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Towards a Mapping Framework of ICT-enabled Innovation for Learning

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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. This priority is directly linked to the Europe 2020 educational headline targets regarding early school leaving and tertiary attainment levels.

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 that only a few innovative projects manage to survive beyond the early adopter stage and become fully embedded in educational practice.

This report is part of a larger study on "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 further define the concept of 'Creative Classrooms' (CCR) and to provide a better understanding of ICT-enabled innovation in E&T, and in adult education that can be up-scaled in a cost-effective way. A set of policy recommendations for educational policymakers, stakeholders and practitioners for mainstreaming of ICT-enabled innovation for learning through the up-scaling of 'Creative Classrooms' in Europe will also be developed.

This report contributes to the first work package of the project. It aims to define and classify ICT-enabled innovation for learning that involves large groups of learners and/or teachers/educators at system level, both within formal E&T and outside formal learning settings.

Progress on this study can be followed on the project website:
http://is.jrc.ec.europa.eu/pages/EAP/SCALECCR.html.

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[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.

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1. Objectives of this report

This report aims to define and classify ICT-enabled innovation for learning that involves large groups of learners and/or teachers/educators at system level, both within formal Education and Training (E&T) and outside formal learning settings, with reference to the conceptualisation of 'Creative Classrooms'.[2] To this end, results from desk research are complemented here with a proposal for a mapping framework of ICT-enabled innovation for learning.

This report also provides the basis for an in-depth analysis of a number of existing relevant initiatives showing how ICT-enabled systemic innovation is implemented on a large scale.

This document should therefore be regarded as a working paper to be further developed after discussions with key stakeholders, policy makers and practitioners in the field of Education and Training (E&T) in Europe.

2. Background

The project "Up-scaling Creative Classrooms in Europe" (SCALE CCR) was launched in December 2011 by the Information Society Unit, JRC-IPTS on behalf of DG Education and Culture, and will finish in June 2013. It aims to further define the concept of 'Creative Classrooms' (CCR) and to provide a better understanding of ICT-enabled innovation in Education and Training (E&T), and in Adult education, which can be upscaled in a cost-effective way. The main focus will be on formal education settings, although informal ways of learning will be considered as well. The project contributes directly to the objectives of three of the Europe 2020 flagships: the Digital Agenda, the Innovation Union Agenda and "Youth on the move".

In SCALE CCR, up-scaling is not considered as a one dimensional process, involving solely the expansion of numbers of schools implementing specific ICT-enabled innovation for learning. Instead, the objectives of SCALE CCR project are:

- To define and classify "ICT-enabled innovation for learning" across a range of settings and participants;
- To develop a concept of 'Creative Classrooms' (CCR) and reference parameters;
- To identify and analyse the implementation strategies underpinning a number of highly effective ICT-enabled innovation for learning in order to bring to the surface commonalities of purpose, scope and impact; and
- To propose concrete policy recommendations for the further development and mainstreaming of 'Creative Classrooms' (CCR) in Europe.

The definition and classification of ICT-enabled innovation for learning, together with a conceptualisation of 'Creative Classrooms', an in-depth analysis of implementation strategies of existing ICT-enabled innovation for learning and a definition of policy recommendations for educational policymakers and stakeholders will constitute the main outcomes of the SCALE CCR project.

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[2] See Bocconi, S., Kampilys, P. and Punie, Y. (2012). 'Innovating Learning: Key Elements for Developing Creative Classrooms' Scientific and Policy Report, Institute for Prospective Technological Studies, Joint Research Centre, European Commission. Available at: http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=5181

3. Setting the context

3.1. Definition of innovation

Although a wide range of definitions has been proposed, there is no generally accepted single definition of innovation. Table 1 includes a selection of miscellaneous definitions which have the following key components in common:

- Innovation is an *intentional activity*; the innovator does something (deliberately) rather than merely thinking about it.

- This intentional activity is designed to address unsolved problems and *benefit* in some way the *innovator(s)* (individual, team or organization) through the development or improvement of a product, process or method.

- Innovation -whether incremental, radical or disruptive- is about *change* and implies a degree of *novelty*; innovative product, process, or method must be novel to some extent, at least for the innovator(s).

- Innovation is a *dynamic* and *unpredictable social process* involving *complex interactions* between various actors who "actively seek to learn from one another".

- Innovation occurs in a specific social, economic, technological, organizational and cultural *context* that influences its development, diffusion, and use*.

