau (in this volume) refers to the second PISA study (OECD, 2004) which reveals that most 15-year-old pupils have never worked with computers at school. He refers to two projects – NIMIS (1998-2000) and SEED (2001-2004) – which demonstrate how effectively new technology can be used to support learning processes. By and large, however, Jim Slotta’s (this volume) unpleasantly simple question as to why education has failed to take advantage of so many information technology resources has yet to be answered. It is still addressing a void, a deficit of today’s education whose refusal to integrate technology forces pupils to lead a second life, as it were. While modern media is an integral part of their life after school, pupils travel each and every morning into the analogous past which characterises their school life.

Moreover, school has so far hardly responded to scientific findings on the influence of the built environment on learning and achievement. As early as the late seventies, Carol Weinstein (1979) drew attention to the importance of the physical environment in an extensive research review. In a research review 20 years later, Glen Earthman conceded that in America and most certainly not just in America, “a large number of school buildings […] are in substandard condition” (Earthman, 1999, p. 365) and that important factors such as adequate space and classroom furnishings are not seriously attended to. In the late 20th century, schools and classrooms were obviously built as spaces in which pupils could be taught collectively. Considerations reflecting an understanding of school as an integral part of society seem to play little if any role at all. In particular, technical, spatial, and educational developments which characterise our postmodern society are hardly to be found in the schools of today and are far from being educational standards. Van Note Chism and Bickford (2002) put in a refreshingly pithy way: “An institution that proclaims learner-centred instruction yet builds rooms that focus on the teacher and ignore the need for learner comfort and interaction is […] contradicting itself“ (p. 92). They also draw attention to yet another inherent contradiction within the school and classroom-design of today. In times of competition between educational institutions, appearance becomes an important economic factor. That which is true of colleges duly applies to schools: “parents […] have elevated expectations for comfort, aesthetics, modern technology, and convenience” (p. 92). Therefore, cutting down on financial resources when it comes to adequately designing schools and classrooms will in the long run not prove economical at all. This is once again strikingly contradictory: a society that so energetically supports the influence of economy on schools does not seem to be in the least bit bothered by such uneconomical practices. One can not help but get the impression that, yes indeed: all coherence has gone.

The classroom of the present is clearly characterised by the structures of its predecessors which considerably influences implementation of the Classroom of the Future.

It would appear that the Classroom of the Future will have to be a project of discontinuity in that it can hardly be the genealogical successor to the classroom of the present. In being geared towards the future, it will have to refer to the past.
Today’s classrooms still very much possess the rank-and-file structure familiar from the 19th century and are at the same time expected to be places in which constructivist concepts are put into practice. This is simply contradictory. Historically speaking, the classroom of the present has the shape of the 19th century and the contents of the 20th century. Somehow, this does not go together.

For the implementation of the Classroom of the Future, this means that serious lessons must be learnt from history. The school in general and the classroom in particular must be brought forward to the point at which modern society is at. Several contributions in this book make an effort towards moving in this direction and suggest taking both technological and architectural aspects into account when reforming the classroom of the present to meet the challenges of the new millennium. Technologically enhancing cooperation, using technology to foster cognition and motivation (Holleis, Schmidt, Drewes, Atterer, & Dollinger, in this volume), or applying tabletop shared interfaces to promote cooperative story-telling and motivating even boys to tell stories (Gelmini Hornsby, this volume) are just a few examples which illustrate the considerable benefit of bringing technology into schools, as is aimed for in the Classroom of the Future. For this project, however, it is clear that even the best technological or pedagogical ideas cannot be used to their full effect if they are not architecturally integrated into the classroom. In his contribution, Stefano Baraldi (in this volume) shows how learning spaces can be designed appropriately and that it is possible to combine architectural, technological, and educational considerations.

Yet, all of these ideas are not merely visions, visionary as they may seem. The Classroom of the Future is a project which is taken seriously – at least by those countries which are prepared to take their schools out of the past and into the future. This may most notably apply to England, where the “Building Schools for the Future” programme aims to rebuild or renew every secondary school in the country. Joanna and Rosamund Sutherland’s contribution (this volume) reflects the reality of building classrooms and schools of the future. Here, an educationalist and an architect, both of whom are and were involved in building classrooms and schools of the future, join forces and in a way stand for an integrative solution in designing modern learning environments - that which is at the very heart of the Classroom of the Future. One cannot help but rediscover Edward Robson’s remark that “the plan of school buildings depends on the method of tuition” within this cooperation.

Situating the classroom within its historical coordinates all too clearly underscores that the physical learning environment has always been on the agenda. Throughout its history, the classroom was never the “neutral or passive container” (Burke, 2005, p. 490) that it seems to have been turned into over the previous decades. The problematic influences outlined in the introduction may help to explain this development. In any case, there is once again a “growing interdisciplinary and international interest in matters of space and place in educational contexts” (Burke, 2005, p. 489) and an awareness that “particular spatial arrangements encourage or constrain particular ways of […] working together” (McGregor, 2004b, p. 348). The Classroom of the Future represents a
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project that has the potential to put historical lessons into practice and to resolve
the incoherence of form and function that seems to be at the core of widespread
dissatisfaction with today’s learning environments. Let us take John Donne’s
metaphysical lament as the touchstone of today’s innovative impetus in the
educational domain. At the end of the day it boils down to the simple question if in
the wake of all those eager plans to improve on school education we will in, say
10 to 20 years, still have to refer to John Donne (1611) when speaking of our
classrooms: “[…] all in pieces, all coherence gone”?

NOTES
1 Two basic components are inherent to the term "dispositif": (1) From a strategic perspective,
a dispositif is situated and used in the context of power and knowledge and accompanying strategies.
(2) In its historical context, a dispositif is not static but changes and evolves from the
discursivinfluences that shape it. It might cautiously be referred to as a cultural relay.

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