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ICT-enabled innovation for learning in Europe and Asia

Exploring conditions for sustainability, scalability and impact at system level

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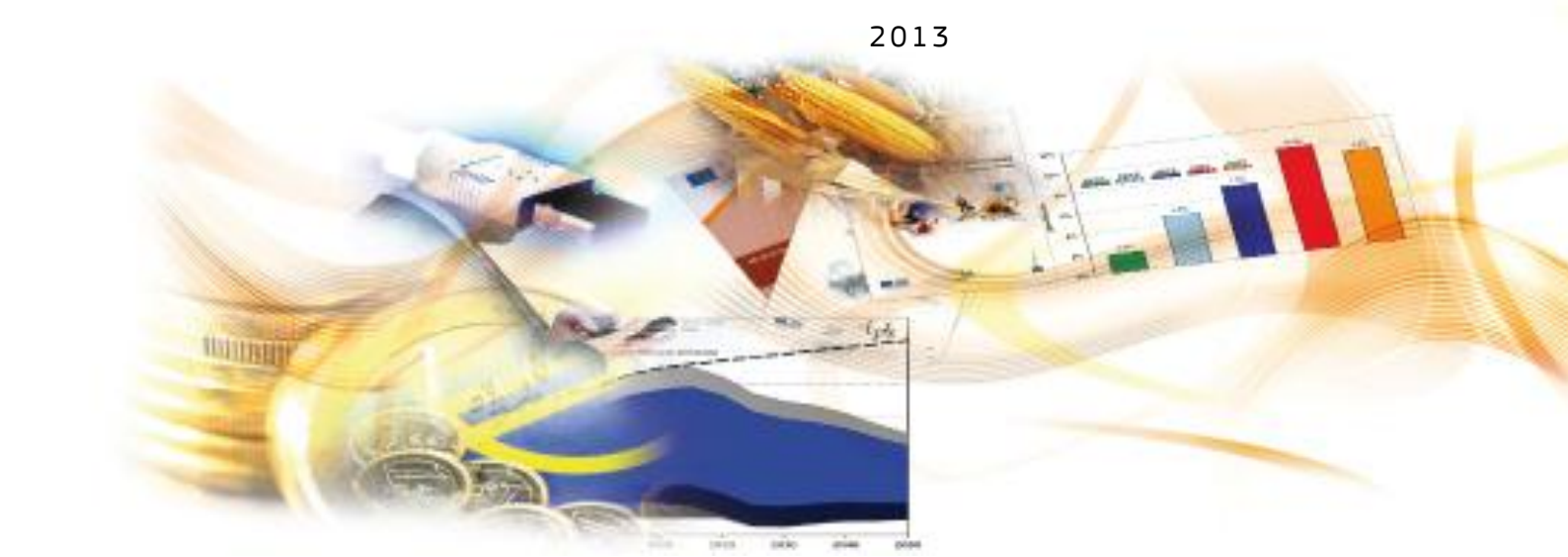

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Preface

The Europe 2020 strategy acknowledges that a fundamental transformation of education and training is needed to address the new skills and competences that will be required if Europe is to remain competitive, overcome the current economic crisis and grasp new opportunities. Innovating in education and training is a key priority in several flagship initiatives of the Europe 2020 strategy, in particular the Agenda for New Skills and Jobs, Youth on the Move, the Digital Agenda, and the Innovation Union Agenda. Accordingly, one of the five targets for measuring the success of the Europe 2020 strategy is the modernization of European Education and Training systems with the goals of reducing early school leaving and increasing tertiary education attainment.

Policy makers and educational stakeholders recognise the contribution of ICT to achieving these targets, and more broadly, the role of ICT as a key enabler of innovation and creativity in Education and Training (E&T) and for learning in general. It is however also highlighted that the full potential of ICT is not being realised in formal education settings and major questions are arising on the sustainability, impact, costs and mainstreaming of initiatives of ICT-enabled innovation for learning in Europe.

This report is part of the project "Up-scaling Creative Classrooms in Europe" (SCALE CCR) launched by the Information Society Unit at JRC-IPTS[1] in December 2011 on behalf of the Directorate-General Education and Culture (DG EAC), to be completed in June 2013. The project aims to provide a better understanding of ICT-enabled innovation for learning that has significant scale and/or systemic impact and to further define the concept of Creative Classrooms (CCR). A set of policy recommendations for policy and decision makers for mainstreaming of ICT-enabled innovation in Education and Training across Europe will also be developed.

This report analyses three cases of ICT-enabled innovation for learning from Europe (*eTwinning*; *1:1 Learning in Europe*; and *Hellerup School,* Denmark) and four cases from Asia (*e-Learning Pilot Scheme*, Hong Kong SAR; *Knowledge Construction with Technology (CoREF)*, Japan; *Third Masterplan for ICT in Education (mp3)*, Singapore; and *Digital Textbook project*, South Korea), covering aspects such as scale and nature of innovation, learning outcomes targeted, the role of technology in the innovation, and the implementation strategies. The lessons learnt about the necessary conditions for sustainability, scalability and impact at the system level are also discussed.

Progress on the SCALE CCR project and related publications can be followed on the project webpage: http://is.jrc.ec.europa.eu/pages/EAP/SCALECCR.html

Yves Punie

Project leader ICT for Learning and Inclusion

[1] The Institute for Prospective Technological Studies (IPTS) is one of the seven scientific institutes of the European Commission's Joint Research Centre (JRC). IPTS consists of five research units, one of which is the Information Society Unit.

Acknowledgements

The editors of this report would like to thank Godelieve Van den Brande, Jesus Maria Alquezar-Sabadie and Ana Carla Pereira from the Directorate General Education and Culture, for their ongoing support and feedback throughout the entire project and the members of the Education and Training 2020 Thematic Working Group on "ICT and Education" for providing valuable insights and feedback in various stages of the project.

We are also especially grateful for the invaluable insights and opinions of seven experts who are involved in ICT-enabled innovation for learning in Europe. These insights were gained during interviews with Ola Erstad (University of Oslo), Paul Kelley (Science+Technology in Learning), Marco Kools (CERI-OECD), Anne Looney (Irish National Council for Curriculum and Assessment), Irene Pateraki (Greek eTwinning National Support Service), Helle-Kirstine Petersen (Hellerup School), and Riina Vuorikari (e-Learning expert).

Thanks are also due to the stakeholders and experts (see Annex 1) who gave their time and valuable expertise at the expert workshops held in Seville (December 2012) and Hong Kong (January 2013) at which the preliminary results of the SCALE CCR project and the seven case reports included in this publication were presented. Thanks also go to our colleagues from the Information Society Unit, IPTS, for their valuable support during the expert workshop in Seville, in particular Barbara Brečko, Anusca Ferrari, Christine Redecker, and Jonatan Castaño Muñoz. We would like also to thank Patricia Farrer for her editorial support.

Last but not least, this report would not have been possible without the invaluable contribution of the case reports authors, who also actively participated in the two expert workshops.

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Executive summary

Background

Educational stakeholders recognize the role of ICT as a key enabler of innovation and creativity in Education and Training (E&T) and for learning in general. They also highlight that, although the infrastructure to promote ICT use for learning and a sound research base to guide the process are widely available, the full potential of ICT is not being grasped in formal education settings. The majority of schools in Europe and beyond are not reaping the benefits of new technologies as enablers to modernize E&T systems.

In order to modernise E&T systems, true ICT-enabled innovation for learning is needed that improves significantly upon the status quo and achieves scale and systemic impact. Large-scale pilots in real-life environments have been conducted in the E&T context in many countries in Europe and other world regions to speed up the transfer of innovation research into educational practice. However, success in initiating change does not guarantee that such changes can be sustained over time and only a few ICT-enabled innovations for learning manage to survive beyond the early adopter stage and become fully embedded in educational practice.

This report presents results from a study on the implementation and dissemination strategies of ongoing ICT-enabled innovations that have already achieved significant scale and/or impact in E&T systems in order to understand their aims, outcomes, impacts and also to clarify the nature of their pedagogical, technological and organizational innovation. The study is part of a larger project on 'Up-Scaling Creative Classrooms in Europe' (SCALE CCR), which was launched by the Information Society Unit at IPTS in December 2011 on behalf of the Directorate General Education and Culture (DG EAC).

The seven case reports

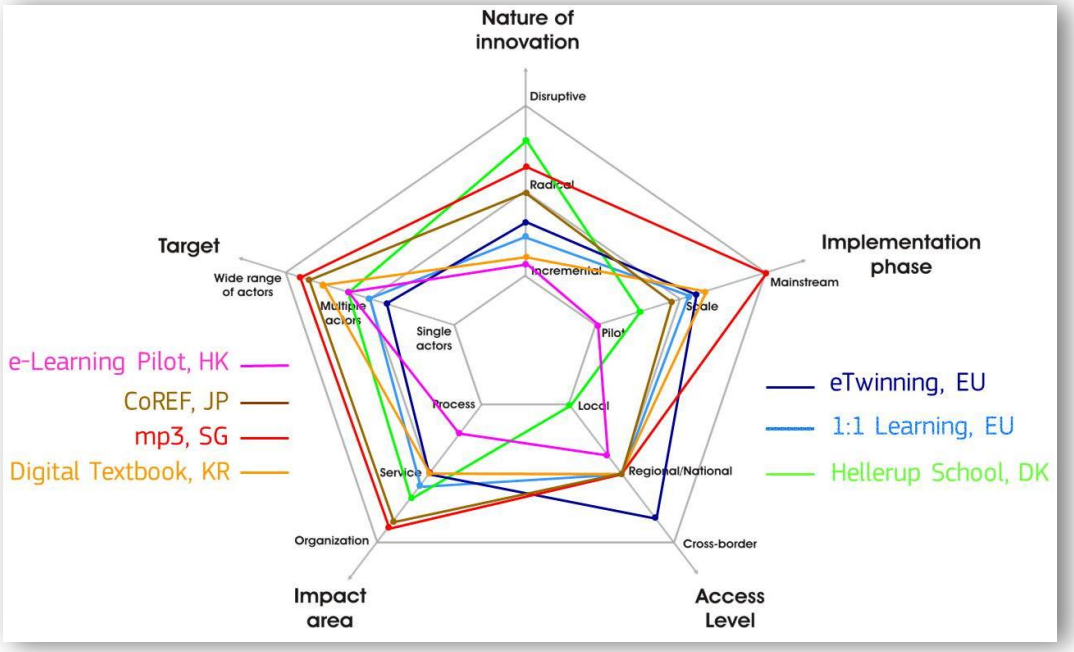
This study is made up of in-depth analyses of three cases of ICT-enabled innovation for learning from Europe and four cases from Asia. All the cases are based on reports written by European or Asian experts following a common template and include feedback from educational stakeholders. The following 7 cases were analysed in terms of implementation strategies, prospects for scalability and sustainability, and impact at system level:

- *eTwinning* (Europe), a fast-developing community of schools in Europe with more than 200,000 registered teachers from 33 European countries who registered for free to use its safe online environment for cross-border projects and blended CPD activities.
- *1:1 Learning in Europe*, a collection of 31 recent 1:1 initiatives, launched in 19 European countries, which equipped *all* students of a given class, school, or age group with a portable computing device.
- *Hellerup School* (Denmark), an innovative public school (primary-lower secondary) that has successfully adapted its pedagogy and physical spaces based on students' needs to promote diversity, flexibility, and creativity as well as to support a variety of learning strategies and styles.
- *e-Learning Pilot Scheme* (Hong Kong SAR), a three-year pilot scheme on e-Learning in schools to explore suitable modes and necessary support measures for the development of effective e-learning solutions that are sustainable, transferable and scalable for Hong Kong.
- *CoREF* (Knowledge Construction with Technology by the Consortium for Renovating Education of the Future), a project that aims to change Japanese traditional teacher-centric education into a more student-centric one by using networks-of-networks to create a large community of learners.
- *mp3* (Third Masterplan for ICT in education, Singapore), a system-wide initiative that builds on the vision and outcomes of the 1st and 2nd Masterplans. The Third Masterplan aims to engage the entire school population in self-directed and collaborative learning with ICT in order to meet the challenges of the 21st century.

- *Digital Textbook* (South Korea), a pilot project that aims to develop digital textbook contents that are more accessible and easy to use by leveraging the potential of mobile devices and social network service tools to provide students with more interactive, authentic, and rich learning experiences.

Mapping the seven cases onto an innovation framework

Six out of the seven cases of ICT-enabled innovation for learning analysed (apart for CoREF, Japan) have either developed over a period of more than ten years or are initiatives that have built on system level initiatives that started more than ten years ago. Furthermore, with the exception of the *Hellerup School*, all of the other cases have direct engagement or are part of a government initiative at regional, national and/or supra-national levels. The following figure presents the innovation characteristics of the seven cases mapped onto the five-dimensional framework of ICT-enabled innovation for learning (Kampylis, Bocconi & Punie, 2012) and it clearly reveals the great differences found between them on all five dimensions.



As can be seen from this figure, some of the initiatives such as the *e-Learning Pilot Scheme* in Hong Kong or the *1:1 Learning initiatives* in Europe are more incremental in nature with the use of ICT bringing about minor gains such as offering easy access to multimedia resources. *Hellerup School,* however, is much more innovative and brings in many radical and disruptive learning and teaching practices.

Some of the initiatives are clearly pilots, such as the Hong Kong *e-Learning Pilot Scheme,* which was set up by the local government to explore critical issues and concerns related to scaling and mainstreaming. Others, on the other hand, such as the *Third Masterplan for ICT in Education* (mp3) in Singapore, have already reached the mainstreaming stage.

In terms of geographical coverage, the initiatives span from totally local initiatives like *Hellerup School* that serves its own local community, up to *eTwinning* that is a supranational cross-border initiative covering a large number of European countries.

Given these differences, the applied pedagogical, technological and organizational innovations in the seven cases vary from affecting practices (e.g. teaching and learning processes) to introducing new means (services), up to undertaking reforms at system level (organization).

Regarding actors, some of the initiatives involve specific target groups (e.g. school staff and students in primary and secondary schools in *eTwinning*) and others involve a greater variety of

stakeholders including actors from industry and academia such as in *Hellerup School*, *CoREF* or *mp3* cases.

Considerable diversity is found not only across the seven cases that were analysed in-depth but also *within* each of the cases. At one end of the internal diversity spectrum is the case of the *1:1 Learning in Europe*, comprising effectively 31 innovations, all of which involve the deployment of 1:1 portable computing devices to enhance students' learning outcomes. These 31 recent 1:1 learning initiatives also differ one from another in terms of all five dimensions of the mapping framework. *Hellerup School*, is at the other end of the diversity spectrum among the set of seven cases, involving one school and one focused vision. It is also the only case that was not initiated with substantial government level support and intervention, although it is a publicly-funded school.

Technology used and its role in scaffolding innovation

Of the seven innovation cases, ICT played a focal role in five. The *1:1 Learning in Europe* and the *Digital Textbook* project in South Korea are both national efforts to make productive use of a specific technology: 1:1 portable learning devices and digital curriculum resources respectively. The Singapore *mp3* and the *e-Learning Pilot Scheme* in Hong Kong are both efforts to leverage the potential of ICT to transform learning at a system level. In the *eTwinning*, *CoREF* and *Hellerup School* initiatives, technology is used to support the innovation introduced, though no single technology is advocated.

Conditions for ICT-enabled innovations to have significant impact on learning

Three conditions were identified as critical for technology-enhanced learning to achieve significant impact on student' learning outcomes:

1. *Pedagogy first*: Where substantial learning gains were observed, implementation has always focused on the use of ICT to empower student learning and supporting learner-centric pedagogy that leverage learner interest and encourage self-directed learning and collaborative knowledge creation;
2. *Teacher support and teacher autonomy*: Changing pedagogical practice, even if the changes are simply incremental, requires teacher learning, in particular learning through practice and reflection;
3. *Better definitions and assessment for 21st century skills*: While the term *21st century skills* has become a buzz word, there is a lack of specificity or consensus on what these skills are, and how they can be assessed.

Scaling up ICT-enabled innovation is primarily a learning challenge

Innovation is about change. While many different changes need to take place at individual, organizational and system levels, ultimately the most difficult changes to make are those involving changing practices rather than changes in technology or other contextual factors. In particular, it is the behavioural changes that challenge the common wisdom and widespread professional/community beliefs about (i) how people learn, (ii) the role of the teacher, (iii) the best way to measure learning outcomes, and (iv) the role of a school. Changing beliefs and practices are usually incremental and evolutionary rather than quantum level revolutions by nature. Learning at various levels must take place for any innovation to claim some level of success. An inspection of the policies and strategies in the seven case studies analysed reveal the following characteristics in the nature of the learning support they have provided:

a. *Encourage learning that is experiential, generative and self-organizing*. While all seven cases of innovation are top-down initiatives by virtue of the locus of their initiating agencies, bottom-up agencies play an important part in the implementation and development of these innovations.
b. *Provide architectures (i.e. structures and mechanisms) for learning across sites and levels.* Architectures for learning are conducive to self-directed, autonomous and self-organizing learning needed for implementing and scaling up innovations.

c. *Propagate and consolidate learning to higher levels of the system hierarchy through changes to services and organization.* Developing, implementing and evaluating changes in governance, management and school routines should be considered as an important part of intentional learning for scaling up innovations to organization level and beyond.
d. *Technology as an integrated infrastructure for learning at multiple levels*. In selecting ICT-enabled learning innovation cases for the present study, the role of technology that we focus on are those that directly contribute to the learning of the targeted learners under the specific education and training context. As discussed earlier, the technology use ranged from being an add-on tool to a fully integrated digital infrastructure.

Ecological framework for developing effective policies and strategies for mainstreaming ICT-enabled innovation for learning

Building on the understanding that the challenge to scaling up innovations is primarily a learning challenge at all levels of the system hierarchy, what strategic and policy insight have we gained about scaling up ICT-enabled learning innovations? First of all, we note that all the seven cases have achieved different levels of success in generating and sustaining innovative learning practices in their respective contexts. However, the strategic dimensions and the prospects for their sustainability and scalability differ according to the respective case authors. Through our analysis of the cases, we have identified four central principles that differentiate the strategic effectiveness of different innovation initiatives.

1. *Multiple pathways to innovate and scale*. The seven innovations are very different from each other, yet they have all made progress towards realizing the transformative potential of ICT in supporting learning, and have thus demonstrated ecological validity for their specific context. There is no single or best route to innovation and scaling up; there are multiple pathways, each with its own constraints and conditions for success and sustainability.

2. *Ecological diversity of innovations foster scalability.* Most of the innovations involve more than one school site, and there is diversity across sites even within the same innovation. Innovations that have achieved larger scales of implementation may have developed changes at service and organizational levels that are more congenial to other, more disruptive innovations, even though they themselves remain relatively incremental in nature.

3. *Leadership for strategic alignment as a necessary condition for scalability*. While strategies for scaling innovations should support multiple pathways and ecological diversity in innovation, there is a danger of loss of direction resulting in the innovation process becoming a random walk that never go far beyond the initial starting point.

4. *Foster multilevel, system-wide connectivity and strategic partnership*. In all the seven innovation cases, decentralized bottom-up strategies coming from various partners outside of the school and the central agency comprise a prominent type of strategic support for implementation and scaling up the innovation. These bottom-up partner strategies help to mobilize resources, increase the problem solving and innovative capacity of the project, and solicit both tangible and intangible support.

In this report, we have ventured beyond a metaphorical use of ecological analogues to propose a framework for effective policies and strategies to mainstream ICT-enabled learning innovations that comprise four guiding principles. We hope that the framework presented would be able to guide different trajectories of change observed under different contexts and stimulate further research on the scaling up of ICT-enabled learning innovations, leading to more refined and robust models of innovation and change strategies.

Abbreviations and relevant URL links (if available)

1:1 – Student to portable computing device ratio
1:1Learning – The JRC-IPTS project 'Overview and analysis of 1:1 learning initiatives in Europe'
21CC – 21st Century Competencies
AfL – Assessment for Learning
BYOD – Bring Your Own Device
CCR – Creative Classrooms
CITE – Centre for Information Technology in Education of the Faculty of Education, HKU
CoL – Collaborative learning
CoREF – Knowledge Construction with Technology in Japanese classrooms by the Consortium for Renovating Education of the Future (Japan)
CPD – Continuous Professional Development
CSS – Central Support Service of eTwinning
DG EAC – Directorate General for Education and Culture (European Commission)
E&T – Education and Training
EACEA – Education, Audiovisual and Culture Executive Agency of European Commission
EC – European Commission
EDB – Education Bureau of the HKSAR Government
ETD – Educational Technology Division (Singapore)
EU – European Union
EUN – European Schoolnet
HA – Holistic Assessment initiative (Singapore)
HKSAR or **Hong Kong SAR** – Hong Kong Special Administrative Region
HEI – Hypothesis-Experiment Instruction
HKU – University of Hong Kong
HOT – Higher Order Thinking
ICT – Information and Communication Technologies
IDA – Infocomm Development Authority
IDM – Interactive Digital Media
IL – Information Literacy
IP – Intellectual Property
IPTV – Internet Protocol Television
IT – Information Technology
ITE – Information Technology in Education
ITT – Initial Teachers Training
JRC-IPTS – Joint Research Centre – Institute for Prospective Technological Studies
KCJ – Knowledge Constructive Jigsaw
KERIS – Korea Education and Research Information Service
LLP – Lifelong Learning Programme (European Commission)
LMS – Learning Management System
LD – Learning Diversity
MEST – Korean Ministry of Education, Science and Technology
MEXT – Ministry of Education, Culture, Sports, Science and Technology (Japan),
MoE – Ministry of Education
MoEC – Ministry of Education and Culture
mp3 – Third Masterplan for ICT in Education (Singapore)

NNs – Networks of networks
NIE – National Institute of Education (Singapore)
LMS – Learning Management System
LSL – Learning Sciences Lab of National Institute of Education (Singapore)
LS – Learning Sciences
NNSs – National Support Services of eTwinning
NPOs – Non-Profit Organizations
NGO – Non-Governmental Organization
OECD – Organisation for Economic Co-operation and Development
OJT – On the Job Training (a legislated requirement for teachers in Japan)
OLPC – One Laptop Per Child initiative
PAG – Pedagogical Advisory Group of eTwinning
PD – Professional Development
PISA – Programme for International Student Assessment of OECD
R&D – Research & Development
RCKI – Rapid Collaborative Knowledge Improvement
SAL – Self-Accessed Learning
SCALE CCR – The JRC-IPTS project 'Up-scaling Creative Classrooms in Europe'
SDL – Self-Directed Learning
SEN – Special Educational Needs
SES – Socio-Economic Status
SMEs – Small and Medium-sized Enterprises
SNA – Social Network Analysis
SNS – Social Network Services
T&L – Teaching and Learning
TPD – Teacher Professional Development
VLE – Virtual Learning Environment
WG – Working Group on Textbooks and e-Learning Resources Development (HKSAR)

1. Introduction

Yves Punie, Panagiotis Kampylis & Nancy Law

1.1 Scope of this report

This report is part of a larger project on 'Up-Scaling Creative Classrooms in Europe[2]' (SCALE CCR), launched by the Information Society Unit at IPTS in December 2011 on behalf of the Directorate General Education and Culture (DG EAC). The main objectives of the SCALE CCR project as a whole are:

1. to define and classify "**ICT-enabled innovation for learning**" across a range of settings and participants, including groups of learners and teachers/instructors at system level, both within and outside formal education settings;
2. to develop the **concept of Creative Classrooms** (CCR) and the related **reference parameters** for pilot initiatives in scaling up CCR;
3. to identify and analyse the **implementation strategies** of a number of effective ICT-enabled innovations for learning in order to bring to the surface commonalities of purpose, scope and conditions for sustained impact at system level;
4. to propose concrete **policy recommendations** for the further development and sustainable mainstreaming of CCR in Education and Training (E&T) across Europe.

Based on the results from earlier stages of the project (Kampylis, Bocconi & Punie, 2012; Bocconi, Kampylis & Punie, 2013b), the present report looks at the implementation and dissemination strategies of ongoing ICT-enabled innovation for learning with significant scale and/or impact in E&T in order to further understand their aims, outcomes, impacts and also to clarify the nature of their pedagogical, technological and organizational innovation.

1.2 Background and context

Education is one of the most important levers for ensuring competitiveness and prosperity in the age of globalization. Around the globe, nations and regions are working hard to benchmark their education systems to establish a solid foundation for economic development in the 21st century. The goal is not just to see how they rank, but rather to identify and learn from top performers and rapid improvers (namely from E&T systems that offer ideas for boosting their own performance) how to improve their own systems.

The Europe 2020 strategy acknowledges that a fundamental transformation of E&T is needed to address new skills and competences required if Europe is to remain competitive, overcome the current economic crisis and grasp new opportunities. Innovating in E&T is a key priority in several flagship initiatives of the Europe 2020 strategy, in particular the Agenda for New Skills and Jobs, Youth on the Move, the Digital Agenda and the Innovation Union Agenda (European Commission, 2010). Furthermore, the modernization of European E&T systems—reducing early school leaving and increasing tertiary education attainment levels—is one of the five targets for measuring the success of the Europe 2020 strategy.

Educational stakeholders recognize the contribution of ICT to realizing these targets, and more broadly, the role of ICT as a key enabler of innovation and creativity in E&T and for learning in general. The use of ICT in education is an important element in the European Commission's strategy and in its recent Communication on 'Rethinking Education: Investing in skills for better socio-economic outcomes' the need to scale up the use of ICT in learning and teaching was emphasized (European Commission, 2012). Moreover, in European countries, national policies for ICT in education exist and many activities are undertaken to promote the use of ICT in E&T (e.g. Balanskat, Bannister, Hertz, Sigillò, & Vuorikari, 2013).

[2] Progress on the SCALE CCR project can be followed at http://is.jrc.ec.europa.eu/pages/EAP/SCALECCR.html

However, it was also highlighted that, while the infrastructure to promote ICT use for learning is largely available, and also a sound research base to guide the process, the full potential of ICT is not being grasped in formal education settings. Thus, the majority of schools in Europe and beyond are not reaping the benefits of new technologies as enablers to modernize learning and teaching practices (e.g. Bocconi, Kampylis & Punie, 2012). International surveys such as PISA on digital reading (OECD, 2011), EURYDICE (2011) and STEPS project (Balanskat, 2009) describe the seriousness of this implementation gap, its negative implication on learning outcomes and the need to take immediate action.

The Digital Agenda Assembly session on "Mainstreaming e-Learning in education and training" in June 2011, confirmed that scaling up ICT-enabled innovation for learning to system level is a key factor for the further modernization of E&T. Only few innovative projects, however, manage to reach beyond the early adopter stage and become fully embedded in educational practice. According to Law, Yuen and Fox (2011), the more innovative an initiative is, the more difficult it is to scale up. The key issue to tackle is sustainable large-scale implementation. Making projects work on a big scale with a wide scope, involving large groups of learners and/or teachers/instructors at system level has different enablers and barriers compared to small-scale classroom ICT-enabled innovation for learning. Classroom practices are inextricably linked to and dependent on factors inside and outside the classroom, at school and societal levels. Success in initiating change does not guarantee that such changes can be sustained over time.

Large-scale pilots in real-life environments have been conducted in Education and Training, in many countries in Europe and other world regions with the goal of speeding up the transfer of innovation research into educational practice. Some of the ICT-enabled innovations these pilots promote have already achieved significant scale and/or impact. In this report, we discuss the findings in relation to the SCALE CCR objectives, based on a structured comparative study of the pilots at various stages of maturity and differing contexts in Europe and Asia.

1.3 Structure and contents of the report

As outlined above, one of the key objectives of the SCALE CCR project has been to identify and analyse the implementation strategies of ongoing cases of ICT-enabled innovation for learning that have an impact at system level, in order to address current gaps in the knowledge base of scaling up educational innovations by understanding commonalities, enablers, barriers and key challenges. We are guided by two main purposes in the present report:

- An exploratory and descriptive purpose, intended to make a contribution to expanding the knowledge base on ICT-enabled innovation with significant scale and/or impact at the system level; and
- An analytical purpose, intended to contribute to identifying success factors and conditions for mainstreaming ICT-enabled innovation with a systemic impact on Education and Training in Europe and beyond.

The structure and contents of this report reflect these two purposes. First, we provide 'snapshots' of the current stage of development of seven diverse cases of ICT-enabled innovation for learning in Europe and Asia, covering aspects such as scale and nature of innovation, learning outcomes targeted, the role of technology in the innovation, implementation strategies, and prospects for sustainability, scalability and impact at the system level. Then, at the end of the report, we present the analytical dimension of the study, and discuss the lessons learnt about the necessary conditions for sustainability, scalability and impact at the system level.

In particular, the report is organized as follows:

- Following this *Introduction*, *Chapter 2* outlines the methodological approach used in the present study, covering the overall approach, the criteria for selecting the cases, the research activities carried out and an overview of the cases;
- *Chapters 3* to *9* present each of the seven case reports: the *eTwinning* community for schools in Europe; the *1:1 learning initiatives in Europe*; the *Hellerup School* in Denmark; the

e-Learning Pilot Scheme in Hong Kong schools; the *Knowledge Construction with Technology* in Japanese classrooms; the Singapore's *Third Masterplan for ICT in Education* (mp3); and the *Digital Textbook* project in South Korea. Each case report is structured in six sub-sections, as follows:

- The 'Case overview' provides a brief description of the contextual background and history of the innovation and the main reasons for selecting the case in terms of its significance for the SCALE CCR project.
- The 'Scale and nature of innovation' sub-section examines the geographic and institutional coverage of the innovation, its stage of development, conceptual basis and leadership and organizational aspects of the innovation.
- Next is a sub-section on 'Strategies for implementation and scaling up of the innovation', which considers the innovation development strategies and the monitoring, accountability and evaluation mechanisms adopted.
- The subsequent subsection presents the 'Outcomes and achievements' of each case in terms of student learning, teacher learning and developments in partnerships among stakeholders and community building.
- The sub-section 'Innovation prospects: sustainability and scalability' considers key factors and strategies that contribute to the successful implementation of the specific initiative. Moreover, the prospects and challenges for its sustainability and scalability, and the lessons learned are discussed.
- Finally, in the sixth sub-section, reflections and issues regarding the specific case of ICT-enabled innovation for learning are discussed.

- *Chapter 10* of the report provides a synthesis of the commonalities and differences and discusses what lessons can be drawn for policy and research in the future.

Finally, *Annex 1* provides the list of participants at the expert workshops held in Seville (December 2012) and Hong Kong (January 2013.) *Annex 2* gives some brief information and contact details of the case report authors. *Annex 3* provides the case report template.

2. Approach and methodology

Panagiotis Kampylis, Yves Punie & Nancy Law

2.1 Overall approach

The present study, undertaken as part of SCALE CCR project, mainly aimed to identify and analyse the implementation strategies of a number of cases of ICT-enabled innovation for learning with significant scale and/or impact at the system level in order to bring to the surface commonalities of purpose, scope and impact and propose a set of policy recommendations for mainstreaming Creative Classrooms (CCR) in Europe. A clarification of the terms *ICT-enabled innovation for learning*, *Creative Classrooms* and *scaling up* is provided in the following paragraphs.

In this report and in the context of the SCALE CCR project, the term *ICT-enabled innovation for learning* refers to profoundly new ways of using and creating information and knowledge made possible by the *disruptive* use of ICT—*as opposed to* using ICT for sustaining or replicating traditional practices (Kampylis, Bocconi & Punie, 2012; Law, Yuen & Fox, 2011). The innovative potential of ICT in education can only be realised if its use is accompanied by the necessary pedagogical and institutional changes (Kampylis, Bocconi & Punie, 2012).

Accordingly, *Creative Classrooms* are conceptualized as innovative learning environments that fully leverage the potential of ICT to innovate and modernise learning and teaching practices (Bocconi, Kampylis & Punie, 2012). The term 'creative' refers here to the innovation and modernisation of learning and teaching practices through technologies (collaboration, personalisation, active learning, entrepreneurship, etc.). Likewise, the term 'classrooms' is considered in its broadest sense as including all types of learning environments, including informal and non-formal ones.

In the context of SCALE CCR project, *scaling up* is not seen as a one-dimensional process, involving solely the expansion of numbers of schools implementing specific ICT-enabled teaching and learning activities (e.g. providing portable computing devices to all students). Neither does scaling up refer to recipes for replication of successful implementation or to 'one-size-fits-all' models of innovation. In contrast, scaling up is considered to be a contextualized process that involves all the challenges of implementing sustainable systemic change characterized by complexity and shifting priorities (Bocconi, Kampylis & Punie, 2013a; b; Coburn, 2003; Fullan, 2011; Law, Yuen & Fox, 2011; Levin, 2008; OECD/CERI, 2010; Shapiro, Haahr, Bayer, & Boekholt, 2007). Moreover, scaling up educational innovation is considered to be an organic process that allows for continuous change and flexibility for future adaptations in order to address the shifting priorities and requirements of society. Last but not least, scaling up ICT-enabled innovation for learning does not refer to future classroom scenarios but to what is emerging in today's practices made possible by taking advantage of existing and emerging technologies (e.g. Aceto, Borotis, Devine & Fischer, 2013; Johnson et al., 2013).

The case reports in the subsequent chapters focus on the dynamic aspects of the change process and the interdependencies that play a crucial role in determining the sustainability and scalability of the innovations, and how implementation strategies influence the interdependencies of factors at various levels: classroom, school, regional, national and cross-national. The cases are analysed with a particular focus on identifying the ecological conditions for success (Law, Yuen & Fox, 2011), by investigating which strategies/conditions may reduce the obstacles and/or enhance the enabling factors for change and sustainability. This study has a particular contextual focus on organised learning settings such as Primary and Secondary Education and also Continuous Professional Development (CPD). Last but not least, the cases were also analysed in terms of how success and failure factors reflect the five interrelated dimensions for scaling up educational innovation outlined by Clarke and Dede (2009), building on the four dimensional model by Coburn (2003):

- *Depth* (i.e. deep and consequential change in teaching and learning practices);

- *Sustainability* (i.e. maintaining the depth of the innovation over time in the original and even subsequent contexts, making the necessary adaptations and changes);
- *Spread* (i.e. the spreading of change—outwards and inwards—to greater numbers of learners, teachers, school leaders and other stakeholders);
- *Shift* (i.e. to shift authority, knowledge and ownership of innovation from external actors to learners, teachers and schools for developing an internally understood and supported innovative practice at pedagogical, technological and organizational level); and
- *Evolution* (i.e. incorporating the ideas and creative energy of teachers and other stakeholders to revise and adapt the innovation as an organic process, which is a product of depth, spread and shift).

2.2 Research questions

The case reports presented here focus on a series of research questions that address key policy concerns relating to the conditions, enablers and barriers for sustained development and progressive mainstreaming of ICT-enabled innovation for learning with impact at the system level. The research questions can be summarized as follows:

- *What are the conditions for sustainability of ICT-enabled innovation for learning?* A key challenge for any innovative learning environment is to have stable and sustainable progress over time. Concern has been expressed that only a few initiatives of ICT-enabled innovation for learning manage to go beyond the pilot phase and reach sustainable development. The case reports present the funding and leadership models of each initiative and also the mechanisms that allow the innovation to move forward.
- *What are the necessary conditions for ICT-enabled innovation for learning to reach a large scale?* Although there are many initiatives of ICT-enabled innovation for learning worldwide, usually they are not large scale. The case reports authors discuss the implementation strategies and prospects for scaling up the cases at hand.
- *What are the necessary conditions for ICT-enabled innovation for learning to have a significant impact at system level?* Systemic change involves the interaction of many elements, if not all, of the education ecosystem: content and curricula, assessment, teaching and learning practices, organizational strategies, leadership and values, connectedness, and infrastructure (for more detailed descriptions of the key elements of ICT-enabled innovation for learning, see Bocconi, Kampylis & Punie, 2013b). Systemic change generally involves changing beliefs and developing new skills and alignments, which are facilitated by appropriate social infrastructure and mechanisms that are referred to as architectures for learning (Law, Yuen and Fox, 2011; Stein & Coburn, 2008). The in-depth analysis of the seven cases focused on their impact at the system level, following an 'ecological' approach that captures the complexity and interrelation of the key elements of the specific initiatives.
- *What are the effective policies and strategies for mainstreaming ICT-enabled innovation for learning in Education and Training?* One of the key objectives of the Europe 2020 Strategy calls for enhancing creativity and innovation at all levels of E&T in Europe. In each case report the outcomes, achievements and lessons learnt are discussed and synthesized in the *Synthesis and Conclusions* chapter at the end of this report.

2.3 Methodology

The overall methodological approach adopted follows accepted models and practices used in case studies (Yin, 2003). It also incorporates additional data collection methods that include consultations with stakeholders, chosen to suit the particular focus of the SCALE CCR. The key methods applied were:

- Desk research for identifying, selecting and analysing the cases: Data collection and content analysis covered a wide range of materials such as websites, wikis and blogs; journal and conference papers; book chapters; technical, evaluation and policy reports; promotional literature (e.g. leaflets); video clips; and slideshow presentations.

- Consultation on the selected cases with education stakeholders from Europe and Asia in the context of two expert workshops:
    - 'Scaling up ICT-enabled innovation for learning: Inputs from Asia and Europe', 12-13 December 2012, Seville, Spain with 25 participants (stakeholders from Europe and the authors of the case reports from Asia; see Annex 1);
    - 'Scaling up ICT-enabled innovation for learning: Asia – Europe expert seminar', 22-23 January 2013, Hong Kong with 18 participants (stakeholders from Asia and the authors of the case reports from Europe; see Annex 1).
- Interviews with experts and practitioners: a number of semi-structured interviews with experts and practitioners were also conducted to gain further insights and information about the selected cases.

The data collection and analysis of the cases were based on a common case reporting template (and associated rationale) developed by the Centre for Information Technology in Education of the Faculty of Education at the University of Hong Kong (CITE in short) in close collaboration with JRC-IPTS (see Annex 3). The aim of the template was to identify the key elements surrounding an innovation that needs to be captured by the case reports authors in order to address the SCALE-CCR project goals. In particular, the case reports template captures the pedagogical, technological and organizational dimensions of the innovations and also other important factors associated with the scalability and sustainability of those cases.

2.4 Selection criteria

The SCALE CCR research team made a strategic decision to analyse in-depth cases of educational innovation, not only from Europe but also from other world regions, in order to share experiences and insights on what works and what does not in large-scale implementation of ICT-enabled innovation for learning at system level.

Desk research revealed that several Asian countries have long innovation histories in education, ongoing large-scale initiatives of ICT-enabled innovation for learning and high ranking in international benchmarking on educational performance, such the OECD's Programme for International Student Assessment (PISA). Thus, a call for tender was launched by JRC-IPTS for a study on ICT innovation in education in the Asian region[3] and CITE was selected as the contractor. In particular, the key objective of the CITE-led component of the study was to identify and analyse how initiatives of ICT-enabled innovation for learning with significant scale and/or impact at system level in the Asian region are developed, sustained, and further implemented. CITE took responsibility for identifying the case report authors for the selected Asian cases to ensure that they have good knowledge not only of the cases but also about the local context of ICT-enabled innovation for learning.

The overall procedure adopted for the selection of European and Asian cases for in-depth analysis was as follows:

1. Through desk research and consultation with stakeholders, a number of cases of ICT-enabled innovation for learning in Europe and Asia were identified. A list of European 'promising cases' was compiled by JRC-IPTS and CITE prepared another list of Asian ones.
2. An appraisal of the two lists was undertaken. The appraisal covered:
    i) verification that not only *technological* but also *pedagogical* and *organizational innovations* are involved;
    ii) verification that the case example is still *ongoing* and that *reliable and relevant data can be captured*;

[3] The title of the study was 'Case analysis of ICT-enabled innovation for learning in Asia: Asia-Europe Expert seminar on up-scaling ICT innovation for learning' (LearnInnovAsia&Europe) and carried out by CITE from October 2012 to May 2013.

iii) verification that each case reflects a genuine and unique *ICT-enabled innovation for learning* that has reached *significant scale* and/*or impact at system level*;

iv) an appraisal of the *richness* i.e. quality and quantity of data potentially available to the research teams;

v) an assessment of the degree and nature of the potential *difficulty* involved in writing up the case report as per the required structure;

vi) an assessment, and initial mapping of the cases on the framework of ICT-enabled innovation for learning (Kampylis, Bocconi & Punie, 2012; see also Figure 1) in order to reach the best-possible *diversity* in terms of nature of innovation; implementation phase; access level; impact area; and target of innovation.

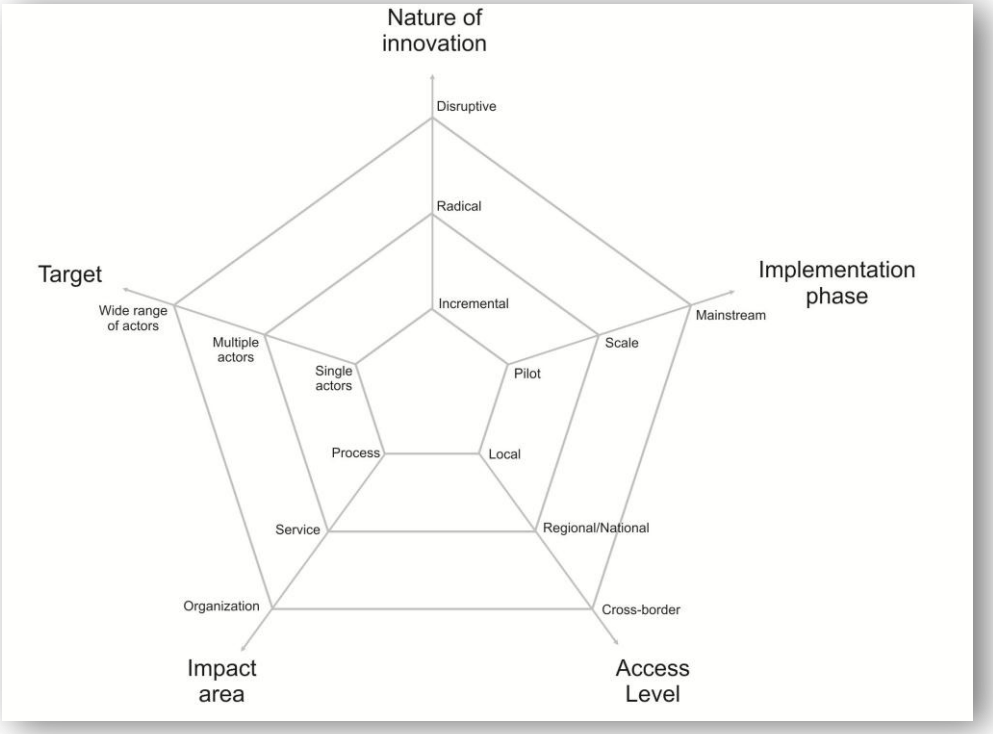


Figure 1: The mapping framework of ICT-enabled innovation for learning

At the end of this process, seven cases –three from Europe and four from Asia– were selected for in-depth analysis. The cases are briefly described and summarised in Section 2.5, Table 1 below. In particular, the three European cases of ICT-enabled innovation for learning cover the majority of the European countries and represent diverse settings in terms of the nature of innovation, access level and impact area (see Figure 2 below).

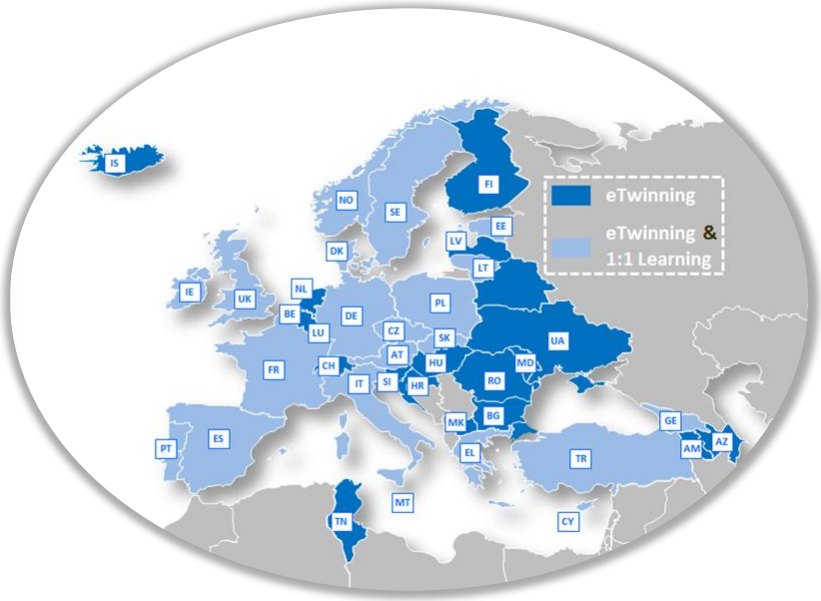


Figure 2: The geographical coverage of the European cases of ICT-enabled innovation for learning (*eTwinning,*[4] *1:1 Learning in Europe*[5] and *Hellerup School*[6])

The Asian cases selected for in-depth analysis reflect the above mentioned criteria. They cover initiatives in ICT-enabled innovation for learning from four top performing countries from Asia: Hong Kong SAR, Japan, Singapore and South Korea (see Figure 3).

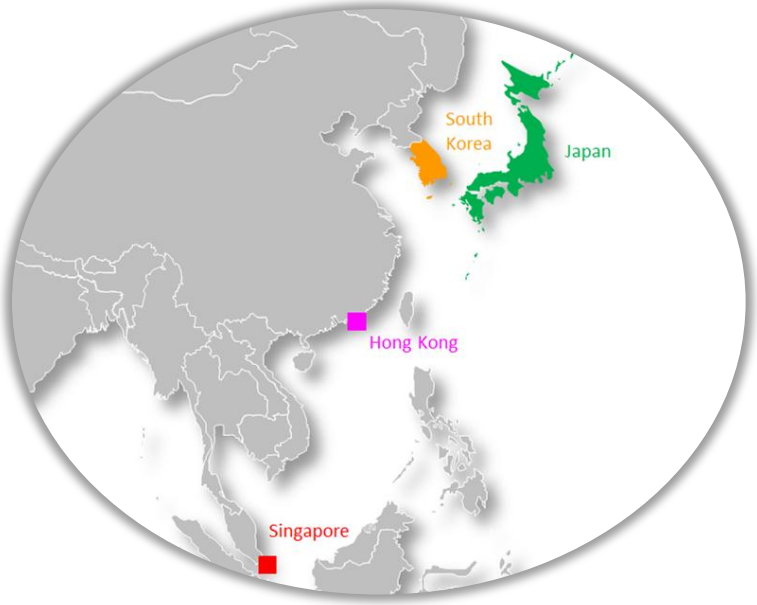


Figure 3: The geographical coverage of the Asian cases of ICT-enabled innovation for learning

[4] The 33 countries that participate in eTwinning are: AT-Austria, BE-Belgium, BG-Bulgaria, HR-Croatia, CY-Cyprus, CZ-Czech Republic, DK-Denmark, EE-Estonia, FI-Finland, MK-Former Yugoslav Republic of Macedonia, FR-France, DE-Germany, EL-Greece, HU-Hungary, IS-Iceland, IL-Ireland, IT-Italy, LV-Latvia, LT-Lithuania, LU-Luxembourg, MT-Malta, NL-Netherlands, NO-Norway, PL-Poland, PT-Portugal, RO-Romania, SK-Slovakia, SI-Slovenia, ES-Spain, SE-Sweden, CH-Switzerland, TR-Turkey, UK-United Kingdom. The 6 countries that participate in eTwinning Plus countries are: AM-Armenia, AZ-Azerbaijan, GE-Georgia, MD-Moldova, TN-Tunisia and UA-Ukraine.

[5] The 19 European countries with 1:1 Learning initiatives are: AT-Austria, CY-Cyprus, CZ-Czech Republic, DK-Denmark, EE-Estonia, FR-France, GE-Georgia, DE-Germany, EL-Greece, IL-Ireland, IT-Italy, LT-Lithuania, NO-Norway, PT-Portugal, SK-Slovakia, ES-Spain, SE-Sweden, TR-Turkey, UK-United Kingdom.

[6] DK-Denmark.

The key reasons for the selection of each of the seven cases from Europe and Asia are briefly presented in the following section.

2.5 Overview of the seven selected cases from Europe and Asia

Table 1 provides a brief summary of the main features and the key reasons for selection of the seven cases of ICT-enabled learning innovation included in this study.

Table 1: Overview of the cases

Case title	Country/ Region	Short description	Key reasons for case selection
eTwinning	Europe	eTwinning is a fast-developing community of schools in Europe: 200,000 registered teachers and more than 100,000 schools from 33 European countries have signed up to use its free and safe online environment for cross-border projects and CPD activities. As part of the eTwinning Plus initiative, selected schools from 6 additional countries have joined the eTwinning community since March 2013.	It is a unique cross-border initiative that utilizes social networking mechanisms for enhancing collaboration, communication and intercultural awareness among the school communities in Europe using ICT. It is a safe and supportive network for cross-border projects and teachers' peer learning and professional development.
1:1 Learning	Europe	It is actually a collection of 31 recent 1:1 initiatives, launched in 19 European countries, which equipped/have been equipping all students of a given class, school, or age group with a portable computing device. The 1:1 learning model intends to lead to pedagogical change and innovation modernizing Education and Training in Europe.	The analysis of these 31 initiatives provides evidence of impact on motivation; student centred learning; teaching and learning practices; learning outcomes; and parents' attitudes. Furthermore, it provides valuable insights on the approaches to implementation, financing models and mainstreaming strategies of ICT-enabled innovation for learning.
Hellerup School	Denmark	An innovative public school that has successfully adapted its pedagogy and physical spaces based on students' needs to promote diversity, flexibility, and creativity as well as to support a variety of learning strategies and styles.	Although it is a small-scale initiative, Hellerup has for more than a decade (i) adopted innovations that impact the whole school ecosystem, shedding light on change at the system level and (ii) had a significant influence on other school ecosystems worldwide.
e-Learning Pilot Scheme	Hong Kong SAR	A three-year pilot scheme on e-Learning in schools to explore suitable modes and necessary support measures for the development of effective e-Learning solutions that are sustainable, transferable and scalable for Hong Kong.	It is a strategic initiative of the Third Information Technology in Education Strategy in Hong Kong that builds on the previous two strategies and aligns with the territory-wide education reform launched in 2000.

Case title	Country/ Region	Short description	Key reasons for case selection
Renovating Education of the Future Project	Japan	This project aims to change Japanese traditional teacher-centric education into more student-centred, socio-constructivist learning in classrooms from elementary to high schools, to reduce dropout rate during transition between school levels and to find a better way for university-level scientific knowledge to be introduced to younger students.	It is considered to be one of the more effective reform initiatives and is expected to provide evidence-based recommendations on educational policies, including the national standards, school grading systems and curriculum development.
Third Masterplan for ICT in education (mp3)	Singapore	mp3 is a system-wide initiative targeting the entire school population in Singapore "to enrich and transform the learning environments of students and equip them with the critical competencies and dispositions to succeed in a knowledge economy", building on the vision and outcomes of the 1st and 2nd Masterplans.	mp3 is a concerted, centralized government effort that involves a significant level of financial investment, a complex array of support and strategies as well as mechanisms to stimulate bottom-up initiatives.
Digital Textbook	South Korea	This is a governmental pilot project to develop digital textbook contents that are more accessible and easy to use by leveraging the potential of mobile devices and social network service tools to provide students with more interactive, authentic, and rich learning experiences.	This project is a national undertaking for phase 4 of the ICT Masterplan and will continue to be a main task for the final phase (5) of the Masterplan. It is connected to the national knowledge database and web-based resources for teaching and learning activities.