Author(s)	Year	Definition
Mulgan et al.	(2006)	"...new ideas that work to meet pressing unmet needs and improve peoples' lives". (p. 7)
OECD & Eurostat	(2005)	"...the implementation of a new significant improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations". (p. 46)
Renzulli	(2003)	"...original, solution oriented *actions* that address previously unsolved problems in unique and creative ways". (p. 79)
Robinson	(2001)	"...essentially a process of social change and therefore complex, multi-level, culturally situated, occasionally irrational and unpredictable". p. 25
Cairney	(2000)	"...a dynamic social process involving complex interactions between various actors and institutions that actively seek to learn from one another". (p. 18)
West & Rickards	(1999)	"...the intentional introduction and application within a job, work team, or organization of ideas, processes, products, or procedures that are new to that job, work team, or organization and that are designed to benefit the job, work team, or organization". (p. 45)
Smits	(2002)	"...regarded as interactive processes in which there is a large extent of coevolution of scientific, technological and societal systems". (p. 866)

Table 1. Selected definitions of innovation

3.2. Definition of educational innovation

Formal education settings are ideal environments for enabling experiences of innovation that learners can then transfer to real-life settings (Schwartz, Varma, & Martin, 2008). In general, there is a reciprocal relation between innovation and education. On the one hand, appropriate education and training are prerequisites for fostering innovation, developing and transforming student creative potential into adult innovation[3] (Shavinina, 2012). On the other hand, innovations are also needed to improve education and training in order to effectively meet the needs of 21st century learners

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[3] According to Shavinina (Shavinina, 2012), innovation education refers to *"...a wide range of educational interventions aimed at developing and transforming child/student talent into adult innovation. It means those societal actions aimed at helping children/students to become adult innovators"*.

(Cachia, Ferrari, Ala-Mutka, & Punie, 2010; OECD/CERI, 2010; Redecker et al., 2011; Shapiro, Haahr, Bayer, & Boekholt, 2007).

Nowadays, educational innovation is regarded as a top priority target all over the world (e.g. European Commission, 2010; Fullan, 2010; Levin, 2008; U.S. Department of Education, 2012). According to OECD/CERI (2010, p. 14), educational innovation is "...any dynamic change intended to add value to the educational process and resulting in measurable outcomes, be that in terms of stakeholders satisfaction or educational performance".

However, educational innovation is not easy to accomplish; in formal education settings, it is often regarded as a highly demanding challenge that usually meets resistance because of its intrinsic complexity (OECD/CERI, 2009). As it also implies a slow process of change, innovation frequently fails to become systemic or to yield a sustainable outcome (Fullan, 2011a, 2011b; Hannon, 2009; Levin, 2008; Shapiro, et al., 2007), though true educational innovations are those "…products, processes, strategies and approaches that improve significantly upon the status quo and reach scale" (Shelton, 2011).

3.3. Definition of ICT-enabled innovation for learning

In the knowledge society, technologies are playing an increasingly important role in fostering and driving education innovation (e.g. OECD/CERI, 2010; Redecker, Ala-Mutka, Bacigalupo, Ferrari, & Punie, 2009; Shapiro, et al., 2007).

In this report and in the context of the SCALE CCR study, the term *ICT-enabled innovation for learning* refers to the profoundly new ways of using and creating information and knowledge made possible by the use of ICT (*as opposed to* using ICT for sustaining or replicating traditional practices). It deals with both formal and informal learning, covering traditional education settings (schools and higher education) and adult education. Last, but not least, this ICT potential for innovation must be realised and accompanied by the necessary pedagogical and institutional change.

Attention is thus focused on a new culture of learning afforded by technologies (Thomas & Brown, 2011), where learners are at the centre of the learning process, participating in ways that were not possible before. Flexibility, personalisation and different learning styles can be combined; and learning can be authentic, motivational and conceived as a social process (Punie, Cabrera, Bogdanowicz, Zinnbauer, & Navajas, 2006), enabling peer-to-peer informal interactions that lead them to learn from each other. Interaction with ICT provides learners and teachers with novel ways of dealing with a task. For example, it can enable them to inquire and gather data in the field, thus changing the nature of the activity itself and fostering creative thinking and meaning-making (Ferrari, Cachia, & Punie, 2009; Loveless, 2008).

Research in the field also shows that digital technologies have great potential to enable creative processes (Craft, 2005; Loveless, 2008). As argued by Loveless (Loveless, 2007), creative learning activities need meaningful contexts and ICT can offer tools for creating such contexts. These tools can represent information in a variety of modes that enable learners to make changes, try out ideas and approaches to problem solving. Both learners and teachers need the opportunity to engage, play and become familiar with the distinctive contributions that ICT can make to their creative practices, which other media and tools do not offer. Attention and efforts should thus focus on fostering teachers' preparation for a pedagogy for creativity (Loveless, 2011). Ensuring the necessary accessibility and flexibility can be a challenge for both teachers and schools due to current models of resources, timetables, curriculum, and assessment requirements, which can inhibit learners'

engagement with creative processes and lead to a superficial or fragmented focus on products (Loveless, 2007).