3. Case report 1: eTwinning – the community for schools in Europe

Panagiotis Kampylis & Yves Punie

3.1 Case overview

eTwinning (www.etwinning.net), the European Commission-funded initiative for establishing and supporting a community for schools in Europe, was launched in January 2005 as the main action of the European Commission's *e-Learning Programme*. Since 2007 it has been firmly integrated in the *Lifelong Learning Programme*[7] (LLP) as part of the Comenius sub-programme which aims mainly to help young people and educational staff better understand the range of European cultures, languages and values (Figure 4). It is worth noting here that under the *subsidiarity principle* of educational policy in European Union, Member States are in charge of their own education and training systems, but they co-operate within the EU framework in order to achieve common goals.[8]

eTwinning is recognized by practitioners and stakeholders as a successful European ICT-enabled innovation that contributes to the modernization of education and training in the EU (European Commission, 2013). Its main objectives complied with the decision by the Barcelona European Council[9] in March 2002 to promote school twinning as an opportunity for all students to learn and practice ICT skills and to promote awareness of the multicultural European model of society. At the time of writing (April 2013) *eTwinning* involves more than 200,000 teachers, head teachers, librarians, IT coordinators etc. (the so-called *eTwinners*) working in schools in one of the 33 European countries involved.[10] The eTwinners can utilize the tools and the secure internet spaces offered for meeting virtually, exchanging ideas and practices, and engaging in cross-border projects using Information and Communication Technologies (ICT). *eTwinning* also provides additional services to teachers including the search for partners for Comenius school partnerships,[11] the opportunity of taking part in communities of practice (e.g. *eTwinning Groups*[12] and *Teachers Rooms*[13]) and the participation in *Professional Development Workshops*[14] and *Learning Events*[15] (online and/or onsite) at regional, national or European levels (European Commission, 2013).

2008 was an eventful year in the development of *eTwinning*, with the introduction of the new version of the *Portal*[16] and a clear move towards a web 2.0 and social networking approach[17] (Crawley, Gilleran, Scimeca, Vuorikari, & Wastiau, 2009), which had a direct impact on user registration. While the growth of *eTwinning* was stable in the first four years (more or less 80% per year), it was greatly accelerated in the school year 2008-2009, with a growth of more than 300%

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7 With a budget of nearly €7 billion for 2007 to 2013, the LLP funds a range of actions such as exchanges, study visits and networking activities helping to develop the education and training sector across Europe.

8 See more at http://ec.europa.eu/education/lifelong-learning-policy/treaty_en.htm

9 http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/ec/71025.pdf

10 Since March 2013, selected schools from five Eastern Partnership countries (Azerbaijan, Armenia, Georgia, Moldova, Ukraine) and Tunisia are also involved through eTwinning Plus (http://plus.etwinning.net).

11 http://ec.europa.eu/education/comenius/school_en.htm

12 The current list of eTwinning groups can be found at http://www.etwinning.net/en/pub/progress/groups.htm. See more about eTwinning Groups in the following paragraphs.

13 These informal Rooms are available only to registered users who can either join or create a Room for discussing any topic of interest with their colleagues for a limited amount of time (up to 3 months).

14 Workshops organized by the CSS and/or NSSs that are take place in different European cities throughout the school year aiming at teachers who want to improve their professional skills and competences.

15 Short online events on a number of themes, run by education experts, which offer an introduction to a topic and help participants to develop their skills and knowledge. See also Holmes, 2013.

16 The multilingual online platform (available in 25 languages) in which school staff from the participated countries can freely register in order to conduct *eTwinning* activities.

17 See more about the evolution of *eTwinning* from project to more diversified professional development provisions at Vuorikari et al., 2011a.

compared to the year before (European Schoolnet, 2010; see also Figure 5). During 2009, the eTwinning Groups were introduced, which are private platforms for eTwinners to discuss and work together on a specific topic or theme using a variety of tools (such as forums, wikis, blogs, image galleries etc.) and activities (e.g. webinars, expert talks and so on). Accordingly, in early 2009 the *eTwinning* motto changed from "School partnerships in Europe" to "The community for schools in Europe" (see also Crawley, Gerhard, Gilleran & Joyce, 2010). On Wednesday, 12 September 2012, the updated eTwinning Portal was launched. It will shortly be followed by the launch of the updated *TwinSpace.*[18]

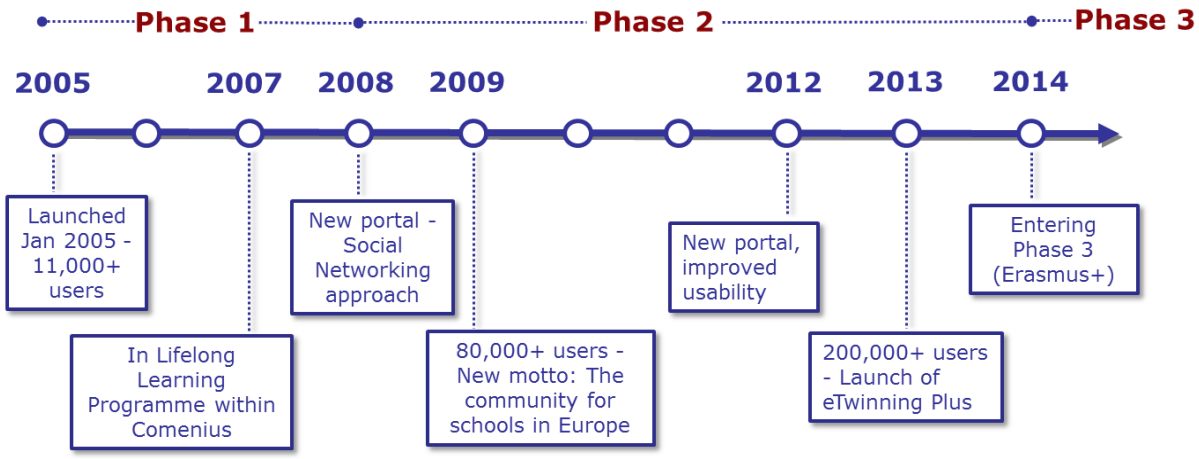

Figure 4: The timeline and milestones of *eTwinning* development

Numerous educational networks at national (e.g. the *Internet en el Aula*[19] in Spain) or cross-national level (e.g. the *Commonwealth Class*[20] or the *TES network*[21]), contribute to teachers' professional development and facilitate peer-to-peer learning and collaboration. *eTwinning* is considered as one of the most sustainable and widespread educational networks in Europe. It is also a concrete case of on-going ICT-enabled innovation with significant impact on Education and Training (E&T) for the following reasons:

- It is a fast-developing initiative that has a stable organisation schema and funding, constant development, and sustainability/scalability plans in place;
- It allows new possibilities for school staff and students to connect with multiple actors (e.g. peers, external experts, wider community) opening up alternative channels for gaining skills and knowledge and broadening their horizons;
- It utilizes social networking mechanisms to enhance collaboration, communication and intercultural awareness among the school communities in Europe;
- It supports teachers' peer learning and continuous professional development through their active participation in collaborative projects, communities of practice and various face-to-face and online training activities;
- It contributes to the development of teachers' professional skills in ICT-enabled innovative pedagogical practices and thus accelerates educational change.

The eTwinning Central Support Service (CSS) portal (http://www.etwinning.net) is run and managed by European Schoolnet on behalf of the European Commission's Directorate General for Education and Culture and it is available in twenty-five European languages.

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[18] TwinSpace is the private and safe place for the project members (students and teachers), the space where planned activities are developed.

[19] http://internetaula.ning.com/

[20] http://schoolsonline.britishcouncil.org/projects-and-resources/commonwealth-class

[21] http://www.tes.co.uk/article.aspx?storyCode=6000208&navCode=285

The eTwinning Plus portal is at http://plus.etwinning.net. The websites of the 35 NSSs can be found at: http://www.etwinning.net/en/pub/get_support/contact.htm.

3.1.1 Key focus and goal of the innovation

The core aim of *eTwinning* is to offer a free and safe platform for teachers and students in Europe to connect, develop collaborative projects and share ideas. The fact of bringing practitioners from various countries within the same platform allows unprecedented networking opportunities thanks to networking tools and opportunities which enable teachers to participate, among other things, in professional development activities from anywhere, at any time.

3.1.2 Learners targeted

eTwinning targets learners at pre-school, primary, secondary and upper secondary school levels (age range of pupils, 3-19). All school staff (head teachers, teachers, librarians, etc.) from schools of the participating countries can involve themselves and their students in one or more *eTwinning* projects in any working language they want to use with their partners. *eTwinning* projects are collaborative opportunities for school staff and students between a minimum of two schools from two European countries to communicate with their peers and work together using ICT.

3.1.3 Learning outcomes targeted

eTwinning projects target mainly the development of competences and transversal soft skills such as collaboration, communication, problem solving, creativity and cultural awareness through meaningful and authentic project-based learning. *eTwinning* projects should have a good balance of ICT use and classroom activities, and should preferably fit into the national curricula of the schools participating in the project.[22]

The five main areas of added value to teaching and learning practices through eTwinning projects are the following (Galvin et al., 2006a):

- Authentic learning: Students are more motivated when engaged in authentic and meaningful learning activities.
- Collaboration: eTwinning projects require collaboration and cooperation at many levels such as teacher-teacher, student-student and/or student-teacher.
- European dimension: eTwinning cross-border projects can by their very nature address the European dimension and intercultural awareness by bringing students and teachers from different countries into contact and broadening their mutual understanding.
- ICT-use: *eTwinning* promotes the application of ICT in schools (e.g. email, web-pages, blogs, videoconferencing, internet, etc.), enabling students and teachers to develop and use their ICT skills in a relevant and authentic way.
- Teacher learning and professional development: An important aspect of *eTwinning* in general and eTwinning projects in particular is its contribution to blended learning and professional development of the teachers involved.

According to Wastiau, Crawley and Gilleran (2011), students' interactions during an eTwinning project actively affect their relationships with their classmates, project partners and teachers. Students are often asked to make choices about certain aspects of work within the project, such as what issues should be discussed online with partner pupils. However, their contribution to the design of the project itself before launching and the key decisions to be made during the project remain largely the teachers' responsibility.

3.1.4 Technology used and the role of technology in innovation

eTwinning utilizes existing and mainstream technologies. The eTwinning CSS portal (www.etwinning.net) is the official online contact point for everyone interested or involved in *eTwinning*. The portal provides all the tools and services necessary for participants to find information, resources, partners, and support for designing and running eTwinning projects in

[22] http://www.etwinning.net/en/pub/get_support/faq.htm

partnership with each other. The CSS also runs a helpdesk to deal with any enquiry or difficulty users may have in relation to *eTwinning*. The eTwinning CSS portal is also closely linked to the portals run at national level by the different National Support Services[23] (NSS) and provides information and tools for awards, learning events, workshops and other activities related to teacher learning and professional development.

School staff registered in the *eTwinning* action work mainly through the *Desktop* (the home page of eTwinners where they can modify their own and their schools' profiles, look for partners to twin with, receive and send e-mails to other eTwinners, access the resources library, etc.) and the *TwinSpace.*[24] Both of these restricted areas and their tools are username and password protected, as one of *eTwinning's* top priorities is to provide schools in Europe with a safe environment for networking and collaboration. Besides *Desktop* and *TwinSpace*, eTwinning projects often take advantage of other suitable ICT tools. There is a set of recommended tools (e.g. for videoconferencing, blogging etc.), but any eTwinner is free to choose the tools that they feel best fit their purpose.

In conclusion, *eTwinning* is regarded as a safe and supportive virtual environment for the community of schools in Europe and the available technologies are used in diverse settings and in many different ways. eTwinning projects use a variety of technologies ranging from low-level technology and ICT tools such as emails for their collaboration to tools offered by the CSS, e.g. the *TwinSpace* and/or NSS websites. They are not, however, limited to these. In many cases, eTwinning projects demonstrate technical mastery and sophistication in the way they take advantage of ICT: using, for example, digital video, Learning Management Systems (like Moodle), blogs, wikis etc. A number of these are highly professional in appearance and have proved effective as vehicles for the projects.

3.2 Scale and nature of the innovation

Now in its ninth year of development (2005-2013), *eTwinning* is recognized by practitioners and stakeholders as a well-established teachers' network, with a stable organization schema and sustainability/scalability plans in place. In particular, the European Commission has proposed expanding *eTwinning* (as part of the new "Erasmus+: the EU Programme for Education, Training, Youth and Sport" from 2014-2020)[25] to widen its current coverage to include non-European countries and to adopt a more systemic/institutional approach (European Commission, 2011).

3.2.1 Scale of the innovation

On 15 April 2013, 200,138 teachers and other practitioners from 104,567 schools[26] in 33 countries (the 27 EU Member States plus Croatia, Iceland, Norway, FYROM, Switzerland and Turkey) were registered in *eTwinning*. 14,743 of the eTwinners are involved in projects registered after 1 June 2012. In terms of projects, 5,768 are currently active and 21,970 have closed.[27] According to the estimations by Wastiau, Crawley & Gilleran (2011), participation in eTwinning projects over the first six years of its development (2005-2010) must have involved close to 750,000 students across 33 countries in Europe.

[23] http://www.etwinning.net/en/pub/get_support/contact.htm

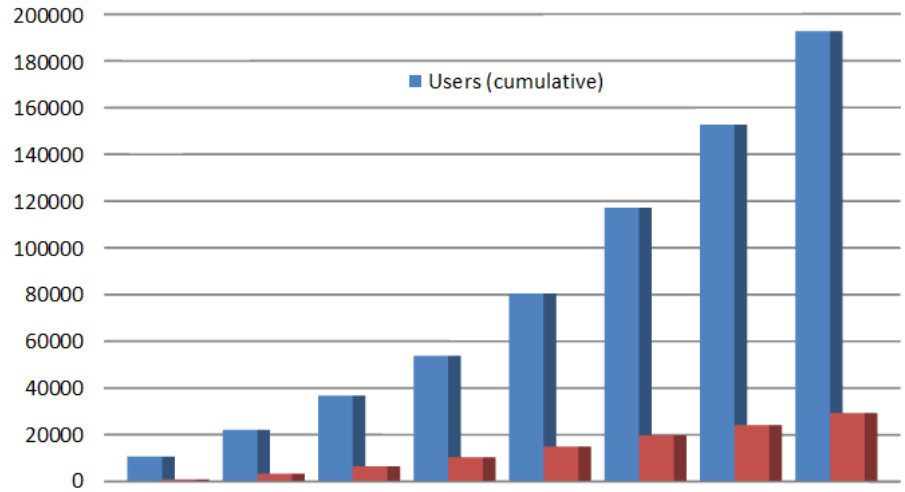
[24] See more at http://www.etwinning.net/en/pub/discover/tools.htm#

[25] Previously *Erasmus for all.*

[26] The average ratio of registered eTwinners per school is 1.96, whilst about 40% of schools registered in eTwinning have more than one teacher registered (figure from November 2012).

[27] The figures refer only to eTwinning, as there are no statistics yet available from eTwinning Plus, and the numbers are constantly increasing. You can see the current number of registered users, schools and projects at the eTwinning CSS portal: http://tinyurl.com/crwonh8. See also the interactive map of eTwinning coverage and statistics by country at http://tinyurl.com/c8ddff3

While these figures are constantly increasing[28] (Figure 5), eTwinning activities currently engage on average with only 3.3% of the potentially eligible teaching population within the participating countries (based on updated figure from Vuorikari et al., 2011a). Therefore, according to Rogers' model of diffusion of innovation (2003), *eTwinning* in most countries still remains confined to teachers who are "innovators" in using ICT for cross-border school collaboration.[29]



	2005	2006	2007	2008	2009	2010	2011	2012
Users (cumulative)	10585	22162	36698	53814	80454	117223	152726	192610
Projects (cumulative)	970	3369	6578	10371	15023	19700	24184	29413

Figure 5: *eTwinning* statistics[30]

On the other hand, based on calculations regarding the number of schools present in each country, it can be seen that the coverage of schools (up to 25%) is much higher than the coverage of teachers. This in turn could potentially provide an opportunity to increase the *eTwinning* reach[31] to teachers through local dissemination (Vuorikari et al., 2011a). One way of local dissemination is through *School Teams,*[32] namely any group of teachers, librarians, head teachers etc. within a school who are involved in *eTwinning*, as is documented in a set of eTwinning case studies (Vuorikari, 2013). On the other hand, it is rather common that even the most experienced eTwinners still tend to work in relative isolation within their schools (European Commission, 2013). In summary, wider take up is needed to scale up *eTwinning* from its current phase into the mainstream in order to achieve impact at a systemic/organizational level.

3.2.2 Funding of innovation

eTwinning is a European Commission-funded initiative with stable and sustainable funding from the Comenius programme for schools in Europe. The 2013 annual work programme on grants and

[28] A comparison of the figures of 15 April 2013 with the ones of 24 July 2012 (European Commission, 2013, p. 34) reveals that in a period of approximately 9 months 29,975 new users (+14.97%) and 11,652 schools (+11.14%) have registered on the eTwinning platform. Accordingly, the number of projects has grown steadily. See more about recent statistics of eTwinning at http://bit.ly/10Vx2nt

[29] Some countries have passed the 2.5% milestone of "innovators" (e.g., Estonia, Iceland, Slovakia, the Czech Republic, Slovenia and Finland) and are currently targeting the segment of "early adopters" within their teacher population (Vuorikari et al. 2011a).

[30] The number of projects refers to all projects registered and might include ones not been approved or deleted.

[31] eTwinning reach= the registered users / teacher population

[32] See also http://www.etwinning.net/en/pub/news/news/etwinning_school_teams_divide.htm

contracts for the "Lifelong Learning Programme" foresees 2,300,000 € for CSS and 9,400,000 € for distribution among the NSSs of *eTwinning*.[33]

eTwinning does not fund individual projects but rather the provision of online tools, services, support and recognition for facilitating cross-border collaboration between schools and teacher professional learning and development.

3.2.3 Leadership, organization, and main actors

The leadership and organization of *eTwinning* is tiered, involving the following main actors:

- *European Commission*: initiated *eTwinning* and funds it.
- *European Schoolnet (EUN)*: EUN, a network of 30 European Ministries of Education, coordinates *eTwinning* at European level through the CSS, which is responsible for the fully multilingual eTwinning portal through which registration, the finding of partners and the actual collaborative work takes place using the collaboration tools and services it offers. The CSS also organizes specific training sessions for teachers and coordinates -together with the Education, Audiovisual and Culture Executive Agency (EACEA) and the European Commission- the network of National Support Services (NSSs).[34]
- *National Support Services*: promote the *eTwinning* action by providing training and support (face-to-face, by phone and online) to participating schools, at national or regional levels and reward teachers for their successful participation in eTwinning projects. Moreover, NSSs ensure that *eTwinning* evolves in a way which meets the particular needs of local schools.
- *Ambassadors:* experienced eTwinning practitioners who share their experience and knowledge with other teachers interested in *eTwinning* on a local and/or regional level.
- *eTwinners:* Staff from the schools from the 33 participating countries can freely register in *eTwinning* and participate in cross-border projects and/or in the professional development activities organized by the CSS and NSSs. Students are involved in the eTwinning projects that eTwinners from their schools design and implement.

3.2.4 Conceptual basis of the innovation

eTwinning mainly promotes school collaboration in Europe through the use of Information and Communication Technologies (ICT). *eTwinning* started as a central action in the EU's e-Learning programme[35] for fostering among young people awareness of the European model of a multilingual and multicultural society. In particular, eTwinning actions focus mainly on four interrelated and interconnected areas through the exploitation of ICTs:

1. the promotion of lifelong learning;
2. the endorsement of collaboration;
3. the development of communication skills; and
4. the development of intercultural awareness.

According to a recent study involving approximately 6,000 eTwinners (European Commission, 2013), some of the main advantages reported by registered users are increased friendships and feeling part of an international community; opportunities to collaborate, and experiment with ICT-enabled innovation for learning; and gaining insights into professional, social and cultural life in other countries.

For students, *eTwinning* offers opportunities to collaborate with peers with different cultural and linguistic backgrounds and supports the development of linguistic and cultural competences.

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[33] See also http://ec.europa.eu/dgs/education_culture/documents/calls/c_2012_5363.pdf. Besides the funding by EC, NSSs are also receiving some additional national contribution.

[34] http://eacea.ec.europa.eu/llp/funding/2012/documents/call_etwinning/Invitation_to_submit_WP_final.pdf

[35] http://ec.europa.eu/education/archive/elearning/programme_en.html

eTwinning provides a good means to integrate ICTs into teaching and learning practices. The flexibility and diversity that characterize eTwinning projects allows their adaptation to the available means, the teachers' and learners' needs, and the level of access to equipment.

The development of eTwinning conceptual and pedagogical framework was based on, among others, the work of the Pedagogical Advisory Group (PAG), which was composed of experts coming from teacher training, school inspection and pedagogical research. A series of three 'Reflections on eTwinning' reports produced by the PAG of the CSS in 2006-2007 (Galvin, et al., 2006a; b; Zeidler, et al., 2007) defining the pedagogical landscape for the *eTwinning* action and pointing to areas in which *eTwinning* could make a significant contribution to pedagogical change – in particular, towards a more learner-centred approach to education (European Commission, 2013).

3.2.5 Summary

Figure 6 presents a mapping of the nature and current stage of development of *eTwinning* to the framework of ICT-enabled innovation for learning (Kampylis, Bocconi & Punie, 2012).

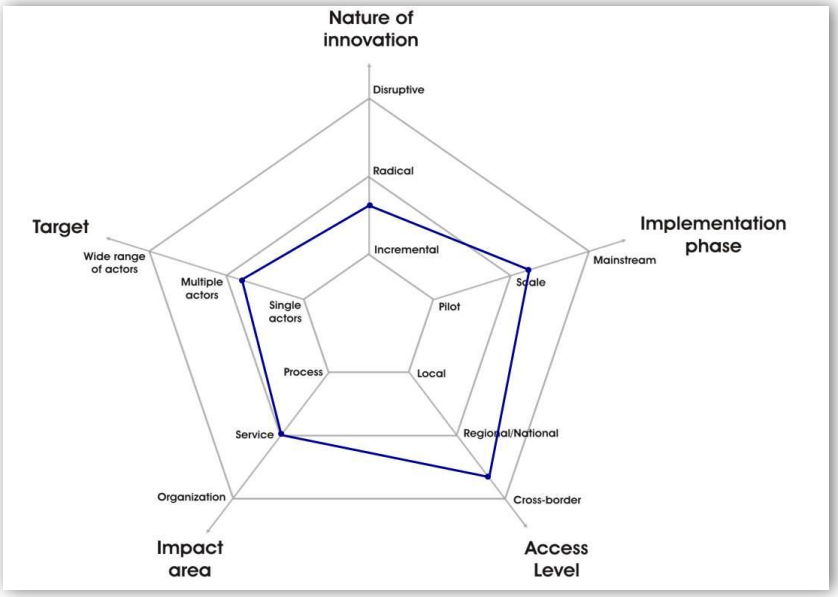

Figure 6: Mapping *eTwinning* to the framework for ICT-enabled innovation for learning

Nature of innovation: started as an incremental innovation in its early years aiming at school twinning, *eTwinning* has now shifted to a more radical innovation, expanding its services and offering to participating teachers concrete opportunities for networking, online collaboration and professional learning and development.

Implementation phase: Now in its ninth year of development, *eTwinning* has enjoyed steady growth in the number of teachers registered on *eTwinning*, as well as in the number of other teachers who are not registered but participate in *eTwinning* activities. However, the current *eTwinning* reach is limited to innovators and early adopters (Cachia & Bacigalupo, 2011; Vuorikari et al., 2011a) and a wider take up is needed to move it from its current scale into a more mainstream practice.

Access level: 33 European countries (the 27 EU Member States, Iceland, Switzerland, Norway, Turkey, Croatia, and the Former Yugoslav Republic of Macedonia) are involved in *eTwinning*. Since March 2013 *eTwinning* has widen its coverage through eTwinning Plus (http://plus.etwinning.net) and there are also plans for its further expansion from 2014 as a key part of EC's *Erasmus+*

programme (which will succeed LLP from January 2014) in the area of education, training, youth and sport.[36]

Impact area: *eTwinning* impacts mainly at the service level offering the tools and framework for project-based learning and opportunities for teacher professional development. Hence, it affects mostly the teaching and learning practices, but it does not impact schools at system/organisation level.

Target: *eTwinning's* current target group involves school staff (and their students) from the participating countries that can freely register and use the online tools offered, for cross-border projects and professional development activities.

3.3 Strategies for implementation and scaling up of the innovation

3.3.1 Agency for change

The strategies for implementing and further developing ICT-enabled innovation for learning might involve combinations of centralized/decentralized and top-down/bottom-up strategies. The *eTwinning* change/leadership model has both centralized/decentralized and top-down/bottom-up aspects that are summarized in Figure 7. These are briefly presented below.

- Centralized top-down aspect: This is a top-down initiative led by the Steering Committee of eTwinning (European Commission, Education, Audiovisual and Culture Executive Agency, and CSS, which sets directions, monitors and manages the project, and provides full funds and resources through the CSS.
- Decentralized top-down aspect: While the general directions are set top-down, the NSSs are in charge of implementing a development plan for the schools under their jurisdiction and to provide resources, support and dissemination to encourage innovation at the regional/national level. Moreover, eTwinning Ambassadors and other education stakeholders (e.g. school advisors) often provide pedagogical/technical advice to teachers at local/regional level.

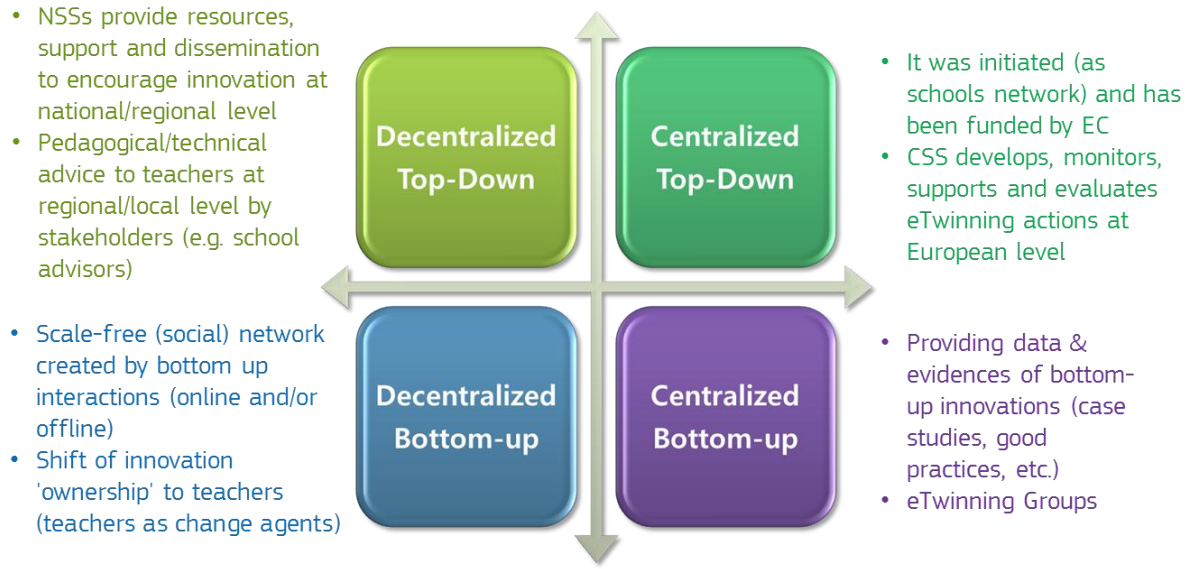

Figure 7: Leadership strategies operating at different levels in *eTwinning*

- Centralized bottom-up aspect: This refers to leadership models and dissemination of innovation at the school level. For instance, schools provide data & evidences of bottom-up

[36] http://tinyurl.com/cnu6h6h

innovations (case studies, good practices) that feed dissemination activities and publications of NSSs and CSS (see for instance Crawley, Gilleran, Nucci, & Scimeca, 2010a; b). eTwinning Groups are also an example of structured bottom-up initiatives which are supported/monitored centrally and offer additional provisions for teacher learning and professional development.

- Decentralized bottom-up aspect: *eTwinning* is a professional network developed mainly by bottom-up interactions (online and/or offline). As in other grassroots initiatives, eTwinners have been empowered to take the ownership of innovation and decide what to do and how to do it, with the sole requirement of exploiting ICT and collaborating with colleagues in another European country. As a result, ICT-enabled innovation for learning in *eTwinning* is largely teacher-led and leadership is exercised in a de-centralized, bottom up fashion.

3.3.2 Professional development provisions

When *eTwinning* was launched in January 2005, the main provision was to support schools twinning through collaboration projects. However, CSS recognized even at the early stage the need (and potential) for more systematic provisions to support teachers' professional development. Provisions that have been made include European-wide professional development workshops organised by CSS (started at the end of 2005) and online courses at the national level organized by NSSs (since 2006). A significant transformation of *eTwinning* took place in 2008 as it moved beyond being the community for schools in Europe and strengthened its focus on building a teachers' professional development network, with the progressive introduction of regional workshops (both online and face-to-face), Groups, Teachers' Rooms, Learning Events and so on in the following years (for details see Vuorikari et al., 2011a).

Currently, there are many levels and areas of teacher professional development possibilities (both formal and informal) in *eTwinning*, at local, regional/national and European levels:

- European-wide Professional Development Workshops organized by the CSS;
- European and national conferences organized by the CSS and NSSs;
- Online learning events organized by the NSSs and/or the CSS;
- Webinars, seminars and workshops organized by eTwinning Groups and NSSs;
- Self-organized peer-to-peer learning, mainly through eTwinning Projects, eTwinning Groups, and Teachers' Rooms.

All these provisions for professional development help teachers:

- To broaden their views and increase access to best practices and innovations;
- To improve their competence in foreign languages and communication skills;
- To learn about other school systems and teaching techniques;
- To enhance in-school collaboration through multidisciplinary projects that stimulate professional discussion and cooperation among local teachers e.g. through eTwinning School Teams;
- To become more confident in ICT usage and more innovative in the pedagogies they practice (Galvin, 2009).

3.3.3 Monitoring and evaluation mechanisms

Evaluation at system level:

- Annual reports from CSS and NSSs;[37]
- Monitoring and analysis by EUN (e.g. Vuorikari, 2013).

[37] Can be accessed at http://eacea.ec.europa.eu/llp/project_reports/project_reports_comenius_en.php

Evaluation at project level:[38]

- The *eTwinning Label* is granted to projects that are approved by the NSSs;
- The *Quality Label* is awarded at national level by NSSs, after application. The NSSs apply the following five requirements in granting the Quality Label to a project: (i) the project must have common goals and a shared plan; (ii) it must be finished, or in its last stages; (iii) the applying teacher must have made a significant contribution to the project; (iv) a certain degree of collaboration must appear; and (v) project results must be visible. Once these five requirements are met, the project is then evaluated on six prescribed criteria and the quality label will be awarded if the project is judged to have broadly achieved excellence in the following areas: (i) pedagogical innovation and creativity; (ii) curricular integration; (iii) collaboration between partner schools; (iv) use of technology; (v) sustainability and transferability; and (vi) results and benefits;
- The *European Quality Label* is awarded at European level;
- The *European eTwinning Prizes*[39] are awarded through an annual competition which began in 2006. Awards are given to schools that have run high quality eTwinning projects. There are three categories, according to the age of the students involved: 4-10, 11-15 and 16-19 years old. Submissions for the European Prize competition take place in the autumn for projects which ran during the year before. Awards are presented to winners at the annual eTwinning Conference which takes place during the following spring.

3.4 Outcome and achievement

ICT-enabled innovation for learning, supported by *eTwinning,* impacts (i) *students' motivation and learning outcomes*; (ii) *e-learning pedagogy;* (iii) *teachers' learning and professional development*; and (iv) *partnership, collaboration and community building* at the school level. The key outcomes achieved to date by *eTwinning* in these areas are summarized in the following sections.

3.4.1 Student motivation and learning outcomes

- *eTwinning* contributes to the development of transversal soft skills such as collaboration and communication in students;
- It provides students with opportunities to collaborate with peers from different cultural backgrounds, thereby developing a broader view of the European dimension and improving mutual understanding over borders of similarities and differences in culture, habits, religion, etc. The international contacts help to develop the students' personalities and to broaden their horizons both as individuals and as future professionals in an open Europe. It therefore contributes to a world based on openness, tolerance and fairness;
- It helps young people to get to know the history of other European countries and their peoples, so it can smooth stormy elements in history and exploit the common ground;
- It helps students to develop their linguistic competences in a foreign language in an authentic context and communicate with real people, very often non-native speakers, with whom they have to make themselves understood. Talking to people of the same age and with similar interests makes them braver in using foreign languages and become less afraid of making mistakes;
- eTwinning projects are stimulating, motivating and fun provided that they are well structured, time-limited and results-oriented. When these projects happen in authentic, real life situations within a rich context they have considerable potential to broaden perspectives on learning, and result in improved learning outcomes;
- *eTwinning* combines traditional and new media and gives students the opportunity to use ICT (multimedia and communication tools) in a natural and meaningful way. For instance, in

[38] http://www.etwinning.net/en/pub/progress/awards/european_prizes/evaluation.htm

[39] eTwinning Prizes are also awarded at national level but different rules and procedures are followed by the NSSs.

many eTwinning projects, students have created blogs or websites and use the TwinSpace to develop their information and communication skills;

- Depending on the subject(s) involved, *eTwinning* can contribute to achieving curriculum objectives in geography, foreign languages, mother tongue, history, sciences, etc.
- It addresses management skills such as co-operation, planning, responsibility, and decision making;
- Participation in eTwinning cross-border projects often improves the pedagogical relationship between teacher and students and raises pupils' self-esteem and self-confidence;
- Last but not least, it supports and recognises the new digital youth culture (Galvin et al., 2006a).

3.4.2 e-Learning pedagogy

- It has enabled the de-privatisation of teaching as a profession and supported the sharing of ideas, practices and materials, discussing common interests, running joint projects, and engaging in professional development activities (Vieluf et al., 2012);
- It has served as a good context to integrate ICT in teaching and learning practices to promote pedagogical innovation (project-based pedagogies, authentic learning etc.) based on openness, exchange, interaction and fun;
- It has helped to promote integration of different pedagogical approaches and contents (personally and culturally dependent) in the daily school lessons and broadens the way teachers work in the classroom;
- In many countries, cooperative and collaborative ways of learning lag behind and instructive methods still dominate. *eTwinning* contributes to the desired paradigm shift in those countries. Collaboration between pedagogically more advanced countries (schools) and those practising primarily instructive teaching can have impact on the latter, increasing their awareness about innovative teaching and learning practices.

3.4.3 Teachers' learning and professional development

- Collaboration among teachers engenders a sense of involvement in an international teaching community and creates opportunities for social and emotional support, exchange of ideas, critical reflection and practical advice (e.g. Holmes, 2013);
- Safe, supportive and non-bureaucratic space for experimentation and sharing. It can enhance professionalism, feelings of self-efficacy and prevent stress and "burnout";
- It has contributed to the promotion of life-long learning in teachers;
- Formal and/or informal teacher learning and professional development through face to face and/or online collaboration
    - Within the school, e.g. eTwinning School Teams;
    - Across schools, e.g. projects, networking;
    - With other stakeholders such as education experts and academics, e.g. through online learning events and face-to-face meetings at local, national or international level.
- It gives the opportunity to develop teachers' professional competencies: for example, linguistic competences using a foreign language in an authentic context and communicating with colleagues across Europe. Thus, it helps teachers to develop their ICT, management, communications and personal skills such as flexibility in thinking and changing perspectives;
- International projects and using ICT contribute to the appeal of lessons, so students become more attentive. Thus, teaching becomes easier and more efficient;
- International projects are stimulating, motivating and fun for the teachers and have considerable potential for improving the relationship between students and teachers;
- It can stimulate teachers to develop learning materials and educational resources collaboratively and share them with their colleagues, making the exchange of ideas, educational knowledge and know-how possible.

3.4.4 Partnership, collaboration and community building

- *eTwinning* has proved to be much more than an online support tool to promote ICT use in schools—it has grown into a grassroots community for knowledge exchange and as a catalyst for change in many schools;
- It has promoted collaboration among teachers in schools throughout Europe through the use of ICT, crossing national boundaries and giving schools the opportunity to become part of an intercultural collaborative learning community;
- It has influenced the vision and mission of the participating schools through bringing the experience of ICT integration, internationalisation, collaboration, project-based learning to them;
- The eTwinning projects have a relatively low threshold because of all the support strategies and tools offering a relatively easy (only few administrative procedures) and cost-effective way of beginning international cooperation and networking at the school level, which in many cases have led to other projects (e.g. Comenius) or networking practices (e.g. it is often the starting point for a longer and sustainable co-operation among schools);
- Several eTwinning projects involve parents and/or the wider school community in the educational process.

3.5 Innovation prospects: sustainability and scalability

Now in its ninth year of development, *eTwinning* is considered as a successful and stable ICT-enabled innovation for learning with good prospects for further development directed both towards improving and deepening the experience of participating students, teachers and schools and towards strategies for expanding its existing reach and scale. Five scenarios[40] on the possible futures of teacher networks in 2025 have been developed in the context of the TeLLNet project,[41] challenging assumptions and stimulating thinking about current and future practices (Vuorikari, et al., 2012; Vuorikari & Scimeca, 2013).

3.5.1 Prospects for sustainability

A key factor of *eTwinning* sustainability is its stable funding by the European Commission, which will continue through 2014-2020 via the *Erasmus+* programme. The CSS, following a distributed leadership model based on the principle of subsidiarity, relies to a significant extent on the network of NSSs in promoting *eTwinning* at the regional/national level, as well as in obtaining feedback on successes, challenges and possible new directions. The effectiveness and quality of the services provided by NSSs, and their engagement at many levels in sustaining and strengthening *eTwinning* at regional/national levels appear to be essential to the further development of *eTwinning*, and can impact significantly on students, teachers and schools.

The high numbers of engaged teachers (200,000+) have positive implications for sustainability and value for money although the impact from *eTwinning* on teachers, students and schools is sustainable when more teachers from the same school are involved over a longer period time. CSS has already addressed this issue in the eTwinning School Teams campaign in spring 2012 (see also Vuorikari, 2013).

Furthermore, there are several initiatives by the CSS and NSSs to involve more stakeholders such as head teachers in eTwinning actions, as research reveals that if *eTwinning* is to have a sustainable impact at the school level, the head teacher needs to be closely involved, if not the driving force behind the school-based eTwinning activities.

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[40] The five diverse scenarios are the following: eNet – European Education Network (expansion of eTwinning as centralized network); My Network (user-centred social network approach); Intelligent agents (technology-focused approach); Diversified Teaching Career (Autonomous learning and teachers as mentors); Informal Learning Camps (Bottom-up peer learning).

[41] In the context of TeLLNet project eTwinning was studied through visualization techniques, Social Network Analysis (SNA) and prospective scenario building exercises (http://www.tellnet.eun.org).

According to a recent study on the impact of *eTwinning* (European Commission, 2013), successive eTwinning projects can be key parts of a strategic plan for the schools to have a cumulative and sustained impact from eTwinning experiences by increasing the scale of the projects (involving more pupils and subjects though not necessarily more partners) and/or building successive projects around a particular curriculum area. In this process, the leadership of the head teacher, as well as more successful retention and engagement of experienced eTwinners within the school will again be a critical factor in ensuring sustainable impact.

Finally, for sustainable impact on pedagogical practice, there is a need for *eTwinning* action to encourage a greater focus on learning outcomes based on a clear framework that can be developed by a new Pedagogical Advisory Group through an extensive consultation with CSS, NSSs and education stakeholders.

3.5.2 Prospects for scalability

There are several factors that contribute to the further development and scalability of *eTwinning*. First, on 4th March 2013, *eTwinning Plus* (http://plus.etwinning.net) was officially launched as an extension of *eTwinning*. eTwinning Plus is a pilot project, which provides a platform for schools in Eastern Partnership countries (Azerbaijan, Armenia, Georgia, Moldova, Ukraine) and Tunisia to link with schools participating in *eTwinning*. With a budget of 1 million € approximately, eTwinning Plus is offered as a free service to all staff of preselected schools from the six partner countries and it is available in English and Russian. *Partner Support Agencies* have been created in each partner country to manage (including the pre-selection of schools) and promote eTwinning Plus. Information and training sessions are organised for Partner Support Agencies and teachers.[42] Moreover, the Commission has proposed to expand *eTwinning* [43] as part of the new *Erasmus+* programme from 2014-2020 to make it a platform for all schools that co-operate across borders with EU support. *Erasmus+* is expected to offer new opportunities for combining eTwinning projects with student and staff mobility that can lead to deeper collaboration and networking between schools in Europe.

Second, there are attempts at national level for *eTwinning* to become an integral part of curricula, teacher initial training and professional development and increase the formal recognition and participation rates.

Third, eTwinning Ambassadors can play an increasingly important role in spreading the impact of *eTwinning* at regional/national levels by promoting participation in *eTwinning* and providing hands-on expertise and training for the novice or less experienced eTwinners. Experienced eTwinners can also play a key role in local dissemination and scaling up of *eTwinning* through School Teams (for more details, see Vuorikari, 2013).

3.5.3 Challenges for scalability and sustainability

There are several factors that challenge the mainstreaming and scalability of *eTwinning*. Time emerge as the most significant barrier for the mainstreaming of *eTwinning*, along with a non-conducive school environment characterized by inadequacies (i) in ICT infrastructure, (ii) in support from colleagues and (iii) in flexibility of the curricula (European Commission, 2013). Even when eTwinners invest the time and energy required to run projects, their efforts lead to limited or no official recognition from their educational authorities because eTwinning activities are quite poorly integrated into national systems of accreditation and reward. However, the issues of compensation and recognition are closely related to the setting of some standards by which eTwinning projects and progress could be assessed. This assessment should be done in a way that will not abolish the open, inclusive, non-bureaucratic and flexible character of *eTwinning*.

Although one of the biggest impacts of *eTwinning* on participating teachers is in the development of ICT skills and confidence, the lack of digital skills is still a barrier for many teachers, preventing them from participation in *eTwinning*.

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[42] http://www.enpi-info.eu/mainmed.php?id=483&id_type=10

[43] http://ec.europa.eu/education/news/20120401_en.htm

Another key challenge is to ensure that the vast majority of registered users will involve in collaborative projects, as this involvement can unlock the real potential of *eTwinning* to stimulate personal and professional achievements and gains, to benefit students and build European school networks (European Commission, 2013).

eTwinners also report the lack of funding available for project work as one of the main challenges of being involved in *eTwinning*. Another challenge for its sustainability and scalability is that *eTwinning* is not part of Initial Teachers Training (ITT) and many teachers are not trained on project- and problem-based learning. Moreover, project work is usually not part of the formal summative assessment taking place in the majority of the schools, discouraging some teachers from engaging in eTwinning projects.

Last but not least, *eTwinning* should explore how the platform, or certain layers of it, can be made interoperable with other networks, which would allow users to export and import personal information from other networks and share specific information across different networks without affecting the existing community elements based on trust and peer confidence (Cachia & Bacigalupo, 2011).

3.6 Reflections and issues

eTwinning is "unique in its scale and scope, and has no precedent or comparable initiative within or outside Europe" (European Commission, 2013) as a blended, open, safe, free of "user" cost and non-bureaucratic network that brings many existing school collaboration and school outreach projects under the same umbrella and enables innovative pedagogical practices. Although the distributed organization of *eTwinning* (CSS, NSSs, Ambassadors, etc.) allows for a certain degree of autonomy at regional/national level and its centralized governance and structure creates a safe and supportive environment for teachers and students to interact, there are several concerns about its flexibility, openness and interoperability with other networks and initiatives. Overall, the main assets of *eTwinning* have always been the provision of support and tools not only for cross-border school projects but also for formal and informal professional development and networking.

Several studies reported effectiveness of *eTwinning* in providing to both teachers and learners concrete opportunities for meaningful and authentic project-based learning and development of key competences and 21st century skills (e.g. European Commission, 2013; Crawley, et al., 2010a). However, there is a need to re-focus *eTwinning* by putting students at the centre of planning for its further development and mainstreaming. In order for this to happen, more and better guidance for teachers on how to engage and empower students in making decisions is required right from the design phase of the projects.

Moreover, further evidence-based research is needed for capturing the complex interactions that happen inside and outside of the *eTwinning* platform and the entire network. The recent TeLLNet study,[44] which utilized visualization techniques, Social Network Analysis (SNA) and prospective scenario building exercises, was a good starting point to this new direction of research. (Figure 8 shows a visualization of the *eTwinning* project network where each connection depicts project collaboration between schools). One recommendation from the project was that more research is also needed for capturing the 'invisible aspects of *eTwinning*',[45] namely the interactions that take place outside of the eTwinning platform and that are lost from eTwinning statistics and other monitoring tools.

[44] http://www.tellnet.eun.org

[45] http://www.etwinning.gr/pdwathens/images/monitoring_invisible_proposal_061112.pdf

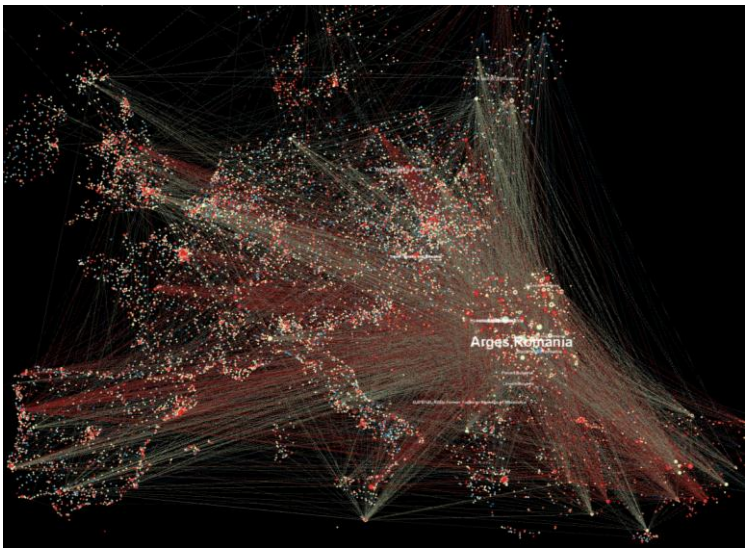

Figure 8: Visual analytics of the cooperation among European Schools[46]

More research on students' learning outcomes and/or competencies gained through *eTwinning* is also required in order to support the case for greater recognition by national authorities of eTwinning projects and experiences as positive achievements by participating teachers and schools.

[46] Data from an eTwinning data set. Source: Tellnet Project (http://bit.ly/111BiMy).

4. Case report 2: 1:1 learning initiatives in primary and secondary education in Europe

Stefania Bocconi, Panagiotis Kampylis & Yves Punie

4.1 Case overview

The case of 1:1 learning initiatives in primary and secondary education in Europe (*1:1 Learning in Europe* in short) is a collection of 31 1:1 learning initiatives recently launched in 19 European countries, equipping all students of a given school, class or age group with a portable computing device. Most of the identified initiatives (23 out of 31) are integral parts of national/regional ICT programmes launched by education authorities in order to promote school innovation.[47] Furthermore, selected initiatives included in the study were launched after 2008 and with significant scale and/or impact on teaching and learning (cf. Section 4.2 below).

In 2000, ICT in Education strategies launched across Europe aimed to push of technology in general, mainly desktop computers, into schools. During the past decade, a number of initiatives in several EU countries were initiated by national/regional governments that focused on providing 1:1 computing access with a personal device to every child and/or teacher. The *One Laptop Per Child Initiative* (OLPC), which started supplying pupils in developing countries with affordable laptops in 2007, might be the most well-known 1:1 programme, attracting considerable international attention and inspiring the emergence of other initiatives based on low cost digital devices (Abell Foundation, 2008).

The Netbooks on the Rise report by European Schoolnet (Balanskat & Garoia, 2010) identified thirty-three 1:1 computing initiatives in 18 EU countries. In moving from a general provision of ICT tools towards 1:1 learning in Europe, two waves of expansion seem to have emerged. The first wave comprised laptop initiatives started in 2003-2004, which mainly focused on distributing computers and equipment at schools/classrooms level with a view to ensuring a wider provision of ICT by increasing considerably the computer:pupil ratio. The second wave of national or regional initiatives launched in 2007-2008 was less technology-driven and increasingly aimed to fulfil educational goals, such as the use of ICT in all subjects to foster competence-based education. Pedagogical aspirations linked to laptop/netbook initiatives focused on the personalization of learning, catering for individuals' learning styles and different types of learners.

Table 2 provides an overview of the main goals and policy contexts from early 1:1 initiatives as described in the Country Fact Sheets from the Notebook on the Rise report (Balanskat & Garoia, 2010). *1:1 Learning in Europe*[48] is considered to be a relevant case for studying the scalability of ICT-led innovation, since almost all the 1:1 initiatives identified, even when implemented at regional or local level, are significant in scale, i.e. involving a large number of students (e.g. about 600,000 in Spain and Portugal or the targeted 15.7 million in Turkey from 2013 onwards) and/or equipping all schools across the entire country (e.g. 2,086 Grade 1 public schools in Georgia).

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[47] The present case is based on the results from the study "*Overview and analysis of 1:1 learning initiatives for Education and Training in Europe* (1:1Learning)" launched by European Commission JRC-IPTS and carried out by European Schoolnet (EUN) from January to December 2012. The main objective of the IPTS/EUN study was to provide an overview of current 1:1 learning initiatives in Europe, focusing on the impact of ICT uses on teaching, learning and organizational practices, with a view to elucidating how innovation is fostered (or hindered) in technology-rich learning settings. In this case report, initial results from the JRC-IPTS 1:1Learning study are further discussed and complemented with evidences from the literature in the field and insights from evaluation reports of some of the initiatives recently completed. The final report of the study can be found at http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=6199.

[48] A summary of the results from the JRC-IPTS study on recent 1:1 learning initiatives in Europe is included in Bocconi, Kampylis & Punie, 2013a.