In order to bring about transformative changes to education, the role of ICT should be *disruptive*, changing both teachers' and learners' roles in the formal settings. Furthermore, for a pedagogical innovation to endure and thrive, it has to be accompanied by changes in values, practices, and infrastructure at the institutional level and beyond. The changes in assessment practices and university admission requirements constitute an example (Law, Yuen, & Fox, 2011).

Hence, the paradigm underpinning ICT-enabled innovation for learning entails a holistic transformational shift towards connecting learning organisations and processes (i.e. connecting the realities of learners' lives and their experience of school). It applies the four principles of social innovation, where innovation is conceived as *open, collaborative, free* and characterised as *"with"* those involved (and not innovation "*to*" or "*for*") (Hannon, 2009, p. 5).

4. Classifications of (ICT-enabled) innovation for learning

Several researchers and theorists have attempted to capture the complex and multi-dimensional nature of innovation by proposing various classifications and typologies. Cooper (1998), proposed a multidimensional model of innovation, in the shape of a cube, for thinking about and evaluating the relationship between organizational characteristics and the adoption of innovation. Cooper's model suggests that strategic approaches to the adoption of innovation must, as a minimum, consider innovation in terms of the three major dimensions: *product-process, radical- incremental,* and *technological-administrative*.
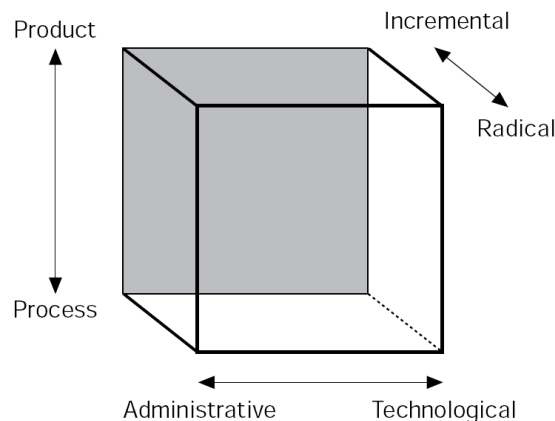

Figure 1. Multidimensional model of innovation (Cooper, 1998, p. 500)

The OECD Innovation Strategy (OECD, 2010) further expands the concept, emphasising the need for a horizontal policy approach to innovation. This promises greater coherence, better performance and a structure more appropriate to the central role of innovation in society today. In this model, empowering people to innovate is essential to the processes and relies on broad and relevant Education and Training policies that offer people throughout society opportunities to be creative, engage in innovation and benefit from its outcomes.

In order to better understand ICT-supported innovations and their sustainability, Law et al. (2011) embarked on an ecological study of the emergent characteristics of ICT-supported pedagogical innovations, proposing the following six dimensions of innovation: (1) learning objectives, i.e. the

extent to which the specific curriculum goals align with authentic content and 21st century skills; (2) teachers and (3) learners' role(s), crucial features in differentiating between emergent and traditional pedagogy; (4) ICT used, i.e. the level of sophistication of the technology used; (5) connectedness, i.e. the extent to which outsiders, such as students and teachers from other schools, experts, parents, are involved in the teaching and learning process; (6) multiplicity of learning outcomes revealed through the learning process.

For each of the six dimensions, the authors also defined a scale of innovativeness that presents features along five levels, from "traditional" to "emergent" to "most innovative4" (p. 34).

- *Traditional classroom*s: the pedagogical practice is traditional across all six dimensions, focusing on pre-defined activities and learning outcomes. They are teacher-centred – students follow instructions and learn from the teacher.

- *Emergent classrooms:* practices are mid-way between the most traditional and the most innovative. The characteristics of emergent classrooms, such as targeting deep understanding and catering for individual differences, were considered good educational practice long before the advent of the contemporary focus on preparing students for the knowledge society.

- *Most innovative classrooms:* the practice is innovative across all six dimensions. Collaborative inquiry abilities are developed by providing authentic learning contexts. Students take responsibility for defining their own learning pathways, while the teacher guides the exploratory process. Teachers also mediate communication between and among students and various outside parties, such as experts and co-learners. Both teacher and students use appropriate technology to support their activities and also to connect with the outside world. Assessment is based on authentic evidence generated during the learning process, reflecting not only the cognitive outcomes but also the targeted process outcomes.

5. A proposal for a mapping framework of ICT-enabled innovation for learning

Elaborating on existing classifications and models of innovation, we propose a mapping framework of five components that address key perspectives relevant for the purposes of the SCALE CCR study.

The aim of the proposed framework is twofold: (i) to provide a further understanding of the nature of ICT-enabled innovation for learning, as defined in this report; and (ii) to map the impact of innovative initiatives using ICT in the Education and Training (E&T) context.

In this framework, ICT-enabled innovation for learning is mapped across the following five trajectories:

1. *Nature of innovation* (incremental, radical, disruptive[5]): this captures the progressive levels of change from the introduction of some new elements (incremental), to a relevant number of innovative elements (radical), to a profound and comprehensive change (disruptive) (Cooper, 1998; Doig, 2005; Leadbeater & Wong, 2010; OECD/CERI, 2009).

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[4] '*Some innovative elements*' and '*innovative*' mark the transition respectively to the '*emergent*' and '*most innovative*' levels.
[5] Several terms have been used, including sustaining, evolutionary, or continuous innovation instead of incremental as well as discontinuous, *breakthrough,* and *revolutionary* instead of *disruptive* (Ansari & Krop, in press; Carayannis, Gonzalez, & Wetter, 2003; Leadbeater & Wong, 2010; Shavinina, 2003; Xu, Houssin, Caillaud, & Gardoni, 2011).

2. *Implementation phase* (pilot, scale, mainstreaming): this describes the stages of development, ranging from limited application (pilot), to more consolidated up-take (scale), to established use (mainstreaming) (e.g. OECD/CERI, 2010).

3. *Access level* (local, regional/national, cross-boarder): this captures the geographical coverage of the innovation, from a restricted area (local), to a broad realm (regional/national), up to an international/world-wide level (cross-border) (OECD/CERI, 2010; Punie, et al., 2006).

4. *Impact area* (process, service, organization): this illustrates the extent of innovation, from affecting practices (process), to introducing new means (services), up to undertaking systemic reform (organization) (OECD & Eurostat, 2005; Robinson, 2001).

5. *Target* (single actors, multiple actors, a wide range of actors): this describes the actors targeted by the innovation, from a specific group (single actors), to a diverse set of actors (multiple actors), up to a variety of stakeholders (wide range of actors) (Cairney, 2000).

The proposed five components are visualized and arranged as a spider's web[6] (Figure 2), illustrating the interconnections and pointing to the complexity of efforts needed to improve Education and Training in a balanced, consistent and sustainable way.
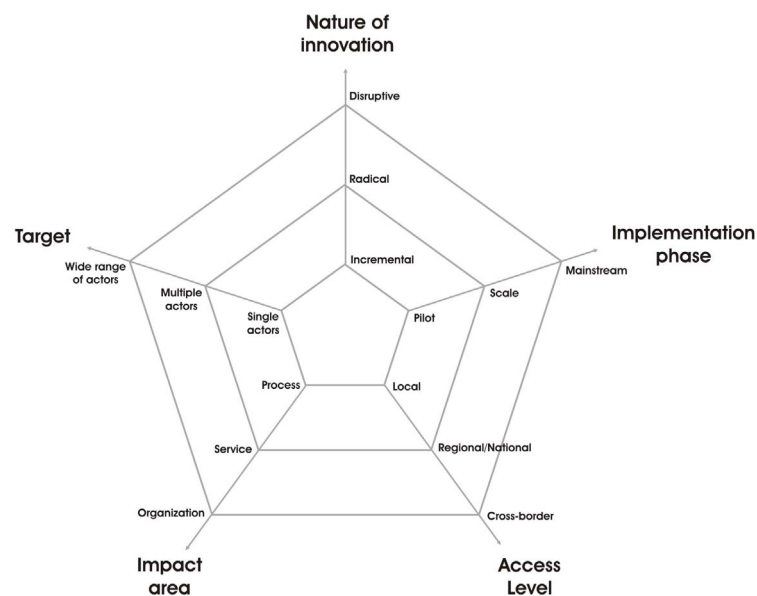

Figure 2. A mapping framework of ICT-enabled innovation for learning

This mapping framework will be used in the context of the SCALE CCR study to analyse and compare a number of existing relevant initiatives, showing how ICT-enabled innovation for learning is implemented on a large scale.

A preliminary application of the proposed framework has been carried out and we present some examples in the following section.