Table 2: Policy goals and framework for early 1:1 initiatives in Europe

	2003 -2004 (first wave)	2007-2008 (second wave)
Overall aims	• to increase **technological equipment** in schools or classrooms	• to promote the **general use of ICT** and the individual **access to Internet & educational resources** • to reduce the **digital divide** and to promote **e-inclusion**
Pedagogical aims	• to foster **peer learning** • to work with computers **anywhere, anytime**	• to allow students acquiring **ICT-based skills and competencies** • to link **formal** and **informal learning** • to **integrate ICT across the curriculum** • to support **individual learning styles** and **personalized learning**
Policy Framework	Part of ICT infrastructure programmes	Part of educational plans

Overall, the main reasons to consider 1:1 learning initiatives as a relevant case of ICT-enabled innovation for learning include:

- Shifting focus on the notion of 1:1 learning rather than 1:1 devices (Dixon & Tierney, 2012; Wilson & Gielniak, 2012); the learner and the acquisition of key competences become prominent in recent initiatives, with each student taking an active role based on the use of his/her personal device in a connected and well equipped classroom.
- Piloting of the initiatives on a smaller scale before they are scaled up and in some cases mainstreamed. This provides valuable insights into the main mechanisms and basic conditions for fostering the scaling up processes.
- Increasing attention and diffusion of 1:1 computing initiatives in several world regions (e.g. Thailand's One Tablet per Child - OTPC policy).[49]

4.1.1 Key focus and goals of the innovation

According to information collected by EUN in the 1:1Learning study (country case reports were filled in by national policy makers and researchers directly involved in the specific initiative or via desk research), recent 1:1 initiatives in Europe generally pursue more than one objective and indicate clearly one or two primary goals. Overall objectives stated in 1:1 case descriptions (cf. Table 3) include:

- To lead to pedagogical change, innovating curricular approaches and learning dynamics. Various initiatives also state the home use of devices by students or teachers to expand learning opportunities outside the classroom.
- To address economic inequalities, reducing the digital divide by improving access to ICT for students and promoting e-inclusion on a more general level.
- To support digital competences, improving students' ICT skills and motivation and impacting also on improved learning outcomes.
- To expand ICT provision in schools by further increasing computer:student ratios.

[49] http://bit.ly/1OcALHc

Table 3: Objectives tackled by the 31 1:1 initiatives in Europe

Main objectives of the 1:1 learning initiatives	No. of initiatives	Initiatives by country[50]
Innovate classroom and learning practices	7	UK, AT, IT, FR, DK
Implement 1:1 pedagogy	9	EU, ES, PT, SK, SE, IT, CZ, DE, DK
Improve students' learning outcomes	4	UK, SE, IE
Improve students' ICT skills and motivation	7	AT, FR, GE, ES, DE, CZ
Improve access to quality educational resources	3	DK, NO, TR
Foster anytime-anywhere learning opportunities (school &home use of the device)	12	AT, ES, CY, EE, FR, UK, EU
Increase ICT provision in schools	8	EL, FR, LT, TK
Provide access to (advanced) ICT equipment	4	CY, DK, LT,
Improve communication between students, teachers and parents	5	AT, CZ, FR, ES
Support leadership development	1	DK
Reduce the digital divide	5	CY, IE, LT, FR, PT, TK
Collect hands-on experiences /evidences	3	AT, LT, EU

4.1.2 Learners targeted

Students in primary and secondary education are identified as the main target group by all 1:1 initiatives. Given the strong focus on pedagogical issues, teachers are also acknowledged as a key target. Although several initiatives aim to "narrow the digital divide", parents and families are explicitly targeted only by some initiatives (e.g. Portugal or Lithuania). Usually, participating schools were identified directly by Ministries of Education (MoEs) or regional/local educational authorities, or selected for participation through an application mechanism.

4.1.3 Learning outcomes targeted

In providing ubiquitous access to ICT devices to school students, several initiatives highlighted improved learning outcomes as one of the main targets (e.g. all three UK initiatives, the Irish project and the Swedish initiative *En–till-En)*. The evaluation of the projects focused, however, very much on a change in overall exam results and students' grades rather than on actual improved learning outcomes. Several initiatives had among their core objectives the strengthening of key competences (subject-independent), digital competences and subject-related competences, though these objectives were evaluated in a similar way. New classroom and learning dynamics were also expected outcomes of many initiatives. For example, the *Learning2Go* project and the *iPad Scotland* pilot (UK) identified the learning dynamics of students as a key focus and highlighted how 1:1 computing provided students with *"new ways of approaching learning by themselves"*.

4.1.4 Technology used and the role of technology in the innovation

The identified initiatives offer a wide range of equipment to schools (summarised in Table 4). Students and teachers received laptops and netbooks in most cases, and in some cases, tablets. Only a small number of initiatives provided students with smartphones (e.g. the *Learning2Go* in the UK). In only 2 projects (the Austrian initiative *Mobile Lernbegleiter im Unterricht* and the *Dudley Project* in the UK), schools and parents were allowed to choose what equipment to adopt. Most of the initiatives provided additional equipment to schools, such as educational software, interactive whiteboards or video projectors, Wi-Fi access (in the school but also in communal areas or at home), flash drives, digital cameras, scanners and printers (e.g. *Ordina13* in France*, Escuela2.0* in

[50] Country codes (source: Eurydice, 2012): AT-Austria, CY-Cyprus, CZ-Czech Republic, DK-Denmark, EE-Estonia, FR-France, GE-Georgia, DE-Germany, EL-Greece, IL-Ireland, IT-Italy, LT-Lithuania, NO-Norway, PT-Portugal, SK-Slovakia, ES-Spain, SE-Sweden, TR-Turkey, UK-The United Kingdom, EU-Europe.

Spain, *New School - Digital School* in Greece, the *ArdesiaTech* pilot in Italy, *Achieving through Innovation* in the UK, and the Irish project *Connect School*).

Table 4: Overview of technology provisions in the 31 1:1 learning initiatives in Europe

Technology used	No. of initiatives	Initiatives by country
Laptop	10	CY, CZ, EE, FR, EL, IE, IT, NO
Netbook	5	AT, GE, IT, PT, EU
Notebooks	7	DK, DE, SK, ES, SE, UK
Tablet	6	AT, FR, LT, TR
Smartphones	3	AT, UK
Software (e.g. word-processors, educational software, anti-virus)	16	AT, CY, DK, EE, FR, GE, EL, IT, LT, PT, ES, TR, UK, EU
Internet access (e.g. Wi-Fi, broad band)	18	At, CZ, DK, FR, GE, DE, IE, IT, LT, ES, PT, SE, TR, UK
Additional equipment (e.g. IWBs, LMS, digital cameras, USB, etc.)	13	AT, CY, CZ, DK, FR, EL, IE, IT, ES, TR, UK

Regarding the role of technology, almost all the initiatives specify that the 1:1 devices should support innovation in teaching and learning, raise standards across the curriculum and improve ICT skills and confidence through increased usage. Dixon and Tierney (2012), stimulating the discussion around what constitutes best 1:1 learning practices and which questions should be addressed when considering allowing students to bring their own devices, argue that the decision of what device to adopt should be made with a view to optimizing the pedagogical use of the device. To this end, they propose a *computing capability taxonomy* that classifies the differing capabilities across a range of current 1:1 devices, pointing out that even small devices can have large implications (p.5).

4.2 Scale and nature of the innovation

Most of the identified initiatives (15 out of 31) have been scaled up or mainstreamed. Among these, 5 initiatives (i.e. in Georgia, Greece, Portugal, Spain and Turkey) have been implemented system-wide, or are part of a mainstreaming programme (with the equipment gradually provided to schools in the whole country). Pilot projects carried out at local, regional or national level (i.e. system-wide pilots such as in Estonia, Cyprus, Austria, Italy, Norway) were implemented before being eventually scaled up during a second phase of the project (with more devices given to more students in the same school at different education levels and/or to other schools in other regions). As shown in Figure 9, several initiatives have also been piloted on a smaller scale before being scaled up, and, in some cases, even mainstreamed (highlighted in red).

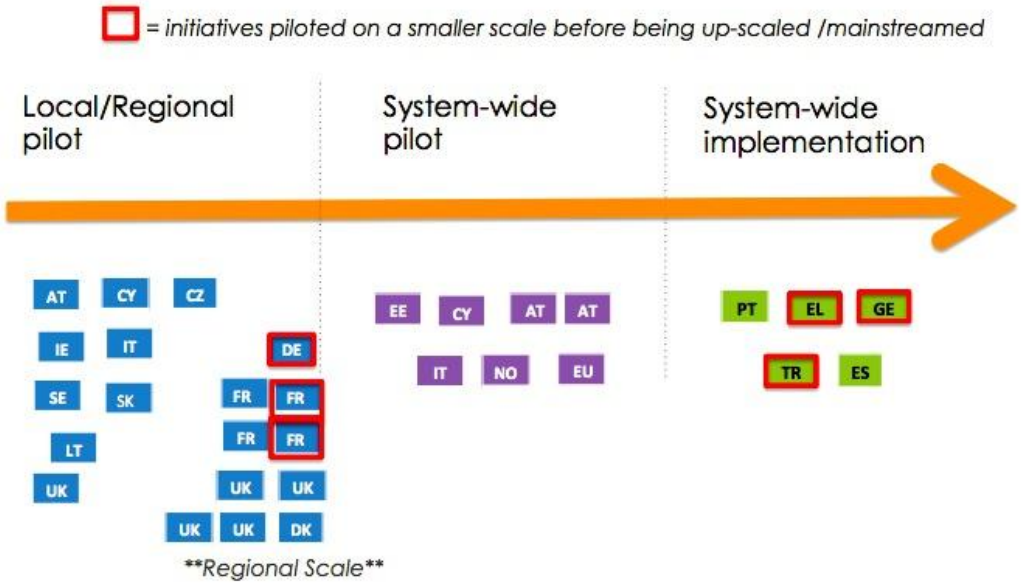

Figure 9: Scale of innovation of recent 1:1 learning initiatives in Europe

Overall, identified initiatives on 1:1 learning cover an estimated number of approximately 17,480,000 students in primary and secondary education (K-12) across Europe with the vast majority coming from Spain (635,000), Portugal (600,000) and Turkey (15,700,000).[51] The inclusion criteria for recent 1:1 initiatives in this chapter were as follows:

- Launched within an educational framework, a majority of the 31 selected initiatives originated from plans or actions launched and supported by the Ministries of Education and/or educational authorities.
- Started not earlier than 2008, or before 2008 and were (i) part of main national ICT programmes (e.g. *Imitative*, Norway), (ii) still ongoing (e.g. *Learning2go* project, UK) or (iii) a well-documented pilot generating important research evidence (e.g. *Connect School Project* in Ireland or the *1000mal1000netbooks in schoolbags* in Germany).
- Achieved significant scale and/or impact.

Therefore, initiatives aiming at equipping families in the first place, and a number of small-scale initiatives only equipping one classroom (e.g. Switzerland), or ICT initiatives that have a more general focus of providing mobile learning devices to students and teachers, are not included in the analysis. Based on the selection criteria, 31 initiatives were identified in 19 European countries, with 5 countries including more than 1 initiative. Figure 10 shows the geographical distribution of 1:1 learning initiatives per country (the first number indicates the number of initiatives; the second one indicates the number of schools involved; values in brackets indicate the estimated number of students involved). The *Acer-EUN Educational Netbook Pilot* (highlighted in orange) ran in parallel in six countries.

[51] After the completion of the pilot phase in 2012, the initiative is being expanded to all 42.000 schools across Turkey from 2013 onwards targeting to involve progressively the approximately 15,700,000 Turkish students (see for instance http://bit.ly/11iayc1 & http://bit.ly/1g019PX).

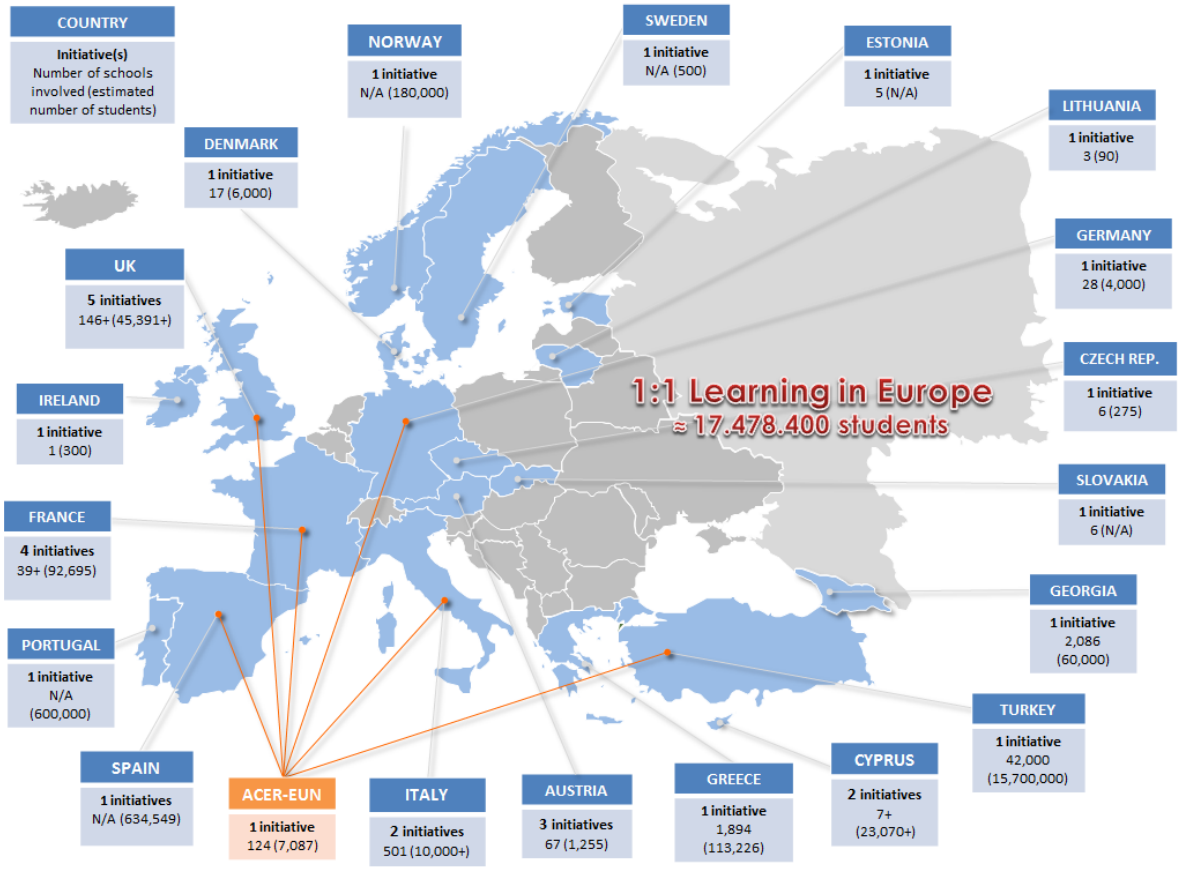

Figure 10: Geographical coverage of recent 1:1 learning initiatives in Europe

4.2.1 Background and scale of the scheme

The stakeholders involved, and their roles in the innovation, varies greatly across recent 1:1 initiatives in Europe. More than half of the initiatives (13 out of 31) originated from plans or actions coming solely out of the Ministries of Education. A limited number of initiatives were initiated by both the Ministry of Education and the regional/local governments (e.g. the *Escuela 2.0* initiative in Spain). In three cases, another ministry was also involved in initiating the projects. In Portugal, it was the Ministry of Public Works, Transportation and Telecommunications. Similarly in Turkey, the Ministry of Transportation cooperated with the MoE, while in Greece the MoE cooperated with the Ministry of Finance.

Some of the initiatives, which were primary launched by the regional governments, also involved the central Ministry of Education as an actor. This was the case with the French projects, which were initiated by the regional governments but were framed in the overall ICT strategy of the Ministry of Education. Therefore the Ministry was closely involved in the running of the project. The local government was the main initiator in the *Dudley* and *Learning2Go*, *iPad at Longfield*, and *iPad Scotland* projects (UK) and also in the Swedish case. Only a few initiatives are solely initiated by industry (e.g. initiatives in Slovakia and Czech Republic), or involve private-public partnerships such as the Austrian *Mobile Lernbegleiter im Unterricht*, the Danish and the German projects.

4.2.2 Leadership and organization of the innovation at the system level

All the initiatives with a national coverage obtained direct support and/or were led directly from the corresponding Ministry of Education. This is the case for the Turkish project *Fatih*, the *Buki* programme in Georgia, the Portuguese project *e-escolinha*, and the Cypriot *Programme for Subsidisation of the Purchase of a Laptop*, where the ICT Project Team of the Ministry of Education and Culture (MoEC) supports the school boards, providing guidance to students and parents, performing the necessary audits and issuing the cheques for the grant.

As mentioned above in Section 2.1, the Spanish initiative and the French project *Un collégien, un ordinateur portable* were special cases in that they were managed at two different (national and regional) levels. For example, in the Spanish *Escuela 2.0* initiative, the Ministry collaborated with the regional Autonomous Communities for the design and implementation of these projects in order to articulate the new actions with the ongoing related regional plans, since the regional authorities were responsible for the allocation and administration of resources in all cases. Other initiatives providing support at regional or local levels include the 1:1 programmes in the UK, the Slovak project (*Notebook for Every Pupil*) and the Austrian initiative (*LMS 4EduBooks*) where the local government sent an inspector to monitor and help with the organisation, while the school itself was responsible for training, design and the evaluation of the project.

In general, where the Ministry of Education and local/regional governments collaborate as the main implementers, the Ministry provides general guidance and advice, while the local or regional government decide on the specific parameters of the project. The Austrian initiative (*LMS 4EduBooks*) provides an illustration of the exact dynamics of this lateral organisation. Here, the Ministry only provided organisational advice regarding the ICT infrastructure, while the local government sent an inspector to monitor and help with the organisation and the school itself was responsible for training, design and the evaluation of the project.

4.2.3 Leadership and organization of the innovation at the project/school level

Only a small number of projects (8 out of 31) highlighted the involvement of school principals, school local authority, ICT managers, specific school coordinators and project teams. Some of the initiatives analysed are part of a second phase of ICT in education strategies, and it is therefore likely that administrative and coordination expertise is already available.

Parents were mentioned as actors involved in the implementation process in only seven initiatives. These are the *Acer-EUN Educational Netbook Pilot*, the French *POP1-POP2*, the *Buki* in Georgia, the *Use of iPad* in Lithuania, the *Netbook for Every Pupil* in Slovakia, the *Learning2Go* in UK, the Portuguese *e-escolinha* and the *Vzdelani21/Education* project in the Czech Republic, where parents had to approve the placement of their child in a digital class and support the funding of the laptop. *Ordina13* (France) and in the Austrian *Netbooks in Education* pilot project parents were also involved in the research activities.

There are a few initiatives where the suppliers of the devices (industries, SMEs) were involved in the implementation by providing technical support to schools under the warranty of the equipment. The support is provided by private companies establishing standard helpdesks for parents and schools, such as the *Buki* initiative in Georgia. In other cases, the support was provided by sending in educational consultants or technicians to those schools requiring assistance (e.g. *Achieving through Innovation* programme in the UK).

In general, universities played a major role in the evaluation of initiatives (e.g. the *iPad Scotland* in UK), as well as in the training of teachers (e.g. *LMS 4EduBooks* project in Austria).

There are three main financing models arising from the identified initiatives:

- The *full financing model* refers to those initiatives that are entirely financed at national level, in general by the Ministry of Education, or by the regional/local administrative authorities. In several cases, funding is granted to selected schools (or classes within a school) that apply for a grant in order to receive the ICT infrastructure (e.g. the French project *Ordincollège19*); in other initiatives grants are allocated to a selection of schools and no grant applications are required (e.g. the *Programme for Subsidisation of the Purchase of a Laptop* in Cyprus).
- Another substantial group of initiatives followed a *co-financing scheme*, where parents are responsible, jointly with the schools or with the administrative authorities, for covering the costs of the devices provided. In Norway (*Imitative*) the costs are shared between counties, the Ministry and students (every student in upper secondary education pays an annual leasing fee of about €100 and is provided with a laptop).

- Finally, in a few programmes the equipment is delivered *free of charge* and the project implementation itself is financed by the technological partner companies involved in the initiatives (e.g. Microsoft in the Danish *Elsinore Municipality* and in the Slovakia *Netbook for Every Pupil* initiatives; Acer in the *Acer-EUN Educational Netbook Pilot*; Intel, Microsoft, SMART Technologies in the Italian *ArdesiaTech* project).

4.2.4 Conceptual basis of the innovation

Although 'leading to pedagogical change and innovation' is a stated objective in almost all of the identified 1:1 initiatives in Europe (cf. section 1.1), no specific pedagogical model clearly emerged from the initiatives' documents. Overall, the majority of initiatives generally refer to several learning principles they intended to foster by using 1:1 devices and strategies, including: active learning and constructivist approaches; autonomous/self-learning; project-based learning; cooperative /collaborative learning; inquiry-based learning. Whether those learning principles actually guided and impacted on the implementation process can only be determined by evidences from the evaluation studies. For example, the *Acer-EUN Educational Netbook Pilot* initiative (involving six European countries) explored different pedagogical modes and developed a number of 1:1 pedagogical scenarios to help and guide teachers running 1:1 classrooms. The scenarios highlight the fact that the learners have access to netbooks at all times, taking advantage of a blended learning approach alternating online and offline activities, but also alternating different teaching paradigms (Vuorikari et al., 2011b).

4.2.5 Summary

Figure 11 presents the *1:1 Learning in Europe* mapped onto the *mapping framework of ICT-enabled innovation for learning* developed by JRC-IPTS in the context of the SCALE CCR project (Kampylis, Bocconi & Punie, 2012).

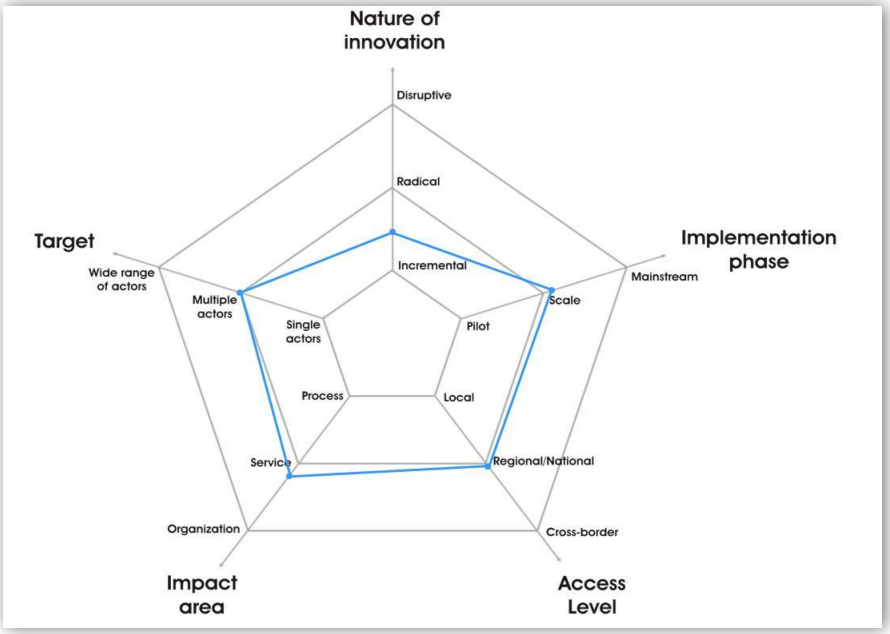

Figure 11: The mean reach and impact of the 31 1:1 learning initiatives in Europe
(source: Bocconi, Kampylis & Punie, 2013b)

The mapping framework provides a "snapshot" of the current state of development of 1:1 initiatives in Europe and offers valuable insights on the emerging trends regarding their nature, reach, target groups and impact on teaching and learning. Overall, 1:1 learning initiatives in Europe can be considered as mostly incremental (*nature of innovation*), moving progressively to more radical approaches where the emphases are on active learners and 1:1 pedagogies. The implementation phase is at the scale level for about half of the 1:1 initiatives have already reached a significant

scale, involving a large number of students (e.g. 180,000 in Norway and 113,226 in Greece) and are moving towards mainstreaming (e.g. 600,000 students in Portugal, 634,549 in Spain and 15,700,000 in Turkey) (*implementation phase)*. About half of the initiatives are embedded in regional/national strategies (*access level)* but only one initiative was cross-border, involving learners from six European countries (i.e. *Acer-EUN Educational Netbook Pilot*). The vast majority of the analysed 1:1 initiatives are at the service level, addressing key aspects related to the provision of equipment to schools and the development of infrastructures both inside and outside schools (*impact area)*. The main beneficiaries (*target*) in most cases of 1:1 initiatives are in fact still the students and teachers who received laptops and netbooks.

4.3 Strategies for implementation and scaling up of the innovation

4.3.1 Agency for change

Recent 1:1 initiatives employed four main approaches to innovation development, as shown in Figure 12. Majority of 1:1 initiatives are based on centralised top-down strategies or a combination of centralised top-down and bottom-up approaches. Several initiatives depended on decentralised bottom-up approaches, employing public-private partnerships. A few initiatives relied solely on a centralised bottom-up process, reflecting the degree of active involvement by the schools themselves in the process.

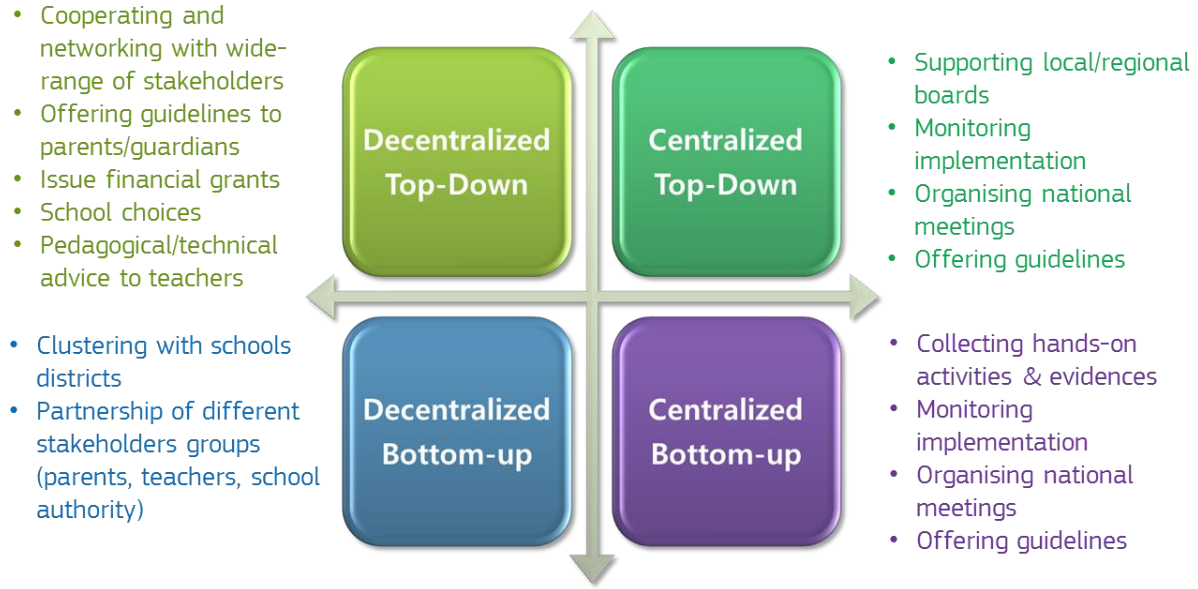

Figure 12: Leadership initiatives found in the *1:1 Learning in Europe*

Implementation of centralized vs. decentralized and top-down vs. bottom-up approaches to innovation development in the case of *1:1 Learning in Europe* are briefly summarised below.

Centralized top-down approaches are employed in mostly large-scale initiatives such as the Georgian and Portuguese projects. In general, centralised top-down support includes providing guidance to students and parents, logistics support, and training. *Centralized bottom-up* models mainly include responses from schools (or school networks) to develop their own project proposals. Examples of centralised bottom-up implementation are the two Austrian projects, the *Ordicollège19* project (France), and the Slovak and Swedish projects. The *Escuela 2.0* initiative in Spain followed a mixed approach, combining both centralized top-down and bottom-up implementation strategy, where both the Ministry and the autonomous regions provided the overall framework and introduced the initiative but schools are also taken into consideration for all deployment issues.

Decentralized top-down models involve leadership by both national and regional government. While the national government (Ministry) provides the general guidance, the regional authority is usually in charge to issue financial grants, to select schools, and to provide pedagogical/technical advices to

teachers and parents. For instance, in Germany, based on results from the *1000mal1000netbooks in schoolbags* initiative, a new project on the use of tablets in 18 schools will start in the region of Lower Saxony financed by parents but supported by the Ministry of Education. This is an example of ongoing 1:1 computing activities in a specific region of Germany, where the use of individual ICT devices is now part of the regional ICT plan in that region. *Decentralized bottom-up* leadership models employ partnerships of different stakeholders groups (parents, industry, school authority), as well clustering with schools districts. Examples are the two UK projects - *Dudley* and *Achieving through Innovation*, where the implementation process was outsourced by the Local Authority to a private company (RM Education). Schools had to set out the required parameters for the project before RM Education took over the implementation.

A variety of stakeholders, which shows the diversity of school systems in Europe, played an important role as *key change agents* in 1:1 innovations. At system level, the regional/national government is responsible for ICT policy and vision, funding, curriculum, assessment, and teacher training.

At school level, school leaders have a strategic role in leading and managing the innovation process and creating capacities within the school. Teachers are key change agents as regards facilitating students' learning and within the process of implementing 1:1 initiatives.

Several initiatives also highlighted the importance of including parents in the process as they are committed to their children's well-being, learning, and development. Parents are one of the most critical interest groups, especially as regards investment (financing devices) and security.

Universities were involved as key partners in several initiatives mainly to offer in-service training for all teachers on a regular basis, as well as to evaluate project outcomes and to define the educational principles underpinning the innovation (e.g. the *Learning2Go project* in UK).

Private companies had a much more prominent role in the implementation phase of the initiatives. Overall, 15 out 31 initiatives included IT companies as key partners in the implementation phase. In most cases this was in the form of providing the hardware and software or the infrastructure for the initiative, but in some projects this extended to other roles such as providing training and support during the initiative. It is worth to highlight that the Lithuanian project *Use of iPad tablet devices in education* was unique in involving publishing houses in the initiative. Commercial suppliers, local sponsors and local maintenance service partners were also indicated as key partners in the implementation phase of 1:1 initiatives.

4.3.2 Professional development provisions

Training constitutes a crucial aspect of the organisational framework of 1:1 learning initiatives. Overall, training focused on teachers' professional development. However, in some cases, training sessions targeted also students (TK, UK), headmasters (LT) and content developers (AT).

Some initiatives foresee a certificate for those teachers who attended the training sessions (e.g. awarding the title of "ICT trainer" in the *LMS 4EduBooks* in Austria, the *e-escolinha* in Portugal, and the *Fatih* in Turkey). In Portugal some innovative teacher-training methods were implemented by using *Scratch for teachers* in an autonomous local initiative in the area of teacher training with the aim of sharing resources, stories, experiences that may help other teachers start working with *Scratch at School* as an educational tool.

Among 1:1 identified initiatives various actors organised different types of training including:

- Self-organised training sessions established by the schools involved in the initiative via workshops, through a peer-to-peer learning approach, or during classes in order to involve the students as well (e.g. in the UK). In the *Acer-EUN Educational Netbook Pilot* 1:1 pedagogical scenarios were provided in order to help teachers to share best practices.
- External training provided by local and/or national administrative authorities. Most of the training sessions are offered by (or organised in close collaboration with) the Ministry of

Education and/or by regional authorities via online tutorials or through conferences/workshops held either in schools or in the Ministry's premises.

- Training offered by specialised centres or universities (only in the Greek initiative).
- Training provided by the technology companies that equipped the schools. Only a few initiatives foresee the participation of the technology companies involved in the projects for the provision of training sessions. Such private actors offer their support through tutorials on the practical usage of the equipment they provide.

4.3.3 Governance, management and school routines

A variety of support strategies were implemented at the school level. Most initiatives organised the school implementation of the project via the appointment of one or two project coordinators (usually an ICT teacher teaching in the school involved in the initiative), equipped with a laptop and with all the additional devices, who are charged with providing support to the other teachers of the schools through several training sessions. The schools involved in the project had also a crucial role in supporting and disseminating the project strategies to the educational community, including teachers, parents, pupils, etc.

Finally, in other cases, such as the Czech initiative *Vzdelani21/Education21*, schools have a crucial role in the implementation of the project, investing in building the technological infrastructure for the equipment, i.e. wireless connectivity and a stable network.

No information is available about changes in everyday routines (e.g. timetabling).

4.3.4 Monitoring and accountability mechanisms

Based on the innovation development approach employed by the initiative (cf. section 3.1), different monitoring and accountability mechanisms were implemented by national/regional governments. Overall, no specific information is available in the documentation of the initiatives about these mechanisms.

4.3.5 Evaluation mechanisms used

Most of the identified initiatives (26 out of 31) were evaluated or are about to be evaluated (as many of the identified 1:1 initiative are recent or ongoing and evaluation results are not yet available). The main actors of the evaluation are in most cases universities, which carried out independent external evaluations. Additionally, in some cases, such as Italy, Lithuania, the UK and France, national organisations with an expertise in evaluation and research were conducting the evaluation.

In general, the evaluations carried out are single interventions towards the end of the project. The main methods used are qualitative, combining several elements, e.g. carrying out case studies, including interviews with various stakeholders, lesson observations and focus groups) and collecting information via questionnaires. During the Estonian initiative, monitoring software was installed to monitor logs in students' computers. No real long-term evaluations are being carried out except for *e-escolinha* (Portugal). The three years project evaluation on the educational use of the Magellan computers in primary schools develops dynamic research actions with voluntary participation of teachers guided by a research team with experience in initial and in-service training of teachers.

Although evaluations vary greatly between the identified initiatives, the following general foci emerge:

- Examining the realization of the potential of 1:1 teaching for personalised learning, the use of the devices in class and changes in teaching and learning. The evaluation of the Irish *Connect School* project also had a pedagogical focus investigating the daily use of laptops including participation levels in class, attendance rates, and teaching methods developed and students' outcomes.
- Evaluating the pedagogical, organisational and technical impact of the initiative, including changes in students' motivation, competence in the learning processes and in test scores.

- Analysing the contextual conditions.
- Evaluating the social and school level impacts, the use of computers by various actors and in various contexts, in school, at home and within the community.

Evaluation against specific project goals is not an apparent focus of many evaluations. Parents are key stakeholders of the initiative, but are rarely addressed in the evaluations analysed.

4.4 Outcomes and achievements

The key outcome achieved to date by recent 1:1 learning initiatives in Europe is an increased attention and impact beyond the technology itself, including professional development, involvement of parents and school community. Although the type of adoption and adaptation varies across schools and, within a school, across teachers, innovation supported by 1:1 computing affects *students' learning and motivation, 1:1 pedagogy, teacher professional development, and partnership and collaboration with the community*. Major sources of information on the outcomes from 1:1 initiatives in Europe are inputs from national/regional authorities and data emerging from evaluation reports. Overall, evaluations from 1:1 initiatives provided results of achievements.

4.4.1 Students' motivation and learning outcomes

Almost all initiatives refer to students' (and teachers') increased engagement and motivation in classrooms with intensive use of 1:1 devices (e.g. Lithuanian iPads project, German initiative). In some cases, 1:1 intervention led also to improved participation levels in class, and better school attendance rates. In the *Connect School* project (Ireland) teachers noted that the interactive multisensory nature of the initiative was especially useful for weaker and middle band students. The ICT environment including the use of the Virtual Learning Environment (VLE) improved ICT skills and fostered independent learning, although the latter was variable across classes.

In line with the literature, teachers also reported a high level of student motivation at the beginning of the project because of the "newness" effect of the devices as opposed to classes that did not use notebooks. Other positive factors that motivated students were the possibility of carrying out research on the Internet, presenting the results of their work and exchanging more easily with other students.

The 1:1 approach in the Austrian *Netbooks in Education* initiative also supported students' engagement in reflective practices (i.e. allowing them to write about their learning continually in order to document their work and to learn from their experience), as well as to create their own multimedia contents, and try out real life activities in authentic situations (Baumgartner, 2010).

As to learning outcomes, no significant results emerged considering grades. The evaluation of the *Learning2Go* initiative (UK) showed that the level of use is not associated with overall attainment level. Some high-level users achieved beyond their predicted levels or grades in end-of-key-stage assessments while others did not.

In the Estonian laptop project evaluation (Luik, Tõnisson & Kukemelk, 2009), students' grades were compared with the same period of the previous year. The evaluation concluded that laptop as such is not related to changes in students' grades; it was the use of special study software that brought about positive changes. The evaluation also concludes that students' learning styles changed (the number of students who preferred reflective learning style, as well as cognitive and global style increased, while sensing/intuitive style and sequential/global preferences decreased).

4.4.2 1:1 pedagogy

Most of initiatives refer that the adoption of 1:1 strategies challenge classroom practices towards more student-centred learning approaches and development of 21st century skills (e.g. collaboration, problem solving, etc.). Several initiatives also reported emerging and development of 1:1 pedagogies, alternating different teaching paradigms (frontal, individual, collaborative), allocating different tasks to individuals, giving 1:1 attention to students, monitoring students' progress, and providing informed guidance. According to Vuorikari et al. (2011b), in the *Acer-EUN Educational*

Netbook Pilot teachers reported alternating frontal style teaching (83%) with collaborative (81%) and individual (80%) processes in every lesson or sometimes (p.17).

Two studies evaluating the Magellan initiative in Portugal show that the laptop is used by children in various contexts as a personal tool. In the family context, the laptops were mainly used for educational entertainment and communication, writing, drawing, educational games, online encyclopaedias and the Internet for carrying out research. In the classroom, word processing was mainly used for curriculum subjects (e.g. language learning, Mathematics and Arts).

The evaluation of the Lithuanian iPad project suggests that students received more opportunities for learning because of the mobile character of the device, became more independent in their learning, more responsible and used it at home. Likewise the evaluation of the *Acer-EUN Educational Netbook Pilot* showed that the fact that the students have ownership of netbooks and can use them after the school day offers extended learning opportunities and educational activities outside official school hours (Vuorikari et al., 2011b).

4.4.3 Teacher learning and professional development

Professional learning that teachers receive was acknowledged as a crucial factor affecting the quality of the implementation of several 1:1 initiatives. Insights from interviews with experts involved in evaluating or implementing 1:1 initiatives in Europe emphasize teachers' need for continuous feedback, repeated short bursts of training followed by mentoring at their own premises. To this end, the importance of building networks of practitioners who can support each other is also reported.

Effective training and support mechanisms include early familiarisation with the equipment, ongoing school-based support and training as well as blended- and peer-learning among teachers. Staff access to equipment can encourage dialogue and opportunities to share practice. 1:1 programmes should be integrated within an overall professional learning plan.

Moreover, teachers need to be able to experiment with new learning materials suited to the national core curriculum and the regional/local curriculum adopted by the school. In the UK (*Achieving through Innovation* initiative), the main focus of training was on using the software to enhance teaching and learning in the core subjects, and using the equipment to address different learning styles and abilities. Training was tailored to the specific needs of each school; as such they may have been half-hour sessions after school, during teachers' Planning, Preparation and Assessment (PPA) time, or during a lesson so that teachers learn at the same time as pupils.

4.4.4 Partnerships, Collaboration and Community building

Most of recent 1:1 initiatives highlighted the importance of starting partnership and formal collaboration plans with a variety of stakeholders including commercial suppliers, local sponsors and local maintenance service partners.

Public-private partnership with industry played a crucial role in the implementation phase of several initiatives (e.g. in Czech Republic, Denmark, Germany) in order to equip schools/students with the devices. In Portugal the Magellan computer initiative had some important industry spill-over effects. The producer of the Magellan computers has deployed over three Million devices in different parts of the world, e.g. Latin America (Uruguay, Venezuela), Asia and Africa. Major textbook publishers started to invest in digital content and provide content for Magellan computers. The major Portuguese educational publisher had been running the Virtual School for many years and had become a leader in providing digital solutions for students, schools and families.

Partnership with local community members and/or other school districts were also started in a number of initiatives providing professional training and on-going support.

Scientific partnership were mainly started to monitor and evaluate the process of implementation. In the UK, the Wolverhampton local authority worked with an external researcher to help them define the educational principles underpinning the *Learning2Go* project (UK). Another example of involving universities other than in evaluation alone is the *LMS 4EduBooks* project in Austria in

which universities offered in-service training for all teachers on a regular basis, organised by the school head teachers.

4.5 Innovation prospects: sustainability and scalability

Given the current economic conditions in many European countries, the sustainability and scalability of most of identified 1:1 initiatives is under pressure as they are dependent mainly on public funds.

4.5.1 The next plans for this innovation

The analysis of recent 1:1 learning in Europe points out that the future success of 1:1 computing initiatives is dependent on embedding the use of the technology within the learning environments of the student. Scaling up and sustainability has to be an ongoing focus, long before any initial implementation. This is a complex issue because of the changing technologies. It impacts on all the other areas beyond the provision of devices, i.e. continuing professional development, resources, and learning and teaching. The research and impact of 1:1 computing initiatives within the learning environment needs to be documented more widely. Evidence needs to be shared and made relevant to others. Practitioners need to increase research capacity, develop resources and embed research at the very beginning of 1:1 learning initiatives and as an ongoing activity throughout the project, rather than just at the end.

4.5.2 Prospects for sustainability

In order to make the scaling up and mainstreaming of 1:1 initiatives sustainable and effective, *strategic planning* and *multi-stakeholder involvement* are required.

In particular, strategic planning should be medium- and/or long-term and should include clear implementation strategies, evaluation and monitoring procedures, and effective training and support mechanisms for both school members and families. It should not only focus on students' achievements but on a number of other essential elements (e.g. students' engagement, attendance, behaviour, and motivation) and cater for an integrated (school/home) and systemic approach to innovation (i.e. including changes in the curriculum, assessment, timetables, and teacher training on 1:1 pedagogies). Pedagogical learning scenarios should outline how digital devices can be used to support a variety of learning strategies. Peer-led training, learning, and project participation should be the focus of advanced professional development supported by online content, tools and platforms. Bannister, Balanskat and Engelhardt (2013) propose fifteen areas that schools need to consider as part of their 1:1 implementation, and point out the importance of providing both students and parents with e-safety advice as an integral part of the school curriculum.

Sustainable planning for investment requires a model that has both cost and value dimensions. Co-financing models in the provision of devices could offer a long-term perspective and possibility to make 1:1 an ongoing programme. New patterns of ownership and deployment models should be adopted in schools (e.g. Bring Your Own Device - BYOD), taking into proper consideration school infrastructure, minimum standard for software and equity issues (Dixon & Tierney, 2012).

Based on the above, it is crucial to involve a variety of stakeholders in the implementation of 1:1 education programmes (such as commercial suppliers, community members, parents and head teachers), increase exchanges to encourage wider collaboration in this endeavour and to network innovative services (thus engaging other schools/districts not directly involved).

On the other hand, existing factors that challenge the sustainability of 1:1 learning include the lack of clear implementation strategies, lack of relevant educational resources, and teachers' expectations. In Portugal, the sustainability of the Magellan initiative, which was based on co-funding of devices (by government and parents), has been affected by the economic austerity measures. In addition, as pointed out by the expert Roberto Carneiro, former Portuguese Minister of Education, 1987-91) interviewed during the 1:1Learning study, large-scale implementations (such as in *e-escolinha* in Portugal) can be challenging when the education system is centralised and prescriptive. Trust between stakeholders such as schools and the government can also be hindered

when the system approach to implementation is centralized top-down and strongly based on annual national testing.

4.5.3 Prospects for scalability

The analysis of the initiatives clearly shows that there is a strong drive towards mainstreaming of 1:1 initiatives with around half of the initiatives being already mainstreamed or scaled up and eight initiatives indicating plans for upgrading from a pilot status to a mainstream status or at least scaling up the number of students involved. In some cases, previous regional projects of a smaller scale were taken into consideration and embedded in the subsequent country-wide initiatives (e.g. the *Escuela 2.0* in Spain). The *Fatih* project (Turkey), that completed the pilot phase at the end of 2012, has plans in place for the mainstreaming of 1:1 computing to all schools in the country from 2013 onwards.

In other initiatives, mainly local or regional pilot projects, mainstreaming refers to extending the devices (scaling up) to more students and schools, or equipping different levels of education or regions involved beyond the pilot phase in a second phase of the project. The *Learning2Go* project (UK) is a long-standing project that started in 2003 and is now in its fourth phase of development.

Finally, based upon completed successful projects, new initiatives are emerging, driven by the regional government in pursuing specific action in the field of 1:1 computing and mobile learning (e.g. in Germany, where the *1000mal1000netbooks in schoolbags* took place, a new regional project "Mobile Learning" will start, to be financed by parents and supported by a team from the Ministry of Education).

Experts involved in recent 1:1 learning in Europe agree that scaling up requires consideration of those elements from the pilot that are to be implemented system-wide and the creation of a framework (objectives, guidelines, tools, knowledge) for system level transfer of innovation. Scaling up needs to be based on evidence of what works and is dependent on individual and social practices, regardless of technology. Hence, it also requires consideration of pedagogical cultures, the building of teachers' networks ("scaling aside") and creating incentives for teachers.

4.6 Reflections and issues

Linking to other existing 1:1 computing initiatives at the international level (e.g. Argueta, Huff, Tingen & OCorn, 2011), recent 1:1 learning initiatives in Europe increasingly move the focus away from the devices and infrastructure to the learners and pedagogies (e.g. Ihanainen & Moravec, 2012; Niramitranon, Sharples, Greenhalgh & Lin, 2010). Several studies also contribute to further understand key factors influencing 1:1 implementation (e.g. Bannister et al., 2013; Heinrich, 2012; Corn, Argueta & Tingen, 2010), which have significant implications for professional discourse, professional learning and school leadership (Digital Education Revolution NSW, 2010; Sauers & Mcleod, 2012).

Regarding the impact on students' achievement, a significant number of both quantitative and qualitative researches are revealing that it is the way the laptops are used in learning that makes the difference and brings about significant improvements in achievements (Digital Education Revolution NSW, 2010; Holcomb, 2009). In a study of 1:1 laptop programme running in four primary and middle schools, Spektor-Levy and Granot-Gilat (2012) found significant differences between the actual competencies of students who learn with personal laptops in 1:1 classes and students who learn with no ICT in class. Findings from this study show that students from 1:1 classes outperformed significantly in nine out of 15 sub-criteria, and in the total score. Additionally, findings also revealed the cumulative benefit of teaching and learning in classrooms with intensive use of ICT, as students who learn with personal laptops for two or four years develop better learning skills and information literacy than students who learn with no ICT (ibid, p. 93). Norris, Hossain and Soloway (2011) also claim that schools report upwards of 30% improvement in standardized test scores where computing devices are being used as essential to the curriculum, i.e., the students use the devices from 40–70% of the school day and for periods after school as well.

Linking to literature on learning sciences and technology enhanced learning, 1:1 strategies increasingly promote the new culture of learning enabled by technologies, where learners are at the centre of the learning process, participating in ways that were not possible before and enabling personalisation, collaboration and authenticity (e.g. Burden, Hopkins, Male, Martin & Trala, 2012; Spires, Wiebe, Young, Hollebrands & Lee, 2009). In addition, flexibility and different learning styles are combined, reflecting key principles of international experiences in technology in Education (Bakia, Murphy, Anderson, & Trinidad, 2011).

The role of teachers in 1:1 classrooms is still reported as the most relevant and crucial factor influencing the implementation quality of 1:1 initiatives. In order to create effective learning environments, teachers need opportunities for professional development in locating assessment tools and aligning them to key student learning outcomes (Dunleavy, Dexter & Heinecke, 2007). Few studies, however, have investigated the effect of 1:1 on the way teachers approach their professional role as educators, but also with regards to the performance expectancy and the facilitating conditions (Burden et al., 2012; Ifenthaler & Schweinbenz, 2013). Kitchenham (2009) has demonstrated that 1:1 computing lead to transformative teaching. When struggling with the challenges of using laptops in the classroom, teachers alternatively engage in critical reflection, critical self-reflection, and critical discourse thus exploring open paths and recognizing 1:1 devices as a powerful tool for learning.

In the literature on social innovation, recent research studies (e.g. Hanleybrown, Kania & Kramer, 2012; Murray, Caulier-Grice & Mulgan, 2010) call into question the idea that any single programme or organization, however well managed and funded, can singlehandedly create lasting large-scale, systemic change (*Isolated Impact* vs. *Collective Impact*). In looking ahead on future implementations and further innovation carried out in the area of 1:1, the five principles[52] identified by Hanleybrown and colleagues (2012) for initiating and leading collective impact initiatives (i.e. common agenda; shared measurement; mutually reinforcing activities; continuous communication; backbone support) appear of strategic importance for enabling innovation in 1:1 education.

[52] (i) Funders and implementers understand that social problems, and their solutions, arise from the interaction of many organizations within a larger system; (ii) progress depends on working toward the same goal and measuring the same things; (iii) large scale impact depends on increasing cross-sector alignment and learning among many organizations; (iv) corporate and government sectors are essential partners; and (v) organizations actively coordinate their action and share lessons learned (p. 2).

5. Case report 3: Hellerup School, Denmark

Panagiotis Kampylis, Barbara Brečko & Yves Punie

5.1 Case overview

Hellerup School (www.hellerupskole.dk) is a Danish open plan[53] public school (combining primary and lower secondary education) that has been created for students 6-16 years of age (grades 0-9) with the overarching goal to adapt the pedagogy and physical space based on students' needs to promote diversity, flexibility, creativity and to support a variety of learning strategies and styles.

Compulsory education in Denmark consists of ten years of primary and lower secondary education including one pre-school year (grade 0) plus years (grades) 1 – 9.[54] Public school education also offers the pupils an optional year (grade) 10, before students can choose to progress on to upper secondary education (e.g. Gymnasium, Higher Technical Examination Programme etc.). Thereafter, students can pursue a higher education, if they are interested.

At the end of the 1990s Gentofte Municipality, lying just north of Copenhagen with a well-educated and well-off population, decided to establish a large school development project to face school capacity problems and provide both physical and structural leadership for its school system. The task was, via a development process, to rebuild the existing schools, build one new school and to create a pedagogical model for all the schools - a model school system (Mikkelsen, 2003; Petersen & Rasmussen, 2012). Hellerup School, the new school, was built in 2000-2002 as "a school of plurality – a school of the present and the future"[55] and as "a network where physical and psychic distances are minimized through simple and direct communication routes running in all directions from a given point" (Mikkelsen, 2003, p. 2).

The school vision, curriculum and pedagogy, were essential to the ground-breaking design of the school. The inside of the three-store school building is spacious (8,200 m^2, providing about nine square meters of space per child) with a good use made of all the space generating a warm and homely feel throughout (Petersen & Rasmussen, 2012). A number of flexible 'home areas' (instead of traditional classrooms) complete with kitchen areas and chill-out spaces form innovative learning environments where almost 750 students follow personalized and project- and problem- based curriculum.

In Hellerup, students are co-responsible for planning their own work, checking back with the teacher to discuss their progress. Teachers are more like mentors guiding children and helping them find ways of learning that suit them and the topic at hand. The building has Wi-Fi throughout and students are encouraged to connect to the internet through school computers as well as their personal devices (e.g. smartphones).

Hellerup School follows a systemic approach to educational innovation that involves and impacts the whole school community by

- developing and sharing a well-articulated common vision to prepare students for a diverse and changing world;[56]
- enabling innovative teaching and learning practices through the ground-breaking school design that can easily be reconfigured by teachers and students;

[53] Open plan schools are not something new. In the '60s there was a trend for 'schools without walls' but the adverse experiences lead to more traditional school type with enclosed classrooms. Last decade, a new era has begun, in which exemplar open plan schools designs such as *Hellerup School* try to create the learning environments for the 21st century education.