5.1. Using the mapping framework: some examples

The following examples mainly serve the purpose of showing how the proposed mapping framework can be used to analyze and compare concrete cases (Figure 3). These initiatives have been selected as they cover different values of the proposed framework, and thus allow us to test it. Moreover,

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[6]   Values in the spider's web are nominal (not discrete) variables, ordered in a meaningful sequence that shows the trend and progress.

they also reflect key principles of open education environments (Vittra, Victoria's government), open educational resources (Stanford's Free Online Courses) and open learning networks (eTwinning).
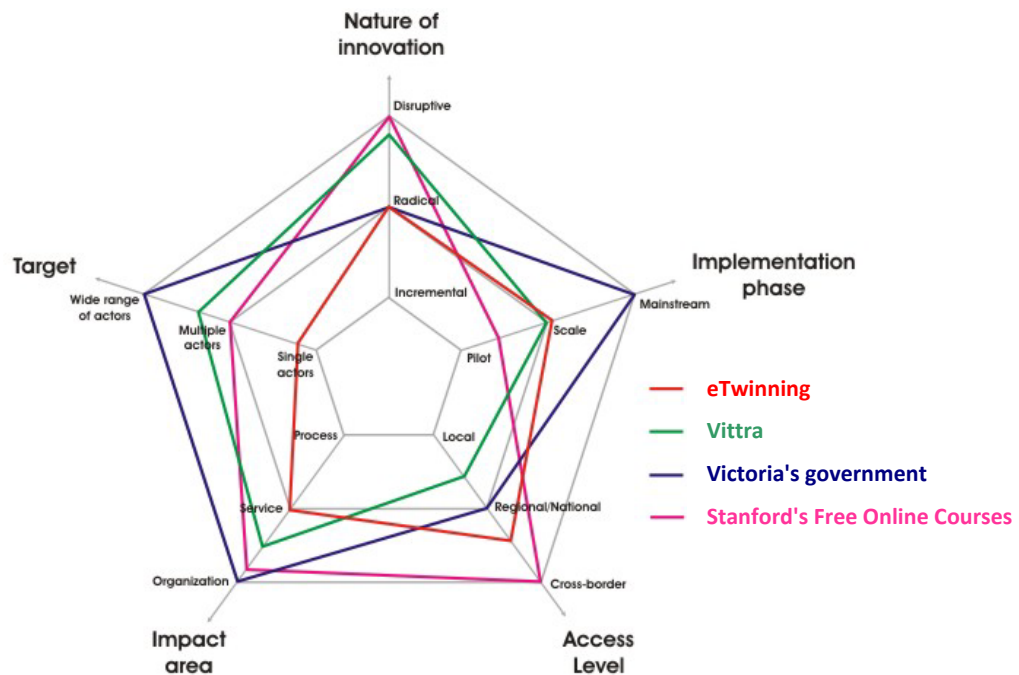

Figure 3. Sample initiatives mapped against the framework of ICT-enabled innovation for learning

However, this preliminary mapping is based on the understanding of these cases from previous studies (e.g. Cachia & Bacigalupo, 2011; Meyland-Smith & Evans, 2009), and an in-depth analysis is necessary for a more accurate, evidence-based mapping.

5.2. eTwinning

eTwinning (www.etwinning.net), the European Commission funded initiative for a schools' community in Europe, is a successful ICT-enabled innovation that contributes to the modernization of education in the EU (Cachia & Bacigalupo, 2011). European teachers can freely register in eTwinning and utilize the online tools offered (the portal and the desktop) for meeting virtually, exchanging ideas and practices, teaming up in groups, learning together through learning events and workshops, and engaging in cross-border projects. Figure 4 maps the innovative characteristics of the eTwinning initiative against the proposed framework.
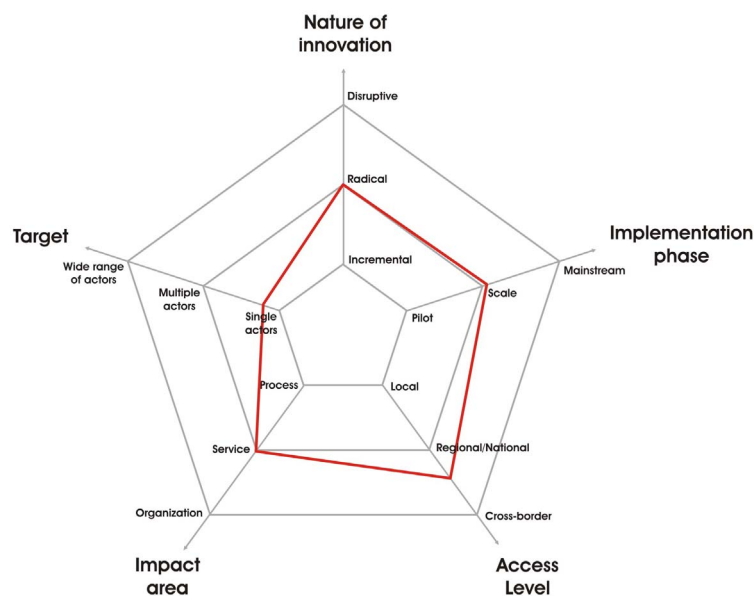
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***Figure 4.** eTwinning innovative components*

***Nature of innovation**: started as an incremental innovation in its early years (launched in January 2005), eTwinning has now shifted to a more *radical* innovation, expanding its services and offering to EU teachers unique opportunities for online collaboration and professional development.

***Implementation phase**: Now in its eighth year, eTwinning involves more than 165,000 teachers in 32 countries and it is recognized by practitioners and stakeholders as a well-established teachers' network, with a stable organisation schema and sustainability plans in place.[7] However, the current reach of eTwinning is limited to innovators and early adopters (Cachia & Bacigalupo, 2011) and a wider take up is needed to move it from its current *scale* phase into the mainstream.

***Access level**: According to its sustainability plans, eTwinning will widen its current *cross-national* coverage (EU countries) to one including non-EU countries.

***Impact area**: eTwinning impacts at *service* level, affecting the teaching/learning practices, but not at a systemic/organisational level.

***Target**: eTwinning's current target group involves primary and secondary teachers (*single actors*). However, in the near future it plans to also offer students the opportunity to use its online tools for initiating cross-national projects with peers (multiple actors).

5.3. Vittra Independent State-Funded Schools

Vittra (http://vittra.se/english/VittraEnglish.aspx) is a private organization that has run a number of Independent State-Funded Schools (ISFS) in Sweden since 1993 (Meyland-Smith & Evans, 2009). Vittra ISFS follow an innovative educational model based on individual action plans and extensive use of ICT that aim to address the EU's eight key competences (European Commision, 2007). A mapping of the innovative characteristics of the Vittra initiative against the proposed framework is presented in Figure 5.

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[7] The European Commission has proposed expanding eTwinning as part of the new "Erasmus for all" programme from 2014-2020 (European Commision, 2011).
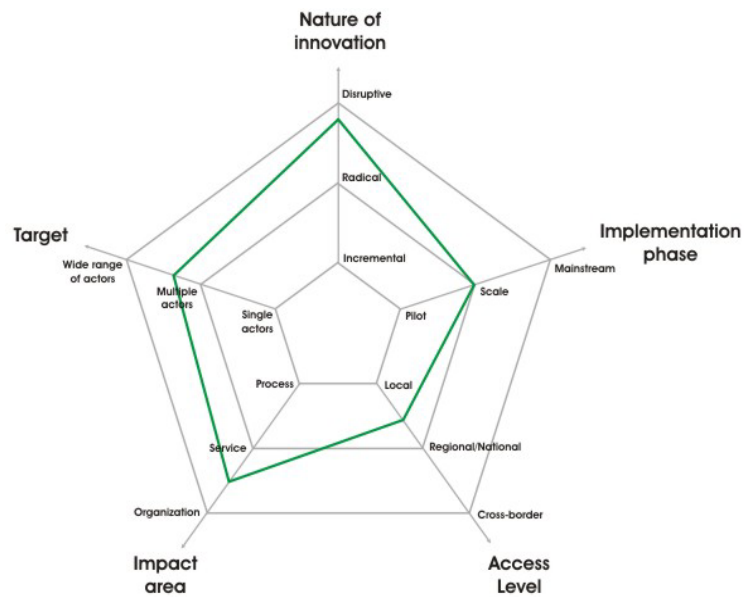
Figure 5. *Innovative characteristics of Vittra Independent State-Funded Schools*

Nature of innovation: Vittra schools should be considered as an almost *disruptive* innovation because they adopt a wide-ranging innovative model mainly based on: a 'one-to-one' computing policy for students from grades 4 and up; 'innovative space arrangements', not separated classrooms but inspiring and colourful learning spaces; 'flexible timetables' that allow for case- and problem-based learning; 'effective bilingualism' in English and Swedish; and 'Individual Development Plans' for personalized learning, that drives each student's development and achievement.

Implementation phase: Now in their 19th year, Vittra schools follow a stable and recognized organisation schema, thus offering a concrete alternative to more traditional public schooling. However, the current reach is limited to a specific number of Vittra schools that involve approximately 8,500 students in Sweden (*scale*).

Access level: Vittra runs over 30 schools and pre-schools in restricted areas of Sweden (local access) moving towards a broader coverage (*regional/national*).

Impact area: The Vittra innovative model impacts several key dimensions of the school ecosystem such as *content and curricula*, *teaching* and *learning practices*, *connectedness*, *infrastructures* and ways of *assessment*. For instance, learners develop effective bilingualism in English and Swedish in order to be equipped for study and work in an international environment. At the same time, they experience and create international contacts through networks and exchange programmes abroad (*connectedness*). An e-library service is in place to allow students to access learning materials 'anytime, anywhere'.