[54] Source: Eurypedia (http://tinyurl.com/bs5c8a5)

[55] www.hellerupskole.dk

[56] www.hellerupskole.dk

- targeting the inclusion of all children supporting a diversity of learning strategies and styles;
- empowering teachers and learners to be as autonomous as possible; and
- remaining open-minded to future adaptations.

5.1.1 Key focus and goals of the innovation

The core aims of *Hellerup School* are to prepare positive, inquisitive and critical learners as well as responsible and 'community oriented' citizens for a diverse and changing world (Buckley, 2010; see also the English section of the school website[57]). As it is not known what knowledge will be needed in the future, competences and skills such as creative thinking, critical thinking, collaboration, problem-solving and intercultural awareness will be essential and therefore key priorities of *Hellerup School* pedagogy. Technology is a key enabler of *Hellerup School's* innovation model and it is embedded in a natural and multidimensional way (e.g. mobile learning, BYOD etc.) into innovative teaching and learning practices (see more about the role of technology at 5.1.3).

5.1.2 Learners and learning outcomes targeted

At the time of writing (April 2013) *Hellerup School* has approximately 750 six- to sixteen- years-old students distributed across 29 classes ranging from 0 (kindergarten) to the 9th grade, with the average class having 22 students, which is slightly above the national average of 20 students per classroom in the Danish public schools.[58]

The main goal of *Hellerup School* is to evoke students' creativity, which is done through project- and problem-based work but also through the national curriculum and to develop soft skills such as collaboration, problem solving and intercultural awareness. The focus of the school is on supporting the individual learner, who learns by exploring and takes a responsibility for his/her own learning (self-directed learning).

Hellerup School has a wish to nurture people who can actively participate in shaping the societal community. In this regard they want to emphasise the ability to deal with diverse cultural contexts together with people from distinct backgrounds with different life projects and goals. Furthermore, being able to deal with situations that one has never dealt with before is an ability that *Hellerup School* wants to strengthen. Each individual must be able to develop standpoints and to argue. Meanwhile, it is crucial that the individual is a part of a community so that the values and cohesiveness of the community are being continuously developed.

At Hellerup, there are no conventional classrooms and no dull corridors[59] but instead a flexible and aesthetically pleasing learning space with numerous facilities for both individual and collaborative learning. The heart of the building is the central stair area – an atrium where a great variety of activities take place: sitting, teamwork, presentations, recreation etc. The stair area allow for visual connectivity and ease of circulation within the school, as well as providing a casual social space for students and staff. All spaces are shaped to accommodate students and the way they learn: there are plenty of different corners, private/collective, quiet/playful that allow children to seek their own preferred space that best fit their learning strategies and styles.

Although the school follows the national curriculum, several cross-disciplinary projects are also carried out each year enabling students to form positive relationship (fostering emotional intelligence), while carrying out activities in authentic context (meaningful activities) and developing transversal soft skills (e.g. problem-solving, collaboration, etc.). This also contributes to keeping the curriculum creative and dynamic. For two weeks of every year, children of all ages work together on a special creative art project, providing opportunities for mixed age learning and reinforcing the sense of community in the school.

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57 www.hellerupskole.dk

58 http://tinyurl.com/dxgm48g

59 Roughly one-third of the typical school building is used not for learning, growing, or interacting, but for getting to the places where learning happens (source: http://tinyurl.com/cuh94qd).

The pedagogical focus is on the individual learner (personalized learning), facilitating active and engaging ways of learning such as learning by creating and learning by playing. More than in other schools, students learn for themselves individually (learning by exploring) and with their peers (facilitating peer-to-peer collaboration). Students are also constantly challenged to take responsibility for their own learning (empowering self-directed learning). Innovative timetables are also developed: students start together for about 10 to 15 minutes and then they can choose to work alone or with their peers according to their needs.

A broad spectrum of assessment methods is used (Shewbridge, Jang, Matthews & Santiago, 2011) including logbooks, individual (digital) portfolios and student plans (engaging assessment formats). The aim is to help students become aware of their own progress and future goals, as well as of how they learn (embedding formative assessment). ICT-based national tests are also part of the evaluation.[60]

5.1.3 Technology used and the role of technology in innovation

Hellerup is committed to aiding students and staff in creating a 21st century learning environment following BYOD policies but also by providing devices such as personal computers, laptops, netbooks and tablet, so every child has access to ICT. Everyone at Hellerup is able to access the wireless network with her/his personal devices (laptops, netbooks, tablets, smart phones, etc.) or school ICT infrastructure during the school day. The ICT infrastructure is updated regularly to handle all different devices and offer fast and reliable internet connection to teachers and students.

As students already have ICT-rich lives, in Hellerup there are no ICT classes; ICT is regarded as a tool that students use in a natural and creative way both in and out of school. Technology is used in nearly all projects and in many school activities. Smart phones are used a lot because they are handy, easy to carry, and offer many tools in the same device: video camera, calculator, audio recorder, audio player etc.

Moreover, *Hellerup School* has been participating in several ICT Research & Development (R&D) projects such as the e-book project with Microsoft and University of Pedagogy in Copenhagen and the tablets project with Microsoft and Acer.

5.2 Scale and nature of the innovation

5.2.1 Leadership and organization of innovation

The school has a headmaster but the organization decisions are taken within the management team, which works closely with teacher teams. There are teacher teams consisting from 5 to 13 teachers each. Teacher teams decide together about innovations to be taken and in general there is a strong support and openness for creative ideas and innovative teaching and learning practices from the management team.

The school board consists of 5–7 parents, elected by and among the school's parents, two staff representatives and two student representatives. The school head and the deputy headmaster are appointed members on the board. The school board is responsible, among other things, for recruiting teachers that have the competences and willingness to follow the innovative model of *Hellerup School*.

The building programme of the school was developed through a close collaboration between the architecture firm LOOP,[61] consultants and participants in the school development project, as well as the wider school community: students, parents, teachers, the school board, the municipal board, etc.[62]

The teachers work in autonomous teams, designing activities that address individual students' interests and learning styles. In order to develop their professional practices, school staff

[60] http://tinyurl.com/crvrkqx
[61] https://sites.google.com/a/loop.bz/loop-en-2/film-presentations/hellerup-school
[62] http://tinyurl.com/cpku48c

participates in diverse training programmes on a regular base. The autonomy of teacher teams reflects the distributed leadership approach adopted by the school.

5.2.2 Funding and budget of innovation

Hellerup is a public, state funded school and its yearly budget depends on the number of students involved (currently there are around 750 students). The cost for the building amounted to approximately 14.3 million euros, excluding Value Added Tax (Petersen & Rasmussen, 2012).

5.2.3 Conceptual basis of the innovation

The educational philosophy of Hellerup has been influenced mainly by Reggio Emilia schools in Italy, where the use of physical space is seen as an essential element of their educational approach, as well as by the Learning Style Model of Dunn and Dunn (1978) and the Multiple Intelligences Theory of Howard Gardner (1999), both of which promote teaching practices that address multiple learning strategies and styles.

5.2.4 Summary

Figure 13 presents a mapping of the nature and scale of *Hellerup School* against the framework of ICT-enabled innovation for learning (Kampylis, Bocconi & Punie, 2012).

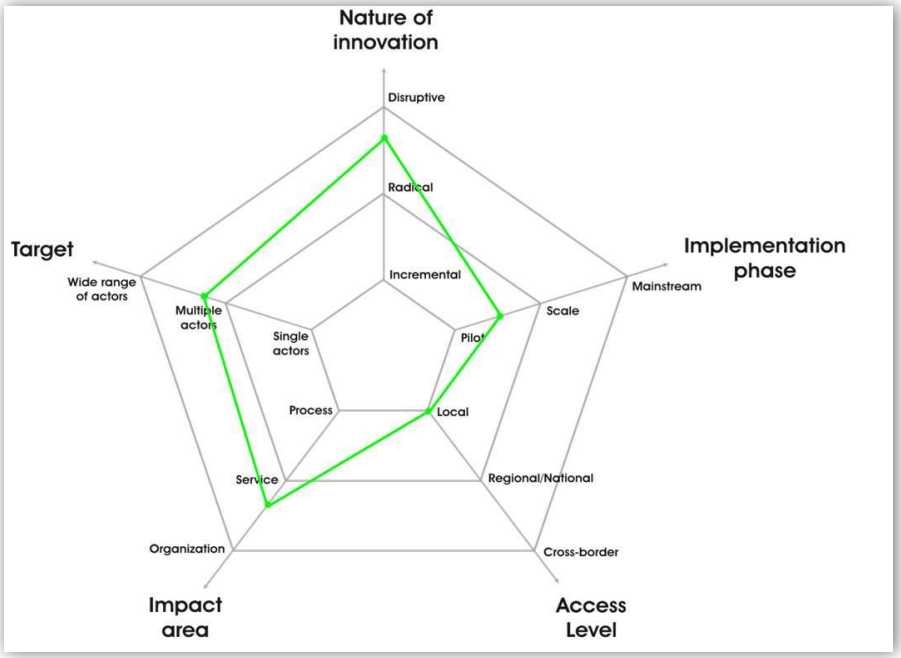

Figure 13: *Hellerup School* mapped to the framework of ICT-enabled innovation for learning

Nature of innovation: *Hellerup School* should be considered as an almost disruptive innovation because it adopts wide-ranging innovative approaches based mainly on: (i) innovative "learning by doing" pedagogical practices to foster creativity; (ii) extensive use of cutting-edge ICT (e.g. students are encouraged to use smartphones in nearly all projects and to stay in touch with their teachers and peers); (iii) innovative space arrangements (not separated classrooms but inspiring and flexible learning spaces within a purpose-built building with revolutionary design); (iv) flexible and adaptive timetables based on the pedagogical content and individual needs; (v) provisions for personalized learning that drives each student's development and achievement; teachers are more like mentors, guiding and helping them find ways of learning that suit them and the topic at hand; and (vi) wide-ranging partnerships with other schools, universities, industry and organizations.[63]

[63] See for instance at http://ingenious-science.eu/web/guest/hellerup-school

Implementation phase: Innovative pedagogical practices have been implemented in *Hellerup School* since 2002, and have proved to be sustainable. However, the current reach is limited to this specific school and involves about 750 students and around 50 teachers, and hence is only at the pilot phase. Further scaling up of the school's innovative pedagogical practices and culture is not yet envisaged (Davies, 2011).

Access level: *Hellerup School* gives only local access to innovative pedagogical practices. However, the broad coverage of the school's innovations by the media (e.g. http://tinyurl.com/d4h73v4) and the educational press (Davies, 2011), as well as numerous visits from educators (e.g. http://tinyurl.com/5wndcf7) may have a positive influence on other schools worldwide.

Impact area: *Hellerup School* has adopted an almost systemic approach to innovation, which impacts on several key dimensions of the school ecosystem such as infrastructure, teaching and learning practices, connectedness, leadership and values, organization, and content and curricula (Bocconi, Kampylis & Punie, 2013b). For instance, in order to adapt the curriculum to the school philosophy, project- and problem- based learning has been adopted, which is developed by autonomous teams of teachers with solutions provided by teams of learners who engage multiple learning strategies, choice of approaches and resources (Buckley, 2010 p. 56).

Target: Currently, the wide-ranging innovative model applied in *Hellerup School* addresses multiple actors as it requires new roles for learners (e.g. they become more self-aware about their strengths and potential through individual development plans), teachers (who have to orchestrate personalized ICT-based learning rather than deliver knowledge), team coordinators (who have to coordinate complex and non-typical school timetables, space arrangements etc.) and parents (who have defined roles in working with teachers and other parents to agree on the best way forward for the students).

5.3 Strategies for implementation and scaling up of the innovation

The core strategy for implementation and scaling up Hellerup innovation for learning is to spread the core pedagogical, organizational and technological innovations mentioned above through partnerships with schools, industry, and academia at local, national and international level and to remain open-minded to future adaptations and developments.

5.3.1 Agency for change

The strategies for implementing and further developing innovation for learning might involve combinations of centralized / decentralized and top-down / bottom-up strategies. In the case of *Hellerup School*, at system level, both centralized top-down efforts as well as centralized bottom-up initiatives from the school can be found (see Figure 14).

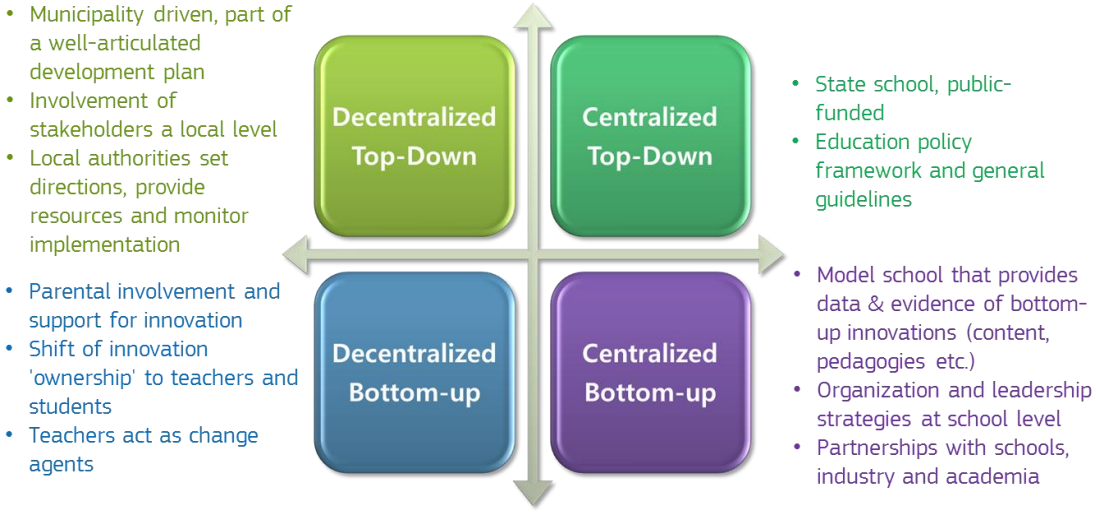

Figure 14: Different leadership strategies found in the *Hellerup School*

The centralized top-down include mainly the funding of the school by public money (based on the number of students) and the setting of the general education policy framework (e.g. national curriculum and education acts).

The centralized bottom-up strategies refer to the leadership strategies at school level as well as the dissemination of innovation at local, regional, national and international levels. The school also takes advantage of partnerships with industry and academia (e.g. on ICT projects) organized in a centralized, bottom-up fashion.

Decentralized top-down models employ leadership and innovation management by the local authority (Gentofte municipality). While the central government provides the general guidelines, the local authority is in charge of developing a vision and development plan for school under its jurisdiction (in collaboration with education stakeholders), to issue financial grants, to provide pedagogical and technical advice to schools and monitor the implementation of innovation for learning.

Finally, there are also decentralized bottom-up supportive initiatives from the community such as parental support of innovative pedagogical practices and BYOD policies of *Hellerup School*. Hellerup enables teachers and students to take ownership of the innovation to work in flexible and autonomous teams and to make decisions for innovative pedagogies, content, timetables etc. Students are also involved in the planning of learning activities and to follow personalized learning strategies. Hence, Hellerup's innovation for learning is to a great extent teacher-led and it is exercised in a de-centralized, bottom-up fashion.

5.3.2 Governance, management and school routines

In Denmark, the municipal boards are responsible for the educational system in a given municipality. The municipal board may choose to delegate part of its powers to the schools such as the power to appoint staff (although neither the school board nor the school head can dismiss teachers without the approval of the municipal board). The individual school is managed by a head teacher who takes responsibility for the administrative and educational management of the school and answers to the school board and the municipal council for the work of the school. In addition (s)he is to carry out her/his work in cooperation with the school staff and students. As regards teaching, the head is to ensure that the teachers plan and structure the class work with appropriate challenges for all students (Mikkelsen, 2003).

In Hellerup, each student belongs to a class of about 22 children around the same age. Three or four classes that are similar in age group belong together in the same 'home area',[64] which is a more organic replacement of the traditional classroom and students' basis for everyday school life. For each home area there is an autonomous team of teachers who plan all teaching and learning activities and timetables whereas the students participate in planning and goal setting for their own and their home area's work. The year plan alternates between periods of disciplinary and interdisciplinary projects and periods of teaching in subjects. In both periods, students are divided in to groups in terms of their learning styles, social grouping, level of ambition, interests, technical level, individual aims etc.[65]

Each 'home area' consists of a mixture of large and small spaces, such as the 'hexagons', which are minor 'instruction rooms' without roofs made of folding wall elements and planned for around 25 students. Students are briefed together in these areas before finding the appropriate place in the school they are comfortable to work in (Tierney, 2011). Actually, in Hellerup, learning is taking place everywhere and all areas have at least two functions (Mikkelsen, 2003). There are only few enclosed, specialized rooms such as the Forum (for sports activities and big events), the Kulinarium (for cookery lessons), the Naturium (for sciences like physics, chemistry and biology) and the Kulturium (for creative, practical and musical developments).

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[64] There are altogether nine home areas with 75-100 students in each at 330-400 m^2.

[65] See more at the English section of the school website at www.hellerupskole.dk

Special emphasis has been put on the acoustical conditions of the school during the initial design and acoustical improvements were performed in the period 2007-2010 for reducing noise (Petersen & Rasmussen, 2012). The interior of the school is dominated by wood: the staircase, balconies, and panels around the building. The wood creates a warm atmosphere and together with the slippers or socks that students and teachers wear inside the school,[66] it helps to provide calm and tranquillity. Furniture is used as spatial dividers to promote the flexible learning environment which enables innovative teaching and learning practices (Mikkelsen, 2003). The teachers' "room" (the Kuben) is located on the upper floor but without walls and the school head's office is in an open space at the centre of the building. Outside and on the roof terrace of the building there are colourful playgrounds with undulating surfaces for the students to explore whereas there is an absence of fencing around the playground and school site.

5.3.3 Monitoring, accountability and evaluation mechanisms used

In Denmark there are no provisions for any "educational inspection" or evaluation of schools at national level but each municipal board supervises the work of the schools of the given municipality. This supervision includes both administrative and educational aspects but there are no detailed provisions as to its extent and character. In the latter years, increasingly more municipalities, including Gentofte Municipality, have been adopting a strategy of overall municipal school policy combined with a considerable degree of decentralization for the individual school. This is frequently followed up by a demand that the schools draw up working plans encompassing partly a report on the school's work in the previous year and partly a development plan for the coming year. The working plan is in some instances made the subject of a talk between the municipal executive for schools and the head teacher, though this is not generally formalized (Mikkelsen, 2003).

5.4 Outcomes and achievements

Taking advantage of key enablers such as the readiness for innovation of all stakeholders across the system, Hellerup has successfully catalysed a cultural change in the way that education for the future is envisioned and implemented at present. The school, as an exemplar part of the extensive modernization of the Gentofte municipal school system, has played a substantial role in the modernization of this once industrial area.

5.4.1 Student learning outcomes

At Hellerup, a wide range of assessment methods, both summative and formative, are used for monitoring students' continuous development such as logbooks (where children describe how they work and reflect upon their own development), portfolios, student plans, internal and external evaluation plans of language and math skills, national tests, student presentations and so on. The main aim of the formative and summative assessment methods used is to make teachers and students aware of their developments and set future goals. The school applies a policy of positive language that reinforces positive attitudes in all aspects of school life (Buckley, 2010). Moreover, *Hellerup School* has developed individual plans of action for the students, goals are set individually for projects, lessons and periods of time, and the teachers define the frame for working and sets the goals with the students but the students often define their own method for reaching the goals and evaluate and reflect when the goals are reached. Individual plans of action are used as a dynamic way for documenting not just the goals set by teachers and students, but also to monitor how, when and if these goals are achieved.

In addition, as pointed out by Hellerup teacher Helle-Kirstine Petersen in an interview, students from Hellerup mostly enrol into higher education and they are very successful. Their strengths are shown especially in project work, time management, collaboration skills, independence, knowledge of their own learning abilities and strengths etc.

[66] http://agcchicago.org/wp-content/uploads/2012/11/Third-Teacher_FINAL_Idea59.pdf

5.4.2 e-Learning pedagogy

At Hellerup, teachers work in autonomous multidisciplinary teams of five to thirteen members, each team being responsible for three or four classes, co-developing timetables, content, pedagogies etc. in order to help students not only to acquire knowledge but also to develop key competences and 21st century skills. Students take an active part in the planning of learning activities and they develop their personal learning strategies according to their needs and learning styles. Hence, teachers mainly act as facilitators and mentors and ultimately the students take responsibility for achieving their learning goals (personalized and self-directed learning).

Municipality authorities and (school) community had a clear educational vision and created the school building in order to achieve it. Hence, at Hellerup, innovative forms of teaching and learning as well as flexible physical space and organization structures fit together like two parts of the same story. The school environment reflects a workplace where students have control of the physical space and the curriculum. This makes them comfortable and confident in themselves.

There is emphasis on project- and problem- based learning and the school encourages students to bring their own ICT devices (e.g. smartphones) to school and use them creatively for communication and personalized learning. Furthermore, the school also provides students with a great variety of devices such as personal computers, laptops, netbooks, and tablets. For supporting an innovative and seamless use of ICT, the school has updated several times the ICT infrastructure, putting emphasis not only on the provision of devices but also on the provision of fast and reliable Wi-Fi that can support all the different devices that students and teachers use extensively throughout the school premises.

One important area of pedagogical competence is the design and implementation of assessment activities. At Hellerup, multiple forms of assessment, both formative and summative are used for capturing students' progress, knowledge acquisition and skills development. Following this holistic assessment approach, which includes also self- and peer-assessment strategies, the assessment becomes part of the learning processes (assessment *for* learning).

5.4.3 Teacher learning and professional development

At Hellerup, there is a strong emphasis on recruiting and investing in competent and open-minded teachers, and there are several provisions and strategies for teachers' continuous professional development:

- Teachers participate in national and international seminars, workshops, conferences and CPD events and then train their colleagues (cascade training);
- Training seminars and CPD activities are organized in the school;
- Working in an open plan school promotes peer learning as the teaching practices are visible and transparent (de-privatization of learning);
- Teachers work in autonomous teams co-developing timetables and learning materials, becoming more confident and skilful in designing and implementing innovative pedagogical practices;
- The Hellerup management team provides teachers with a lot of support to apply new ideas and innovative pedagogies in practice.

5.4.4 Partnership, collaboration and communication building

Hellerup School has an international profile and takes part in school networks, partnerships and projects with academia (e.g. the University for Pedagogy of Copenhagen, Denmark) and industry (e.g. it is a Mentor School for other schools in the "Microsoft Partners in Learning Program"[67]).

Students and teachers are encouraged to communicate through ICT with peers from other schools in Denmark and abroad for developing their skills, knowledge and competences.

[67] http://www.wise-qatar.org/node/9988 and http://tinyurl.com/bnk7e9r

The school is located in a rich area in the north of Copenhagen and the community has high education level. Parents know what kind of skills and competences are necessary for today's and future jobs and support the school's innovative pedagogical practices.

The school has attracted widespread attention by the media,[68] designers (e.g. Cohen, 2010) and the wider education community[69] for its ground-breaking school design and innovative teaching and learning practices.

5.5 Innovation prospects: sustainability and scalability

Now in its eleventh year of development (2002-2013), *Hellerup School* is recognized as a well-established innovation for learning at a small scale but with significant impact at the system level. Its prospects for sustainability and scalability are discussed below.

5.5.1 Prospects for sustainability

Hellerup has contributed to the reform of the once industrial area in which it is located as the demand for studying in this innovative school is very high, adding value for the local community and ensuring a stable funding (as a public school), which according to the Danish system is based on the number of students. Having a long-standing innovation record, stable funding, a well-established multi-stakeholders engagement to satisfy short term needs while *fulfilling* the *long term vision*, as well as the strategies and plans in place to be a school of the future, the prospects for the sustainability of *Hellerup School's* innovative character are fairly promising.

The cultural change that is evident in *Hellerup School's* pedagogical, technological and organizational innovations as well as the shift of the ownership of innovation to teachers, students and parents are also crucial enabling factors for its sustainability.

The well-established partnerships with academia, school networks, partnership with industry, acknowledgements from the Ministry of Education,[70] as well as the broad coverage of the school's innovations by the media[71] constitute additional factors that can contribute positively to the sustainability and further development of Hellerup as a model school for experimenting innovative pedagogical, technological and organizational practices.

There are also challenges to the sustainability of this innovative school. One key challenge is the limited budget for projects that hinders, in some cases, the seamless expression of teachers' and students' creativity. There are also concerns about students' and teachers' health with regard to their high exposure to electronic devices, such as smartphones and netbooks during the school day which makes it essential that the day is planned with physical exercise in between screen work. Last but not least, the Danish Ministry of Education has introduced over the last decade more national tests for students, in which factual knowledge is predominantly tested and assessed. This approach puts pressures on teachers to 'teach for the tests' rather than focus on facilitating students to develop key competences and 21st century skills such as creativity and collaboration.

5.5.2 Prospects for scalability

Although *Hellerup School* follows for more than a decade pedagogical, technological and organizational innovations that impact on several key dimensions of the school ecosystem, it remains a local initiative and there are no plans in place for reaching a bigger scale at the regional or national levels.

The key challenges for scaling up the Hellerup model include the following:

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[68] See for instance at http://www.guardian.co.uk/smart-class-2025/denmark-hellerup-schoop-learning-by-doing

[69] See for example at http://www.hse.org.uk/hse/wp-content/uploads/2012/02/Summer09.pdf

[70] For instance, Hellerup School has been mentioned by the ministry of education as an example of New Nordic School (see more about the New Nordic School initiative at http://www.nynordiskskole.dk

[71] See for instance at http://news.bbc.co.uk/2/hi/uk_news/education/6276055.stm

- It constitutes a radical innovation that requires a clear common vision with both short- and long-term goals;
- It requires readiness for innovation of key stakeholders (teachers, parents, local authorities etc.) and their engagement and commitment over time for fulfilling the long term vision;
- There is a need for cultural change and professional competence of the education community for implementing radical pedagogical, technological and organizational innovations over time encouraging experimentation and allowing mistakes and sensible risk-taking;
- Teachers need continuous professional development provisions and support for developing a willingness to "lose the control" of the classroom and play the new roles of facilitators and mentors;
- It entails rethinking the physical spaces in which learning takes place (e.g. user-centred premises and furniture) and high investment in school infrastructure;
- It necessitates continuous update of ICT infrastructure for supporting ICT-enabled innovation for learning in general and 1:1 and BYOD policies in particular.

5.6 Reflections, issues and lessons learnt

By breaking down the metaphorical and physical walls, Hellerup represents a paradigm shift and illustrates how pedagogical, organizational and technological innovations can be applied at the system level. Key lessons emerging from Hellerup case include:

- Hellerup has been implementing pedagogical, technological and organizational innovations that cover all key aspects of the school ecosystem such as teaching and learning practices, connectedness, infrastructure, leadership, and organization strategies, having as the main goal to prepare students for the changing world in which they live.
- *Hellerup School* offers a high degree of learner choice and empowerment in every possible area in which they can have a voice and choice. The same is true for the well-selected Hellerup teachers who work in autonomous team and are empowered to act as agents of change rather than objects of change. As a result, the leadership capacity of the entire school community is high leading towards a trend of increasingly wider distribution of leadership, responsibility and autonomy over time (Buckley, 2010).
- The school (and wider) community wanted to make sure that the school will stand for innovative teaching and learning practices and the space will be used to make this achievable. Hellerup is maybe the best example of stakeholder and user engagement in the design process of an innovative school. Municipality invited policy makers, consultants, architects, school experts, school board, administrators, teachers, students, parents, community residents, higher education partners, business leaders and even police officers to actively take part in the design of the school for the 21st century. The development took two years and the insights came mainly from modern workplaces, community centres, libraries and cultural centres. However, the lesson is not to create thousands of 'Hellerups' but to follow a similar approach (stakeholder and user engagement, time for development and testing and so on) for the school design to be relevant to each specific community and to cater for innovative teaching and learning practices and 21st century learning outcomes. Stakeholders involved in systemic innovation for learning should be aware that the change process cannot be fully controlled and predicted; it requires tolerance for ambiguity and sensible risk taking.

Hellerup clearly is not a 'fast-track innovation' but the outcome of a well-articulated and continuous development process that requires clear vision, political commitment and sustained effort over time by all stakeholders involved. This investment on time is evident for instance in the design, construction and testing phases of the school building development and it is one of the most important lessons one can learn from this specific case. However, Hellerup model is unique and

cannot 'be transferred' into another context e.g. by copying design principles or school routines. The key lesson from Hellerup case is that innovation for learning is a very complex and slow process that requires cultural change and collaboration between stakeholders from policy (e.g. Ministries of Education and local authorities), industry (e.g. IT providers) research (e.g. research centres), educational practice (e.g. teacher unions) and the wider public (e.g. parents) to build trust and subscribe to the disruptive vision and practices of the school.

Hellerup experience reveals also that all stakeholders involved should remain open-minded to future adaptations and engage in the constant evidence-based development of innovation at hand. This long-term commitment by all the stakeholders involved is difficult to be achieved and probably one of the main barriers for scaling up Hellerup even at local or regional level.

While Hellerup is now in its eleventh year of development having implemented a wide-range of learner-centred pedagogical, technological and organizational innovations at system level and having attracted much national and international attention through various media, the available research (e.g. evaluation reports) is still limited. Thus, further research that provides evidence of impact on students' motivation, self-directed learning, attitudes and learning outcomes, and also evidence of effective implementation strategies, teachers' professional development, or possible long-term impacts on lifelong learning is needed.

In conclusion, Hellerup is a concrete case of a school that tackles the key questions around what 21st century students should learn, how they should learn, where they should learn and with whom they should learn. Based on the lessons we learnt from the Hellerup case we may understand that we need empowered teachers to work in autonomous teams; learners that are allowed to have choices for their own self-directed learning; physical spaces that offer inspiration, variety, flexibility and comfort; and stakeholders such as policy makers and parents that support innovative teaching and learning practices over time.

6. Case report 4: e-Learning Pilot Scheme in Hong Kong Schools

Nancy Law

6.1 Case overview

The ***e-Learning Pilot Scheme*** is part of a territory-wide initiative in the Hong Kong Special Administrative Region (HKSAR) to promote the use of ICT for transformative teaching and learning to achieve the broader education reform goals of nurturing students' lifelong learning ability. It is part of the strategic initiatives of the Third Information Technology in Education Strategy (Education Bureau, 2007) and is also aligned with the Education Reform launched in 2000 (Education Commission, 2000).

HKSAR launched in November 1998 its first policy document on information technology in education, *Information Technology for Learning in a New Era: Five-year Strategy 1998/99 to 2002/03* (Education and Manpower Bureau, 1998). Prior to this, computers were only available for use in teaching and learning at the secondary level in the context of computer-related school subjects such as computer studies and computer literacy. The goals of this First Strategy were to help students develop an understanding of the pervasive impact of IT on society and their daily lives and to develop their higher order thinking skills as well as their abilities to seek, evaluate, organize, and present information. Very specific quantifiable targets were set to be achieved by the end of this five-year period: at least 25% of the teaching and learning within the school curriculum would be supported through IT and that, within 10 years, all teachers and Secondary 5 graduates would have achieved competence with IT tools. These were to be accomplished through four strategic components: ensuring computer access and Internet connectivity for students at school through the provision of computer laboratories; providing opportunities for teachers to learn how to use IT; providing digital resource to support IT use across the curriculum; and fostering a community-wide culture of collaboration to support the implementation of the Strategy.

The second IT in education strategy, *Empowering Learning and Teaching with Information Technology* (Education and Manpower Bureau, 2004), was a three-year strategic plan for IT in education in Hong Kong launched in July 2004. This document acknowledged that the first strategic plan succeeded in laying the necessary infrastructure, providing teachers with basic training in the use of IT, and collecting a rich repository of digital education resources. It also identified a number of principles that are important strategic directions for effective implementation of an IT in education strategy based on the findings from the evaluation of the First Strategy: clear leadership and direction from the government, professional development and support for school heads as visionary leaders and agents of change, the need for transforming/innovating the learning and teaching process at the classroom level, and the need for policy to provide flexibility to cater for diversity in school readiness for implementation. Unlike the First Strategy which did not have a clear learning outcome goal, the Second Strategy specified one primary policy goal: was to *empower learners with IT* so that "students will acquire the necessary skills, knowledge, and attitudes for lifelong learning and creative problem-solving in the information age" (Education and Manpower Bureau, 2004, p. 11).

The Third Strategy on IT in Education, *Right Technology at the Right Time for the Right Task*, was launched for consultation in October 2007. Unlike the HKSAR Second Strategy or the Singapore's Third Masterplan for ICT in Education (mp3 in short; see Looi, 2013, this volume), both of which have a primary focus on student learning outcomes, and the latter being even more focused than the former by highlight only two specific pedagogies—self-directed learning and collaborative learning—the Third Strategy assumes a much less directive stance. It sees IT as "only one of many mediators in learning and teaching. …our strategic focus is the human factor. …We have not set goals according to a projection of what a future school will be…" (Education Bureau, 2007, p. 4)

because "…teachers and students will need to decide whether the use of IT is the most effective mediator for a particular learning and teaching activity" (ditto).

It is within the context of the Third Strategy that the then Chief Executive of the HKSAR government announced in his 2008-09 Policy Address that the Government would look into the development of e-Learning resources. In this regard, the Working Group on Textbooks and e-Learning Resources Development (WG) was set up soon afterwards to study the use and development of textbooks and e-Learning resources. In October 2009, the WG released a report and among its recommendations was the launch of a three-year pilot scheme on e-Learning in schools to explore suitable modes and necessary support measures for the development of effective e-Learning solutions that are sustainable, transferable and scalable for Hong Kong. A total budget of HK$ 61M (approximately € 6,0M) was approved for this initiative.

In January 2011, the Education Bureau of the HKSAR Government (EDB for short) announced the list of 21 awarded pilot projects, involving a total of 61 schools (19 secondary, 31 primary and 11 special education schools). Funding was given to the projects so that preparation could start immediately, and schools were requested to start their e-learning plans in classrooms from September 1, 2011 for three consecutive school years. Hence the pilot scheme is still in its early stages, with more than half of the project period still ahead.

This *e-Learning Pilot Scheme* launched by the EDB in May 2010 is one significant initiative in the implementation of the Third Strategy. While this scheme involves only 61 schools (Hong Kong has in total 532 primary schools (grades 1-6), 464 secondary schools (grades 7-12), and 60 special-needs schools), it is a very pertinent project for studying ICT-enabled creative classrooms in Hong Kong for the following reasons:

- It builds on earlier efforts to integrate ICT into teaching across the curriculum that started 14 years ago;
- The learning goals targeted are aligned with the lifelong learning goals promoted by the EDB when it first launched its education reform in 2000;
- This pilot scheme goes beyond previous IT in Education related pilot projects, which focused mainly on technology development or classroom pedagogy. Another important feature of this scheme is that it aims to seek insight on the scaling up of innovations, including the possible partnership roles of the private sector such as publishers and Information Technology (IT) vendors.

The official website for the *e-Learning Pilot Scheme* is at http://edbsdited.fwg.hk/e-Learning/eng/index.php?id=3. The proposals of the 21 awarded pilot projects can be found at http://edbsdited.fwg.hk/e-Learning/eng/index.php?id=5. The website for the evaluation project on the pilot scheme can be found at http://e2.cite.hku.hk/en/index.htm

6.1.1 Key focus and goals of the innovation

According to the formal documents of this project published by EDB, the objectives of the *e-Learning Pilot Scheme* are:

- To develop, try out and evaluate when and how e-Learning works best to bring about effective interactive learning, self-directed learning, catering for learner diversity in different curriculum and school contexts in Hong Kong;
- To explore commercially viable business models for the development of e-Learning resources, in order to meet needs of schools, teachers and students through collaborative partnership between pilot schools and other sectors;
- To help EDB chart the way forward for progressively wider use of e-Learning in schools.

6.1.2 Learners targeted

The target participants in this scheme are primary, secondary and special education needs schools in Hong Kong and the classes targeted in these projects range from grades 1 to 12.

During the first year of its operation (2011-12), there were about 3,370 primary students and 1,409 secondary students involved in some way in the pilot projects. The schools selected for participation cover a wide range of demographics, with many of the schools located in areas with relatively low social economic status, and a wide geographical spread.

6.1.3 Learning outcomes targeted

The *e-Learning Pilot Scheme* is an effort to leverage the potential of ICT to further the goals of the education reform launched in 2000, which aims to foster students' lifelong learning abilities. The launch document for this scheme not only identified self-directed learning as a specific learning outcome, but also listed effective interactive learning and catering for learner diversity as the goals of this initiative. However, the evaluation project that the EDB commissioned was more specific in identifying 21st century skills as the focus of the learning outcome evaluation, and in particular identifies information literacy and self-directed learning as the learning outcomes for which data collection is to be conducted. On the other hand, the learning outcomes targeted by individual projects and schools are wide ranging, and may not necessarily focus on lifelong learning or 21st century skills.

6.1.4 Technology used and the role of technology in the innovation

As this is an e-Learning pilot project, ICT is expected to play a pivotal role in realizing the educational goals targeted by the schools. The technology used by the pilot scheme projects is very varied. The scheme does not prioritize or put specific requirements on the kind of technology to be adopted. Hence the kinds of technology involved in the projects may involve the deployment of digital learning resources, learning management systems or mobile devices (e.g. tablets). All schools in Hong Kong have at least one computer room, a computer with Internet access and LCD projection in nearly all classrooms, as well as broadband Internet access.

The scheme documents specify that ICT should be a catalyst for transforming education; e-learning should be student-centred rather than technology-centred, and should focus on achieving the goals specified in 6.1.1 above.

An examination of the 21 pilot project proposals reveals that the intended roles to be played by technology are very different in the different projects. Further, it was found that the intended roles and the actual roles played could be very different. This will be reported in later sections.

6.2 Scale and nature of the innovation

This is a pilot project that builds on earlier experience and knowledge gained from the two earlier IT in education strategies in Hong Kong and is aligned with the goals of the overall education reform launched in 2000 to enhance the lifelong learning ability of the students.

6.2.1 Background and scale of the scheme

All publicly funded schools were invited in early 2010 to apply for participation and funding from the scheme on a voluntary basis by submitting a project proposal, and selection was on a competitive basis. A total of 100 applications involving 232 schools were received, which represents an enthusiastic response from the school sector (there is a total of ~1000 primary and secondary schools in Hong Kong).

The criteria for selection, as announced by the EDB, were based on the quality of the proposal in the following areas:

- The project implementation plan, the teaching and learning method and the curriculum design principles;
- Partnership arrangements (with content providers, technology providers and academia);
- Sustainability and scalability;
- Role of ICT in supporting learning;
- Evaluation mechanism;

- Dissemination plan;
- Other favourable factors for selection include the involvement of a cluster of schools instead of a single school in a project, the goal of the pilot includes changing the school management culture, and the availability of additional external resources.

A selection panel comprising government officials, and members of the WG took the responsibility of selecting projects for the award of funding from the scheme. While selection was on the basis of merit, it was also carried out in such a way as to "*… fully [cover] all key learning areas and learning stages and the project objectives also include the enhancement of students' information literacy and learning effectiveness through the use of IT, and the enrichment of the depository for learning and teaching materials*."[72] The total approved budget for the entire scheme over three years was HK$ 61M (equivalent to € 6M). In January 2011, the EDB announced the award of 21 successful pilot projects, involving a total of 61 schools, with a geographic distribution covering all districts of the HKSAR territory. Of these, eight projects are at secondary school level, involving a total of 18 schools, and 11 are primary school pilot projects involving a total of 32 schools. The remaining two are projects submitted by one and 10 special education schools respectively. The school subjects and grade levels targeted also varied widely across projects even within the same type of schools. Table 5 provides an overview of the 21 pilot projects. It can be seen that the funded projects are very diverse in nature and organization. While nine of these are single school projects, 12 involve the partnership of two to ten schools. The subjects included in the piloting of e-Learning also differ greatly from a single school subject to nearly all the key academic school subjects. Most of these involve the development of online platforms for the delivery of digital learning resources, and a few aim to introduce mobile learning. In terms of the learning outcomes targeted, all projects include at least one 21st century skill such as information literacy and self-directed learning. However, as can be seen from the information listed under the last two columns which describes the nature of the samples of students' work collected from the pilot classes, the teachers involved in the projects may not understand or have the competence to integrate e-Learning activities that help students develop the 21st century skills claimed in the project proposals. Seven of the projects submitted only paper-based samples of student work in the first year. One third of the students' work submitted was drill and practice type of exercises. In the remainder of the samples of students' work submitted, the most popular 21st century skills demonstrated were low level information literacy skills such as defining information needs, accessing and managing information. Only three projects (projects 12, 16, 20) were able to demonstrate some elements of self-directed learning.

[72] http://www.info.gov.hk/gia/general/201101/03/P201012310128.htm

Table 5: An overview of the 21 e-Learning pilot projects

Proj. no.	Grade levels*	Schools involved	School subjects targeted	e-Learning Project focus	Learning outcome focus**	Outcomes demonstrated in students' work submitted in Year 1	ICT used in student work?
1	7-9	1	Integrated Humanities	Develop web platform with digital resources for mobile learning, peer collaboration	IL	Information access	Yes
2	7-9	1	Chinese, English, Liberal Studies, History, IT	LMS with interdisciplinary learning resources mapped to different student learning profiles	SDL	Traditional reading comprehension	No
3	7-9	1	Math, Integrated Science, Chinese, English	e-Learning platform to be developed from Moodle, i-tools, GeoGebra, Sketchpad, etc.—support visualization of difficult academic concepts	LD, AfL	Access & manage information	Yes
4	7-9	1	Math and Liberal Studies	Develop LMS with web applications, games, learning objects & virtual tutor with speech capabilities as adaptable personal learning environment for SEN students	SDL, LD	Traditional drill and practice on computation	No
5	1-6	1	Chinese, English, Math, General Studies	Develop comprehensive school-based teaching and learning materials with the support of commercial partners	IL, AfL, motivation	Communication, ethical use of information	Yes
6	4-6	1	General Studies, Visual Art, Math	Integrate IT tools, web applications on existing e-learning platform for student-centred learning, e-portfolios & remote collaboration with students in Beijing & Taipei	IL, SDL, LD	Access & manage information	Yes
7	1-3	1	English Language	Digitize English readers, set up e-Learning platform for students, teacher sharing of resources, class preparation	SDL, LD, creativity	Manage & create information	Yes
8	1-3	1	Chinese Language	Enhance existing e-Learning system with multi-sensory components and games for mildly handicapped students	SDL, LD	Traditional drill and practice matching exercise	No
9	7-9	1	Math	Develop e-Learning platform with information management capability to support validation of students' outcomes	AfL	Traditional drill and practice on computation	No
10	10-12	4	Liberal Studies	Develop web platform with T&L resources, support peer- & self- assessment, ability-based assignment of learning	LD	Traditional essay writing	Yes

11	7-8	5	Chinese, English	Develop e-Learning platform with learning resources to scaffold writing and build database to track learner progress	IL, motivation	Define information needs	Yes
12	7-9	4	English	Provide adaptable learning objects that support mobile learning to support student collaboration and learning	SDL, LD	Define, access, manage & create information, SDL (set goal, self-monitor)	Yes
13	1-6	5	Chinese, English, Music, IT	Develop animation & other educational software, delivered through a portal for SDL, assessment, feedback & creativity	Creativity	Manage information	Yes
14	4-6	2	Chinese	Develop cloud-based adaptive e-Learning platform for SDL in school & at home, support parent participation	SDL, AfL, LD, motivation	Access, manage & create information	Yes
15	1-3	4	English	Integrate use of web 2.0 technology and teaching resources to support learning	SDL, Creativity	Define information needs	No
16	4-6	2	General Studies, Math	Develop an e-Library resource system to support mobile e-learning	Motivation, Creativity, HOT	Full range of IL skills; SDL (set goal, self-monitor, feedback, revision)	Yes
17	1-9	10	Chinese, Personal Social and Humanities Education	Develop an e-Learning, teaching and assessment system for students with differing physical and intellectual disabilities.	LD, AfL	Traditional exercises (MC, fill-in blank, copybook)	No
18	1-3	2	English	Set up e-Learning platform & Wi-Fi for mobile learning, replace printed textbook with e-Learning materials	SDL, LD	Traditional exercises (MC, sentence writing)	No
19	4-5	2	Chinese (Putonghua), Math	Game-based e-Learning using avatars and a semi 3D learning environment	SDL	Use animation software to create picture	Yes
20	1-6	6	Chinese (grades 1-3), Gen. Studies (grades 4-6)	Use tablets, web 2.0 tools, phonics & other language learning resources, scientific investigation tools	IL, SDL, AfL	Manage/communicate information, SDL (peer evaluation)	Yes
21	4-6	6	Chinese, English, Math, General Studies	Research on development of IL in different subject areas using web-based learning materials, e-portfolio, self-assessment	IL, AfL	Access, manage, create information	Yes

* Grades 1-6 are in primary schools and grades 7-12 are in secondary schools.

** IL=information literacy, SDL= self-directed learning, AfL=assessment for learning, LD=catering for learner diversity, HOT=higher order thinking, MC= multiple choice.

6.2.2 Leadership and organization of the innovation at the system level

The EDB set up a Steering Committee to monitor the implementation and evaluation of the *e-Learning Pilot Scheme*. There is a small team of 5 officers in the EDB who go round the different project schools to play a dual role of monitoring project progress based on the submitted proposals as well as supporting project progress. These officers may give advice after understanding the implementation status and difficulties encountered, as well as facilitate dissemination and communication.

6.2.3 Leadership and organization of the innovation at the project/school level

At the individual project level, each of the 21 projects has its own project coordinator and coordinating team. For projects involving more than one school, each school in the project cluster will also have its own coordinator and ideally should also have its own coordinating team. A few of the cluster projects share the development, implementation and evaluation responsibilities equally among the cluster school partners, while others adopt a "centre-periphery" model in which the coordinating school take up the key responsibilities for project development, professional development and evaluation, as well as the dissemination of the project outcomes to other schools in the project cluster for adoption and further scaling.

The background and experience of the schools and project team members involved in the leadership and management at the school level vary greatly across the projects and across schools in the same project cluster. Some of the pilot schools have a long history of ICT-enabled innovation for more than 10 years, and have a long history of engaging in school-based curriculum development, while others, particularly the "periphery" schools in cluster projects, have little experience in e-Learning implementation or school-based curriculum development experience. There is no explicit requirement or guideline on the composition or structure of the project leadership team, nor are there any recommendations on how best to structure and lead the partnership between coordinating and periphery schools.

The stakeholders involved and their roles in the innovation vary greatly across projects. Only a few projects engage parents or community groups in the conceptualization or implementation of the *e-Learning Pilot Scheme*. Most of the projects have IT service providers and textbook publishers as business partners, as recommended by the EDB. A few have, in addition, a university-based individual or team, or a teacher professional society as a partner to provide e-Learning curriculum development, pedagogical design, professional development and/or evaluation service or consultancy support.

The funding for schools to conduct the e-Learning pilot projects come almost entirely from the Government earmarked fund for this scheme. Hence sustainability of funding is a concern for all of the pilot schools.

6.2.4 Conceptual basis of the innovation

One cannot gain an adequate understanding of an innovation without knowing the conceptual basis underpinning the innovation, at least as far as the leaders of the innovation are concerned. In the case of this pilot scheme, the concepts and goals held at the system level needs to be differentiated with those at the project or school levels.

There is no explicit theoretical or pedagogical model for this e-Learning pilot scheme. This relative a-theoretical stance is typical of the education reform initiatives in Hong Kong. The key stance explicitly taken is that e-Learning has to promote "transformative" uses of ICT, i.e. not for traditional modes of learning. However, what is transformative or traditional is left to the schools to interpret. There is also no explicit model of change management. The diversity in focus and kinds of practices involved in the awarded projects is a clear demonstration of the absence of any theoretical orientation in learning or pedagogical theory adopted in the selection process: the foci of the awarded projects vary from developing e-textbooks for key subjects in the entire primary school curriculum, to developing creative uses of technology for specific 21st century learning skills.

One primary goal of the *e-Learning Pilot Scheme* is to identify good models of sustaining and scaling up e-Learning innovations through partnership. In this regard, the scheme at the system level also does not prioritize any particular model of change or partnership. There are different formats of school collaboration (including no collaboration), as well as great diversities in arrangements with business partners. It is clear that the *e-Learning Pilot Scheme* is perceived as a sandbox for ICT-enabled innovations. There is no clear guideline or criteria in these two substantive aspects of e-Learning innovations, even though Hong Kong had its first *e-Learning Pilot Scheme* launched in 1997! It is not clear what have been learnt in these areas at the system level by examining the implementation of the current pilot scheme with previous e-Learning initiatives.

6.2.5 Summary

Figure 15 presents a mapping of the nature and scale of the Hong Kong *e-Learning Pilot Scheme* onto the SCALE-CCR framework for ICT-enabled innovation for learning (Kampylis, Bocconi & Punie, 2012). It can be seen that although the goal of the *e-Learning Pilot Scheme* is to encourage and support uses of ICT in schools for transformative modes of learning, the projects in general are still very much incremental in nature. On the other hand, the selected project schools cover all school types and geographical regions within Hong Kong, and so the access level is towards the regional end of the spectrum. The main impact areas are at the process level, contributing to the development of different learning and teaching practices through the integration of ICT. Some conscious efforts have been made, particularly at the system level, to foster the development of new e-Learning service models in the private sector, particularly in the ICT sector serving schools and educational publishing. While progress in extending the impact area is still very slow, the range of target actors involved are quite wide, including not only school personnel but also the private sector, researchers, teacher educators, parents and other community groups.