Target: Currently, Vittra schools address *multiple actors* as they follow a wide-ranging innovative model that requires new roles for learners (e.g. they become more self-aware about their strengths and potential through the Individual Development Plans that constantly document and evaluate their development and achievement), teachers (who have to orchestrate rather than deliver personalized ICT-based learning), and school leaders (who have to coordinate complex and non-typical school timetables, space arrangements, assessment methods etc).

5.4. Stanford's Free (massive) Online Courses

Stanford University, one of the world's leading research and teaching institutions, is offering several online courses for free (http://stanford.edu/online/courses), thus extending the benefits of Stanford-style education to those who lack access. These online classes are taught by the regular Stanford faculty and are highly interactive. During Autumn 2011, approximately 43,000 people successfully completed a course. Figure 6 maps the Stanford's free online education initiative against the proposed five components of the framework on ICT-enabled innovation for learning.
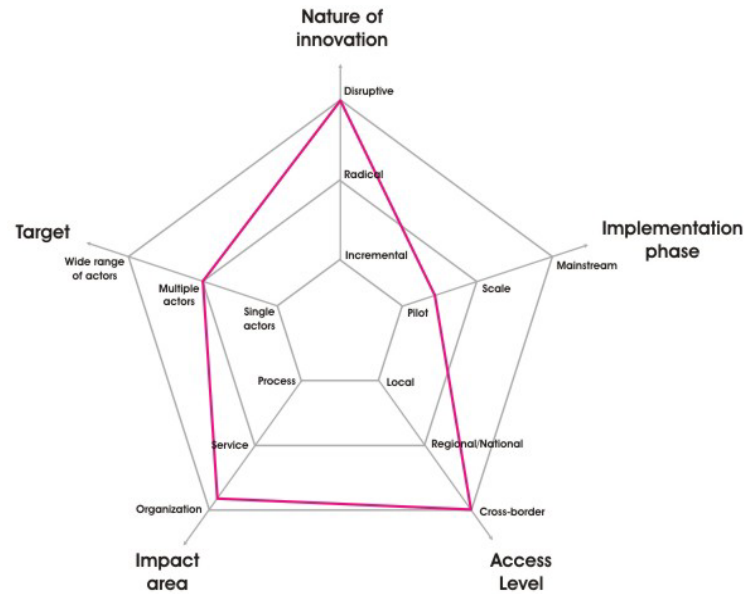

Figure 6. Stanford's free online education innovative components

Nature of innovation: Stanford online education can be regarded as *disruptive* in the way professors are taking technologies designed to enhance learning for Stanford students and extending them to a broad online audience (and for free). Enrolees are actually requested to do all the same work as the Stanford students, including a number of hours per week of studying, weekly graded homework assignments, a midterm exam, and a final exam. For Stanford students, online content expands the classroom experience: professors experiment with a "flipped classroom" model, shifting classroom time from lectures to interactive activities such as problem-solving, reviewing difficult material and working in teams.

Implementation phase: Following a successful *pilot phase* that offered three online courses (with more than 350,000 participants) launched by the School of Engineering, Stanford's free online classes are now part of a broader university initiative which aim to continue expanding and refining education offerings, both on and off campus (14 classes are scheduled in 2012, including cryptography, anatomy, and game theory). Moving towards a scale phase, plans include an "on-campus lab" for experimentation. In addition, a multidisciplinary faculty committee, including several Stanford School Deans and other key members from across campus, has been recently established to explore some of the complex issues involved.

Access level: Stanford's online education innovation has *cross-boarder*, world-wide coverage. During Autumn 2011, about 356,000 people from some 190 countries (from India and South Korea, to New Zealand and Ghana, to Iran and the Republic of Azerbaijan) subscribed in one or more of the three pilot classes offered. In some cases, volunteer students also translated course's lectures into 44 languages, including Bengali.

Impact area: Stanford's free online education has most impact at *organisational* level, addressing a number of the essential components of a university education: *admissions, lectures, peer interaction, professor interaction, problem-solving, assignments, exams, deadlines, and certification*. Lectures are delivered as short, interactive video clips that include live quizzes and instant feedback that allows students to quickly determine their understanding of material and work on problem areas. At the same time, participants rank questions to be posed to the instructors and help each other through online discussions similar to a comment thread on a social networking site. Only formal certification has not yet been fully addressed: college credits are issued only to Stanford's matriculated students, though participants who complete a free online course are awarded an official Statement of Accomplishment.

Target: Currently, Stanford's Free Online Courses address *multiple actors*: regular Stanford faculty and matriculated students, other students and educators outside the college, and anyone interested in learning one of the proposed subjects (i.e. housebound students, adult learners, seniors learners, etc.).

5.5. Victoria's government educational innovation

Innovation in education pursued in Victoria in recent years has been focusing on leading practices which have been recently up-scaled. The *Leading practices and design* initiative supported by the Victoria government encourage innovation in secondary school classrooms across the Victoria region, see:
(http://www.education.vic.gov.au/researchinnovation/lpd/default.htm).