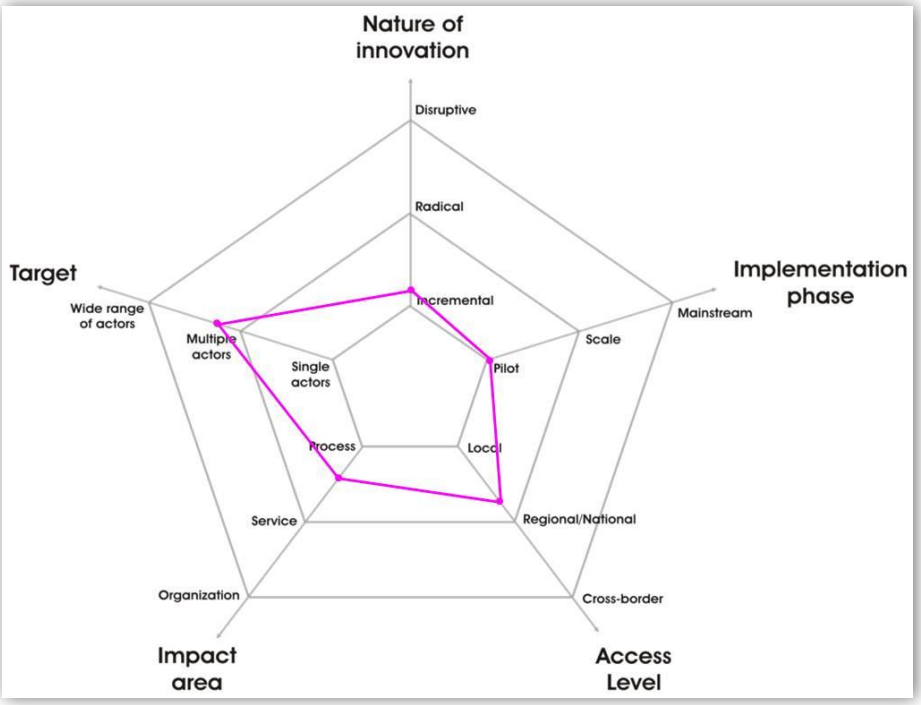

Figure 15: Mapping the Hong Kong *e-Learning Pilot Scheme* to the SCALE-CCR framework for ICT-enabled innovation for learning

6.3 Strategies for implementation and scaling up of the innovation

6.3.1 Agency for change

Strategies for implementation of change are often categorized into either top-down or bottom-up ones (Hargreaves, 2007). For initiatives such as this one, which involve centralized promotion and

support, and at the same time provide options for schools to either join or ignore the initiative, then one can conceptually classify the strategies for implementation of such innovations as involving a combination of system- and school-level engagement. The specific strategies involved could be categorized as centralized vs. decentralized and top-down vs. bottom-up, as shown in Figure 16. In the case of the Hong Kong *e-Learning Pilot Scheme*, at the system level, both centralized top-down efforts from the Government as well as centralized bottom-up responses from schools can be found. The former includes the directional guidelines and specifications for application, monitoring and evaluation mechanisms of the project as well as the funding and support structures. The latter refers to the voluntary participation in the scheme, the content and focus of the schools' proposals, leadership strategies at the school level as well as the responses of the private sector to partner with schools in the pilot projects.

Outside of the scheme itself, there are also decentralized bottom-up supportive initiatives from the community such as parental support to provide funding for 1:1 computing, NGOs operating schemes to bridge the digital divide by providing computers and internet connections to children from low-SES (Socio-Economic Status) families.

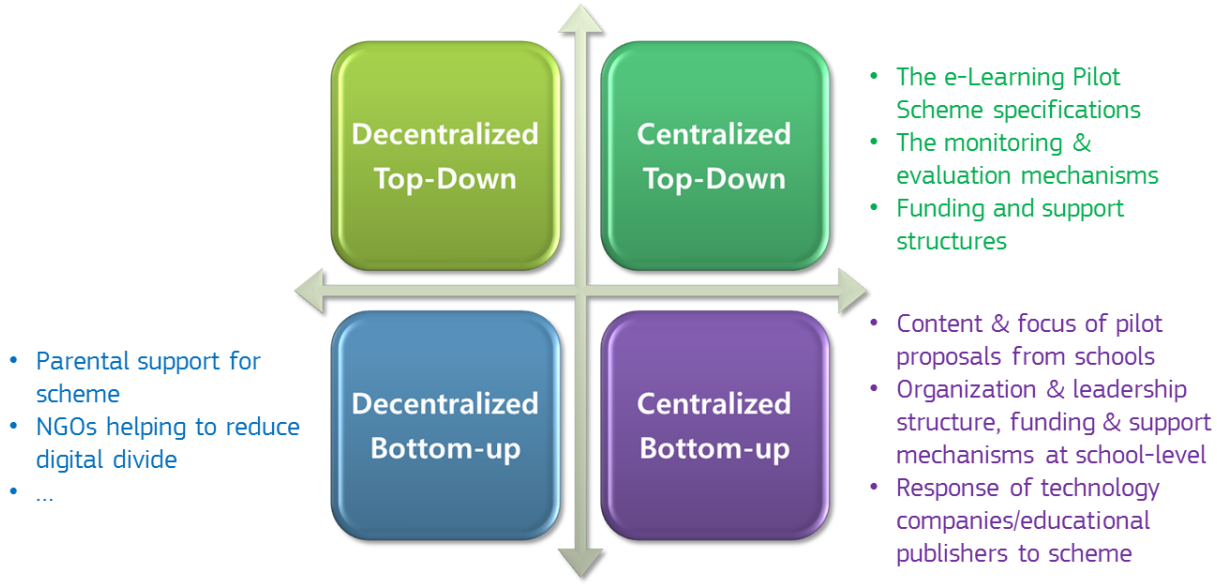

Figure 16: Different leadership strategies found in the *e-Learning Pilot Scheme*

While the Scheme as a whole is a centralized initiative, there could be a possibility of three types of leadership models at the school level. It could be a totally top-down initiative from the principal, an essentially bottom-up initiative where interested teachers make a proposal to the principal for support to submit an application to the EDB, or it could be a combination of both top-down encouragement from the school leadership to identify and propose suitable e-Learning projects and bottom-up efforts of teachers in the school to develop details of the proposal based on their interest and expertise. Most of the proposed projects involve some level of teacher input, but the extent to which a project is a top-down initiative from the principal varies greatly across schools.

There are two levels of change agents. At the system level the Undersecretary for Education was at the time the key change agent publicizing the scheme and putting different mechanisms in place for the Scheme. At the school/project level, it is various. In all cases, the principal would have to play some role in initiating and supporting the change. What differ across projects are the specific roles played by the principal and in particular the other members involved in the change management and the kind of organization structure put in place for the development and implementation of the pilot project.

In terms of partnership involvement, the *e-Learning Pilot Scheme* requires that each project includes the involvement of some partners. In particular, the engagement of IT service providers, textbook and educational resource providers was strongly encouraged as a key mechanism for sustainability,

though research and development units in universities and professional education societies were also possible partners in the scheme.

6.3.2 Professional development provisions

At the launch of the scheme, the EDB did not see the need for the provision of systematic professional development (PD) to the pilot schools at the system level as the nature of the pilot projects were diverse and the scheme allows for the project budget to include funding for relevant school-based provision of relevant professional development. However, after reviewing the first year interim evaluation report, the EDB recognized the need for more systematic provisions to support teachers' development of e-Learning pedagogy as well as a better understanding of different learning technologies. The EDB has also put aside resources to support pilot school teachers/principals to take part in conferences and other PD events locally, nationally or internationally.

The EDB also requires each project to offer a PD event each year, from the second year, to all schools in Hong Kong to disseminate their project innovation, and publicized through the official EDB training calendar, as a mechanism for dissemination of good practices from the pilot projects.

PD provisions at the school level are very variable. All schools recognize the need to organize for themselves the necessary technical training related to their project, e.g. how to use tablets for taking photos and uploading to server. On the other hand, the awareness of the need for pedagogically oriented PD is often low and often not available at the school level.

6.3.3 Governance, management and school routines

In order to manage and coordinate that project at the school level, most of the project coordinators have lighter teaching load. Several of the cluster projects have arrangements for monthly cluster meetings, a few has arrangements for peer observation/school-based peer support. One of the cluster projects has hired a part-time clerical staff to provide administrative support to the project. Some schools have set times for school-based project team members to meet and plan, but no specific timetabling arrangements have been made to facilitate this to happen within school teaching hours.

It is anticipated that there will be new challenges due to lack of alignment between the needs of the innovation and existing school routines. However, it is not clear whether and how schools handle such situations. At the time of writing, information at this level of detail is only available for two schools. In one of these schools, when the project team leaders receive feedback from teachers on their concerns, s/he will inform the principal and try to make arrangements to provide suitable support (e.g. counselling and pedagogical support from a more experienced teacher to help with e-learning curriculum unit design and co-teaching arrangement).

6.3.4 Monitoring and accountability mechanisms

There are also two evaluation projects commissioned by the EDB to carry out both formative and summative evaluations of the project through collecting both qualitative and quantitative data. The areas of concern for the evaluation are: models of e-Learning, models of professional development and school change, models of partnership with different stakeholders and models of scaling up innovation. The first project is a longitudinal study from the start of the *e-Learning Pilot Scheme* to provide an overall evaluation of the entire set of 21 projects and 61 schools. Another project is a set of case studies of a select set of projects and schools in the last year of the project to gather more in-depth qualitative, contextual data to shed light on the same areas of concern to supplement and triangulate with the first evaluation project.

6.3.5 Evaluation mechanisms used

The first evaluation project mentioned in the previous section is designed to provide an overall understanding of the progress, achievements and obstacles encountered by the various pilot projects, which began right at the launch of the pilot projects and would continue to the end of the scheme to serve both formative and summative evaluation purposes. This evaluation component

was contracted to a research team from the Centre for Information Technology in Education (CITE), University of Hong Kong (HKU). The evaluation uses mixed methods. On the quantitative side, survey questionnaires are distributed annually to the principals, ICT coordinators, teachers and students. Individual interviews (with school principals, project coordinators, EDB officer in charge of e-Learning pilot project) and focus group interviews (parent focus groups, project coordinators focus groups from partner schools in school-cluster projects and project core team members) are also used. In addition, teachers' e-Learning task design and samples of students' authentic work generated from the learning tasks are also collected each year as data for the evaluation. A second evaluation project is to be a set of case studies to be carried out on a selection of the projects to gain a deeper understanding of the innovations at the project and school levels. This second component was not yet started at time of writing.

6.4 Outcomes and achievements

The pilot projects have only started in September 2011, just over one year ago. Many of the projects have not fully implemented their proposals. The key findings reported here focus on areas closely related to the key objectives of the *e-Learning Pilot Scheme*, based on the first year evaluation results.

6.4.1 Student learning outcomes

The evaluation study asked teachers from each pilot project to provide samples of student work from one of the pilot classes that reveal students' learning outcomes in information literacy, self-directed learning and any other 21st century skills targeted in a curriculum unit that makes use of ICT. The submission need to also include information about the design of the curriculum unit and the specific learning task(s) associated with the samples of student work collected.

Many of the samples of student work submitted by teachers were completed on paper. In some of these cases, students had to search the web to complete the task while in others the role of ICT in the learning task was not clear. It was found that where the learning tasks provided opportunities for students to use ICT for more open-ended exploration and artefact production, different levels of achievement in information literacy and self-directed learning (mainly planning skills) can be observed. Otherwise, the learning outcomes demonstrated through the submitted work were primarily the textbook knowledge and skills often tested and observed in traditional assessment tasks. This indicates that the use of IT in the pilot projects have not been able to bring about transformative learning practices or outcomes as described in the initial pilot project documents.

6.4.2 e-Learning pedagogy

Data collected in the first year of the *e-Learning Pilot Scheme* indicate that many teachers were not familiar with pedagogical uses of ICT beyond that of a presentation tool. Pedagogical uses that involve students' use of ICT is relatively challenging for teachers. The samples of student work and associated curriculum unit and task description reflect the e-Learning pedagogy adopted by the teachers. A few of the submitted tasks could be categorized as "transformative". These involve open-ended learning tasks requiring students to conduct information search and to create artefacts using multimedia. However, the majority of the collected materials reveal pedagogical approaches that were largely traditional such as close-ended tasks requiring search of information online or computer-based drill-and-practice exercises. Many of the submitted work did not require students to use computers for their completion. A very narrow repertoire of e-Learning pedagogy was observed, primarily associated with the use of ICT for teacher presentation and for information search by teachers and students. Teachers were generally not familiar with pedagogy that gives opportunities to learners to make use of ICT. Some teachers indicated during interviews reluctance to allow 1:1 access or students bringing their own ICT devices to school for fear that such devices would become a distraction to classroom learning.

One important area of pedagogical competence is the design of assessment tasks. Nearly all of the assessment tasks only collected the final product that reflects students' achievements in specific content or skill areas. These generally lack information about intermediate stages of the learning

process, hence making it difficult to reveal students' level of achievement of process skills. Further, the tasks generally do not provide opportunities for revision or peer/self-assessment, which would help students to understand and internalize assessment criteria, and be conducive to developing students' self-directed learning abilities (Butler & Winne, 1995; Strijbos, Narciss & Dünnebier, 2010).

From the documentation submitted, it was found that teachers often could not differentiate self-directed learning (SDL), which emphasizes the students' agency in identifying their own learning goals and strategies, as defined in the Singapore's mp3 documentation, from self-accessed learning (SAL), which is essentially self-regulated completion of assigned work which is often associated with a content focused conception of learning. Most of the pilot projects claiming to target SDL were in fact SAL projects underpinned by behavioural pedagogical concepts such that "ability-linked" learning materials and exercises are provided to students based on their test performance.

6.4.3 Teacher learning and professional development

While it anticipated that teacher learning and professional development will accompany success in the implementation of the e-Learning projects, there are no clearly identified professional development goals or strategic mechanisms in the scheme. It is not clear from the limited data collected in the first year of the scheme in what ways the teachers have advanced in their professional competence or understanding. Likewise, at the school level, not many of the projects have professional development plans beyond the learning of necessary technical skills. Further, the importance of enhancing teachers' understanding, planning and implementation skills in e-Learning pedagogy is still largely overlooked.

On the other hand, it has been observed that some projects have specific institutional plans and support for teacher sharing of ideas and collaboration, particularly in cluster school projects where there are built-in mechanisms for joint-school learning and collaboration, there is evidence of advances in teachers' pedagogical understanding and skills of e-Learning pedagogical and greater willingness to experiment with more transformative pedagogies.

6.4.4 Partnership, collaboration and community building

There are two major types of partner relationships promoted by the *e-Learning Pilot Scheme*: partnership among schools, and in particular collaboration in e-Learning innovation among schools within the same project cluster, and partnership between schools and the private sector to evolve sustainable e-Learning business models.

In terms of partnership among schools within the same project cluster, the collaboration was mostly at a preliminary stage as the core coordinating schools were still very much focused on getting the pilot projects off the ground. Some projects reported the lack of appropriate infrastructure (technological and organizational) and mechanisms to support communication and community building among schools within the cluster.

Of the many clusters, impressive development has been observed in one in which the principals were all committed to the project, set up regular monthly meetings for peer observation of e-Learning practices in classrooms in the different schools, followed by debriefing discussions. As these meetings involved the principals and key teachers from each of the schools involved in the cluster, they became the conduits for fast cycles of ideas sharing feeding into action plans/modifications of action plans and adjustment of school routines to accommodate the requisite changes. It was observed that even decisions on project level adjustments could also be made expediently during or after these meeting when deemed necessary. Such meetings were informal in nature, conducive to learning and community building, but without any official status in decision-making. On the other hand, these informal meetings served the innovation well as a sustaining and nurturing architecture for professional development, organizational learning and decision-making within and across the project schools.

Outcomes in relation to partnership developments with business partners were less visible. In fact what have been reported were mainly challenges and difficulties due to conflicts arising during the partnership process. These include:

- IP ownership rights between the schools and business partners when the teachers actually contribute a lot of ideas to the development of contents, interaction designs and tools, as well as to the testing and evaluation of the e-Learning tools and resources.
- Difficulties encountered by teachers in communicating with the business partners due to the latters' lack of sufficient pedagogical and subject matter knowledge.
- Low level of engagement from business partners due to the low profit margin and delays in the delivery of e-Learning technology tools (e.g. Learning Management System) or resources.

The emergence of these problems is not surprising given that only very few instances of such partnership have taken place before this. Identifying, understanding and finding ways to resolve these conflicts and challenges should hopefully be one of the achievements of this *e-Learning Pilot Scheme*.

6.5 Innovation prospects: sustainability and scalability

The e-Learning pilot projects have only just completed its first year of implementation. It is still too early to have a clear picture of the likely accomplishments of the scheme when it is completed. Planned infrastructure developments in hardware, software and/or network infrastructure such as wireless installations are mostly accomplished within the first year, though in some cases the desired functionalities of the Learning Management Systems (LMS) are still not fully delivered. The planned ICT-using teaching and learning activities have also started, though many of the schools experienced delays in digital resources development involving third party collaboration.

6.5.1 The next plans for this innovation

At the system level, as a consequence of the first interim review report of the scheme, the EDB has commissioned a 2-day professional development programme for project schoolteachers (2 per school). However, the exact content of the programme is entirely left up to the bidding contractor to define. The EDB has also scheduled to commission another agency to conduct an in-depth case study for selected pilot projects as part of the evaluation programme for this scheme.

In looking ahead, one possible development could be that the pilot schools are better prepared technologically and pedagogically to implement their e-Learning pilot after the first year of operation, and may be able to have more use of ICT by students. Given that the evaluation results showing the inadequacies in learning task design will be disseminated to the pilot schools, there may be more awareness of the scheme's expectations such that schools will be more able to steering their e-Learning development towards enhancing learners' 21st century skills. On the other hand, this best case scenario may not happen in all projects and schools.

6.5.2 Prospects for sustainability

Within the duration of the *e-Learning Pilot Scheme* at the system level, the EDB will continue to implement supportive actions to ensure continued progress: continuation of the award funding; provision of professional development opportunities, including both locally organized courses and funding for teachers' participation in overseas conferences/course attendance and exchange with other schools; monitoring of project implementation through school visits, classroom observations, etc. These top-down measures will no doubt contribute to the sustainability of the *e-Learning Pilot Scheme* within the project period (i.e. until August 2014). However, the Government has not announced any further measures at the system level on sustaining the e-Learning innovations beyond the *Pilot Scheme*.

At the school level, a few have already developed conditions conducive to longer term sustainability such as a strong visionary leadership, introduction of changes in school routines and more flexibility in management practices, etc. The overall sustainability of the *e-Learning Pilot Scheme* innovations

in the 61 schools is not yet clear at this point in time. However, it is evident that sustainability at the school level will not be straight-forward and cannot be taken for granted.

In the original conceptualization of the *e-Learning Pilot Scheme*, sustainability was to be achieved through two forms of partnership. One form of partnership is collaboration among schools, particularly those within the same project cluster. It is important to note that operations of schools within Hong Kong are generally rather independent. The collaboration among schools within the same project cluster is an innovation in itself for the schools concerned and making the collaboration work is a challenge in itself even when there are resources allocated for liaison and coordination. Hence, it is anticipated that for the majority of the cluster projects, the collaboration among schools within the same cluster will be unlikely to continue unless there is continued funding support for such collaboration beyond the scheme.

Another form of partnership targeted is the establishment of business partnerships that will create an economically sustainable ecosystem. However, there are still no ready solutions to the problems that have emerged so far (e.g. IP rights, communication difficulties, etc.), and the prospect for the establishment of a model of sustainable partnership in e-Learning between schools and the business sector is relatively slim.

There are several factors that challenge the sustainability of the e-Learning pilot projects. First of all, the funding model is project based and so parties involved are not clear about the prospects or mechanisms for sustainability beyond the life of the project. Even though the first IT in Education Strategy in Hong Kong was launched in 1998, the evidence from international studies results (Law, Pelgrum & Plomp, 2008) and preliminary observations from evaluation this *Pilot Scheme* indicate that teachers in general still lack pedagogical readiness for e-Learning. Schools have not yet developed effective leadership structures at the school level after the initiation stage. Most projects have the participation of principal or vice principal in the project teams at the initial stage. However, they do not remain actively engaged in the project once the project is launched.

6.5.3 Prospects for scalability

There are a lot of built-in diversities in these 21 innovation projects, which is expected to lead to scale up possibilities in different school contexts to cater for various e-Learning interests. On the other hand, it is not yet clear at this stage what mechanisms or directions will the authorities take in relation to the likely expansion of the projects. It is evident, however, that projects which involve a cluster of schools, especially those that have established mechanisms (formal and informal) to enhance intra- and inter-school communication and interactions among teachers, will be better positioned in relation to longer term scalability.

Reviewing the project progress, there are a number of strategies that have contributed to enhancing the conditions for scalability. First, the initial publicity and promotion to invite e-Learning pilot proposals from schools emphasized that a key selection criteria is for ICT use to transform student learning. The focus on requiring strong school commitment and on pedagogy as a core selection criterion also contributed to facilitating a positive climate for the implementation of the e-Learning models. Hopefully, as the Scheme progresses, some positive models of e-Learning and partnerships will emerge that would contribute towards a stronger foundation for scalable e-Learning across the HKSAR.

However, there are a number of issues that need to be resolved to scale the pilot scheme projects to interested non-pilot schools. Continued funding for ICT infrastructure, extra staff for pedagogical development and technical support, and continued engagement and support from various partners are obvious challenges. Further, scaling require agency and leadership for change, and not just examples of innovations. The challenge to scalability depends on how different the innovation is from prevalent practices and whether the conditions required for the implementation of the innovation, in terms of tangible infrastructure and other resources, and even more importantly, the beliefs and professional competences of the education community. How far the e-Learning innovations developed in this *Pilot Scheme* and their impact will be scalable depends greatly on how the EDB and the wider community can take advantage of the Scheme as a learning experience to

raise the baseline conditions for effective e-Learning pedagogy to achieve the targeted 21st century learning outcomes.

6.6 Reflections and issues

The *e-Learning Pilot Scheme* 2011-2014 is the second pilot scheme to promote the use of IT for teaching and learning in Hong Kong schools that is directly administered by the EDB. The first one was launched in 1998 as part of the initiatives for implementation of the First IT in Education Strategy in Hong Kong (Education and Manpower Bureau, 1998, to be referred to as *First Strategy* for simplicity). Clearly, one would expect many differences between these two pilot schemes that are 13 years apart. There was no systematic review of the first pilot scheme as is the case for the second pilot. However, one would be struck by how similar the two schemes are in terms of their goals, at least at the rhetorical level. The First Strategy identified "*We should help our students to develop an understanding of the pervasive impact of IT on the society and their daily lives, higher order thinking skills, as well as abilities to seek, evaluate, organise and present information. They also need to develop habits of life-long learning so as to ride on the tides of rapid changes. ...IT can play a catalyst role in the transformation of school education in such direction*." So both schemes seek transformation of learning and teaching through the integration of IT in the pedagogical process. Is there any difference in the selection criteria for what can be considered as "transformative"? An examination of the pedagogical nature of the projects actually selected reveals a similarly wide range of "innovations". It appears that there is no mechanism for deep learning at the system level that allows for the accumulation of knowledge and understanding about 21st century pedagogy based on prior experiences accumulated through the many e-Learning projects that have received support directly or indirectly through the Government in between these two pilot schemes.

There appear to be more differences between the two schemes in terms of considerations for longer-term impact. In the first pilot scheme, all the projects were standalone projects; no partnership requirement was mentioned in the selection criteria and none of the supported projects included any partnership arrangement. For the second pilot scheme, there is a strong belief that involvement and partnership with related business sectors would be an important condition for longer-term sustainability and scalability. This is possibly the right direction to move forward in fostering an economic and human resource ecology for mainstreaming innovative practices. Such developments can be seen in the Singapore mp3 and in the *Digital Textbook* project in South Korea. However, what are the conditions for successful partnership and what strategies are necessary for fostering successful partnership are challenges that hopefully this pilot scheme could contribute to. Another form of partnership promoted by the second *e-Learning Pilot Scheme* is partnership among a cluster of schools to engage in the same pilot project. Such collaboration has been found to be conducive to sustainability and scalability of innovations (Law, Kankaanranta & Chow, 2005). However, even here, the EDB is more tentative and there are eight out of 21 projects that only involve standalone schools.

In the literature on change and sustainability, leadership and organizational learning at the school level has been identified to be of critical importance to the success and sustainability of innovations (Hargreaves & Fink, 2006; Sherer & Spillane, 2011; Stein & Coburn, 2008). There have also been initiatives to support the development of e-Learning leadership in the Second ITE Strategy in Hong Kong. However, there seems to be discontinuities in policy and this aspect has not been picked up either in the Third Strategy or in the present *e-Learning Pilot Scheme*. This contrasts with the trajectory of development of the three Singapore Masterplans where there is a sharpening focus on enhancing principals' understanding of e-Learning as well as challenges and strategies for initiating and sustaining pedagogical innovations. The MoE staff in Singapore is also playing a key role in strategically facilitating the formation of principal networks for experience sharing and collaboration in e-Learning innovations. Learning from past and present e-Learning innovations for sustainable development at both the system and school levels appears to be a greater challenge for Hong Kong.

7. Case report 5: Knowledge construction with technology in Japanese classrooms (CoREF)

Naomi Miyake

7.1 Case overview

The project for reforming public education in Japan has been in action for three years (launched in 2010), led by the Consortium for Renovating Education of the Future (abbreviated as CoREF) at the University of Tokyo, which is an organization founded with special funding from the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in 2008. It aims to change Japanese traditional teacher-centric education into more student-centred, socio-constructivist learning in classrooms in elementary (1st to 6th grades), lower secondary (7th to 9th grades), and upper secondary schools (10th to 12th) across Japan, on all subject areas, so that the university-level scientific knowledge would have a better chance to be integrated in their curricular, to let head-start the scientifically minded young learners. Currently the school structure of 6-3-3-4 (6 year elementary, 3 lower secondary, 3 upper secondary, and 4 college year stratification) is under review, to fulfil two purposes. One is to make shifts between school types smoother, to reduce drop-out rates during the first year of each school level as students make their transition. The other purpose is to integrate college-level education and secondary education, so that the secondary school students could foresee and better prepare for their academic career. This reform movement is in accordance with the review, to find a better way for university-level scientific knowledge to be introduced to younger students.

The reform is based on the strong pedagogy developed at the University of Tokyo and derived from learning sciences research to guide practice in classrooms, through local boards of education at prefectural (for upper secondary schools) and city and town (for elementary and lower secondary schools) levels. Teachers and schools are both self-selected and nominated by the respective boards to participate in the joint effort to foster the development of a diversity of learning outcomes, particularly those referred to as 21st century skills, in public-funded school classrooms, in the context of globalizing Japanese teaching/learning practices. The annual budget for the project is around 450 to 500 thousand dollar (USD) awarded by the Ministry of Education, Culture, Sports, Science and Technology to the University of Tokyo. Each participating board of education also carries some independent budget, in order to localize the support from the University of Tokyo to match its own needs.

The MEXT in Japan has a long history of changing the educational policy from a content-oriented to a more learning skills oriented one (MEXT, 2010). The *CoREF* project has been acknowledged to be one of the more effective reform initiatives in shifting the focuses in research, pre-service teacher education, in-service professional development, and assessment of learning outcomes in the classroom. The outcomes of this reform project are expected to provide evidence-based recommendations on educational policies, including the national standards, school grading systems and curriculum development. It is expected to promote ICT use in classrooms that are not just for enhancing ICT literacy as an independent set of skills, but more tightly integrated into the curriculum to model the use of ICT tools in the real world.

The aim of the *CoREF* project is to covert more traditional, didactic teaching styles prevalent in Japanese classrooms to more future-oriented, collaborative, knowledge constructive approaches. While this project is relatively new in terms of its history of development, it is preceded by many similar reform movements both in and outside of Japan. One of its conspicuous characteristics is the strong pedagogical underpinnings grounded on a socio-constructivist understanding of how people learn, originating from the cognitive and learning sciences (Bransford et al., 2000; Miyake, 2008; 2013). This will be elaborated in the following sections.

As of 2013, there are 51,467 schools in Japan: 13,170 kindergartens, 21,460 elementary schools (grades 1-6), 10,699 lower secondary schools (grades 7-9), 5,022 upper secondary schools (grades 10-12), 1,059 schools for students with special needs (grades 7-12), and 57 technical junior colleges (10-14). CoREF covers some 770 schools in this year. The official website for the *CoREF* project is at http://coref.u-tokyo.ac.jp/, with concise English introduction at http://coref.u-tokyo.ac.jp/en.

7.1.1 Key focus and goals of the innovation

While the participating researchers, policy makers, education leaders and practitioners may have differences in their foci for this project, there is consensus in the following:

- In achieving the learning goals described in the national guideline, it is essential to ensure each individual learner's ownership of learning. All the learners in one class may come up with the same answer, yet each of them should be assured to hold her/his own justification, understanding, related to her/his own trajectory of learning experiences, in and out of school.
- In addition, the reformed classrooms should also promote the development of 21st century skills such as communication, collaboration and innovation skills, through concrete learning activities.
- The learning outcomes in the *CoREF* project can be, and should be assessed during the process of learning, and not through one-off answers to a set of test questions and/or interviews. Assessing each individual's process of learning means that the frequency of such assessment has to be done at short, regular intervals and a lot more often than normally done so far, to feedback to teachers and researchers to support professional reflection. This would make "formative evaluation" truly "formative". The goal of assessment in this project is to foster the learning of individual learners, practitioners, researchers, as well as the society together as a community of independent "learners". This strong emphasis on diversity and independence of learning comes from the reflection shared by MEXT and the leading industries in Japan. One achievement in the reform history of Japanese education is the setting of a clear standard for every school to meet to make sure that the school can provide high quality education for every child who attends the school. While this has been successful, we now also realize that this approach does not allow sustainability and creativity, features crucial for the young today to make better worlds for them, by themselves.
- ICT can and should play a strong role in achieving the above-mentioned pedagogical practices and assessments.
- Policy makers and the society at large play crucial roles for this reform to scale.

7.1.2 Learners targeted

The target participants in this project cover learners from grades 1 to 12, in public elementary (grade 1 to 6), lower secondary (grade 7-9), and upper secondary schools (grade 10-12) in Japan. This stratification is currently under review by the Ministry of Education in Japan. Within this context, there have been exploratory projects to experiment with mixed practices, some more didactic and traditional, while some others cooperative, collaborative and more experimental, across different school types. Among these, the more futuristic practices have paved ways for our project. It is estimated that the number of learners exposed to the innovative collaborative classrooms in the *CoREF* project exceeds a total of 20,000. Records of students' achievements and questionnaire answers have been collected from about one-quarter of these learners, as data for this exploration. The details of these considerations will be explicated in more details in the evaluation section.

7.1.3 Learning outcomes targeted

The targeted learning outcomes include achievements in school subject matter content and the acquisition of learning skills, with particular focus on the 21st century skills. Through the promotion

of collaborative learning, the project aims at fostering the development of collaborative problem solving skills and ICT literacy, two new learning outcomes to be assessed in PISA 2015.

In addition to these, in alignment with the pedagogical framework of this reform, we define a new set of learning goals in terms of the portability, dependability and sustainability of learning outcomes. Portability refers to how far the learners can take with them what they have learned outside of the place they learned it, into other classes, other subject matters, higher grades, to homes and society. Dependability means that what they learned can be retrieved and modified for use in new situations, for solving new problems. The learning outcome is said to be sustainable when its owner can autonomously maintain and raise its quality by reflecting, modifying, and integrating it with information provided later. We will describe these and how they could be assessed in more detail later.

7.1.4 Technology used and the role of technology in the innovation

ICT plays two major roles in this reform. One is to network 5 to 10 education leaders, experienced as well as young, novice teachers at schools, to work together from the stage of designing teaching plans and materials, to practice, and then to reflect for the purpose of formative evaluation, across subject areas, types of schools and districts. A government-subsidized, multi-function wiki plays a major role in connecting small networks of same-school, same-subject, within district practitioners. Learning scientists and reform leaders from local universities, and retired, senior professionals from industries come in as educationally valuable human resources to integrate these small networks into network-of-networks, to create a large community of learners for learners. This concept of network-of-networks, or NNs, is expected to evolve further, rather quickly, to play a larger role to bring the level of Japanese public education to the globally competitive level. The other is an exploratory project of ICT-use in the context of everyday, high quality student-centric classrooms, so that the students will be using ICT fluently, as expected of the 21st century citizen. As a part of the *CoREF* project, a three-year project in one district has just started to provide support to teachers to explore pedagogical possibilities, make concrete plans to practice in their classes, share their experiences and learn from each other.

ICT is also expected to play a fundamental role in the scaling up of this project, which is critical for future developments. In order for teachers, students and practitioners to self-evolve, it is necessary to keep good records of learning to support professional, systematic and scientifically guided reflection. In Japan, classrooms of public schools are being equipped with digital textbooks, digital learning materials, and ICT tools such as digital blackboards and 1:1 tablets, but they are rarely equipped with enough technology to let the learning processes of the practices be recorded, processed and analysed to raise the quality of both teaching and learning through reflection in the social environments. This is considered one of the most important key factors for near-future success and long-term scalability of this project.

7.2 Scale and nature of the innovation

In the 2012 fiscal year (from 2012 April 1st to 2013 March 31st), this project worked with 83 core schools,[73] 675 core teachers and 60 education leaders from 20 boards of education. A total of 615 lesson practices have been recorded. Teachers from elementary and middle schools participated in the legal on-the-job training (OJT) workshops run by *CoREF*. All of the participants have tried some collaborative class practices according to our guideline and framework. This evolved into mutual, collaborative learning teacher communities. Table 6 shows how the project has scaled in quantity so far.

[73] Core schools commit to conducting open classes to showcase their practices, inviting other school teachers and public for discussion. Non-core schools do not have this commitment, but are free to showcase their practices to either a closed audience or to the public.

Table 6: Number of participating parties by year

	2010	2011	2012
Boards of Education	10	19	20
OJT training	0	0	2
Schools (core + non-core)	22	77	263
Elementary schools	4	18	52
Lower secondary schools	9	32	154
Upper secondary schools	9	27	57
Core participants	69	172	735
Elementary teachers	4	25	114
Lower secondary teachers	26	67	440
Upper secondary teachers	9	30	121
Ed. board members	30	50	60

Likewise Table 7 shows how the project evolved in terms of actual classes and recorded practices. The core teachers opened their selected cases to the public, for lesson studies. Among such cases published on the web, there are 121 lesson practices complete with teaching plans, learning materials, students' performance records and the class video. These provide the next generation participants with reference cases to kick-start their trials.

Table 7: Number of created lesson practices by year

	2010	2011	2012
Published on *CoREF* site	32	96	121
Elementary classes	4	27	19
Lower secondary classes	19	49	79
Upper secondary classes	9	20	23
Created at OJT training	0	0	615
Lower secondary classes	0	0	526
Upper secondary & elementary	0	0	89

7.2.1 Background and scale of the scheme

The background for this reform movement toward learner-centred, more group-work oriented practices has been prevailing in Japan, starting around 1960s. Prominent among them are the Hypothesis-Experiment Instruction (HEI) and one of the lesson-study movements called "Manabi-no-Kyodotai," or "School as Learning Community" (Sato, 2012). This pedagogical approach (Hatano & Inagaki, 1991; Itakura, 1971; Saito & Miyake, 2011) emphasizes the formation of plausible models, or "hypotheses", after predicting, discussing and observing the results of science experiments, carefully ordered in units, based on a strong democratic pedagogy emphasizing individual rights to learn, in mutually supportive environments. It focuses on creating classes where the learners can discuss learning topics freely among themselves, including expressing doubts and non-understandings, and asking for basic confirmatory questions and clarifications of others' ideas. This approach is currently in operation in more than 3,000 elementary and 1,500 middle schools, all

connected with lesson-study and action research movements. They are gradually scaling up, but have not extended to the policy level of working with the boards of education.

Apparently these and similar movements in Japan have paved the way for the *CoREF* movement to be recognized by the schoolteachers and principals, as well as by the board members and the Ministry. One consequence of this is the scale of the innovation. The association of *CoREF* with local boards of education was initiated by the policy makers, specifically the visionary persons playing a leading role in the boards of education. *CoREF* selects working partners from among the schools and boards that take the initiative to approach it, who share the basic vision of reform from the start. This means that it has never tried to make contact and persuade those schools and organizations that hold a different pedagogical understanding. Though this could create a serious barrier for *CoREF* in scaling up the innovation, the current strategy is to constantly create positive cases of success with current working partners as well as others who approach the project team. When the number of such cases surpasses the critical mass, the real impact of the project, as well as the robustness of the learning sciences in guiding the achievement of significant impacts will become evident.

7.2.2 Leadership and organization of the innovation at the system level

The leadership and organization of *CoREF* is tiered. The *CoREF* as an institution founded at the University of Tokyo leads the pedagogy, and provides frameworks for class practices, assessments, and schemes for running workshops, some as parts of the project activity and some as on-the-job training. The associated local Boards of Education work with *CoREF* and take lead in concretizing the pedagogy into practice. This takes three forms. One is to form a lesson-study like project team of teachers of the same subject. Their activities often take the form of action research. The second is the formation of a project team within a school, across different grade levels and subject areas. Another is to create a more broadly assembled team of members from participating boards and schools, distributed in from different districts. The organization of *CoREF* is a hierarchically networked community, within which there are small, overlapping networks of teachers, schools, policy makers and researchers forming communities and networks of many different types of combinations: a teacher in a school may be a member of a teacher community formed in the same school, a member of a different teacher community formed around the same subject area whose members are teachers coming from different schools, a member of a yet different community of teachers and board of education members, etc. The same vision and pedagogy of innovation runs through this tiered organization.

7.2.3 Leadership and organization of the innovation at the project/school level

The tiered organizational structure mentioned above allows participants at different levels to take a leadership position. At the same time, they could also serve as bottom-up forces to enrich the local activities.

7.2.4 Conceptual basis of the innovation

The conceptual, pedagogical base for innovation at *CoREF* is a fundamental framework about how people constructively interact to learn. This guides its policy-making and classrooms practices in steering the course of change in Japanese school education from teacher-centric, didactic pedagogy to learner-centred, collaborative co-creation of knowledge. The basic framework comes from a theory called "constructive interaction," which states that two persons, when engaged in solving a shared problem, exchange roles of a task-doer who proposes possibilities for solutions and a monitor who reflects upon such proposals. Such role exchange potentially promotes each participating individual's understanding of the problem, and eventually leads her/him to arrive at their own solution (Miyake, 1986).

Though group work has been common in Japanese classrooms, such practice has not been guided nor assessed via lenses of the cognitive and learning sciences. In the pursuit of acquiring 21st century skills, current classrooms have been trying to shift their practice from teacher-centric, fact-oriented training to learner-centric, knowledge-building learning. In such classes, the learners' activities are often socially interactive, or collaborative. There are many different ways to make a

classroom collaborative, and there is sometimes confusion about what leads to the different kinds of outcomes. Reviewing recent research in promoting collaborative classrooms, *CoREF* has identified answers to three research questions that clarify such confusion, and turned these into design principles for the basic collaborative class design framework. The three principles can be stated as (1) outcomes of constructive interaction are individualistic, not sharable by other members of the same group (or class), thus each learner should be allowed to hold her/his own expression of the solution, to claim ownership of her/his own understanding, (2) a learner who mostly listens and monitors can still learn as much as more active learners, thus the class activity does not have to assume or enforce equal chance of group members to talk or listen, and (3) for a constructive interaction to lead to productive learning, there is no need to strategically decide on who plays the leader role, but it is essential for the members to share the desire to solve an apprehensively shared problem, or to understand it. The group activity has to conform to these characteristics of constructive interaction.

The exact form of a typical class is provided to the teachers as a starting framework to directly experience the Knowledge Constructive Jigsaw (KCJ) classrooms. This is a strongly scripted yet dynamically modifiable collaborative learning situation based on the Jigsaw method, based on cognitive and learning sciences research on how people think and solve problems together (cf., Miyake, 1986; Shirouzu, et al, 2002; Miyake & Kirscgner, in press). KCJ is the pedagogical framework underpinning the reform in *CoREF*. It emphasizes that each individual student is responsible for integrating the perspectives given by the learning materials and from other students with their own understanding. The class design involves a shared question to be answered and some relevant learning materials from different perspectives distributed among the different groups first in expert groups, to be later exchanged and integrated to answer the question in the jigsaw groups that consist of one member from each expert group (Miyake, 2011). The design naturally requires each student to become a task-doer in the jigsaw group. It also provides each student with chances to be a monitor who infers what the other students say and why they say that, to integrate others' ideas with their own. Yet how often and/or how long one participant plays the role of the doer could differ from individual to individual, and the proportion itself does not affect the quality of outcome. This view is shared by other studies in the field including the importance of "constructive monitoring", similar to the notion of "constructive listening" proposed by Greeno and van de Sande (2007), for better analyses and design of the interactive learning processes (Damsa, et al., 2010).

7.2.5 Summary

Figure 17 presents a mapping of the nature and scale of the *CoREF* project onto the SCALE-CCR framework for ICT-enabled innovation for learning (Kampylis, Bocconi & Punie, 2012). Although the use of ICT is still incremental, KCJ encourages teachers to create realistic situations where the students could find the ICT tools to be both natural and useful. Within *CoREF*, the actors targeted is wide across public schools, their boards of education, research universities, sections of MEXT, as well as senior professionals and their Non-Profit Organizations (NPOs) committed to raising the quality of education. The project schools are spread widely over the geographical regions within Japan, though the coverage is somewhat biased toward south to west of Japan, and so the access level is towards the regional end of the spectrum.

CoREF has influenced school teachers to change their pedagogy and lesson practices, and boards of education to change their OJT trainings. One impact the project has made at the system level is that MEXT is starting to re-evaluate the basic research plan to include collaborative learning as an indispensable challenge to be included in its next national guideline. A few research universities are to form programmes and centres to take learning sciences more seriously. The *CoREF* project itself is moving to reach out to senior professionals, who would be going into schools not just to raise the quality of education but more importantly to widen its scope so that what is taught in schools now would have tighter connections to what is needed in real life in the society.

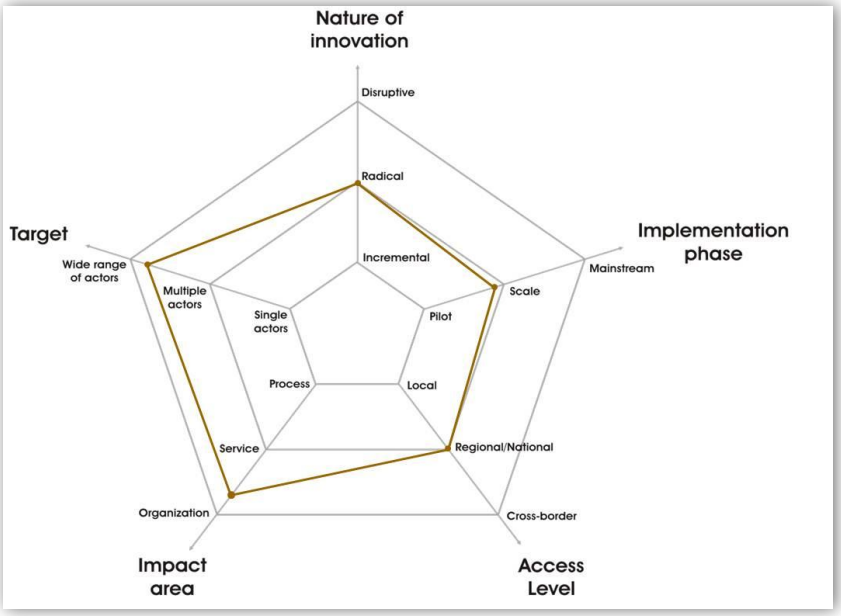

Figure 17: Mapping the *CoREF* project onto the SCALE-CCR framework for ICT-enabled innovation for learning

The implementation phase is pilot, moving towards the scale level, contributing to the development of learning and teaching practices for all subject areas, to be shared among the already participating boards of education and then ready to spread into other education boards. Even though the project has been accepted by many teachers as "possible extensions of what they have been trying to achieve, not unreachable as their next step," the change this project could bring about in terms of goal settings and balance of roles between teachers and the learners could be profoundly deep, to modernize Japanese education. In this sense, the nature of innovation is radical. It could take, at least some ten years or so for this reform to be the mainstream standard of lesson practices in Japan. The project has impacted organizational level by having the education boards to restructure their teacher support sections as well as the OJT sections, so that those two sections, which have been working independently, to work together, for better results.

7.3 Strategies for implementation and scaling up of the innovation

The core strategy for implementation and scaling is to spread the core pedagogy mentioned above on how people learn in social contexts, and on the learning science basis of collaborative learning practices. All the workshops and joint work between *CoREF* and its associate members such as teachers, schools, boards of education, learning science researcher groups of other universities as well as support groups of senior professionals are designed with this strategy, so that the participants would also be able to explain the basic pedagogy to enhance and spread it to others. This can be done in diverse ways, such as creation and sharing of practice plans and materials, co-constructions of new lessons, opening their classes to be observed and discussed by new comers, developing new assessment methods to better communicate the foundations and outcomes, and publishing the endeavour. This case report is one of such efforts of *CoREF*.

7.3.1 Agency for change

Agency for change is tiered, according to the tiered structure of *CoREF*. In the tiered structure, there are the top and middle levels, centralized and de-centralized leaders, as well as actors at the bottom to middle level stratifications. Hence all the four types of agency for change indicated in Figure 18 can be found in the present project.

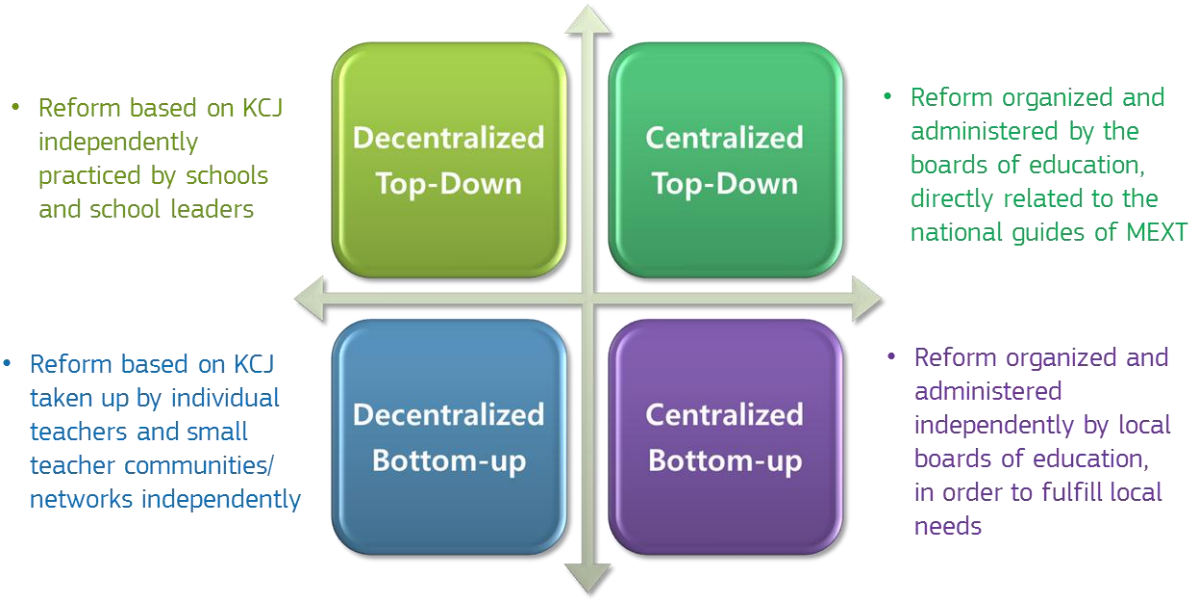

Figure 18: Leadership initiatives found in the *CoREF* project in Japan at the system level

In the *CoREF* project, there is definitely Centralized Top-Down strategy involved because it is led by the *CoREF* learning science consortium at the University of Tokyo, which is funded by MEXT and supported by Boards of Education. The prefectural boards of education themselves are decentralized because each one has its own policy and vision, which leads to the decentralized top-down fashion for the schools to participate in the project. One level down from there at each school, the principal and the education leaders forming the core of the reform as a "top" to lead each individual participating practitioner. When the project is viewed from the perspectives of these practitioners, they are free to create her/his own class with their own materials, share freely with the participating and other teachers in the same and other schools, across different subject areas. Hence such leadership is exercised in a de-centralized, bottom-up fashion. These local efforts are put together by the local boards of education, each of which independently form the bottom-up base to create the de-centralized leadership with other education boards, to the entire project.

The project also takes advantage of the communities of learning science researchers belonging to other universities, education supporter communities (often in the form of NPOs, or Non Profit Organizations), of senior professionals, as well as groups of academic societies who all are experienced educational supporters. *CoREF* integrates their efforts to lead this reform, so that each such community can contribute, both centrally to their members and de-centrally by keeping their independence, to promote the reform.

7.3.2 Professional development provisions

CoREF has successfully taken responsibility for professional development provisions, required both by the Ministry as well as by local education boards. The Ministry requires OJT for beginning teachers for secondary schools. In Saitama prefecture, all the participants are required to create and run at least two Knowledge Constructive lesson practices in their schools. The training consists of a one-day workshop on the basic socio-constructivist view of collaborative learning through experiencing such class activities. It comprises a half-day workshop to study sample class records, with assessment and class design creation for two actual classroom practices complete with record keeping; and another half-day exchange of such experiences and follow up discussion with experienced teachers. About 40 % of the trainees plan to continue this practice into the second year and beyond. Some 10 % of them agreed to act as mentors for the next year's OJT training. A local education board at Kashiwa-city in Chiba prefecture created their own 5th year OJT training for all middle and elementary school teachers. They participated in a three-day workshop to cover similar contents, to be able to run the KCJ classes at their schools, one of which was opened for public lesson study.

7.3.3 Governance, management and school routines

These are taken care of by each participating school, under the guidance of its principal as well as the rules set by their local boards of education. As for running the KCJ, they also conform to the common rule of making the teaching plan and learning materials available to others, opening all or part of the student performance records, particularly their answers to the class questions at the beginning and end in comparable forms, and the audio and video records of the class. Schools are also encouraged to report the status of their students' understanding levels and situations in the previous and subsequent classes. In addition, participating teachers are expected to report their findings when they undertake some evaluative action, such as comparing classes run under the framework against more didactic classes, or testing the students at their term exams held some intervals (such as three to six, or even twelve months) after the experimental classes were conducted. These additional, spontaneous evaluation reports from teachers are so valuable that these have been announced to be a part of the project routine.

7.3.4 Monitoring and accountability mechanisms

The tiered structure of the organization allows each level to monitor the activities above and below, to come up with their own accountability interpretations. Two connected tiers often get together to exchange their monitoring results and check accountability. *CoREF* as a whole group gathers once a year, separately for prefectural and city-town boards of education, to host a symposium for internal exchange of monitoring results and to communicate with outsiders on this project. These opportunities provide us with chances to expand and scale up our movements to new participants.

7.3.5 Evaluation mechanisms used

Outcomes and achievements of our project require defining a new set of goals to achieve, examine and refine new assessment methods. Currently the new set of goals is defined as content achievement, its portability, dependability and sustainability. Outcomes of learning, including both content achievements and acquisition of cognitive skills, have to be "portable" in the sense of being taken out by the owner to other, new situations; "dependable" in the sense of being usable in adaptive ways by the owner to identify and solve new problems; and "sustainable" in the sense of letting the owner ask new questions, get motivated to learn further, and integrate them with new pieces of information and knowledge for the creation of innovative ideas.

Content achievements: Content achievements are assessed at several points in the learning process. As mentioned above, the class opens with answering the topic question of the day and ends with answering again the same question. Most often the answers are collected in written form, but they can be in any form, such as diagrams, models, or concept maps. Each individual's two answers can be compared against each other, with reference to the practitioner's expected answer. The answers can also be assessed as a class to find out how one class compares against other classes, differing in time, school and across districts, if any of such comparison is meaningful to make the practice better.

Portability: Among other cognitive skills, portability has been measured most often by asking students the same question again in much larger intervals, like 3 to 6 months, or a year. This can be done through interviews, or at summative test sessions. Asking the learners to solve a near transfer problem after such an interval, in different subject area contexts, can also assess portability. Teachers in the same school can exchange their observations of how often, and in what ways, the students mention what they have learned in KCJ classes in other contexts, like in a class of different subject area, or a class at a different grade level.

Dependability: When some learning outcome is dependable, its owner learner should be able to solve far transfer problems. The dependability can be observed by teachers on how well the students can solve the problems and understand the core materials when they proceed into a more advanced, new lesson unit. Teachers' reports on the ease of teaching after the KCJ-oriented introduction can be an indication of dependable learning.

Sustainability: The sustainability has been measured by the amount of work they do after the class in relation to what they have learned. This could happen during recesses, after school sessions, or at home. Sustainability can also be measured by the students' answers to questionnaire questions about how much they prefer to study in the KCJ type classes, on further, more challenging topics. In addition to these we are developing a new assessment method to categorize and count the number of self-generated questions on topics taught in the KCJ classes. Such questions themselves are indicators of sustainable learning. We also plan to create extended curricular to support the students to follow up on their self-generated questions, so that we could understand how such questions could be a new resource of learning, to strengthen its sustainability.

7.4 Outcomes and achievements

7.4.1 e-Learning pedagogy

The idea and the fluency of the network of networks have spread widely among the stakeholders. The concrete, effective cases for e-learning KCJ are just coming in, to be expanded in the continuation of OJT trainings scheduled to happen in two education boards in the 2013 fiscal year, and then to expand to two more boards in 2014. We plan to assess the outcomes in the same way as KCJ outcomes.

7.4.2 Student learning outcomes

Content achievements: The content achievement levels for the KCJ classes measured with traditional tests tend to be high, at around 60 to 80 % compared to 30 to 60 % in regular classes. The comparison of the two answers taken at the beginning and the end of the class constantly shows the progress of and the depth of learning. Performances on near transfer problems, as well as teachers' reports of cases where the students mentioned about their KCJ learning in other subject topics, are common, showing the potential for portable learning in the KCJ lesson practices.

Portability: The portability of KCJ lesson outcomes has been reported high, even after six months to one year later, though the number of such reports is still small. High performance on near transfer problems and reports of students' spontaneous mentioning of KCJ learning outcome in classes on different subject areas are common, indicating the strengths of the KCJ curricula.

Dependability: As mentioned above, the dependability is assessed through practitioners' reports. A math teacher at grade 4 reported a case when she taught how to find the area of a composite rectangle (a composite shape created by juxtaposing two rectangles) using the formula of pure rectangle area in the KCJ fashion. Her students were ready to "make up" a new formula for triangular area on their own, even though the new formula was a topic to be taught in the subsequent unit as a "new topic to be learnt". A history teacher at an upper secondary school reported that after teaching several units of European history, his students developed the attitude to look into complex, intricate dynamics behind a newly introduced "historical event", apparent from the utterances of the learners like, "Ok, who were involved in what kind of roles, this thing cannot be explained by one cause, of course". We plan to collect these reports systematically in 2013, to clarify the nature of dependability so that we could develop better assessment methods.

Sustainability: For the learning outcome to be sustainable, teachers often gather data from consequences of the KCJ classes. They tend to increase "spontaneous homework", which is homework done at home not because it is assigned by the teacher, but because the student wished to extend the study. A more interesting case of KCJ class outcome's sustainability occurs when the scheduled class period ends before the intended activities and objectives are completed, which is not rare. After such a class, teachers often notice and report that the students kept working over lunch and stayed in school to continue, and they often come back to the next class ready to give their new, more developed answers.

We have observed that the KCJ classes tend to let students generate their own "next challenges," or advanced questions. After reaching the understanding that a leaf of a tree looks green because it does not use the green spectrum of light for photonic synthesis, an upper secondary school student asked, "Do the leaves of sea-weed look brown because they need all spectra of light?" After learning

what the cloud in the sky is made of and how it is made, a lower secondary student asked why the water changes its state from liquid to gas at 100 °C, and how common such change of state is with materials on the earth. Such questions, when answered properly, do encourage the learning to continue, either in class or at home. We are currently exploring the relationship between the kind of learning contents and the self-generated questions. One tendency appears to be stable: when the learning materials are laid out in engineering context rather than in scientific context they tend to encourage more engineering oriented questions. These observations provide us with a new set of research questions for further investigation into proper assessment methods.

The students' answers to the questionnaire asking about the positive perception of their own progress of learning stay constantly high (around 80%). The trend is higher for elementary and secondary students, yet not low at all for upper secondary school students. The percentage of positive answers does not differ between schools with high achieving students and schools believed to have more low achieving students. The more experiences the teachers have, the more positive the students' answers. This positive feedback could be interpreted not as due to the novelty of this approach, but as evidence of having cultivated the learners' potential learning skills which are portable, dependable and sustainable.

7.4.3 Teacher learning and professional development

Teachers come to freely discuss among themselves in small networks about their experiences of success and failure, using terms they have acquired from the learning and cognitive sciences. We have found that three years of experience could prepare teachers to become ready to act as effective mentors to non-participating teachers at workshops as well as in their own schools. This is good news because such professional development could be a key to a naturally evolving scale up of this kind of reform endeavour.

Let us illustrate a case we have identified as a profound change of an experienced teacher in one upper secondary school. He spontaneously joined the core teachers of our project at the same school, realized the value of the KCJ method, and developed a new curriculum and a set of new assessments to measure the outcomes. In essence he changed his tests from "fill-in-the-blank and multiple choice" type to "read and summarize some new texts and criticize them" type, on topics related to what they had learned through the KCJ approach. What he found was that the students performed a lot better on these "more difficult" tests. The average score was around 80% correct. He commented on this experience, "We could have underestimated our students. They perform a lot better, if we help them to develop their learning skills they already have but have not used fully."

7.4.4 Collaboration and community building among schools within the same project cluster

As mentioned above, schools in the same district, under the governance of the same education boards, as well as across districts are starting to form a network-of-networks to share their experiences and understanding of how people learn, to achieve higher quality practices. We need to take advantage of this, to act as yet another key to scale up our reform.

7.4.5 Working with business partners

We have two different types of business partners. One is Japanese leading industries, including ICT companies, to help support our reform endeavour by providing information to be used in KCJ classes, working with teachers to develop KCJ learning materials, conducting after school reform-related workshops, and such like. The ICT sector also plans to work with us to develop better solutions of collecting and utilizing potentially big data of learning processes coming from collaborative classrooms. The other business partners are senior professionals who retired from their companies. We are developing schemes for these senior R&D professionals to help school teachers create teaching plans on topics outside of MEXT endorsed textbooks (which is roughly in the direction of bringing in more engineering into science, for example) to have them help create teaching plans as well as cloud-based answering systems to take care of the sustainability of the learning outcomes.

7.5 Innovation prospects: sustainability and scalability

7.5.1 Key existing factors that contribute positively to project sustainability

Recently, MEXT decided to award the University of Tokyo to continue the reform project at *CoREF* for five more years, from 2013 to 2017. The superintendents of schools associated with *CoREF* are working to increase the number of participating boards of education. Possibilities for stronger ties with industries are being explored, particularly in the use of ICT for better professional reflection, record keeping and analyses.

7.5.2 Key existing factors that challenge project sustainability

There are many challenges to sustainability in the introduction of a different pedagogy, with different visions for the future of learning. Raising standards of learning up to globally competitive levels is another challenge, particularly when movements like MOOCs need to be taken into account in the reform. MOOCs, in one way, could provide basic, didactic information-disseminating, web-based classes to be used in flipped style classes, which could strengthen some aspects of Japanese public education. They could also give support to globally-oriented movements where the Japanese students could be recruited into world-leading higher education institutions. If this latter trend would become stronger in Japan, Japanese local schools would need to strengthen local education, to sustain and develop local communities. How to balance globally oriented and locally supported education has become a challenging problem for all schools in Japan.

7.5.3 Prospects for project scalability

In the coming two to three years, the project participants are expected to expand by 20% to 30% each year. There is already enough interest in the community to make this happen. The other prospect comes from reform movements in entrance exams of colleges and universities, and developments of exchange classes between upper secondary schools and universities, both of which are current top priorities for top universities and upper secondary schools in many districts, and provide us with chances to expand our reform efforts.

7.5.4 Strategies most critical to the sustainability and/or scalability of this innovation

We regard the strategy for shifting the pedagogy of teachers as most critical for our scalability. The strategy of networking small, effective networks appears to be a successful way to approach, yet we need to keep looking into other possibilities. The potential use of ICT to collect and analyse the learning process data from many classrooms participating in this project could enhance effective reflection among teachers, which, in turn, could be a necessary and promising strategy to make the shift happen more quickly.

7.5.5 Most important impact of this innovation

The most important impact we have started to observe, and would like to witness is actualizing the higher level of educational practice ubiquitously, from the bottom to the top, to cover all the students. By “the higher level of educational practice” we mean higher than what Japan has achieved in general so far. Japanese public schools have been successful in helping the students to achieve a set goal through a uniform process. We are trying in this project to raise the level from “achieving the set goals” to “going beyond such goals.” In order to do this, we have developed a new method of practice to help students achieve not only a deeper comprehension of the contents, but also the better strategies of self-regulated learning through constructive interactions. This shift has to happen “from the bottom to the top”, by which we mean not just the top-achieving students but the students who used to be regarded as at the “bottom” level. We are beginning to identify cases where the method we propose has improved the individual progress of the students who were not regarded as “good” students but were able to strive and perform at higher levels through constructive dialogues in classrooms

7.6 Reflections and issues

Reflections on what we have done in the recent four years give us three challenging topics. The biggest challenge of the *CoREF* project resides in the need to change the basic concept about learning of both the teachers and the learners. The old, experience-based concept of learning was didactic, a process involving those who know handing down the knowledge to those who do not know. The society requires a newer concept, which defines learning as a process rather than an outcome. Learning as a process has to be dynamic, practiced by each individual differently from others, and progresses over time. The teachers who are quick to grasp this shift tend to be more successful in our project. We do not know yet a sure method to support the slower teachers' conceptual change.

Secondly, we have come to realize that the needed conceptual change could be promoted by providing the newcomers with already established teaching plans, with matching learning materials, so that they could "experience" the differences. To do this, we need lots of good plans, already tested-out in classes. This is a challenging task for us, because of the volume of plans we need to develop.

Thirdly, we need to rapidly grow the number of learning scientists, who could bridge theoretical understanding and effective practices. Learning sciences has not been taught well or encouraged to develop either in undergraduate programmes or in graduate schools. We could learn a lot from other countries where there are strong centres in the learning sciences, such as Hong Kong, Singapore, Australia, the U.S.A. and some European countries.

CoREF has worked so far to raise public awareness for needing more real, concurrent data of how people learn, because while the students talk and think in KCJ classes, their dialogues and associated externalized objects are rich sources for analysing the learning processes at micro levels. Teachers, for the first time in our educational reform history, are ready to reflect upon the data showing how her students, individually thought, solved the problem, and learned in the target class, each time she conducts the KCJ class. The education leaders both at school and the education boards are ready to join the teachers to collaboratively create next class plans, based on such reflections. The learning scientists are also ready to work together with the teachers, the students, and the education board leaders so that they all, as a learning community, promote the reform led by *CoREF*. This is a new movement, yet to be jointly promoted by similar movements in the U.S.A., as well as in Europe, under the name of the "big data," or e-science projects. We are currently discussing possibilities for concrete collaboration in this direction (i.e., to promote learning sciences of how people learn and promote reform based on the findings to come) with institutions from U.S.A. and Canada.

8. Case report 6: Singapore's third Masterplan for ICT in education (mp3)

Chee-Kit Looi

8.1 Case overview

Singapore is a small city-state with one of the highest gross domestic product (GDP) per capita in the world. With a key national focus on developing human capital, its ICT in Education policies are formulated with the goals of preparing its student citizenry for the knowledge-based economy, and to enhance the learning experiences of students in schools.

In August 2008, the *Third Masterplan for ICT in Education* (mp3) was launched by the Minister of Education, working towards the grand vision of "Harnessing ICT for Future Learning" (Figure 19). The First Masterplan (mp1), which ran from 1997 to 2002, focused on equipping schools with the basic ICT infrastructure and in training teachers with a basic level of ICT integration. The Second Masterplan (mp2), which ran from 2003 to 2008, focused on effective and pervasive use of ICT in Education by seeding innovations in schools. *mp3* "continues the vision of the 1st and 2nd Masterplans to enrich and transform the learning environments of students and equip them with the critical competencies and dispositions to success in a knowledge economy".[74]

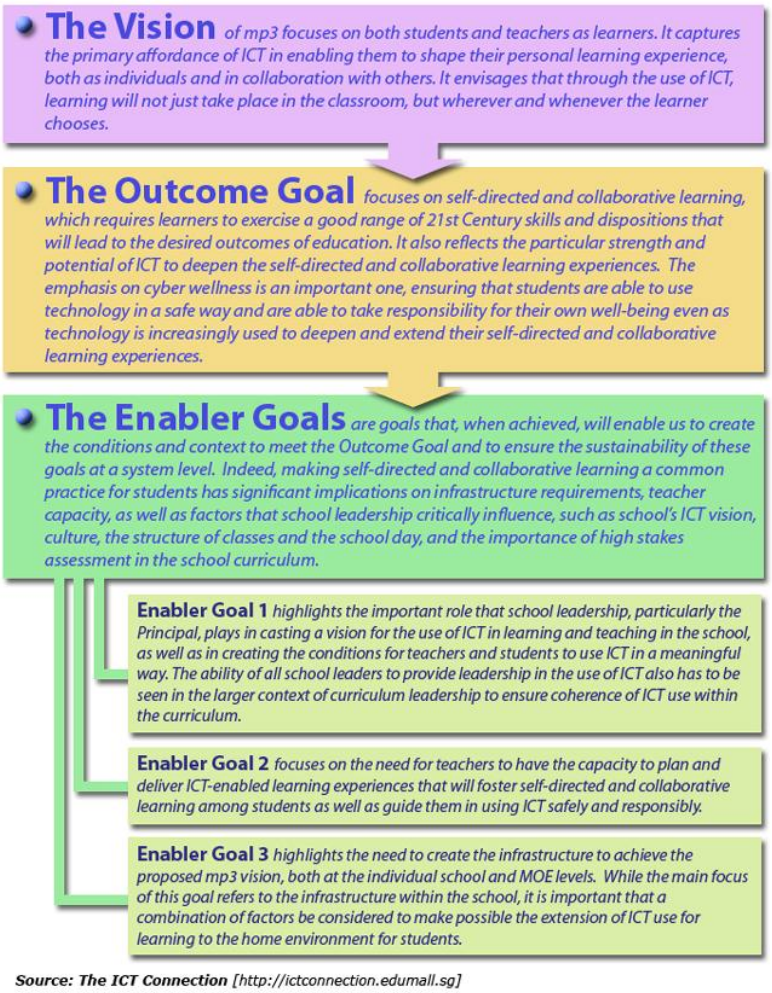

Figure 19: Outcome and Enabler Goals for *mp3* (source: http://ictconnection.edumall.sg)

[74] http://ictconnection.moe.edu.sg/masterplan-3

mp3 is a very concerted government effort to drive the use of ICT for teaching and learning in Singapore schools. It has a very clear focus and the Ministry of Education (MoE) set up a division as a focal point to drive the Masterplan. *mp3* involves high-level government support including a significant level of financial investment, a complex array of different types of support and strategies (targeted at different levels of the education system and the whole eco-system of education including industry and other service providers) and multi-pronged strategies aimed at school leaders, mid-level school administrators, teachers, teacher educators, parents and others.

Thus a study of *mp3* represents an informative study on how such centralized efforts in the city-state together with bottom-up initiatives in the area of ICT in education have impacted teaching and learning processes and outcomes. The study will illuminate how various initiatives have been implemented and their scale up success.

Education and government officials from many countries and regions have come to Singapore to study the city-state's *mp3* and its implementation. It is timely now to document the current status and progress of *mp3* as a succinct case study of a national learning innovation project in Asia. The budget for implementing *mp3* is not disclosed publicly as an official position, at least before its completion. To provide some indications, mp1 (1997-2002) had a total budget of $2 billion in Singapore dollars (approx. 1,19 billion euros), or on an annual basis, $650 per student (approx. 387 euros) or $1 million per school (approx. 595,000 euros; Lee, Goh, Fredriksen & Tan, 2008). mp2 (2003–2006) had a budget of $600 million (approx. 357 million euros), or $300 per student (approx. 179 euros) or $450,000 per school (approx. 268,000 euros). The cost of mp1 was higher as it provided the capital investment needed to equip schools with the necessary ICT infrastructure.

The official website for *mp3* is:
http://ictconnection.edumall.sg/cos/o.x?c=/ictconnection/pagetree&func=view&rid=665

8.1.1 Key focus and goals of the innovation

Working towards the vision 'Harnessing ICT for Future Learning', the four *mp3* goals are: (i) students possess competencies for self-directed and collaborative learning through the effective use of ICT; and (ii) teachers have the capacity to tailor and deliver ICT-enabled learning experiences for students to develop these competencies; (iii) school leaders provide the direction and create the conditions to harness ICT for teaching and learning; and (iv) ICT infrastructure that supports teaching and learning anywhere, anytime. Figure 19 shows the outcome and enabler goals for *mp3*.

8.1.2 Learners targeted

mp3 is a national level initiative, covering all 362 schools in Singapore. These include primary schools (Primary 1 to 6), Secondary Schools (usually Secondary 1 to 4), and Junior Colleges (JC 1 and 2), typically providing school education for students with ages 7 to 18.

8.1.3 Learning outcomes targeted

The key focus of *mp3* is on self-directed learning (SDL) and collaborative learning (CoL) with ICT. It is believed that engaging students in SDL and CoL with ICT could better prepare Singaporean students to meet the challenges of the 21st century.

Students develop competencies for self-directed and collaborative learning through the effective use of ICT as well as become discerning and responsible ICT users. Drawing on Gibbons' definition (2002) of SDL as initiating personally challenging activities and developing personal knowledge and skills to pursue the challenges successfully (Gibbons, 2002), MoE considers students to be engaged in SDL if there is some manifestations of ownership of learning, management and monitoring of own learning, and extension of own learning.

Collaborative learning is where students work in pairs or groups to solve a problem or to achieve a common learning objective. Students engaged in collaborative learning are expected to develop Effective Group Processes, and Individual and Group Accountability of Learning.

There could be other goals with technology as an enabler such as developing new media literacies, focusing on formative assessment, data-driven teaching and learning, developing skills for

creativity, teaching productivity skills, and so on (Reich, 2012). Singapore has chosen just two of these to focus on, namely, self-directed learning (SDL) and collaborative learning (CoL).

8.1.4 Technology used and the role of technology in the innovation

mp3 is about students developing competencies for SDL and CoL through the effective use of ICT as well as becoming discerning and responsible ICT users. ICT is central to the innovation.

8.2 Scale and nature of the innovation

The broad strategies of the third Masterplan for ICT in Education are (MoE, 2008):

1. To strengthen integration of ICT into curriculum, pedagogy and assessment to enhance learning and develop competencies for the 21st century;
2. To provide differentiated professional development that is more practice-based and models how ICT can be effectively used to help students learn better;
3. To improve the sharing of best practices and successful innovations; and
4. To enhance ICT provisions in schools to support the implementation of *mp3*.

These strategies are elaborated below.

Strengthening integration of ICT into curriculum, assessment and pedagogy

ICT will be more extensively integrated into the planning, design and implementation stages of the curriculum, assessment and pedagogy. Students' learning outcomes in the syllabi, national examinations, and classroom experiences will be aligned to 21st century skills such as ICT skills, and the ability to communicate persuasively and collaborate effectively. Students will be required to use ICT to look for information, synthesize reports, give peer feedback, and collaborate with peers within and outside school.

Differentiated professional development

At the systems level, MoE will train a pool of ICT Mentors with strong pedagogical groundings to model and lead professional development efforts within and across schools. A learning roadmap will also be developed to help pace teachers in learning how to effectively use ICT in their classes. At the school level, school leaders can create the environment for teachers to reflect and learn from each other about effective teaching practices that incorporate ICT use in the classrooms to achieve desired learning outcomes for their students.

Improve the sharing of best practices and successful innovations

To improve the creation and sharing of best practices, MoE will support the establishment of a funding scheme called eduLab. The scheme invites applications from schools, possibly working in collaboration with university researchers and fund will be provided for the creation, prototyping and testing of school-initiated innovations.

MoE supports schools to innovate in the use of ICT and facilitates the sharing of good practices among schools through programmes like the FutureSchools@Singapore and LEAD ICT@Schools. The FutureSchools@Singapore initiative was launched in 2007 as a key strategy of mp2 and subsequently *mp3* to support a small number of schools to become technology-enabled Future Schools (FutureSchools@Singapore, 2011). The original plan targeted 5% of schools to be under this programme. These are schools that will push for innovative transformation of the education experience in Singapore. They will lead the way for other schools in providing possible models for the seamless and pervasive integration of ICT into the curriculum for engaged learning in schools. Working closely with the Ministry of Education (MoE) and the Infocomm Development Authority (IDA), FutureSchools@Singapore focuses on innovative teaching approaches that leverage fully on ICT and novel school infrastructure designs to bring about more engaged learning for their students.

The LEAD ICT@Schools programme was launched in 2005 to support schools that conduct research on ICT-based pedagogies and schools that want to experiment with existing ICT-based pedagogies

on a significant scale (Koh & Lee, 2009). Schools awarded participation under this programme have additional funds for ICT implementation. About 15% of schools are under this programme.

Enhanced ICT provisions

Accessibility of ICT to students will be increased through more flexible and mobile infrastructure provisions such as wireless internet access, piloting 1-notebook-to-1-pupil ratio in more schools, and higher data bandwidth to the Internet.

8.2.1 Background and scale of the scheme

As mentioned before, *mp3* is a national level initiative, covering all primary and secondary schools, and junior colleges in Singapore.

8.2.2 Leadership and organization of the innovation at the system level

mp3 is led by a *mp3* steering committee in the MoE headed by the Director-General of Education and senior officers (including some school principals), and its implementation is led by the Educational Technology Division of the MoE which provide directives, resources and staff to support schools in the meaningful use of ICT.

8.2.3 Leadership and organization of the innovation at the project/school level

The principal provides the leadership at the school level. Every school has a Head of Department in ICT and an ICT committee that plans and budgets for the use of ICT every year. An important way that teachers are supported in the use of ICT in teaching is through collaborative professional development. An account of professional development at White Sands Primary School (Jackson, 2012) may be a typical account of what is happening in most schools. Teachers meet in monthly professional learning teams to engage in various forms of collaborative professional development to improve the use of ICT and further the school's goals. One of the main professional learning activities is lesson study, where teachers work together to plan, teach, observe and discuss actual classroom lessons. Through lesson study, teachers actually can see technology being used in a live lesson instead of just getting a workshop. Afterwards, they can discuss the good aspects of the lesson and also make suggestions for how to improve. Other professional learning activities include action research, and weekly timetabled time where teachers share and develop best practices in the classroom. The ICT mentor teacher attends all of the professional learning team meetings in order to provide expert advice. These professional development efforts have helped place White Sands at the forefront of innovation and ICT in Singapore.

In terms of research support by the government for innovation in ICT and digital media use in schools, the National Research Foundation (NRF) has a comprehensive framework to grow Singapore into a global Interactive Digital Media (IDM) capital, and research and development on IDM in education is one of the key strategies within this framework to develop Singapore's IDM sector in order to propel Singapore's economy forward and contribute towards the advancement of society.

The MoE's R&D on IDM in Education Programme will support the broader vision of growing Singapore's IDM brand and the Singapore Education brand. MoE plans to support R&D projects on IDM in education that could potentially lead to engaged learning for students in both the school and higher education sectors, development of educational models and tools to equip students with the right skills and competences to be ready for an IDM pervasive environment, and commercialisation of successful pedagogical models, tools and content, where appropriate.

The R&D on IDM in Education programme is headed by the Director of Educational Technology. An R&D programme office has been set up at MoE to be the single point of contact for all matters pertaining to IDM R&D in both school and higher education sectors as well as to oversee the evaluation of collaborative IDM R&D projects.

The MoE has funded the National Institute of Education with two five-year tranches of research funds for doing educational research. The Office of Education Research in the National Institute of Education (NIE) is responsible for awarding funds and managing educational research in Singapore.

A significant segment of the research involves studies pertaining to ICT in education. The Learning Sciences Lab (LSL) was set up in 2005 with the mission of fostering deep student learning with technology-enabled pedagogical practices for cultivating 21st century knowledge and skills through learning sciences research in Singapore schools. Over the years, LSL researchers have worked closely with the schools in Singapore and with the MoE to conduct design-based research on design interventions often involving technology-enabled pedagogies.

8.2.4 Conceptual basis of the innovation

The Masterplans for ICT in Education drive the use of ICT in education. The underlying philosophy of the Masterplans is that education should continually anticipate the needs of the future and prepare students to meet those needs (MoE, 2008). In the first Masterplan for ICT in Education (1997 — 2002), a strong foundation was laid for schools to harness ICT. This included the provision of basic ICT infrastructure and in equipping and training teachers with a basic level of ICT integration competency, which achieved a widespread acceptance for its use in education.

The second Masterplan for ICT in Education (2003-2008) built on this foundation to strive for an effective and pervasive use of ICT in education by, for example, strengthening the integration of ICT into the curriculum, establishing baseline ICT standards for students, and seeding innovative use of ICT among schools.

The third Masterplan continues the vision of the first two Masterplans to enhance and transform the learning environment of students, and to equip them with the critical competencies and dispositions to succeed in the knowledge economy. Thus a key conceptual focus for *mp3* is to equip students and teachers with the 21st century competencies and dispositions. MoE has articulated its own statement of 21st Century Competencies (21CC), and *mp3*'s vision and goals are aligned with these competencies (21CC). For example, they share some common emphasis especially when it comes to the development of competencies and mindsets in our students for Self-Directed Learning (SDL) and Collaborative Learning (CoL)—skills and dispositions which are required of tomorrow's workers.

The MoE website on *mp3* describes[75]:

> "In *mp3*, we want to work with schools to help nurture SDL and CoL inside and outside the classroom through effective use of ICT. If we could get our students to explore and make use of the powerful affordances of ICT, we could enrich their learning experiences. At the same time, we cannot forget the need to nurture in them critical faculties to use technology wisely and in a discerning way – to respect themselves even as they respect others when using ICT.
>
> *mp3* has communication strategies that support such an approach. It seeks to build common understanding of its goals and vision, as well as key concepts. In this way, school leaders and teachers will have the capacity to create helpful structures for their own school and classrooms. They will need to customize these structures, so that they can meet the unique needs of school and classroom.
>
> 21CC cannot stand alone. For its ideals to be realized, it has to be carried out through other policies and strategies. All these have to work together in harmony towards their common goals. And *mp3* is part of this essential support. How well we achieve these goals is directly affected by whether schools can make the best use of ICT to emphasize SDL and CoL. Through *mp3*, we empower school leaders and teachers, helping them to increase the depth of Technological, Pedagogical, Content Knowledge (TPACK) in the classroom."

There is a sense that a focus on two specific goals creates the traction to enable implementers such as teacher-practitioners to cope well with it as a phased approach rather than tangle with a host of different foci.

[75] http://ictconnection.moe.edu.sg/masterplan-3/mp3-towards-21cc

8.2.5 Summary

Figure 20 presents a mapping of the nature and scale of *mp3* onto the SCALE-CCR framework for ICT-enabled innovation for learning (Kampylis, Bocconi & Punie, 2012). As *mp3* is a comprehensive national programme, different aspects of the policies, plans and implementation span different dimensions of the SCALE-CCR framework. As *mp3* is at the systems level and involves multiple and multi-pronged strategies, the target group includes a wide range of actors and stakeholders. Impact happens at different organizational levels at the system, school cluster, and school levels, as well as at the individual level. The impact spans service and process changes. Clearly the intent of *mp3* is to transform teaching and learning in the mainstream. Different types of innovations are found, spanning incremental (such as many system-initiated policies and initiatives to use ICT to make small changes to classroom and other practices), radical (such as some of the school curricular innovations in the FutureSchools) and disruptive ones (such as research intervention projects carried out at schools).

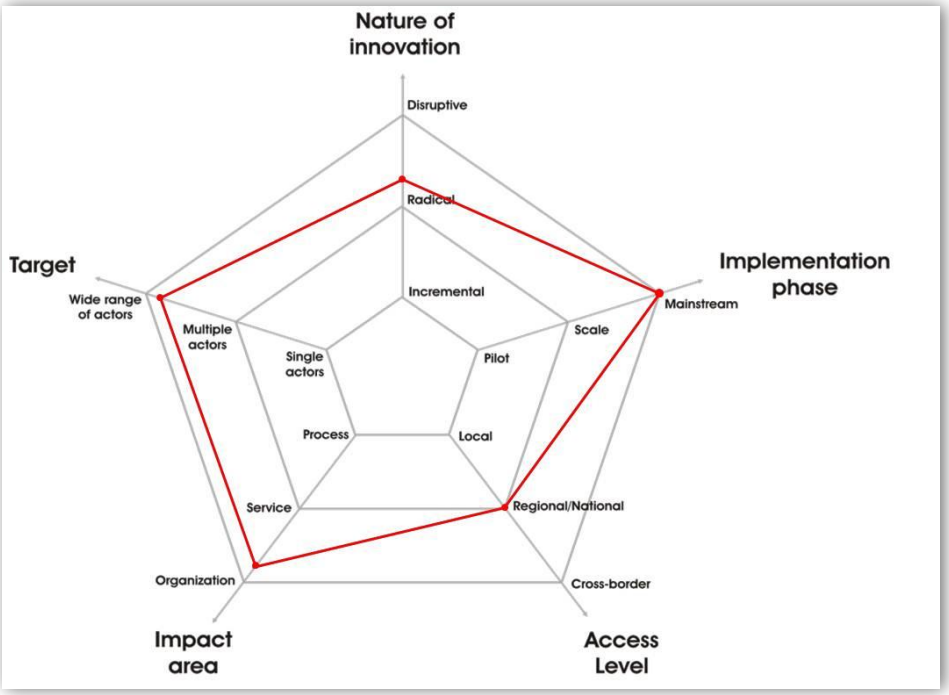

Figure 20: Mapping *mp3* to the SCALE-CCR framework for ICT-enabled innovation for learning

8.3 Strategies for implementation and scaling up of the innovation

8.3.1 Agency for change

Scaling can be approached from micro-level (innovation or intervention) or from macro-level perspectives. We propose a model that views scaling from the perspectives of a continuum from centralized to decentralized and from a top-down approach to a bottom-up approach.

"Centralized" is one of the characteristics of educational scaling in Singapore. The government has a strong presence in enacting directions/policies, taking initiatives, and playing driving forces. The agents in centralized scaling are assigned (top-down) or motivated (bottom-up) to spread certain innovations for certain outcomes, purposes or themes.

There is no pre-defined or definite central theme in "decentralized" scaling model to make all the agents united together, with competition and symbiosis for different scaling themes or factions. Centralized" and "decentralized" are more scaling purpose- or outcome-oriented, while "top-down" and "bottom-up" are more scaling methodology- or process-oriented.

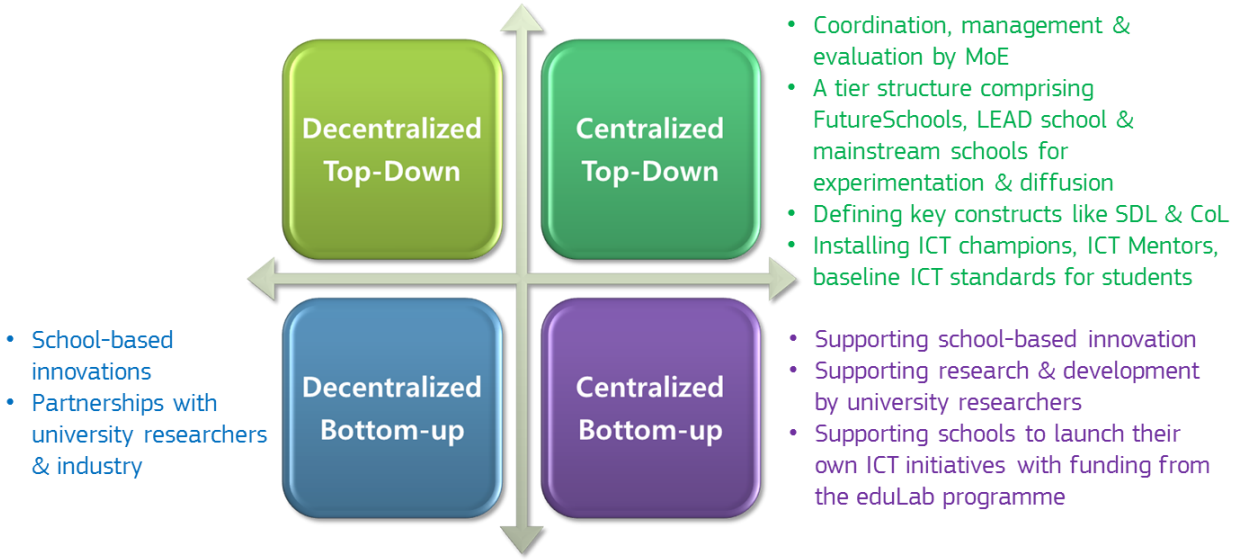

Figure 21: Framework for situating scaling goals and strategies

Centralized top-down scaling

Spread is coordinated and driven from the top. There can be different levels of prescriptiveness, different types of disseminations using mechanisms like workshops, materials, HQ staff as resources, etc. In Singapore, many initiatives from the MoE carry this flavour such as Holistic Assessment, Stellar programme and English Language Institute of Singapore (ELIS).

MoE set up the Primary Education Review and Implementation (PERI) Committee in October 2008 to study how to enhance primary education. One of the recommendations of the Committee is for primary schools to focus on building pupils' confidence and motivation to learn, particularly at the lower primary level when pupils are just beginning school. In the Holistic Assessment (HA) initiative, MoE partnered 16 primary schools to plan and prototype HA models and strategies at Primary 1 and Primary 2, since July 2009. In 2011, these 16 schools extended their implementation to Primary 3, and 67 Phase 1 schools came on board implementing HA at Primary 1. These schools have focused their efforts on building children's confidence and desire to learn by using a range of appropriate assessment modes and bite-sized forms of assessment for richer feedback on learning. The remaining schools have committed themselves to implementing HA by 2013. For more information, please access http://www.primaryeducation.sg/holistic-development-of-your-child/holistic-assessment/

STELLAR is a programme that aims to strengthen both language and reading skills as well as promote a positive attitude towards reading in the foundational years through the use of well-established, learner-centred and developmentally appropriate pedagogical approaches using authentic children's literature. MoE developed STELLAR in 2006 to cater to the diverse range of English language learners in Singapore. After a pilot run involving 90 schools, the programme was implemented nationally at the Primary 1 level, and in subsequent years to Primary 2 to Primary 4. For more information, please access http://www.stellarliteracy.sg

The English Language Institute of Singapore (ELIS) programme was officially launched in 2011 to drive excellence in the teaching and learning of the English language in Singapore schools and to raise the general command of both spoken and written English among all our students. It will play a key role in providing in-service professional development for both English language and English-medium teachers, by developing their competency and offering a range of courses that cater to the learning needs of teachers. ELIS involved more than 6,000 teachers in 2012 and aims to involve 12,000 teachers by 2014 in its courses on pedagogy. For more information, please access http://www.elis.moe.edu.sg

In *mp3*, MoE provided a tier structure comprising FutureSchools, LEAD school and mainstream schools to allow good practices to flourish in selected schools and then scale up to other schools. It defined key constructs like SDL and CoL, and adopted top-down strategies like installing ICT champions, ICT Mentors, baseline ICT standards for students and Future Schools 1.0.

Centralized bottom-up scaling

The tagline for the MoE is top-down support for bottom-up innovations. Policies are set in place to encourage innovations, set directions, provide resources and funding, and aggregate lessons learned from implementation to iterate the innovation and support for the innovation

The change strategies involved in *mp3* are primarily centralized top-down and centralized bottom-up strategies. There is centralized planning by the MoE on intended outcomes, processes, and support strategies for implementation. There is a mix but dominated by top-down strategies.

There are top-down strategies, like implementing base-line ICT standards for students, development and provision of a school self-assessment tool for assessing technology usage and integration, and the FutureSchool programme. There are also bottom-up strategies, like supporting schools to launch their own ICT initiatives with funding from the eduLab programme.

An example of a research project that has shown potential for scaling is the innovation project that introduces rapid collaborative knowledge improvement (RCKI) to schools in Singapore (Looi, So, Toh & Chen, 2011). The innovation is enabled by the use of Group Scribbles software. While the three-year research work was done with three schools, more than ten schools have tried using RCKI in their classroom lessons for different subjects to varying degrees of spread and depth.

Decentralized bottom-up scaling

In decentralized bottom-up scaling, the agency really springs from the ground (grassroots). Scaling is about the building up of constituency. It can be achieved by collaboration with industry partners, or driven by technological or business initiatives.

Thus *mp3* incorporate strategies and mechanisms that are situated in the different quadrants (with greater emphasis on centralized top-down and centralized bottom-up approaches), providing a multi-pronged, multi-level approach to scaling. The different strategies and mechanisms work in tandem in systemic ways to bring the system into adoption and adaptation of the innovation. As a national project, this is akin to the *Digital Textbook* project in South Korea (Han, 2013, this volume) which has also top-down and bottom-up elements for fostering agency of change.

8.3.2 Professional development provisions

A Professional Development Framework for integration of ICT in teaching and learning (ICT-PD) has been developed to define the roles and responsibilities, and a corresponding set of competencies (knowledge and skills) for the different groups of school personnel implementing the use of ICT in schools (mp3, 2008). The framework aims to guide MoE HQ and schools in the planning and development of various *mp3* professional development programmes, as well as help schools understand how the roles of the different school personnel contribute to actualising the various *mp3* goals.

ICT mentors

A pool of ICT Mentors will cascade effective ICT practices in and across schools and to raise the level of ICT use in schools. The training of ICT Mentors has been implemented in 6 phases from 2010 – 2012. These ICT Mentors serve as mentors to teachers on ICT use for learning and teaching in their respective disciplines, provide requisite knowledge on planning and delivering ICT-enriched learning experiences and champion best practices, and facilitate the sharing of ICT resources created by teachers to propagate good ideas and practices.

Consultancy and support for schools

MoE will continue to provide ICT consultancy and support to schools through offering customised professional development programmes, as well as teacher work attachments, and establish sharing platforms, such as annual educational technology conferences, to promote sharing of good ICT practices among schools.

Recognition programmes for teachers

Currently, there are award programmes to recognise the innovative practices of teachers, namely the Microsoft-MoE Professional Development Award and School Digital Media Award for Teachers. Such recognition programmes facilitate the sharing of good practices among the larger community of teachers.

8.3.3 Governance, management and school routines

mp3 is led by a *mp3* steering committee in the MoE headed by the Director-General of Education and senior officers (including some school principals), and its implementation is led by the Educational Technology Division (ETD) of the MoE. The mission of ETD is to be a catalyst in harnessing Information and Communication Technologies (ICT) to enrich learning and teaching (ETD, 2013). Its functions are to provide strategic direction on ICT in education for 21st century learning and to position Singapore as a leader in the use of ICT in education; to provide thought leadership in the effective integration of ICT into learning and teaching; to build capacity of teachers, key personnel and school leaders, through consultancy at schools and the HQ, so as to deepen the pedagogical use of ICT to transform student learning; to engage and create a common vision among school leaders, school key personnel, teachers & HQ officers on the critical role of technology in future learning; to lead and facilitate development and delivery of video and audio resources for education and communication; and to oversee the planning, implementation and management of the ICT Masterplan in Education.

8.3.4 Monitoring and accountability mechanisms

The *mp3* steering committee meets regularly to hear updates on the implementation and evaluation of the programme. Through a dialogic process involving the various personnel in the MoE involved in *mp3* including some school principals as representatives, perceptions and data collected at the Ministry level and at the ground level (in a school, and from principals, teachers and parents) are interpreted to provide a sense of the gaps and challenges to implementation. Consultations are held to provide suggestions for solutions to address and reduce these gaps.

8.3.5 Evaluation mechanisms used

A multi-year comprehensive evaluation study is currently being conducted by researchers from the National Institute of Education (Singapore) that assesses the implementation of *mp3* and its corresponding impact on Singapore schools (Tan, 2013). The target population includes 362 schools under the purview of MoE. The focus of evaluation is the 3rd Masterplan for IT in Education (*mp3*). The study focuses on both process and product evaluation: it assesses the extent to which the four *mp3* goals are achieved and other possible impacts on teachers and students (product) as well as how schools implement *mp3* and possible contributing factors leading to the outcomes (process). In terms of the uses of evaluation findings, this study serves both formative and summative purposes.

The formative evaluation focuses on assessing the implementation processes and achievement of intermediate milestones in schools so that evidence-based advice could be given to both schools and the policymaker. The summative evaluation will provide evidence for the overall achievement, values and worth of the *mp3* as well as recommendations for future masterplans. While providing empirical evidence for the policy maker, this study might be of interest to the research and practitioner community on ICT integration as there are few large scale evaluation studies that focus on both formative and summative evaluation at multiple levels in schools.

This study adopts a repeated cross sectional design to survey P4, P5, S1, S3 and J1 students from 2010 to 2013 to assess the achievement of *mp3* goals. This is complemented by case studies of

12 schools over five years to gain deeper understanding of what happens in these schools at various levels – leaders, teachers, and students. This study adopts a mixed-method design by including survey data (quantitative), interviews of school leaders, teachers, and students, classroom observations, and document analysis (qualitative). Formative evaluation findings will be communicated in yearly reports (2009 for baseline, 2010, 2012, and 2013) and mid-term report (2011). The summative evaluation, to be submitted in 2014, will provide summary for the overall achievement, assessment of values and worth of the *mp3* as well as recommendations for the future masterplans.

A mid-term review of *mp3* was done by an International Review Panel in 2012, but the findings were not disclosed publicly.

8.4 Outcomes and achievements

The key outcome is the cultural change in the readiness of all stakeholders across the system (such as a majority of schools) to adopt and use ICT for teaching and learning, for innovation and for experimentation. On-going and specific outcomes have been achieved in these areas:

- The first five Future Schools have completed their programme; three new Future Schools are undergoing the programme;
- There are more efforts to design school-based curricula for engaged learning and for cultivating 21st century learning skills;
- There is school-wide innovation of learning and teaching models using ICT/IDM;
- There is much research and development going on in the area of infusing technology in pedagogical design;
- Business opportunities have been provided to local corporate entities to develop educational products and services, like LMSs, digital content, educational applications and learning trials.

Student learning outcomes

The *mp3* multi-year evaluation study conducts surveys of practices, perceptions and experiences of the key stakeholders (namely, the principals, the teachers and the students), and classroom observations towards understanding the integration of SDL and CoL components. Such studies are not made public.

Various school-based research intervention and descriptive studies have been conducted by researchers at the Learning Sciences Lab (LSL) of NIE as well as by other NIE researchers. In the context of their specific research interventions and co-designs with teachers, they have reported learning gains in traditional measures of learning, assess beliefs and dispositions, as well as some of the 21st century competencies like collaborative problem solving and critical thinking (please assess the LSL website at http://lsl.nie.edu.sg/ for a range of LSL research projects).

Teacher learning and professional development

Overall, what is discerned is readiness and capacity building of teachers to adopt and use ICT in teaching and learning. Many schools have greater clarity about what CoL and SDL entail. Teachers have incorporated CoL and SDL into their teaching practices and some school leaders have incorporated the evaluation of such skills into the teacher appraisal system.

The benefits of the mentor scheme have cascaded down in the form of more just-in-time and personalised mentoring/professional development sessions, both within and across various subject departments in schools. There is more engagement with diverse stakeholders, especially with regard to the forging of industry-school and university-school collaborations, thus enabling schools to tap on professional capital not readily available within the school ecology. Various research projects conducted by LSL and the rest of NIE involve the co-design of lessons with teachers, providing PD and increasing the capacity of teachers to understand, design, and evaluate ICT-based lessons. All these have led to the development of technology that is more tailored to the contextualized needs of education. Schools have adopted and embraced ICT as part of teaching and learning.

It is expected that as the implementation of *mp3* proceeds and innovations launched, there will be strengthening, sustaining and scaling in the use of ICT to achieve depth. This can be distilled from the shift in teachers' epistemological orientations from being transmissionist to constructivistic and norms of classroom interaction from didactic to dialogic (see for example, Divaharan, Lim & Tan, 2011; Looi, So, Toh & Chen, 2011). The use of ICT needs to be sustained over time despite change of teachers, principals, and the curriculum, to retain the core elements of innovation. The use of ICT for effective pedagogies will be scaled through spreading and diffusing good pedagogical practices across subjects, grade level, whole school, and across schools; and to collectively adapt and enable evolution through participatory efforts of multiple agents in the eco-system to improve the innovation.

8.5 Innovation prospects: sustainability and scalability

As demonstrated by some exemplary practices in schools, teachers have encouraged students' SDL and CoL by harnessing the use of ICT. However, teachers and students tend to associate SDL with fulfilling formal curricular goals, giving less emphasis on encompassing informal learning pursuits.

Key existing factors that contribute positively to project sustainability

A cultural change has permeated the schools. With the ICT infrastructure set up in every school, professional sharing of ICT uses in various conferences, events and communities, and the availability of top-down support, there is a sense of readiness of school leaders, teachers and students to embrace and use ICT. The type of adoption and adaptation varies across schools, and within a school, across teachers. But overall, the floor is raised with regard to the integration of ICT into the curriculum. Other factors include the discursive process of reflection, and the persistent engagement of stakeholders through dialogues.

Key existing factors that challenge project sustainability

Sustaining and scaling is a challenge. Many teachers adopted programmes and planned to use ICT in Education, but faced challenges, including:

- Alignment of learning outcomes to standardized testing and high-stake examinations;
- Trade-offs of teaching for deep understanding vs. covering the curriculum;
- Their epistemological beliefs have not shifted to recognize the value of the ICT-enabled innovation;
- Coming out with alternative formative assessments of students' learning gains, especially in terms of SDL and CoL.

Prospects for project scalability

In *mp3*, scalability is one major concern – how the innovation work and processes developed and learned in the FutureSchool and Lead@ICT schools can be spread and diffused to the other schools in Singapore. From the policy-maker perspective, they are interested to know how the investments in these frontrunner schools can further benefit the mainstream schools.

In looking ahead, the likely expansions in scale for this innovation will involve more collaboration between schools, teachers, and staff from the Educational Technology Division of MoE, industry players and research partners. The key existing factors that contribute positively to its scalability include the availability of funds, willing champions, early successes (in the form of proof of concepts), and increased teachers' capacity to innovate on their own.

The key existing factors that challenge its scalability include the general resistance to change and the preference for the status quo as change involves taking some risks. The efficiency model of stable routines needs to give way to innovation mindsets willing to take calculated risks in encouraging bottom-up experimentations and innovations.

Early conditions for successes in specific contexts may not be applicable to other contexts, and thus the stakeholders need to have realistic expectations on the pace for change. Schools have diverse

contexts, so it is important not to have unrealistic assessment about a school's readiness to scale up innovation. Otherwise, the top-down pressures for change and adoption of policies may lead to superficial scalability that does not fundamentally change teaching and learning.

Strategies most critical to the sustainability and/or scalability of this innovation

A critical strategy concerns the adjustment and fine-tuning of policy and its implementation, through consultative feedback in inclusive conversations involving stakeholders such as the MoE, the school principals, teacher-practitioners and university researchers. The schools are the implementers and they provide feedback from the ground to the policymakers. Data and evidences collected by researchers serve an important mechanism in complementing the possible setbacks in centralized scaling.

Another critical strategy is the provision of PD training across all levels (including pre-service and in-service teacher education) within an ICT-PD framework, in parallel with the ICT Mentors scheme, consultancy and support for schools, and recognition programmes for teachers. These provide a positive socio-political and socio-cultural context for motivating and building up the capacity of teachers to understand and undertake innovations.

Yet another strategy is leadership support at all levels (from the MoE, school cluster, zone and school levels, and within a school, upper and middle management) to support innovation and willingness to take risks at the school level.

Most important impact of this innovation

The capacity building of agents across all levels of the education system, including policy makers, administrators, school leaders, teachers, students, parents, researchers, and industry is probably the most important aspect of the *mp3* innovation. Considering *mp3* as working in a rich and diverse ecological system, the levelling up of the skills, dispositions and agency of the people involved are key to moving the whole system forward in terms of its capacity to innovate, to understand innovations and its risks, to adopt, adapt and evolve innovations, and to build trusting relationships which enable partnerships to be formed to undertake the innovations.

8.6 Reflections and issues

mp3 provides a microcosm of the issues and challenges of mainstreaming and scaling a national innovation. The education system of Singapore has its unique characteristics such as being a centralized system with curriculum and national assessment overseen and developed at the Ministry's level. It seeks to learn from the best practices in the world.

The policies, the goals, the strategies and the implementation of *mp3* are probably unique to Singapore. Yet at the same time, we believe that there are lessons which can be distilled at a macro-level or at a micro-level that be informative to others involved in the mainstreaming and scaling of technology-enhanced learning innovations in the international community. This case study is a start in that direction by providing a brief report of *mp3*. It is also intended to generate further discussions that can help reflect on the *mp3* experiences and on how there might be further improvement if different policies, goals, strategies and implementation programmes are in place.

9. Case report 7: Digital Textbook Project, South Korea

Seungyeon Han

9.1 Case overview

The *Digital Textbook* project in South Korea was an initiative of the Korean Ministry of Education and Human Resources Development (currently the Korean Ministry of Education, Science, & Technology, MEST in short) to develop digital textbook as a study assistance tool, which utilizes digital media to go beyond the limitations of conventional paper textbooks (Korean Ministry of Education and Human Resources Development, 2007). One advantage of digital textbooks is the possibility of updating the content on the fly without the need to wait for new yearly revisions. The government has tested the system since 2007 with the help of pilot schools.

KERIS (Korea Education & Research Information Service) leads national ICT projects including educational information and resources portal service, and e-learning content provisions for elementary and secondary levels, and operate pilot schools with innovation since early 1990s (see Table 8).

Table 8: Overview of the Masterplan for ICT in Education in Korea (Korean Research Information and Service, 2005; 2012)

Phase	Year	Goal	Tasks	Outcome
1	1996-2000	Building infrastructure	-Build infrastructure -Train ICT competency -Open *Edunet,* the portal service for education	-One PC per one teacher -Internet connection in every classroom nationwide
2	2001-2003	Integration ICT into classroom	-Train using ICT in classroom -Develop educational contents -Build information sharing system nationwide -Build digital resources centre	-Learning content & resources -Information & material share system
3	2005-2005	e-learning	-Establish teaching & learning centre -Improvement of teaching methods -Launch cyber home learning	-e-learning content for home service
4	2006-2011	21st century competency	-Tailored instruction -Development of digital textbook	-Tailored instruction -Self-directed learning
5	2012-	Smart-learning	-Using SNS for school learning -Development of e-book	-Learning in social context -e-book and SNS for classroom

Korea's ICT Masterplan is composed of 5 phases. In the first phase, the goal was to build infrastructure in every elementary and secondary school. As a major outcome, Korean government provided at least one PC per classroom and built internet connection in every classroom nationwide at the end of year 2000. In the second phase, the goal was to integrate ICT into teaching and learning activities. The provision of an educational portal allows teachers and students to share educational information and employ Web-based learning contents in their classroom activities. In the third phase, the government launched Cyber Home Learning® systems and developed e-learning contents (elementary and secondary level) available for both classroom use and learners' self-directed learning. The successes of the efforts in these three phases made it possible to launch the textbook innovation. The *Digital Textbook* project is a national undertaking for phase 4 of the ICT Masterplan. The Korean MEST intends to deploy the digital textbook programme for all fifth and sixth grade students in elementary school (six grade system), all three grades of students in middle school and first and second grade students in high school (three grade system). The digital text

book project is still a main task for phase 5 of the Masterplan. The government sets the goal for smart-learning to facilitate learning in social context with different Social Network Services (SNS) tools and mobile devices. The Korean government plans to develop digital textbook contents that are more accessible and easy to use by leveraging the potential of mobile devices and SNS (Social Network Services) tools.

In the beginning stage of the projects (2002-2006), basic research on the digital textbook, its expected effectiveness and design principles was conducted (e.g., Byun, Kim, Jo, Ryu, & Lee, 2005; Byun, Yoo, Yoo, Choi, & Park, 2005). In 2007, the Korean Government launched the *Digital Textbook* project. To start with, a platform and prototype content of 9 subjects at fifth grade (elementary school) were developed. From 2007 to 2011, the *Digital Textbook* project was expanded to the secondary level. During this period, pilot schools were assigned every year and the total number of pilot schools was 340 (14 in 2007, 20 in 2008, 112, 2009, 132 in 2010, 62 in 2011, respectively).

The official *Digital Textbook* project website is at http://www.dtbook.kr/renew/sub/index.jsp

9.1.1 Key focus and goal of the innovation

This government-led educational innovation project aims to equip students for the future. The focus of the *Digital Textbook* project is to provide students with more interactive, authentic, and rich learning experiences. Figure 22 shows the concept map of the *Digital Textbook* project.

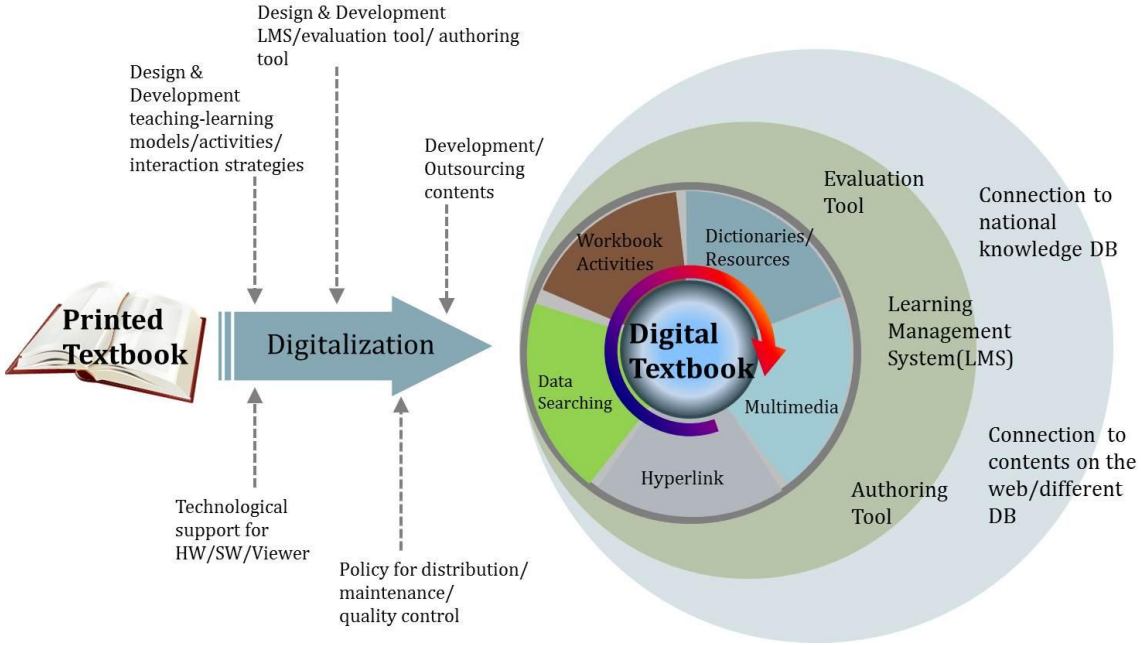

Figure 22: Concept map of the *Digital Textbook* project (source: Korean Ministry of Education, Science, & Technology, 2012)

The concept of digital textbook goes beyond just an electronic version of digitized, text-based learning materials. Digital textbook is designed to be self-contained in nature, equipped with multimedia learning resources as well as tools for evaluation and authoring. It is connected to the national knowledge database and web-based resources for teaching and learning activities.

9.1.2 Learners targeted

The target participants in this project are elementary and secondary schools in South Korea. Basically, any school can propose a research plan with the innovation. A research plan includes what an individual school aims to achieve with the innovation, such as enhancing problem solving skills, self-directed learning abilities etc. Selection is made on the basis of the compatibility and feasibility

of the proposed study as well as geographical coverage. Each pilot school implements 2-4 experimental classrooms based upon budget and teacher availability. In developing a pilot school proposal, both individual teachers' initiatives and the principal's leadership are critical. Table 9 shows the geographical coverage of the project in 2010. There are slight differences in the distribution of pilot schools across the years.

Table 9: Demographics of *Digital Textbook* Pilot School participants in 2010 (132 schools)

	Category	No. of Students	% of all pilot students
Region	Metropolitan	2,424	40.1
	Small & Medium sized cities	933	15.4
	Rural area	2,695	44.5
	Total	6,052	100
Grade	4	294	4.9
	5	2,731	45.1
	6	2,611	43.1
	7	416	6.9
	Total	6,052	100
Gender	Male	3,089	51.0
	Female	2,963	49.0
	Total	6,052	100

9.1.3 Learning outcomes targeted

The educational aim of the *Digital Textbook* project is to help students develop 21st century skills such as creativity, collaboration, communication, critical thinking, and self-directed learning abilities. Recent research findings indicate that digital textbooks contribute to enhancing students' academic achievement, attitude towards subjects (e.g. science), problem-solving skills (Lee & Seo, 2009), and self-regulated learning skills (Noh, Kim & Lee, 2011).

Son (2004) reports that students' attitude, confidence, engagement and concentration level in learning Social Studies improved when using digital textbooks. Kang, Kim, & Park (2005) also report improvement in attitude and academic achievement in Social Studies. There are also studies that indicate enhancement in low achievers' academic achievement by using digital textbooks (Byun et al., 2006; Byun, Kim, Song, & Lee, 2010; Song & Park, 2009; Song, 2008). Byun (2008) further reports higher effectiveness in digital textbook use in rural areas.

9.1.4 Technology used and the role of technology in the innovation

The Korean *Digital Textbook* project provides multimedia learning contents for different school subjects. The use of these digital textbooks requires a specific LMS (Learning Management System) and a Tablet PC specifically designed and developed by South Korea's LG Dacom and American HP, based on the HP Pavilion TX2000 Series Tablet PC with an AMD-based processor, costing around 1.3 million won (~ EUR 902) per unit. The *Digital Textbook* uses Windows XP and Linux Tablet PC Edition as its operating systems.

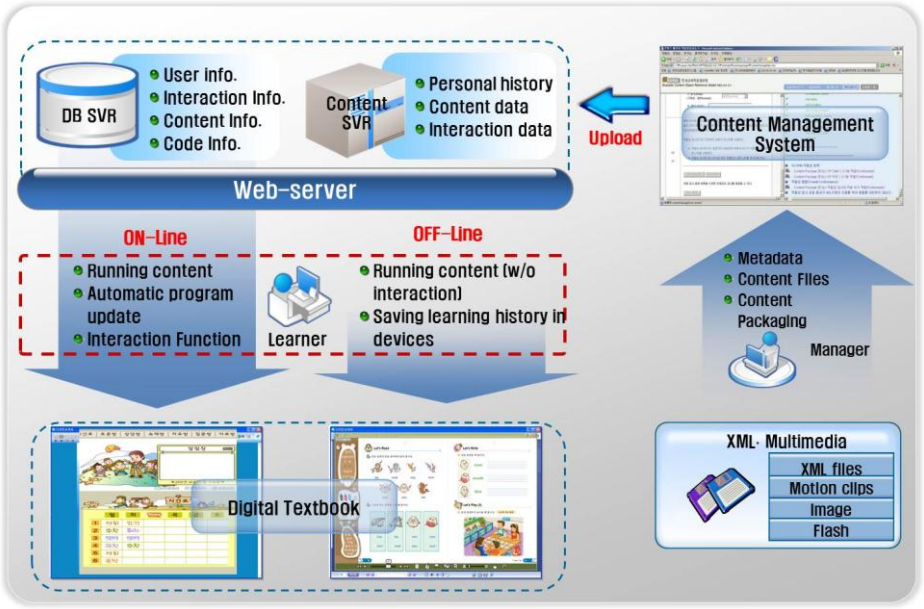

Figure 23: The LMS support for the *Digital Textbook*

The *Digital Textbook* platform is the environment for the creation and access of digital textbook contents, and includes various applications. The web-server includes a database server and a content server. The technical manager uploads information and data through the content management system to the server. Users can run content and interact with others online and offline based on their learning needs.

9.2 Scope, scale and nature of the innovation

The goal of the *Digital Textbook* project is to create a future-oriented learning environment that enables learner-centred learning anywhere and anytime. *Digital Textbook* goes beyond traditional textbooks by providing multimedia, simple simulations (e.g. statistics), and experimental experiences. Once students download the textbook on their home PCs or mobile devices, they can access learning contents on- and off-line. Pedagogical changes have been observed in terms of classroom interactions, students' motivation, learning skills, and academic achievement.

9.2.1 Background and scale of the innovation

During 2007 to 2011, various digital textbook contents were developed. The target subjects included Korean literature, English, Math, Social Studies and Science at the elementary level (5 & 6 grade). Differentiated English textbook was also developed for use at the elementary (grades 3-6) and secondary levels (1st grade).

A total of 340 pilot school participated in the project from 2007 to 2011 (Table 10). Any school can propose a research plan with the innovation; the selection is made upon the basis of the compatibility and feasibility of the proposed study as well as geographical coverage. KERIS and regional educational offices selected the pilot schools, taking into consideration the proposed study's' compatibility and feasibility as well as the geographical location of the school. The research foci of the pilot schools include self-directed learning, problem-solving skills, motivation, etc. These research projects are implemented on a semester basis (Spring/Fall).

Table 10: Number of participating pilot schools over the years

	2007	2008	2009	2010	2011
# of schools	14	20	112	132	62

9.2.2 Leadership and organization of the innovation

At the system level, MEST initiated and provides full funding support to the project. KERIS leads the planning, design, development, implementation and evaluation of the project. KERIS selected the content development service providers through open bidding every year, and the selected company organized the team of textbook authors (who are mostly school teachers or university professors), design professionals (e.g. instructional designer, educational technologist), media developers, and programmers. KERIS entrusted evaluation specialist (mostly university professors) to evaluate the project from 2008 to 2011). Recently, KICE (Korean Institution for Curriculum & Evaluation) is also involved in the policy and official approval process of the digital textbooks. Members of academic societies such as KSET (Korean Society for Educational Technology) and KAEIM (Korean Association for Educational Information & Media) made efforts to run special conferences on related topics.

Government leads the project. University researchers conduct various researches on the project and report on the results to improve and further develop the digital textbooks. Research topics include design principles, effectiveness, teaching strategies, students' motivation, etc. University researchers also plan and implement a variety of teacher training programmes both on- and off-line. Industry plays the role of technology developer(s) and service provider.

9.2.3 Conceptual basis of the innovation

Pedagogical orientation of the innovation

While there is no single theoretical underpinning for the project, it is strongly inclined towards learner-centred perspectives (e.g., American Psychology Association, 1990/1997). There have been efforts to apply different pedagogical models in the different subject areas. For example, **adaptive instruction** was applied in the English language subject. In this approach, learning contents are divided into three levels for grades 3-6. Based on their pre-test scores, students are assigned to different groups and provided with the corresponding level of learning contents based on the assigned different learning paths. Another example is the adoption of **discovery learning** in the Science subject areas.

Design principles of the innovation

To facilitate teachers' use of digital textbooks, 49 learning activities using these textbooks were developed as teaching guides. The activity development project was launched based on the view that a single instructional model does not fit all the different subjects, and that an **activity-based implementation** is more appropriate. Classroom teachers in the pilot schools had access to the digital textbooks during the development process, and they design and wrote scenarios on the innovations they like to explore with these digital textbooks. The learning activities were developed based on the teachers' scenarios. Overall design principles are based on the **Universal Design for Learning** (UDL), which is a set of principles for curriculum development that give all individuals equal opportunities to learn (Council for Exceptional Children, 2005). UDL provides a blueprint for creating instructional goals, methods, materials, and assessments that work for everyone–not a single, one-size-fits-all solution but rather flexible approaches that can be customized and adjusted for individual needs (CAST, 2011).

9.2.4 Summary

Figure 24 presents a mapping of the nature and scale of the *Digital Textbook* project to the SCALE-CCR framework for ICT-enabled innovation for learning (Kampylis, Bocconi, & Punie, 2012). The *Digital Textbook* project is at the systems level and engages broad involvement of multiple actors and stakeholders. The impact spans service and process changes. Although the goal of the *Digital Textbook* is to transform the teaching and learning process, the pilot schools' projects in general are still incremental in nature. On the other hand, the geographical coverage of the pilot schools is nationwide, and hence access is towards the regional/national level. The implementation phase is at the scaling up stage and moving towards the mainstream.

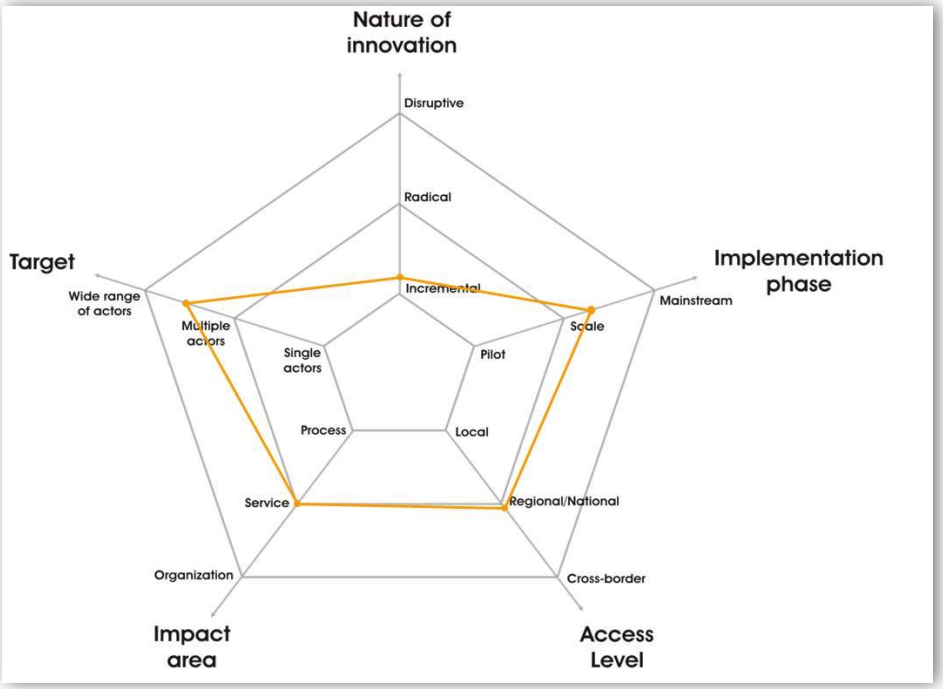

Figure 24: Mapping the *Digital Textbook* project to the SCALE-CCR framework for ICT-enabled innovation for learning

9.3 Strategies for implementation and scaling up of the innovation

The *Digital Textbook* project is a strategic government initiative strongly backed by a number of agencies at the system level, with multi-pronged implementation mechanisms.

9.3.1 Agency for change

The agency for change for the *Digital Textbook* initiative has both top-down and bottom-up components.

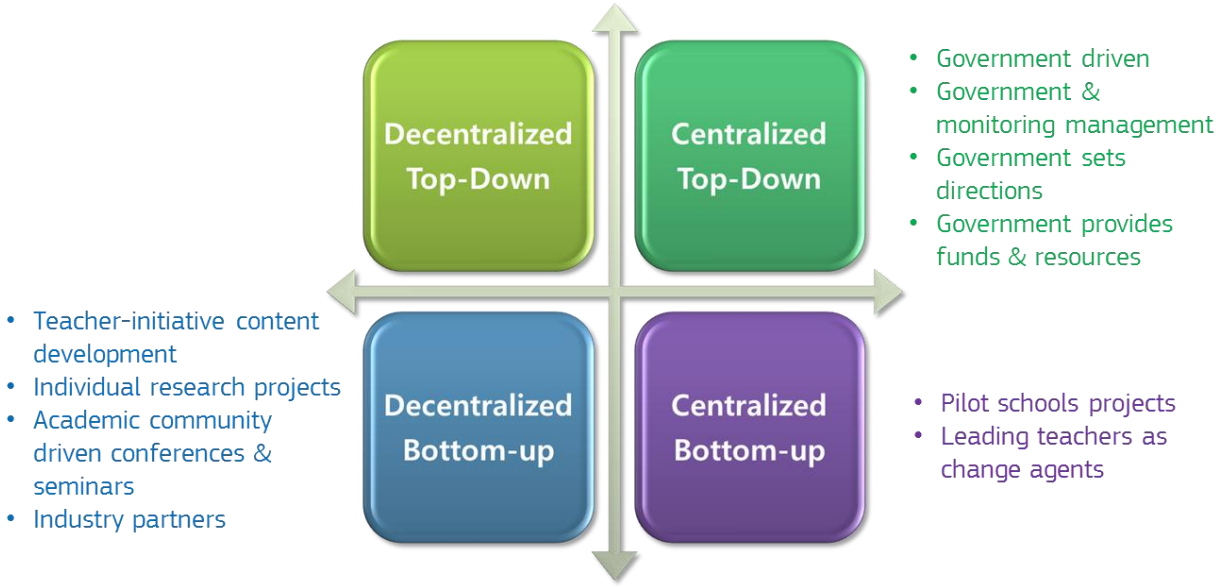

Figure 25: Different leadership strategies found in the *Digital Textbook* project in Korea

There are a number of centralized top-down strategies in the form of government-led measures. The South Korean government sets the strategic direction of the initiative, monitors the process, manages the project, and provides full funding and resources. KERIS acts as a key partner in the innovation. KERIS analyses teachers' and students' needs, guide the project, manage the pilot schools, and evaluate the project.

There are also centralized bottom-up components in terms of agency for this innovation. Any school can apply for pilot school projects and lead teachers in these schools are key change agents in this project. They plan, design, and implement instruction that uses the digital textbooks.

There are also decentralized bottom-up components in this innovation. School teachers directly involved in the pilot projects also contributed agency through contributing proposals on teaching models and learning activities for using the digital textbooks. University researchers are also important change agents. At the beginning stage, they set guidelines for the design and development of digital content and the learning management system. They also provided consultation to teachers and schools, as well as conducted various evaluation studies in classrooms.

9.3.2 Professional development and technical support provisions

At the beginning of the project, initial technical training and support was deemed necessary. Professional development provided by KERIS focused on the installation and use of the Learning Management System (LMS) for accessing the digital textbooks. There was also sustained provision of technical support and services throughout the whole project period.

To implement the learning activities for instructional purposes in the individual subjects, training for students and teachers is also required. Online manuals and online training programmes were made available. Online training programmes address the following topics: ubiquitous learning and digital textbooks, infrastructure for digital textbooks, functions of digital textbooks, instructional design for digital textbooks, teaching models, classroom interactions, etc.

Face-to-face workshops for teachers were also provided. These workshops were conducted during the summer and winter breaks, which provide opportunities for participants to share best practices and cases of successful digital textbook implementation. The workshop programme included the following topics: educational changes, foundations of digital textbooks, technical training for using the LMS platform, diverse teaching-learning models for using digital textbooks, features of multimedia content in digital textbooks, instructional design for digital textbooks, best practices of classroom use and relevant recent research findings. KERIS and regional education offices (belongs to MEST) laid the basis for exchanging information, developing and sharing cases of teaching and learning using digital textbooks.

9.3.3 Governance, management and school routines

According to recent research (Kim et al., 2009), changes in operation and management structure as well as in everyday routines have resulted as a consequence of the innovation. The demand for teachers' time for student counselling increased. Research (Kim, et al., ibid) reported that *Digital Textbook* reduces teachers' class preparation and learning material development time, so students counselling time increased as result. Also, funding given to the pilot schools made it possible for the lead teachers to have reduced teaching loads. These changes may account for the reported increase in teachers' career satisfaction (Kim et al., 2009).

9.3.4 Monitoring and accountability mechanisms

Each pilot school proposed a study plan for using the digital textbooks during the semester. The school has to report on the final results of the study for formative evaluation (middle of the semester) and summative evaluation (at the end of the semester). KERIS monitored each school's study activities, provide feedback, and conduct the formative and final evaluation.

9.3.5 Evaluation mechanism

As mentioned above, KERIS conducted formative and final evaluations for the pilot schools every year. The evaluation activity is more consultative in nature, and the purpose is not for judging the

success level of the schools. For formative evaluation, each pilot school should prepare a mid-term report on what they have done with the innovation and to present their work in public meetings hosted by the regional educational offices and KERIS. Schools in the same region share the outcomes and provide feedback to each other. For the final evaluation, each pilot school needs to prepare a final report with empirical data (such as students' academic achievement, skill, attitude improvement or other educational outcome) and present the outcome at the nationwide meeting. The evaluation is to judge pass or fail of the project.

On the other hand, researchers were commissioned by KERIS to conduct an evaluation study every year to identify educational effectiveness of the project. The evaluation is a complete enumeration study in nature and researchers was commissioned by KERIS take responsibilities for conducting the study. Key findings from the evaluation study are presented in Table 11.

Table 11: Key design elements, sample information and major findings from the annual evaluation studies for the *Digital Textbook* project (2008-2011). Source: Noh, Kim, & Lee, 2010.

	2008	**2009**	**2010**	**2011**
Dependent variables	Academic achievement	Academic achievement	Academic achievement	Academic achievement
	Attitude on subjects	Attitude on subjects	Learning engagement	Satisfaction
	Self-directed learning ability	Self-directed learning ability	Academic achievement	Academic achievement
	Problem-solving skills	Technology leadership		Problem-solving skills
Participants	24 schools (18 pilot schools + 6 control schools)	129 schools (110 pilot schools + 19 control schools)	132 schools	63 schools (sampling pilot classes + control classes)
	5 & 6th grade (n=4,284)	5 & 6th grade (n=16,736)	4, 5, 6, & 7th grade (n=6,052) - Additional study on 18 sampled schools out of 62 pilot schools	4, 5, & 6 (n=5,120)
Major findings	Pilot school shows higher academic achievement & problem solving skills	Pilot school shows higher academic achievement	Pilot school shows higher academic achievement (science)	
	Pilot school (rural area only) shows higher self-directed learning skills & attitude on subjects	Pilot school shows higher attitude on subjects	Pilot school shows higher learning engagement, self-directed learning skills, problem solving skills	

9.4 Outcome and achievement

The infrastructure for digital textbooks set up in the pilot schools has been expanded to support other schools. Since 2007, the baseline has been expanded through the development and application of pilot digital textbooks. The original digital textbooks have been revised to take account of new curricular changes and technological advances. From 2012, *Digital Textbook* contents become available through mobile devices without the need for access through the LMS by using HTML5, etc.

9.4.1 Key outcomes achieved to date

At the close of the *Digital Textbook* project, a total of 340 pilot schools have completed their research and development projects in the use of digital textbooks. In addition, 123 studies have been done on a range of topics including design principles, teaching strategies, effectiveness, etc., through case studies and other research methods. KERIS provided the reinforced support for the operation of pilot schools.

KERIS conducted evaluations for this project every year since 2008. The key elements and findings from these project evaluations are summarized in Table 11. The evaluation studies focused on the students' academic achievement, attitudes on subjects, problem-solving skills and self-directed learning skills. It was found that the digital textbooks partly increased the academic achievements of students in elementary schools, especially in science and social studies. In addition, students from rural areas showed higher achievement in science and social studies with digital textbooks than with printed textbooks. However, meta-analysis on the effectiveness of the innovation reports that it was more effective in metro-city levels than rural settings in terms of academic achievement (Byun, Ryu, & Song, 2011). It is difficult for researchers to control different variables in schools settings, thus other variables such as private tutoring might affect academic achievement (Ryu & Byun, 2012). Further investigation and in depth analysis is needed. The digital textbooks also helped elementary students improve problem solving skills and self-directed learning more than the printed textbooks (Byun, Kim, Song, & Lee, 2010; Noh, Kim, & Lee 2010).

While running the pilot school projects, both the government and related organizations also put much effort into building the legal and institutional basis for the use of digital textbooks. Regulations regarding textbooks have been revised to secure the legal status and official approval of digital textbook use in schools. Recently, Korea Reprographic and Transmission Rights Association allow free transmission of e-book contents for educational purpose only. As a result, once the printed textbook is officially approved, the publisher must develop and provide the corresponding digital textbook within a year.

9.4.2 Successes and impacts

The *Digital Textbook* project created an open learning environment, enabling learner-centred learning anywhere, any time. Students, teachers and parents can download multimedia contents using the school certification code. Through the pilot schools, more learner-centred, self-directed, motivating learning activities were designed and developed. Digital textbooks provide authentic and vivid learning experiences. It integrates multimedia contents into the textbook so that students and teachers can easily make use of diverse learning resources such as high-quality images, animations, video-clips, experiments, and simulations in their activities. The pilot schools in this project were located throughout different areas in South Korea and now the contents are available anywhere.

The *Digital Textbook* project has been found to contribute to reducing the digital divide among students. Recent research (Kim et al., 2012) reports significant differences between digital textbook and paper textbook classes regarding academic achievement. *Digital Textbook* classrooms achieved higher scores in social studies and science for rural schools. However, further investigations on different subject areas such as language arts and math, in various settings are needed to generalize the findings. The project also enhanced students' and teachers' digital literacy.

One of the important goals of the project was to reduce the private tutoring market. This is both an implicit and explicit aim of the project. South Korea's education has been too much focused on preparing students for college admission. As a result, students and parents relied heavily on the private tutoring system. To resolve this situation, Korean government initiated the digital textbook innovation (Korean Ministry of Education and Human Resources Development, 2007). The development of the *Digital Textbook* cannot directly change the educational system itself, but Korean government expects the project to gradually reduce the private tutoring market by providing high quality learning materials for every student. We expect both the reliance on and the size of the

private tutoring market for college admission to be gradually reduced with the increasing use of digital textbooks (Byun, Kim, Song, & Lee, 2010; Kwon, 2009).

9.5 Innovation prospects: sustainability and scalability

Pilot schools and lead teachers will continue their practice and gradually change the classroom ecosystem. Research institutions such as KERIS will continue to examine various aspects of *Digital Textbook* implementation and spread the best practices generated. In particular, the e-textbook initiative has already been started by the Government to build on and scale the outcomes of the *Digital Textbook* innovation.

9.5.1 The next plans for this innovation

The *Digital Textbook* project has completed the pilot phase and moved into the scaling phase. There is also some significant enhancement to the design of the digital textbooks in this process. The project is now referred to as the e-textbook project, and Table 12 highlights the differences between the earlier phase of digital textbooks from the e-books in the current phase. The MEST sets 2012 as the start of smart education, and the e-book project is one example of the smart education. E-book is platform free and can be downloaded for access without internet connection. Further, these can be accessed by any teacher, student or their parents in the formal school system.

Table 12: Key differences between Digital textbooks and E-books

Digital textbooks	E-books
Everything can be found in paper-based textbooks	Connects with outside resources and social networking system
Complicated platform (requires specific LMS)	More flexible (Platform independent)
Web-based	(interactive) PDF, downloadable for offline use
Limited accessibility	Open to all students/teachers/parents
Copyright issues unresolved	Copyright issues resolved

Existing digital textbooks contain different multimedia learning resources as a whole, but e-book is of a simple and lighter format, which is flexibly connected with outside resources and tools. E-books do not require any specific LMS to access or manipulate the textbook. Recently, Korea Reprographic and Transmission Rights Association allow free transmission of e-book contents for educational purpose only. Any copyrighted materials in e-book can be used and transmitted to students, teachers, and parents with a school certification code.

Institutions such as KERIS and KICE as well as university researchers have actively contributed to the establishment of policy and guidelines for design, development, standardization and system of approval of digital textbooks. A major resolution was passed so that all textbook publishers must develop an e-book as a companion volume for every paper-based textbook approved for publication by the government, and the e-book volume must be published within a year after formal approval. A total budget of KRW 57B (~EUR 40M) was approved for this initiative.

9.5.2 Prospects for sustainability

Research findings provide evidence for the effectiveness of the *Digital Textbook* initiative. Recent research reports indicate that the project contributed to enhancing students' academic achievement, attitude towards the learning in specific subject areas (e.g., science), problem-solving skills, and self-regulated learning skills. The role played by the lead teachers as change agents is very important for sustainability. They design and implement specific teaching and learning approaches for using digital textbooks. The experience and success stories were shared within the teacher community. Pilot school teachers achieved success as excellent role models for ICT integration into classroom learning and teaching.

South Korea has a relatively good technological environment in terms of the level of access to computers in schools and the bandwidth for internet access at home and school. Technology enhanced learning environments complete with personal computers, IPTV (Internet Protocol Television), electronic board, flat TV, etc. are available in most schools. Teachers and students can easily use electronic and digital devices for everyday teaching and learning activities.

There are also challenges to the sustainability of this innovation. Cost effectiveness of the *Digital Textbook* is one key challenge. Although research findings provide support for the effectiveness of digital textbooks, their cost effectiveness is being examined comprehensively. Government funding is continuously available, but a question about cost-effectiveness in comparison with paper-based textbooks was raised by different sectors including politicians and researchers. There are also concerns about students' and teachers' health (e.g., Visual Display Terminal syndrome) with regard to their exposure to electronic devices in the classroom.

9.5.3 Prospects for scalability

There are several factors that contribute to the scalability of the *Digital Textbook* innovation. First, the e-book that followed on from the *Digital Textbook* initiative is accessible by anyone who possesses a school certification code. It is not dependent on access through specific platforms and can be used on PCs or mobile devices. Once downloaded, students can access the textbook offline. This allows the project to expand to every single student in South Korea.

Second, there are existing electronic educational resources that can be exploited for e-textbook development. South Korea has started the development of its educational information and resource service portal since the 1990s. It has also developed e-learning & IPTV content for use at the elementary and secondary levels. Additionally, teacher communities have been developing and sharing teaching materials for classroom activities. The convergence of multimedia and e-learning resources can enhance the ways and effectiveness of use of digital textbooks in classrooms.

Third, South Korea has a relatively good internet infrastructure in terms of penetration and bandwidth. Moreover, wireless internet services are available and the coverage of the services is expanding. Students can access digital textbooks and other electronic resources at home and in local community spaces.

However, there are also challenges to the scalability of the *Digital Textbook* innovation. While South Korea has a relatively good computer and internet infrastructure in schools, not every classroom is equipped with enough computers for use by individual students. In general, each classroom has one computer for teacher use and each school has one or two computer labs. Even pilot schools have only one or two computer labs each (referred to as smart classrooms). For everyday use in schools, students may not have enough opportunities to use the digital textbook on their own. On the other hand, teachers can project digital textbook content on the electronic board or IPTV in the classroom. Students can also use the digital textbooks on their own mobile devices or home PC. Another big challenge is the cost of mobile devices. Although the cost of mobile devices may vary greatly, currently not every student can afford to have it for educational purpose. If the price goes down, more students can access the digital textbooks in the classroom.

Teachers' willingness to allow students to use mobile devices in the classroom can be another challenge. Not all teachers or schools are open to the use of electronic devices in the classroom for fear of these being used by students for non-learning purposes (e.g., gaming, instant messaging, etc.). The school culture needs to change for this problem to be resolved. Another concern is that while government-driven implementation may lead to fast adoption, the innovative features of the learning activities may be lost and the fundamental changes targeted may not be achieved.

To scale up the innovation, one of the most important issues is to reduce the price of mobile/ personal devices so that every student can use the digital textbook in classroom learning activities. It is also of critical importance to put in measures that facilitate cultural change in schools such as publicizing the benefits of using digital textbooks and providing observation opportunities on ways that other teachers make use of digital textbooks in and outside of the classroom. Teachers' active

participation, actual adoption and comprehensive support are necessary to sustain and scale change.

9.6 Reflections and issues

While the *Digital Textbook* project has generated some learner-centred pedagogical practices and evaluation studies have also reported on the effectiveness of the project, there are some issues that warrant further consideration. Though many researches have been done, most studies focused on exploring the directions for digital textbook design and development (Ryu, 2012). Research on digital textbooks started as early as 1997 and the pilot schools have conducted different projects over the last 5 years. However, researchers and policy makers are still exploring design principles and implementation guidelines. Meta-analyses of studies on the effectiveness of digital textbooks have yielded an effect size of just 0.13 (Ryu, 2012). These findings indicate that more in-depth research on students' learning and teacher development is required. Furthermore, the research methodologies adopted should not merely measure achievement based on validated survey tools (e.g. scale instruments to measure motivation level, self-regulated learning ability, and problem solving skills), but provided in depth understanding of the learning outcomes and processes.

There is a lack of linkage between digital textbooks and previous ICT integration projects. Given the history of education developments over the past decade and more, some teachers suffer from "innovation fatigue': "innovation, again?" being a typical response from these teachers. Even teachers who have played leading roles as change agents feel overwhelmed with the new ICT policy. They do believe that ICT use in the classroom can make their teaching (and students' learning) more meaningful in many ways. However, they often believe that the introduction of ICT would impose more duties on them (Han & Lee, 2010; Lee, Han, & Moon, 2010). Teachers already have access to abundant multimedia learning contents (mostly web-based) produced by other teachers, professional developers, and government agencies (e.g., KERIS). As teachers in pilot schools, they have experienced the e-learning project, u-learning project, IPTV project, *Digital Textbook* project, and now the smart learning project. All projects started from government efforts to foster students' competency and learning abilities. However, ICT innovation projects often end with impetuous conclusions and left few success stories (Lee, Moon, & Han, 2007). Teachers involved in these different projects have been exhausted with similar and repetitive projects, not seeing any linkage between them. What is really needed with regard to plans and strategies for ICT integration to transform learning and teaching is to establish a long-term plan that support evolution.

10. Towards a policy framework for understanding and scaling up ICT-enabled innovation for learning: synthesis and conclusions

Nancy Law, Panagiotis Kampylis & Yves Punie

10.1 Revisiting the scope and research questions for the present study

As described at the beginning of this report, the present study is part of a larger project on 'Up-Scaling Creative Classrooms in Europe (SCALE CCR),[76] the main objectives of which are, briefly:

- to define and classify "ICT-enabled innovation for learning" across a range of settings and participants;
- to develop the concept of Creative Classrooms (CCR) and the related reference parameters for pilot initiatives in scaling up CCR;
- to identify and analyse the implementation strategies of a number of effective ICT-enabled innovations for learning in order to bring to the surface commonalities of purpose, scope and conditions for sustained impact;
- to propose concrete policy recommendations for the further development and sustainable mainstreaming of CCR in Education and Training.

As part of this overall effort, the present study sets out to address the following research questions:

1. What are the necessary conditions for sustainability of ICT-enabled innovation for learning?
2. What are the necessary conditions for ICT-enabled innovation for learning to reach a large scale?
3. What are the necessary conditions for ICT-enabled innovation for learning to have a significant impact at system level?
4. What policies and strategies are effective for mainstreaming ICT-enabled innovations for learning in Education and Training?

In this final chapter, we will begin by providing an overview of the cases to highlight how these cases are similar or different in terms of the five innovation characteristics, and the technology used and their roles across and within each of the innovations. This provides a clear analytical overview of the characteristics of these case studies for understanding the basis for our synthesis and conclusion and also their limitations.

Section 10.3 summarizes our findings on research question 3, the necessary conditions for innovations to have significant impact on learning. It is known that more disruptive innovations are more challenging to sustain or scale up (Law, Yuen and Fox, 2011), but are more likely to reap the benefits of new technologies as enablers to modernize learning and teaching practices. Hence, understanding the conditions for sustainability and scalability of more disruptive innovations are of greater interest and relevance to this study. Classrooms, teacher practices, schools and education systems are nested, interdependent elements of the wider socio-economic and political milieu and constitute the wider ecological context that education and education innovations are situated. Based on this ecological understanding, the challenges of and conditions for sustainability and scalability are actually similar. Hence research questions 1 and 2 are addressed together in Section 10.4.

The final section of this chapter builds on the previous analyses, and in particular relates the characteristics of the cases to the policy and strategic context and features of the case studies to propose a model for developing effective policies and strategies for mainstreaming ICT-enabled innovations for learning in education and training (research question 4).

[76] http://is.jrc.ec.europa.eu/pages/EAP/SCALECCR.html

10.2 Overview of the cases

The in-depth analysis of ICT-enabled innovations for learning in Europe and Asia reveals that six out of the seven cases (apart from CoREF in Japan) are about initiatives that have either developed over a period of more than ten years, or that have built on system level initiatives that started more than ten years ago. Furthermore, with the exception of the *Hellerup School*, all of the cases have direct engagement with or are part of a government initiative at regional, national and/or supra-national levels. In the previous chapters, we have presented the seven structured case reports that provide a rich description of the background and nature of these initiatives mapped onto a five dimensional framework for ICT-enabled innovation for learning (Kampylis, Bocconi & Punie, 2012; to be referred to in brief as mapping framework), their respective agencies and strategies for change, achievements to date and their prospects for sustainability and scalability. In this final chapter, we will begin with a summary of these case reports, highlighting the nature of these initiatives, the learning outcomes they have targeted, their respective stage of implementation and impacts achieved, as well as the conditions for their sustained impact and challenges to scalability identified. This will be followed by two analytical sections, one on insights gained about the conditions for ICT-enabled learning innovations to actually bring about improved learning processes and outcomes, and the other on insights pertaining to conditions for sustainability and strategies for mainstreaming of innovations, and a final conclusion. An overview of the seven case studies is presented in Table 13 to summarize the key characteristics and developmental prospects for each of the initiatives.

10.2.1 Diversity in all five dimensions of innovation characteristics

The seven case reports of ICT-enabled learning innovations differ greatly in all five key dimensions of the mapping framework (Kampylis, Bocconi & Punie, 2012): *nature*, scale of *access*, stage of *implementation*, the area of *impact*, range of *target* participants involved and the length of time the innovation has been in operation.

- *Nature of innovation:* the cases represent different levels of innovation (organizational, pedagogical and technological) from incremental to radical or even disruptive ones.
- *Implementation phase:* the current stage of development of the cases is diverse (pilot, scale, mainstreaming) including initiatives that provide examples of sustainable development and potential for impact at system level.
- *Access level:* the geographical coverage of the initiatives is also diverse, from involving a limited area (local) to a broad realm (regional/national), up to international level (cross-border). Moreover, the cases selected reflect a range of different geographical locations (from Europe and Asia) and cultural environments.
- *Impact area:* the applied pedagogical, technological and organizational innovations in the seven cases vary from affecting practices (process) to introducing new means (services), up to undertaking systemic reforms (organization).
- *Target:* among the selected cases, there are initiatives that involve a specific target group, to a diverse set of actors, up to a variety of stakeholders (wide-range of actors).

Figure 26 is a representation of the innovation characteristics of the seven cases mapped onto the five-dimensional framework. It clearly reveals the great diversity found across the seven cases on all five dimensions, and not simply in the extent of innovativeness of the initiatives.

As can be seen from Figure 26, some of the initiatives such as the *e-Learning Pilot Scheme* in Hong Kong and the *1:1 Learning in Europe* are rather incremental in nature, involving in many instances simply using ICT as a medium to deliver information and resources, or as a tool for carrying out existing activities such as completing exercises. The use of ICT may bring about minor gains such as offering easy access to multimedia resources and supporting machine scoring and feedback to objective type testing/exercises. These incremental initiatives pose fewer challenges to scaling up and eventual mainstreaming, but the main risk is that the adoption may not bring about the 21st century learning outcomes that were the rationale for e-Learning development in the first place.

Table 13: A summary of the key features of the seven ICT-enabled learning innovations, including conditions and barriers for scalability

Name / Short description	Learning outcomes targeted	Nature of Innovation	Implementation phase & impact	Conditions for sustained impact and scaling up	Challenges/barriers to sustainability/scalability
eTwinning, Europe The EC-funded initiative for a schools' community in Europe covering 33 countries. Since March 2013 it covers 6 additional countries (eTwinning Plus).	Authentic learning; collaboration; intercultural awareness; ICT-use; teacher learning and professional development, awareness of the European dimension and enhanced intercultural understanding.	Started as incremental innovation; shifted to a more radical innovation through offering more opportunities for professional networking and development.	Launched in 2005; 200,000+ registered users (primary and secondary school staff). Fast developing initiative (at scale phase) with scalability plans in place. Impact through blended network & TPD service to influence process.	CSS & NSSs provide multiple levels of top-down agency to support bottom-up innovation. Funding for 2014-2020 via *Erasmus+*. Sustainability good at system level.	Low scalability at school level, mainly because of limited (or no) compensation and recognition. In many countries still not integral part of the curricula and teachers initial education and in-service training. Teachers ICT skills and confidence still a barrier. Project work is usually not part of the formal assessment.
1:1 Learning, Europe 31 recent 1:1 initiatives in 19 Europeans countries, which equipped/have been equipping all students of a given class, school or age group with a portable computing device.	Ubiquitous learning, development of key competences, new classroom and learning dynamics, improvement of ICT skills and motivation.	Overall, the analysed 1:1 learning initiatives can be considered mostly incremental, moving progressively to more radical approaches (e.g. 1:1 pedagogies).	Majority of initiatives are scaled up or mainstreamed. Impact primarily at service level—provision of equipment and development of digital infrastructure.	Impact objectives if underpinned by LS principles—teacher role, objectives, guidelines, tools, knowledge matter. Need productive learning scenarios and medium to long-term plan.	Large scale implementations are challenging due to the current economic climate and new patterns of ownership and deployment models need to be adopted (e.g. BYOD) for sustainable development and further uptake.
Hellerup School, Denmark Public school established in 2002 that support diversity, flexibility, & various learning strategies and styles through innovative open plan	Creativity, personalized and self-regulated learning, key competences and 21st century skills (e.g. collaboration and intercultural awareness),	Almost disruptive innovation that re-designs almost every aspect of the school (physical infrastructure, leadership practices etc.) to provide a coherent learning experience appropriate for	School (primary & lower secondary) has about 750 students and 50 teachers. Impact on T&L processes, infrastructure, organization, leadership practices within school. Wide dissemination	Success in building coherent school ecology, high teacher ownership, strong parent & community support, industry & academia partnership. Pressure from high-stake national tests, and to	The national tests (where factual knowledge is predominantly assessed) that has introduced by the MoE is challenging the sustainability and further uptake of Hellerup. This model of almost disruptive

physical space, rich ICT infrastructure, learner-centred curriculum & pedagogy.	community building.	nurturing 21st century competences & catering for learner diversity.	through media nationally & worldwide.	maintain vitality as school of the future today.	innovation requires readiness and long-term engagement by all the stakeholders involved and high investment in school premises and infrastructure.
e-Learning Pilot Scheme, Hong Kong SAR Initiative of Third IT in Education Strategy (2012-2014) to identify effective models of e-Learning and scalability through public-private partnership. 61 schools in 21 projects, covering all geographic areas & educational levels.	To foster students' 21st century/lifelong learning skills, including information literacy and self-directed learning, and to cater for learner diversity.	Most of the projects are incremental in nature. Only a few projects target inquiry-oriented learner-centric pedagogy.	While the project is building on the previous two IT in education strategies, the programme is a pilot in nature. Most projects target changes in the learning process, while a few involve changes in service through partners.	Top-down strategies (i.e. continuation of the funding, provision of TPD opportunities, monitoring of project implementation) contribute to the sustainability of the *Pilot Scheme* until August 2014. *Pilot Scheme* is expected to raise the baseline conditions for effective e-Learning pedagogy to achieve the targeted 21st century learning outcomes.	Currently there are no plans on sustaining the *Pilot Scheme* beyond the pilot phase. Continued funding for ICT infrastructure, extra staff for pedagogical development and technical support, and continued engagement and support from various partners are challenges for scalability. Teachers still lack pedagogical readiness for e-Learning and schools have not yet developed effective leadership structures after the initiation stage.
CoREF project, Japan A project for reforming public education in Japan conducted by a consortium led by researchers from the University of Tokyo. It is underpinned by the Knowledge Constructive Jigsaw (KCJ) pedagogy in order to guide the change in classroom interactions away from a didactic model.	21st century skills, particularly collaborative problem-solving and ICT literacy, in addition to school subject matter content.	Although the current use of ICT in Japanese schools is still incremental, the change that *CoREF* could bring about in terms of goal settings and balance of roles between teachers and the learners could be profoundly deep and radical.	*CoREF* is a project with a history of three years and a clear focus on pedagogical innovation. The project has impacted organizational level by having the education boards to restructure their teacher support sections as well as the OJT sections, so that those two sections to work together for better results.	MEXT awarded University of Tokyo to continue *CoREF* from 2013 to 2017. In the coming 2-3 years the project participants are expected to expand by 20-30% each year. Reform movements in entrance exams of colleges and universities are in place providing *CoREF* with chances to expand its reform efforts.	Raising standards of learning up to globally competitive levels and shifting teachers' education and training are critical issues for the sustainability and scalability of *CoREF*. The strategy of networking small teachers' networks appears effective but other possibilities for further uptake should also be explored.

Third Masterplan (*mp3*) for ICT in education, Singapore The *mp3* is a national level initiative, covering all 362 schools in Singapore involving a wide range of actors and stakeholders – including industry and other service providers. The intent of *mp3* is to transform teaching and learning in the mainstream.	Key focus on self-directed learning (SDL) and collaborative learning (CoL) through the effective use of ICT.	Different levels of innovation can be found, ranging from incremental (small changes to classroom and other practices at system level), to more radical (e.g. curricular innovations in the FutureSchools), and to disruptive ones (research intervention projects carried out at schools).	The *mp3* is a national initiative at system level, building on the mp1 (focused on equipping schools with the basic ICT infrastructure) and mp2 (focused on effective and pervasive use of ICT in education). *mp3* impact spans service and process changes; the innovation capacity building of agents across all level of education system is probably the most important aspect of the *mp3*.	The top-down support, the existing ICT-infrastructure and the professional sharing about the educational use of ICT have raised the floor for the integration of ICT into the curriculum. The availability of funds (by the MoE), the early successes and the increased teachers' capacity to innovate on their own, are also conditions for sustainability and scalability.	The general resistance to change and the preference to the status quo challenge the scalability of *mp3*. The top-down pressures for change and adoption of innovation may lead to superficial scalability if schools lack readiness for the innovative use of ICT for fostering SDL and CoL.
Digital Textbook project, South Korea It is a national initiative of the Ministry of Education, Science and Technology in the context of the 4th and 5th phase of the Masterplan for ICT in education. The goal of the project is to create a future-oriented learning environment that enables learner-centred learning anywhere and anytime.	To help students develop 21st century skills and improve academic achievement, attitudes towards subjects, problem-solving skills and self-regulated learning skills by using digital textbooks, mobile devices and social network service tools.	Although the ultimate goal of the project is to transform the teaching and learning process, the pilot schools' project is still incremental in nature.	Having a nationwide geographical coverage, the implementation phase is at the scaling up stage, moving towards the mainstreaming. The project has been found to contribute to reducing the digital divide among students and enhancing academic achievement and digital literacy.	The technological rich environment (e.g. good Internet infrastructure in terms of penetration and bandwidth) both in and out of school contributes to the sustainability of the project. Moreover, the convergence of multimedia and e-Learning resources can enhance the ways and effectiveness of use of digital textbooks in classrooms.	Cost-effectiveness of the digital textbooks and the cost of mobile devices are key challenges for the sustainability of the project. There are also concerns about students' and teachers' health with regard to their exposure to electronic devices in the classroom. Teachers' actual adoption and comprehensive support are necessary to sustain and scale up the innovation.

At the other end of the spectrum, the *Hellerup School* is the most innovative, bringing in many radical or even disruptive learning and teaching practices. By designing a whole new physical and digital learning environment, it has successfully taken on the challenge of imagining and establishing a school of the future *today*.

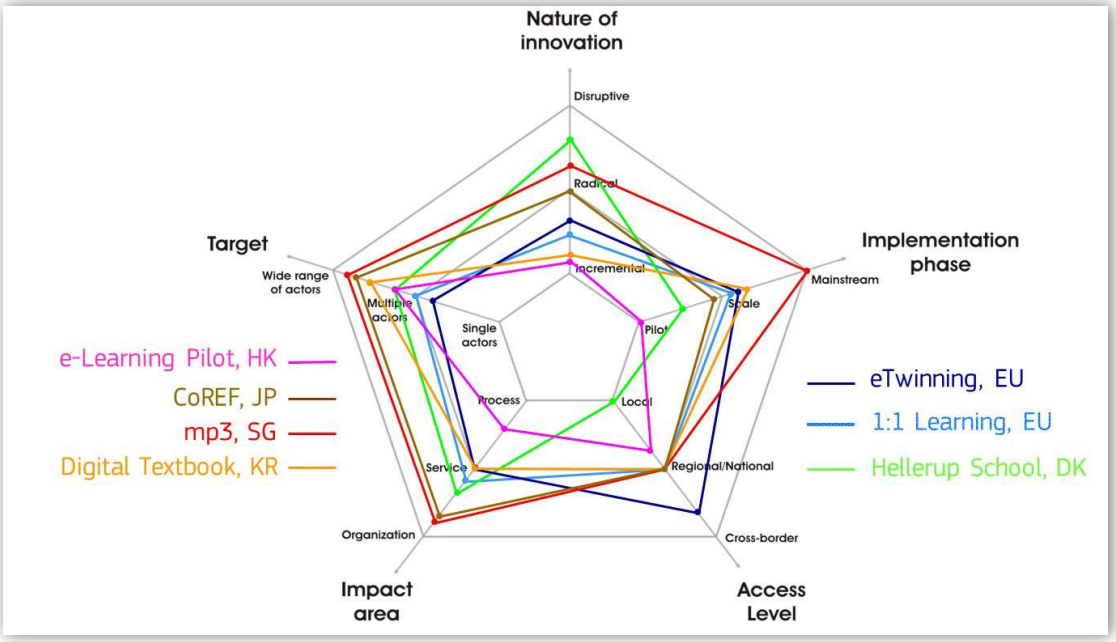

Figure 26: The seven ICT-enabled learning initiatives represented on the mapping framework

Among the seven initiatives, some are clearly pilots in nature, such as the Hong Kong *e-Learning Pilot Scheme* and the South Korea *Digital Textbook* project. Both of these were set up by their respective governments to inform them of critical issues and concerns related to scaling up and mainstreaming. On the other hand, some of these initiatives, such as the *mp3* in Singapore, have already reached the mainstreaming stage.

Another important diversity is the access level of these initiatives. As Hellerup is a school that serves its own community, it is by nature a local initiative. All the Asian case studies cater for a wide geographical coverage within their own country or region. Though *eTwinning* and 1:1 learning initiatives are both found in a large number of European countries, their access levels are in fact quite different. Although 31 recent 1:1 learning initiatives from 19 EU countries are included in the case report in Chapter 4, each initiative only serves stakeholders at the regional or national level it belongs to. *eTwinning*, on the other hand, is a supranational cross-border initiative as was stipulated when it was implemented.

Given these differences, it is not surprising that the impact achieved and target actors involved also differ widely across the seven initiatives.

10.2.2 Diversity in innovation characteristics within each of the initiatives

It is important to note that diversity is found not only across the seven cases. There are also various levels of diversity ***within*** each of the cases, some of which are very substantial. At one end of the internal diversity spectrum is the case of *1:1 Learning in Europe*, which comprises effectively 31 innovations, all involving the deployment of 1:1 portable computing devices to enhance students' learning outcomes. These 31 recent 1:1 learning initiatives also differ one from another in terms of all five dimensions of the mapping framework. Thus, the case report in Chapter 4 is in effect a study of 31 individual case studies of 1:1 learning implementation. The *eTwinning* project in Europe reported in Chapter 3 is also a complex initiative. While all the more than 200,000 eTwinners share

a common ICT-enabled collaboration platform, there is strategic support at various levels by the *eTwinning* Central Support Service and the 35 National Support Services (NSS) in the participating countries. There is an increasing focus on supporting grassroots innovation coming from teachers to connect their classrooms with those of teachers in other European countries. More than 27,000 eTwinning projects have been registered altogether, 5,768 of which are active at the time of writing. The nature, scope and scale of each of these projects can be very different. Hence again, *eTwinning* is a large collection of innovations. Similar to the *1:1 Learning in Europe*, national level support plays an important role in influencing the development of *eTwinning* in the respective countries. On the other hand, this latter initiative differs from the former in that there is little engagement of schools in the process, and teachers participate according to their own interests and self-motivation. The third European case study, the *Hellerup School*, is at the other end of the diversity spectrum of the set of seven cases, involving one school and one focused vision. It is also the only case that was not initiated with substantial government-level support and intervention, although it is a publicly-funded school.

Of the four Asian cases, three are have been initiated, funded and monitored by national (Singapore and South Korea) and system-level government (Hong Kong SAR). The *CoREF* project in Japan is different in that it is led by a University-based consortium, but it is also funded by the MEXT and supported by the regional Boards of Education. Singapore *mp3* is the only initiative that is already at the mainstreaming stage extending the uptake of e-Learning in classrooms through encouraging and focusing on self-directed learning and collaborative learning as the priority pedagogical approaches for developing these two core 21st century competences. With a long history of ICT integration launched since 1997 (start of mp1), the adoption of ICT in Singapore schools when *mp3* started (2008) was already widespread and diverse. On the other hand, the strategic goal of *mp3* is to reduce diversity in pedagogical approaches to achieve the two identified learning outcomes.

Both the South Korea *Digital Textbook* project and the HKSAR *e-Learning Pilot Scheme* share a number of similarities beyond the fact that both are pilot projects put in place to inform further policy initiatives in the areas of e-Book and e-Learning respectively. Both initiatives were interested in innovations, participation was at the school level, and schools were selected on the basis of the innovation plan proposed. However, the criteria for innovation are relatively loose and there are no strictly specified learning outcomes or pedagogies in these two projects. Hence, it is not possible to compare the diversity in pedagogy and intended e-Learning outcomes adopted across the targeted schools in Singapore, HKSAR and South Korea. It is fair to conclude, however, that *mp3* has a clear pedagogical preference and aims to reduce pedagogical diversity whereas the other two initiatives do not have such an explicit goal. In one sense, all three initiatives are similar to the European *eTwinning* and *1:1 Learning in Europe* in that they are initiatives which contain diverse projects.

The *CoREF* initiative in Japan, on the other hand, has the smallest diversity in pedagogy among the participating classrooms. In the other three initiatives, the projects are entirely pedagogically focused. However, given that *CoREF* has been going for only three years and involves hundreds of schools, the diversity in pedagogy is necessarily wider than those found within the *Hellerup School*.

10.2.3 Technology used and its role in scaffolding innovation

Of the seven innovation cases, ICT played a focal role in five. The *1:1 Learning in Europe* and the *Digital Textbook* project in South Korea are both national efforts to make productive use of a specific technology: 1:1 portable learning devices and digital curriculum resources respectively. Hence, how to make best use of the specific technology became the *raison d'être* for these two innovations. The Singapore *mp3* and the *e-Learning Pilot Scheme* in Hong Kong are both efforts to leverage the potential of ICT to transform learning at system level. In these two cases, no single technology is prioritized. Instead, use of multiple and diverse technologies is being encouraged. There are also attempts to build more integrated technology infrastructures, such as wireless networks and learning management systems, to better achieve the targeted educational goals. In this respect, Singapore has a coherent strategy for building integrated infrastructures across the country, whereas the HKSAR does not engage in system level strategies for this purpose. Any

efforts toward building an integrated infrastructure in the latter are left to the individual pilot projects and schools. *eTwinning* is an innovation developed around a single technology, the online collaboration platform developed by the European Schoolnet. However, the *raison d'être* for the innovation is not focused on the technology, but on enhancing collaboration, communication and intercultural awareness among the school communities in Europe by leveraging social networking mechanisms offered by a secure and established platform already available for the European school community.

For the other two innovations, technology is much more peripheral, in a different way in each case. In *CoREF*, the focus is on changing Japanese traditional teacher-centric education into more student-centred, socio-constructivist learning in classrooms. Technology use to support the innovation is introduced and encouraged, but teachers may decide whether or not to use ICT for the innovation. Hence the role of technology is very much that of an add-on tool. No single technology is advocated, but teachers could use robotic agents and different e-learning tools and resources appropriate for the specific curriculum and pedagogical purpose.

Hellerup School is a technology-rich school with an advanced digital infrastructure, which was designed to be embedded and integrated fully into the non-traditional physical infrastructure of the school. The use of technology aimed to fully support diversity, flexibility, and creativity in pedagogy and to cater for a variety of learning strategies and styles. In this particular innovation, though many of the learning goals and activities cannot be fully realized without the pervasive use of technologies, these have become "transparent" and taken for granted.

Figure 27 is a two-dimensional visualization of the nature of the technology used and its role in the seven innovations. It must be emphasized that even though each innovation is represented as a single point on the figure, there is also great diversity within each of the innovations (with the exception of *Hellerup School*), as discussed in the previous section. Each point represents the baseline communality that can be assumed across classrooms/schools within each innovation. The actual technologies used and the roles they played, and the outcomes achieved depends both on the conditions within each innovation site (which refers to a classroom and/or a school, as the case may be), and on the policies and strategies at different levels of the respective education system. These issues are further elaborated in the following sections.

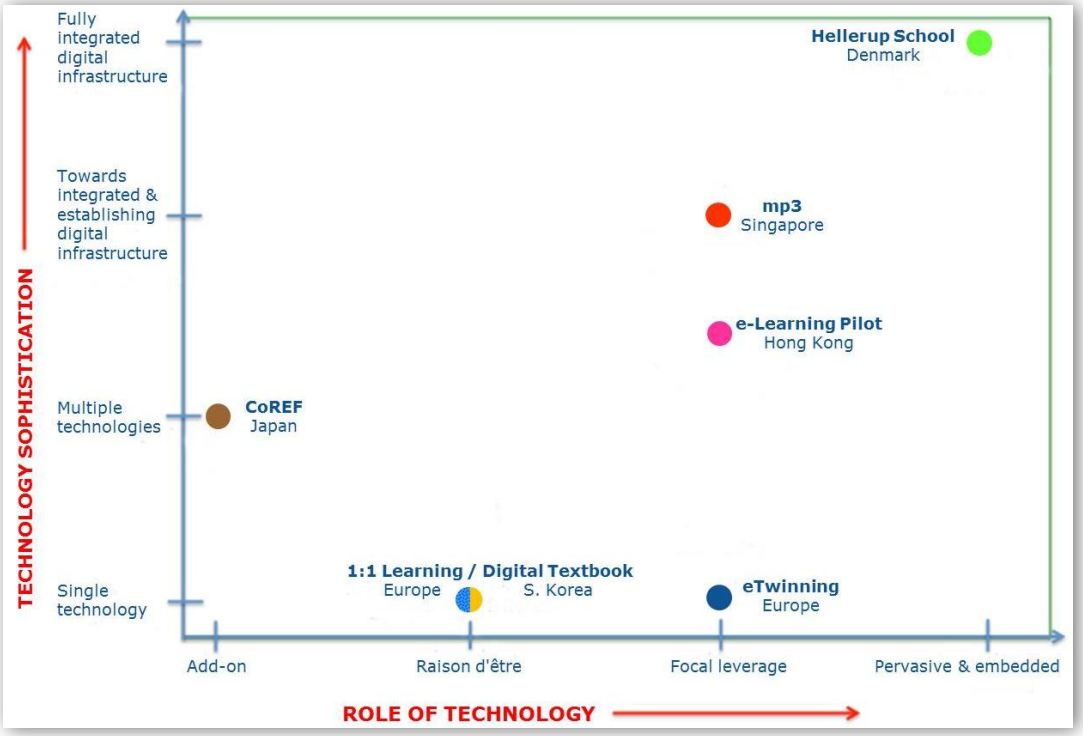

Figure 27: The nature of technology used and their roles in the seven innovations

10.3 Conditions for innovations to have significant impact on learning

Given the huge diversities across and within the seven cases of innovation studied, they provide us with a valuable set of authentic data to identify the cases where significant impact on learning is observed. From this, we can derive the critical conditions for this impact to happen. As mentioned in Chapter 2, two workshops were held involving experts from Europe and Asia, including those closely involved in the seven case studies. The first was in Seville in December 2012 and the second in Hong Kong in January 2013. During these two workshops, and particularly the first workshop, a major theme that was intensively discussed was the kinds of learning outcomes observed and which were the most valuable. During the discussion, it was agreed that in all cases, learners have to be given the autonomy to identify their own learning goals and pathways to develop the necessary 21st century skills and competences.

Hellerup School was recognized as the initiative that has brought about the most significant advances in learning outcomes. First of all, as can be seen from Table 13, the targeted learning outcomes in this innovation are the most ambitious and are the ones most sought after as key competences for the 21st century: creativity, personalized and self-directed learning, collaboration and intercultural awareness, and community building. What is also very impressive is that these lofty goals were actually achieved because of the reinvention of the school from physical design, digital infrastructure, to curriculum and pedagogy to support child-centred, collaborative, self-directed inquiry-oriented learning, grounded on our best knowledge from the learning sciences of how people learn. Three conditions were identified as critical for technology-enhanced learning to achieve significant impact on student' learning outcomes: pedagogy first, teacher support and teacher autonomy, and better definitions and assessment for 21st century skills.

10.3.1 Pedagogy first

For the other six initiatives, it is not easy to compare the learning outcomes achieved at the project level due to large diversities even within each of the innovations, as explained earlier. On the other hand, a common theme that emerged strongly through the discussion was that the pedagogical approach adopted is the primary determinant of students' learning outcomes for all seven initiatives. A technology-centric approach to the integration of ICT is unlikely to have substantial impact on students, particularly in the area of fostering learners' 21st century skills. Where substantial learning gains were observed, implementation always focused on the use of ICT to empower student learning and support learner-centric pedagogy that leverages learner interest and encourages self-directed learning and collaborative knowledge creation. These classroom scenarios tend to be associated with radical and/or disruptive implementations of the innovations.

10.3.2 Teacher support and teacher autonomy

Another theme that emerged through the discussion was the need for the initiative to support teachers' autonomy for the desired learning outcomes to be realized. Changing pedagogical practice, be it simply incremental, requires teacher learning - in particular, learning through practice and reflection. These cannot take place effectively without teacher buy-in, and teachers must be given the space to make autonomous decisions. One very encouraging finding from the discussion was the fact that a change of focus from technology to pedagogy has been observed among the stakeholders, particularly teachers and school leaders. This is the most important professional learning that was found to be associated with enhanced student learning outcomes through the use of ICT. The conditions that encourage and foster this kind of professional learning are crucial for the sustainability and scalability of these initiatives and will be discussed in the next section.

10.3.3 The need to better define and assess 21st century skills

Assessment-related issues were raised by many of the workshop participants as obstacles/ challenges in the context of ICT-enabled learning innovations. While the term *21st century skills* has become a buzz word, there is a lack of specificity or common consensus on what these skills are beyond the rhetorical level, and how such skills can be assessed. These two concerns are in fact very much related and need to be tackled together. One finding from *mp3* in Singapore is that

although the MoE has published two booklets for teachers and education practitioners, one on self-directed learning and the other on collaborative learning, common misconceptions about these two concepts found in other parts of the world still prevail in Singapore. Self-directed learning is often equated with and understood as self-regulated learning, even though the former emphasizes the learner taking responsibility for decisions on what and how to learn and the latter focuses on the learner taking responsibility for self-monitoring and completion of set goals and tasks. Cooperation is what happens when a group of people share out identified tasks and responsibilities to achieve a common goal. It is only a part of what may have to take place when people collaborate. The latter happens when a group of people share a common goal and work together to share and debate their understanding of the problem and develop solutions together. Collaboration has been identified as being necessary and integral to the process of knowledge creation (Scardamalia & Bereiter, 1996). The list of ambiguity goes beyond self-directed learning and collaboration. For example, problem-solving and critical thinking can be very different, depending on whether the term is applied to solving well-defined closed-ended stereotypical problems usually found in textbooks using well-defined techniques and procedures, or if it is applied to the solving of ill-defined, open-ended problems that emerge in authentic real-life situations.

What constitutes self-directed learning or any of the other 21st century skills? This issue cannot be adequately addressed without breakthroughs that are still necessary on how to assess them. Assessment of 21st century skills is particularly challenging, as these will need to differ from traditional methods of assessment in some very fundamental ways. Traditional assessment typically makes use of well-defined problems that can be easily scored for correctness, which do not lend themselves to the assessment of 21st century skills. A new paradigm, methodology and technology will need to be developed to assess quality of product, competence and process. Assessment will need to be conducted over an extended period of time to collect the different kinds of process data that reflect the different levels of skills and understanding necessary for different kinds and stages of the problem solving process. Assessment will have to be an on-going, integral part of the learning process, feeding back valuable formative information to the learner and the teacher to improve the teacher's learning design and to help the learner understand what needs to be improved to enhance their performance.

10.4 Conditions for sustainability and scalability

As mentioned in Chapter 1, the focal concern for this study is to explore the conditions for sustained and scalable impact of ICT-enabled innovations for learning at system level. While there are many examples of successful ICT-enabled pedagogical innovations at classroom or school levels (e.g. Kozma, 2003; Venezky, 2002), whether there can be sustained impact on a large scale, particularly within the mainstream education system is still a matter of debate (Collins & Halverson, 2008; Cuban, 2001). The collection of cases examined in this study cover a wide diversity of contexts, scales and levels of change agency, and all have achieved some level of success in making an impact on learning. These cases provide an invaluable resource for us to develop a better understanding of the conditions for sustainability and scalability of ICT-enabled learning innovations. Since the conditions for sustainability and scalability are similar, we will discuss both together. In the interest of brevity, we sometimes collapse these two ideas into one and refer to these simply as scalability in the remainder of this chapter.

10.4.1 Change as multilevel and interdependent

The cases of innovation from both Asian and European countries were selected such that the starting points and the focal concerns in these initiatives were different. This is important for two reasons. First of all, such diversity reflects the state of affairs in the education arena in many countries around the world. Education has become such a strategic concern for governments, communities, families and individuals around the world that agencies for learning innovation initiatives may emerge at any of these levels. Secondly, irrespective of the level of at which the change is initiated, the change will necessarily impinge on practices and require appropriate adaptation and changes in factors, provisions and priorities at multiple levels within the system. The

case studies within the present volume echoes the findings from the analyses of the SITES M2 case studies of ICT-enabled pedagogical innovations that pedagogical practices exist within the broader educational ecology characterized by nested levels of complexity and interdependence within and across the different levels (Law, Yuen and Fox, 2011). These nested levels of interdependencies from classroom up to international level, including possible agencies at these different levels are well illustrated by Figure 28 from Davis (2008).

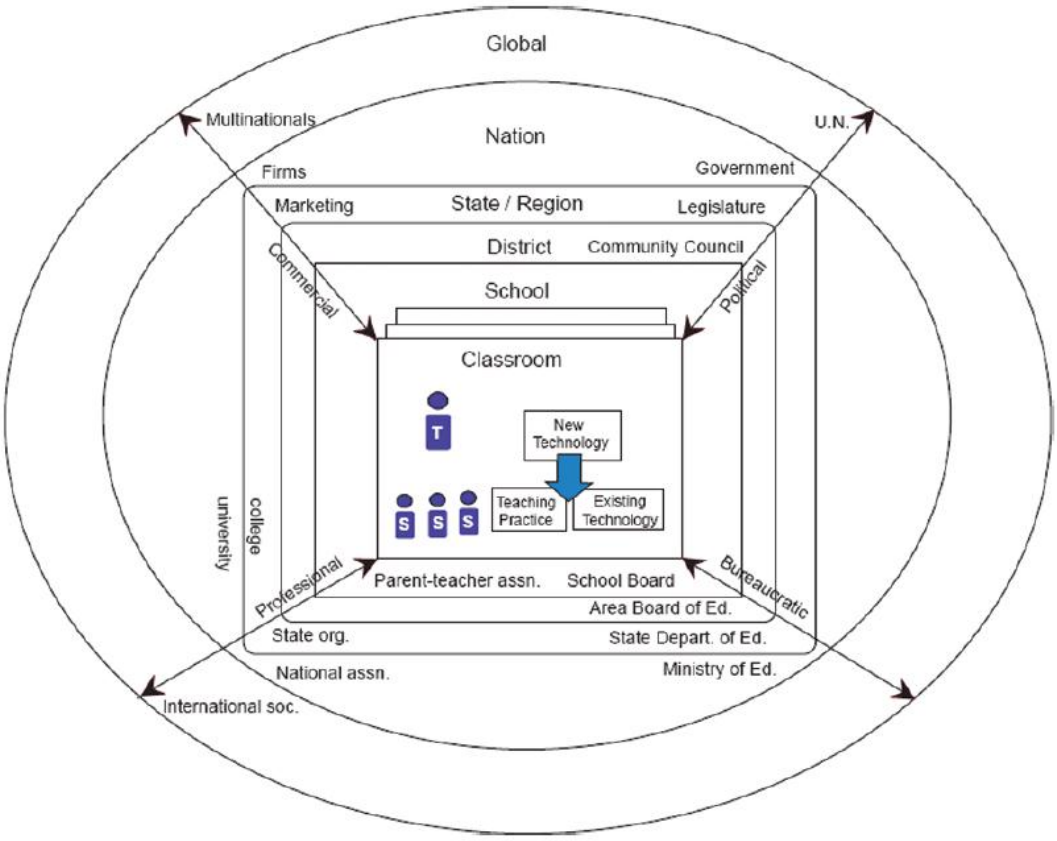

Figure 28: 2 Influences of IT in the global biosphere of education, including nested ecologies (source: Davis, 2008, p. 509)

10.4.2 Common characteristics of successful change from diverse case studies

Despite the wide diversities in the case studies selected, there are some common themes/ characteristics that emerge across all the case studies in relation to their change strategies and processes. First of all, the fact that all of the case studies are perceived to have achieved some positive impact on learning despite the wide diversities indicate that there is no one-size-fits-all approach to change and innovation. All these cases have in fact leveraged the local/national/international support available in their specific context to ensure/amplify their success, indicating that strategies for sustainable development are context-dependent.

Most of these cases of ICT-enabled learning innovations started as incremental efforts and progressively moved towards more radical forms of innovation, indicating that these initiatives have been developed organically over time. The characteristics of these initiatives as well as their respective change strategies have evolved through interactions among the various actors and the many contextual factors. Their successes are clearly not a consequence of high fidelity executions of innovation blueprints, but rather that dynamic adaptations and adjustments were continuously developed and implemented as an integral part of the monitoring, evaluation and feedback cycles, which is consistent with an ecological model of change.

Another common characteristic of these initiatives is that while almost all started as top-down initiatives within their respective contexts, they also have mechanisms in place to encourage and support bottom-up approaches to the innovation. In fact, all seven initiatives have more than one level of agency and strategies at work for their initiation and subsequent development. The specific change forces and strategies for these seven cases are examined and compared in the next section.

10.4.3 Levels of agency, participation threshold and scale of the innovation

Section 10.2 describes the diversity across the seven case studies in terms of the five dimensions of innovation characteristics in the mapping framework. In fact these cases also differ greatly in terms of their change strategies and the nature of the drivers of these innovations. Table 14 summarizes the key levels of top-down agency, top-level strategic focus, mechanisms for supporting lower level leadership and key mechanisms for connectedness.

One important difference from the strategic point of view across the cases is the level at which the key driver of the innovation resides. While learning innovations may be initiated even at the classroom level by the teacher, impact at scale cannot be achieved without some higher level support as such innovations inevitably impinges on curriculum and assessment practices and requires access to technology infrastructure and support. All seven of the case studies included in this volume are supported by multiple levels of stakeholders above the classroom level. On the other hand, for each of the initiatives one key driver for change can be identified, and the level at which this key driver operates has significant implications for the scale of the innovation. Three of the Asian initiatives are national/system level innovations: *mp3* in Singapore, *e-Learning Pilot Scheme* in Hong Kong and the *Digital Textbook* project in South Korea. The *CoREF* project in Japan is in fact also a national level initiative supported by MEXT, even though the geographical coverage is regional at this stage. All of the 31 recent 1:1 learning initiatives in Europe are either national or regional level initiatives. The *Hellerup School* differs from all the other initiatives in that it is a school level initiative, even though it has received recognition and support at the community, national and international levels. At the other end of the level of agency spectrum is *eTwinning*, a European level initiative led by EC, which is a supranational organization.

Irrespective of the key level of agency, each initiative needs to establish a common basis for participation among its stakeholders, which differs across the cases. The common basis defines the lowest denominator expected of all the stakeholders participating in an initiative. For example, *eTwinning* provides a common communication platform and all teachers participating in the project must commit to linking up their classrooms with at least one other classroom in another European country. Obviously, the *eTwinning* project provides professional development and pedagogical guidance beyond the technology platform, and there is additional support provided by the NSSs in the respective countries. However, there are no restrictions on the nature of the pedagogical practice for *eTwinning*. So in this sense the participation threshold for *eTwinning* is very low—in fact the lowest among all seven initiatives. A low participation threshold does not mean that there are no radical or disruptive practices found among the eTwinning projects, but would imply a wide diversity in the pedagogical practices it supports, and that additional strategies would need to be in place if the goal of the innovation was to achieve radical/disruptive changes.

Hellerup School, on the other hand, is a school level innovation that requires all stakeholders—teachers, students, parents and all other school personnel to subscribe to the disruptive vision and practices of the school. The school is committed to being a school of the future today, to be always in the process of seeking improvements, adopting new practices and technologies to address new challenges, and never "completing" its innovation journey. While the school's success has attracted much national and international attention through various media, and enjoys a high demand from parents to place their children in the school, the likelihood of another similar school being built is reported to be slim even in 2013, 11 years after *Hellerup School* started, as the barriers to scaling up this innovation is too high.

Table 14: A comparison of the key agencies, strategic focus and mechanisms for change adopted by the seven initiatives

	Key level of top-down agency			Key strategic focus at top level					Mechanisms for top-down leadership at a lower level				Key mechanism(s) to support connectedness			
Initiative	**School**	**Regional/ National**	**Supra-national**	**Whole school disruptive innovation**	**Teacher PD & exemplar practices**	**Support school-based innovation**	**Monitor, evaluate, identify good models**	**Connectedness - share good practices**	**N/A**	**Unstructured**	**Various [a]**	**Structured**	**Informal**	**Various [b]**	**Organizational support**	**ICT support**
Hellerup School	X			X					X				X			
CoREF Japan		X			X						X			X		
***mp3* Singapore**		X				X						X			X	
Pilot Scheme HK		X					X			X				X		
Digital Textbook S. Korea		X					X			X			X			
1:1 Learning in Europe		X			X	X	X	X			X			X		
eTwinning			X		X			X				X			X	X

[a, b] There are different levels at which the innovation(s) are organized and developed within some of the initiatives between the top level of agency and the school level, hence there are more than one kind of mechanism involved in these cases.

[a] There is no structured mechanisms at the top level and there are both structured and unstructured mechanisms depending on the specific lower level agency.

[b] Mechanisms to support connectedness is weak at the top level, but there may or may not be organizational support for this at the lower level.

Figure 29 is a plot of the common strategic basis shared by the participants within each initiative vs. the respective scale of innovation for the seven case studies. On the vertical scale is the common strategic basis for participation (or participation threshold for short). The common strategic bases leveraged by the seven initiatives, in order of increasing participation threshold are: common communication platform (*eTwinning*), common resources (*Digital Textbook* project), common technology access (*1:1 Learning in Europe*), common strategic directive (*e-Learning Pilot Scheme*), common learning outcomes (*mp3*), common pedagogical model (*CoREF*) and common vision (*Hellerup School*). As discussed earlier, it is expected that the innovations with higher participation thresholds will have a higher concentration of radical to disruptive pedagogical practices among the participating classrooms.

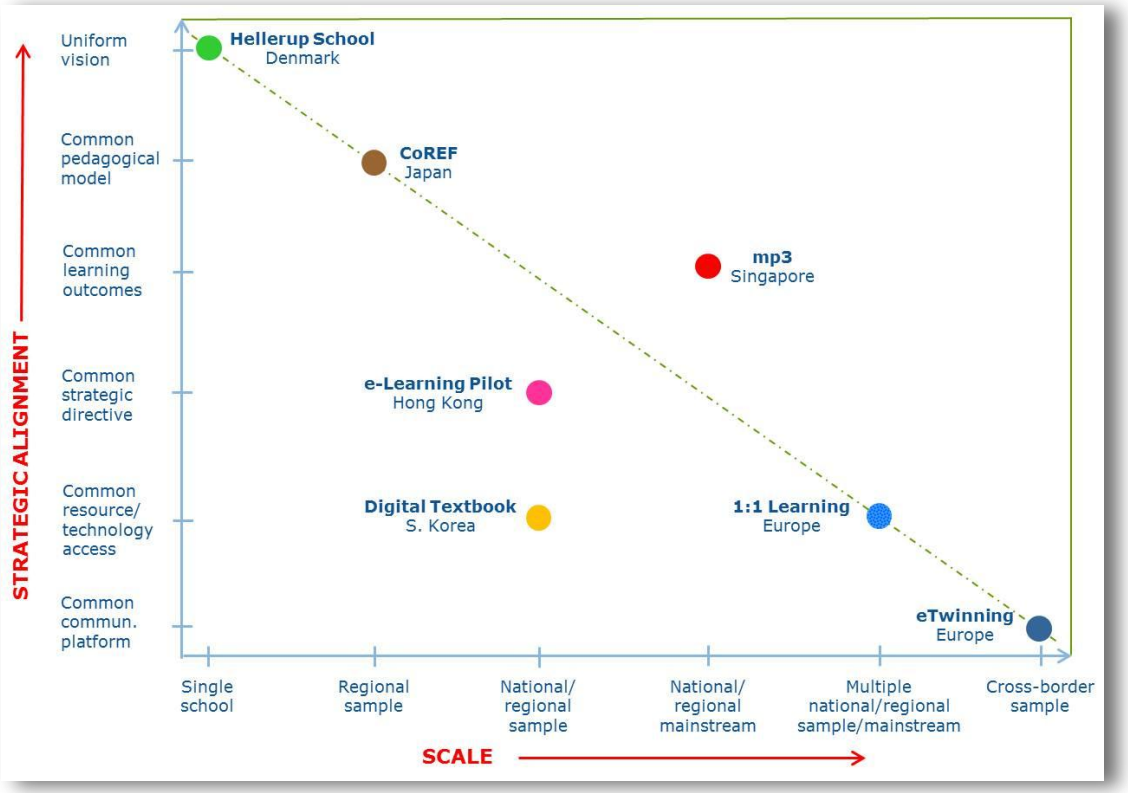

Figure 29: A plot of the common strategic basis shared by the participants within each initiative vs. its scale of innovation for the seven case studies

This graph clearly indicates that *eTwinning* has the largest scale (i.e. cross-border coverage) and the lowest threshold for participation while *Hellerup School* has the smallest scale (i.e. local coverage) and the highest threshold for participation. The other five initiatives are broadly located along the negative-sloped diagonal of this graph, indicating that initiatives that have bigger scales generally have lower participation thresholds. This observation is reasonable, given that to achieve larger scales of stakeholder buy-in for innovations at higher participation thresholds are clearly more challenging. Another way of expressing this relationship is that more innovative practices are more difficult to scale.

On the other hand, the two "scales" of innovation aspects in Figure 29 do not follow a simple linear relationship. For example, some of the European 1:1 Learning initiatives are already at the mainstreaming stage while the South Korean *Digital Textbook* project only covers a small sample of schools in the country. The *e-Learning Pilot Scheme* in Hong Kong is similar to the *Digital Textbook* project in scale as both are system level pilots, but the Hong Kong initiative has a higher alignment threshold for participation as the schools need to propose their own specific e-Learning pilots to achieve a broadly defined transformative learning goal. One important factor influencing scale is the history of an innovation—initiatives with a longer history of development are more likely to

have evolved more innovative practices, and for the associated "ecology" to be more receptive to higher participation thresholds. Based on this argument, it is reasonable for the *Pilot Scheme to e-Learning* to impose a higher participation threshold than the *Digital Textbook* project, since the former is an integral part of the Hong Kong IT in Education Strategy first launched in 1998 while the latter only started in 2007. However, the length of developmental history is clearly not a determining factor since Hong Kong and Singapore both launched their IT in Education strategy/masterplan at around the same time (in 1998 and 1997 respectively), but the former is at a much lower level both in terms of scale and in participation threshold than the latter. While there are diverse practices at different levels of disruptiveness present in the ICT-enabled pedagogical practices in Singapore, self-directed learning and collaborative learning as the focal outcome goals in *mp3* are targeting mainstream practices in schools.

10.4.4 Strategic focus and mechanisms to achieve impact and scale

Each of the seven initiatives has its own participation threshold (i.e. common basis for participation among its stakeholders), as well as its own strategic focus in the implementation process. As the 1:1 learning initiatives is in fact an amalgam of 31 initiatives in different national or regional contexts, it is not possible to identify one single strategic focus for the different initiatives in this collection, and is hence not considered within this section in the discussion of strategic focus. Table 14 reveals that the strategic focus adopted is closely related to the participation threshold of the initiative. For example, schools in the *CoREF* project must agree to adopt the Knowledge Constructive Jigsaw pedagogy, and the project focuses on providing professional development opportunities and exemplar practices to project teachers. *mp3* focuses on providing support to foster school-based innovations. The strategic focus in both the *e-Learning Pilot Scheme* and the *Digital Textbook* project are on the provision of monitoring and evaluation mechanisms, in order to identify good models for subsequent mainstreaming of the innovation. *eTwinning* is very special among these initiatives in that it has two main strategic focus. One focus is to provide the technology and support for teachers to connect their classrooms, which is directly linked with its participation threshold. The other focus is to provide teacher professional development opportunities and to promote more student-centred and project-based pedagogies. It is thus not surprising that *eTwinning*, despite its large scale and low participation threshold, has achieved outstanding outcomes in reported changes in teachers' practices and students' enhanced learning outcomes.

With the exception of *Hellerup School*, all the cases of innovation studied were supranational/national/regional level initiatives providing top level leadership and support for their implementation at the lower levels. However, as mentioned earlier, the changes involved in all these initiatives are multilevel and interdependent. In examining the change strategies and mechanisms present in these six initiatives, we find that there is, in some cases, structured support for top-down leadership at lower levels below the key level of agency. For example, the MoE in Singapore organizes regional workshops and professional development opportunities for principals and teachers to discuss leadership and change issues. Technical and professional development support to *eTwinning* teachers are provided through structured top-down leadership at the national level and below through the respective NSSs. For the other projects, there may not be structured input to ensure leadership at the lower levels to support the innovation.

Another strategic difference across the initiatives is the presence of organized support to foster connectedness across and within different levels of stakeholders involved in the innovations. *eTwinning* is the only initiative that provides both technology and organizational support for connectedness among the many stakeholders, particularly teachers and their students in classrooms around Europe. The only other initiative that is also known to have a strong organizational support at the top level to encourage and promote connectedness is *mp3*. In the other initiatives, the presence of such planned mechanisms to support connectedness among teachers may differ depending on the specific projects/schools concerned, and are labelled as various, or may be entirely informal.

Learning is critical to any kind of innovation, whether incremental, radical or disruptive, and the learning required is more challenging if the focus of the innovation is towards the disruptive end of the spectrum since these are less familiar. Further, if the learning is for the purpose of changing one's practice, there is a risk associated with the implementability of the innovation and whether one can master the knowledge and skills needed for successful implementation. It was found from the case studies that when teacher networks are established and supported in conjunction with the innovations, these can play very important supportive roles in supporting professional learning and school-based, bottom-up innovations, serving as "horizontal" conduits for connecting teacher communities of practice. Other consultative, organizational structures -such as national/regional support services, advisory boards, and steering committees- may also serve as connectivity mechanisms promoting communication and constructive alignment across sectors and levels of stakeholders.

In chapters 3 to 9, the case studies authors have provided detailed descriptions of the agencies and strategies found within the respective innovations that have impact on their success and scalability. At least three types of leadership strategies have been identified for each of the initiatives: centralized top-down, centralized bottom-up and decentralized bottom-up. In some cases, decentralized top-down strategies have also been identified. Both the workshop discussions and our cross-case analyses reveal a common strategic objective underpinning all these cases that are crucial to the scalable success of these initiatives despite differences in specificity—the deployment of top-down strategies to support bottom-up innovations. The presence and multiplicity of bottom-up strategies, whether centralized or decentralized, are indications of ownership from the lower levels of the ecosystem, which are necessary for the creative contributions to continuous evolution of the innovations. One challenge to the management of innovation and change is to ensure that bottom-up innovations are well-aligned with the top-level goals and strategic focus of the entire project and not become as run-away developments that go off in many diverse different ways which may even be counter to the overall objectives. To ensure constructive alignment in strategic direction across the multiple levels and stakeholder groups, connectivity mechanisms and structures to serve as architectures for learning (Law, Yuen and Fox, 2011) become another key strategic direction that needs to be considered. Some of the initiatives (e.g. *eTwinning*, *mp3*) have done well to promote connectivity across different levels and sectors of their ecosystem, with the outcome that they were able to achieve higher levels of impact on students' learning outcomes and/or participation thresholds despite their relatively large scale. Figure 30 provides a graphic representation of these three groups of change strategies and their impact on the change process in relation to the leadership strategy schematic. Where there are structures and mechanisms in place to promote connectivity within and across different levels and sectors of stakeholders to promote learning and constructive alignment, there is much higher probability for sustainability.

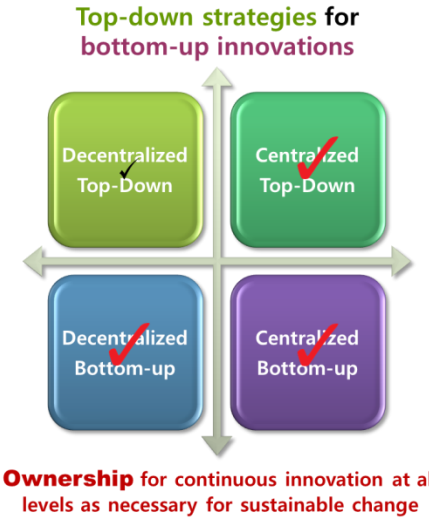

Figure 30: The three most important functional groups of change strategies mapped onto the leadership strategy for change schematic

10.5 Conclusions

In this final section, we begin by summarizing our findings in the form of a model for understanding the scalability (and sustainability) of technology-enhanced learning innovations in education and training. This is followed by a proposal for an ecological framework for developing effective policies and strategies for mainstreaming ICT-enabled innovations for learning in education and training, and a discussion of the research gaps, based on these models.

10.5.1 A model for understanding cases of ICT-enabled learning innovations

ICT-enabled learning innovations have attracted increasing interest from a diverse range of stakeholders over the past decade. This interest has been spurred on not only by the recognition that education could potentially renew/reinvent itself to widen the outcomes and ways of providing opportunities for learning, like many other fields of social and economic activity such as banking, finance and medical practice have done. There is also increasing frustration and puzzlement as to why education has not really changed in any significant way despite the rapid advances in technology and the increasingly widespread penetration of ICT at home and in schools. It is not only that fundamental changes in learning and teaching practices are rare; even the adoption of ICT into students' learning practices are rare (Cuban, 2001; Collins & Halverson, 2009). Among the many who believe in the transformative potential of ICT in education, most are "optimists" who continue to believe that slowly things will change. There are also others who, after analysing the different barriers and challenges, and the systemic interdependence of such barriers, believe that the possibility of this potential being realized in mainstream, publicly-funded schools is rather slim (Collins & Halverson, 2009). It is our view that in order for us to gain a better understanding of the successes and failures of achieving and scaling up ICT-enabled innovations in learning, we need a good model for understanding the nature of the change process involved. In this section, we summarize our findings into a preliminary model based on the research conducted for the SCALE CCR project, and in particular our analyses of the case studies included in this report.

1. ***The key dimensions of an ICT-enabled learning innovation.*** Kampylis, Bocconi and Punie (2012) identified five key dimensions, each comprising a developmental scale for mapping ICT-enabled innovations for learning in order to capture their dynamic and evolving character: nature of innovation (incremental, radical, disruptive), targets reached (single actor, multiple actors, and wide range of actors), implementation phase (pilot, scale, mainstream), impact area (process, service, organization) and access level (local, regional, cross-border). Analyses of the seven case studies using this framework reveal that:
    a. ***Nature of the innovation is the key to achieve impact on learning.*** As discussed earlier, while technology might have been the *raison d'être* for launching a particular innovation, and there may be many different changes involved in the implementation, ultimately it is the pedagogical approach adopted (i.e. pedagogical nature of the innovation) that has the most influence on the experiences and outcomes of the learner.
    b. ***Some dimensions are interdependent and mutually constraining.*** To scale up an implementation from a pilot to the mainstream phase, the targets reached must also expand beyond a few actors to a whole range of actors in the community. In addition, the impact area must go beyond learning and teaching practices and develop appropriate services and organizational changes that are commensurate with the scale of the changes needed. Hence, when we inspect the developmental stages along these three dimensions for the seven case studies, these tend to be more aligned and these need to develop more or less in tandem.
    c. ***Innovations are evolutionary and the developmental scale is a moving target.*** An assumption of scaling up innovations may be to reach the highest developmental point on the scale of all five dimensions. However, similar to the finding reported in Law, Yuen and Fox (2011), our analysis found that more disruptive innovations are

more difficult to scale up. In fact, if a practice has already reached mainstream status, it cannot be considered as disruptive or even radical at that point in time. Hence it is important to note that change and innovation is a process and a journey that involve multiple factors and actors working in tandem. Whether an innovation is incremental or disruptive is relative to the mainstream practice of a particular context, and its nature should be interpreted from an evolutionary perspective.

2. ***Effective strategies to scale innovations must support learning at individual, organizational and system levels.*** Innovation is about change. While many different changes need to take place at different levels as detailed in this report, ultimately the most difficult changes to make are those involving practices rather than technology or other contextual factors. In particular, it is the behavioural changes that challenge the common wisdom and widespread professional/community beliefs about (1) how people learn (e.g. an absorption model of learning, that people learn primarily because they are taught), (2) the role of the teacher (e.g. that the ideal is one who has high-level subject expertise and excellent presentation skills on the subject matter), (3) the best way to measure learning outcomes (e.g. using standardized tests), and (4) the role of a school (e.g. providing a standardized, structured experience for all students to achieve the specified curriculum goals). Changing beliefs and practices are usually incremental and evolutionary rather than quantum level revolutions by nature. Learning at various levels must take place for any innovation to claim some level of success. An inspection of the policies and strategies in the seven case studies analysed reveal the following characteristics in the nature of the learning support they have provided:
    a. ***Encourage learning that is experiential, generative and self-organizing.*** While all seven cases of innovation are top-down initiatives by virtue of the locus of their initiating agency, bottom-up agency plays an important part in the implementation and development of these innovations. None of the cases provided a detailed plan for the participants to "implement". As described earlier, there is great diversity across sites even within the same innovation. Such diversity is characteristic of naturalistic, emergent changes that result from the self-organizing efforts of the actors at each of the various levels who improvise (i.e. innovate) and learn simultaneously through the innovation process.
    b. ***Provide architectures (i.e. structures and mechanisms) for learning across sites and levels.*** With the exception of *Hellerup School*, each of the innovations comprises multiple innovation sites under a common umbrella commitment (or strategic alignment as referred to in 10.4.3), and have built-in formal and informal structures and mechanisms to support communication and learning across the different sites to promote collaboration and peer learning as part of the project/professional development plan. The *Hellerup Schoo*l and the other projects have also organized, on a regular basis, opportunities for the innovation teachers, school leaders, etc. to share their practices and reflections with those not involved in the innovation through professional/academic conferences and various community events. Such architectures for learning (Law, Yuen and Fox, 2011; Stein & Coburn, 2008) are conducive to self-directed, autonomous and self-organizing learning needed for implementing and scaling up innovations.
    c. ***Propagate and consolidate learning to higher levels of the system hierarchy through changes to services and organization.*** While learning outcomes of individuals are commonly conceptualized as the knowledge and skills they have mastered, learning at organizational and system levels is not simply an aggregate of the individual learning at the lower levels. Learning outcomes achieved should be recognizable through improved performance capacities, qualitative or quantitative. Sherer & Spillane (2011) argue that changes in school routines and organizational practices such as timetabling, assessment and appraisal practices are important steps

in reifying and consolidating learning at the school level so as to prioritize and hence facilitate the mainstreaming of innovative practices that emerge. Our analyses of the case studies show that changes in governance, management and school routines are important changes that enhance a school's capacity to adopt and further enhance the innovations at the school level. Monitoring, accountability and evaluation mechanisms have also have important impact on the motivation and likelihood of adoption of innovations at regional or national levels. Developing, implementing and evaluating such routines and mechanisms should be considered as an important part of intentional learning for scaling up innovations at organization level and beyond.

d. ***Technology as an integrated infrastructure for learning at multiple levels.*** In selecting ICT-enabled learning innovation cases for the present study, the role of technology that we focus on are those that directly contribute to the learning of the targeted learners under the specific education and training context. As discussed earlier, the technology use ranged from being an add-on tool to a fully integrated digital infrastructure. The case of the *Hellerup School* demonstrates that increasing integration provides a greater potential for the technology use to contribute to enhancing the learning outcomes associated with the disruptive aspects of the innovation. In the case of *eTwinning*, there is one focal technology—the online collaboration platform. However, we argue that this platform serves as an integrated infrastructure to support learning at multiple levels spanning classrooms, local, regional, national and cross-border levels. The simplicity of a single platform enables communication and collaboration at different levels and allows the platform to serve professional development, sharing of good practices and scaling purposes.

10.5.2 An evolutionary, ecological framework for effective policies and strategies to mainstream ICT-enabled learning innovations

Building on a multidimensional model of innovation that is evolutionary and developmental, and the understanding that the challenge to scaling up innovations is primarily a learning challenge at all levels of the system hierarchy, what strategic and policy insight have we gained about scaling up ICT-enabled learning innovations? First of all, we note that all the seven cases have achieved different levels of success in generating and sustaining innovative learning practices in the respective contexts. On the other hand the strategic dimensions and the prospects for their sustainability and scalability differ according to the respective case authors. Through our analysis of the cases based on the above model, we have identified four central principles that differentiate the strategic effectiveness of different innovation initiatives.

1. ***Multiple pathways to innovate and scale.*** The seven innovations are very different from each other not only in terms of how they map onto the five-dimensional framework, but also in their pathway to innovation and scaling up. The main agent for change could be a classroom teacher as in the case of *eTwinning*, a school in the case of Hellerup, a university consortium in the case of *CoREF*, or a regional/national government in the case of *1:1 Learning in Europe*, even though multiple levels of agency are found in all the seven cases. They differ widely in terms of the technology used and the roles these play in the innovation. Yet they have all gained acceptance and made progress towards realizing the transformative potential of ICT in supporting learning, and have thus demonstrated ecological validity for their specific context. There is no single or best route to innovation and scaling up; there are multiple pathways, each with its own constraints and conditions for success and sustainability.

2. ***Ecological diversity of innovations foster scalability.*** Most of the innovations involve more than one school site, and there is diversity across sites even within the same innovation. Innovations that have achieved implementation on a larger scale may have developed changes at service and organizational levels that are more congenial to other, more disruptive innovations, even though they themselves remain relatively incremental in

nature. In the case of the Singapore *mp3*, the government on purpose created different mechanisms and schemes to stimulate a range of different innovations to achieve a kind of ecological diversity in ICT-enabled learning implementations. Strategies that cater for innovation diversity encourage wider participation in the learning process associated with engagement in innovations. *eTwinning* is a prime example of an innovation that has a low threshold for participation but fosters the emergence of more innovative practices through different means. Since its launch in January 2005, there has been a steady progression in the numbers of teachers involved in *eTwinning* and in the nature of innovations implemented from incremental to more radical ones.

3. ***Leadership for strategic alignment as a necessary condition for scalability.*** Strategies for scaling up innovations should support multiple pathways and ecological diversity in innovation. However, there is a danger of loss of direction resulting in the innovation initiatives going off at tangents and never progressing beyond the initial starting point. A comparison between the Hong Kong and Singapore cases provides a clear illustration of this principle. Both systems launched their first IT in Education masterplan/strategy at about the same time: Singapore in 1997 and Hong Kong in 1998. Both are in the process of implementing their third masterplan/strategy. The three Singapore ITE Masterplans demonstrate a clear progression in objectives and implementation focus: *mp1* built the basic conditions (foundations) for ICT integration, *mp2* focused on seeding pedagogical and associated supporting innovations, and *mp3* aims to achieve strengthening and scaling up through sharpening the pedagogical focus to only self-directed learning and collaborative learning. In Hong Kong, however, there appears to be no mechanism for deep learning at the system level that allows for the accumulation of knowledge and understanding about 21st century pedagogy and ICT use based on the many e-Learning projects that have received support directly or indirectly from the Government, in the context of the three 'IT in education' strategies. Thus, the main difference between the first two strategies that informed the formulation and implementation of the *e-Learning Pilot Scheme* is in the greater technological sophistication of the ICT used.

   In the literature on change and sustainability, leadership and organizational learning at the school level has been identified as critically important to the success and sustainability of innovations (Hargreaves & Fink, 2006; Sherer & Spillane, 2011; Stein & Coburn, 2008). There have also been initiatives to support the development of e-Learning leadership in the Second ITE Strategy in Hong Kong. However, there seems to be discontinuities in policy and this aspect has not been picked up either in the Third Strategy or in the present *e-Learning Pilot Scheme*. This contrasts with the development trajectory of the three Singapore masterplans where there is a sharpening focus on enhancing principals' understanding of e-Learning and the challenges and strategies for initiating and sustaining pedagogical innovations. The MOE staff in Singapore also play a key role in strategically facilitating the formation of principal networks for experience sharing and collaboration in e-Learning innovations. Learning from past and present e-Learning innovations for sustainable development at both the system and school levels appears to be a greater challenge for Hong Kong.

4. ***Foster multilevel, system-wide connectivity and strategic partnership.*** In all the seven innovation cases, decentralized bottom-up strategies coming from various partners outside of the school and the central agency comprise a prominent type of strategic support for implementation and scaling up the innovation. These bottom-up partner strategies help to mobilize resources, increase the problem solving and innovative capacity of the project, and they solicit both tangible and intangible support. In particular, in all the Asian cases, there is a strong belief that involvement and partnership with related business sectors is an important condition for longer-term sustainability and scalability. This is possibly the right way forward in fostering an economic and human resource ecology for mainstreaming innovative practices.

10.5.3 Research to advance ecological studies of innovation from being metaphorical to explanatory and predictive

Ecological approaches to understanding education change have attracted much interest from researchers in the area (e.g. Davis, 2008; Hargreaves, 2003; Zhao & Frank, 2003). However, the ecological model is primarily deployed metaphorically to assist in the construction of a dynamic model of how different elements of the system under study may be related to each other. On the other hand, ecology as a relatively more mature and developed science provides models and principles that have both explanatory and predictive power. In this chapter, we have ventured beyond a metaphorical use of ecological analogues to propose a model of ICT-enabled innovations for learning that details how the different dimensions interact and mutually constrain each other, the strategies that would enhance (or obstruct) scaling up of innovations, and a framework for effective policies and strategies to mainstream ICT-enabled learning innovations that comprise four guiding principles. We hope that the model and framework presented would be able to guide different trajectories of change observed under different contexts and stimulate further research on the scaling up of ICT-enabled learning innovations, leading to more refined and robust models of innovation and change strategies.

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Annex 1

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Annex 3

Case report template (developed by CITE in collaboration with IPTS)

Author / Affiliation

1. Case overview
   - 1.1 Brief history and contextual background of the innovation
   - 1.2 Key focus and goals of the innovation
   - 1.3 Learners targeted
   - 1.4 Learning outcomes targeted
   - 1.5 Technology used and the role of technology in the innovation
2. Scale and nature of the innovation
   - 2.1 Background and scale of the scheme
   - 2.2 Leadership and organization of the innovation at the system level
   - 2.3 Leadership and organization of the innovation at the project/school level
   - 2.4 Conceptual basis of the innovation
   - 2.5 Summary
3. Strategies for implementation and scaling up of the innovation
   - 3.1 Agency for change
   - 3.2 Professional development provisions
   - 3.3 Governance, management and school routines
   - 3.4 Monitoring and accountability mechanisms
   - 3.5 Evaluation mechanisms used
4. Outcomes and achievements
   - 4.1 Student learning outcomes
   - 4.2 e-Learning pedagogy
   - 4.3 Teacher learning and professional development
   - 4.4 Partnership, Collaboration and Community building
5. Innovation prospects: sustainability and scalability
   - 5.1 The next plans for this innovation
   - 5.2 Prospects for sustainability
   - 5.3 Prospects for scalability
6. Reflections and issues
7. References

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Abstract

This report presents three cases of ICT-enabled innovation for learning from Europe (*eTwinning*, *1:1 Learning in Europe* and *Hellerup School* in Denmark) and four cases from Asia (*e-Learning Pilot Scheme* in Hong Kong SAR, *Knowledge Construction with Technology* (CoREF) in Japan, *Third Masterplan for ICT in Education* (mp3) in Singapore and *Digital Textbook* project in South Korea), covering aspects such as the context, scale and nature of innovation; the intended learning outcomes; the role of technology; and implementation strategies. Based on desk research, case reports, consultation with education stakeholders from Europe and Asia, and in-depth expert interviews, the necessary conditions for sustainability, scalability and impact at system level are analysed. Thus, the report brings evidence to the debate about the mainstreaming of ICT-enabled innovation for learning in Europe and beyond, contributing to the Europe 2020 Strategy to modernize Education and Training across Europe.

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