The aim is to continue to improve student outcomes through innovative teacher and school effectiveness strategies and to identify local solutions to education provision challenges in certain geographic localities. Figure 7 draws out the innovative components of this initiative.
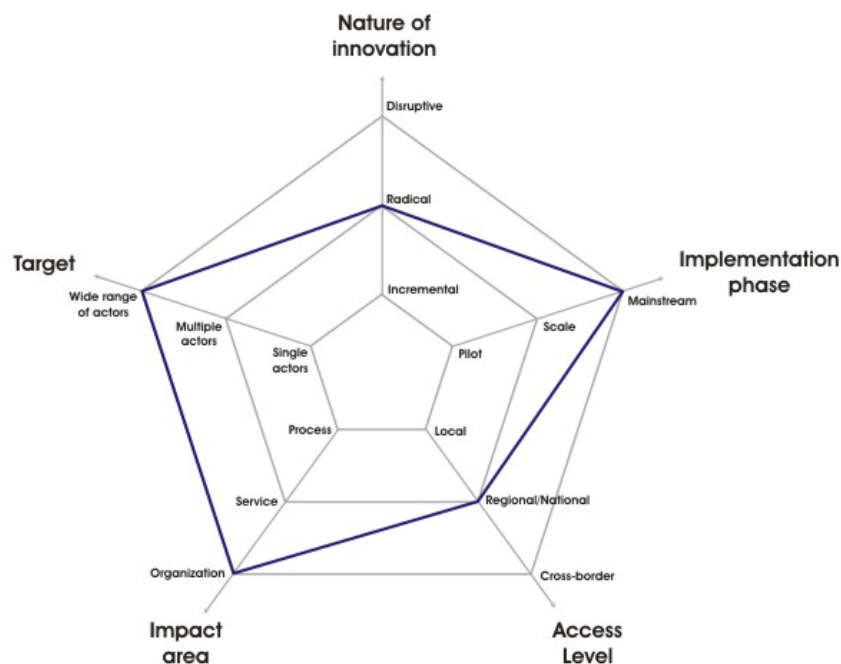

Figure 7. *Innovative characteristics of Victoria's government educational innovation*

Nature of innovation: Victoria's educational innovation strategy can be considered as *radical*, supporting and implementing continual changes around key transformation variables (such as vision of improved student learning, school leadership) in order to achieve sustainable whole school transformation. Government investment has focused on three pillars: additional teachers, accessible ICT, and learning spaces. A range of direct and indirect outcomes from this investment has been articulated into policy and investment discussions around whole school transformation.

Implementation phase: In 2003, Victoria's government launched the Leading Schools Fund (LSF), a school transformation pilot initiative. The Leading Schools Fund initiative developed over a five year period, becoming a key driver of the vision of excellent student outcomes in government secondary schools. The Leading Schools Fund initiative (ceased at the end of 2008) and associated research findings informed the direction of government work in the field of Leading Practices and Design which are *mainstreamed* and contribute to the ongoing school transformation.

Access level: Funding was provided over 3 key phases of the Leading Schools Fund to 162 schools with a secondary component, representing approximately 50% of secondary schools within Victoria state (*regional* area).

Impact area: Resources gave schools significant flexibility to innovate with the combined resources of time, space and ICT, thus impacting on the whole *organisation*. Different types of strategy are considered to have improved the quality of strategic implementation and the achievement of objectives of schools in Victoria: visions for improved student learning; school leadership; curriculum leadership; data collection and use; professional learning; sharing knowledge and practice; resource use; and new models of education provision. These strategies are shaping and transforming teaching and learning practices, which in turn impact on the quality of student experience, learning and achievement.[8]

Target: Victoria's government educational innovation strategy addresses a *wide-range of actors,* including policy makers and stakeholders, schools' leaders, teachers and students.

6. Conclusions

Profoundly new ways of using and creating information and knowledge made possible by the use of ICT have been referred to here as *ICT-enabled innovation for learning*, dealing with both formal and informal learning in school settings and in adult education.

Elaborating on existing models and classifications of innovation, a multidimensional framework of learning innovation using ICT was proposed and visualized as a spider's web.

The proposed framework will be used to better understand a number of existing cases in Education and Training (E&T) in Europe, showing how ICT-enabled innovation for learning has been implemented on a large scale.

It will also help to formulate policy recommendations and to advise educational policymakers and stakeholders on future educational innovation.

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[8] http://www.eduweb.vic.gov.au/edulibrary/public/teachlearn/innovation/lpd/learningpublication.pdf

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Abstract

ICT is regarded as a key enabler of innovation and creativity in both Education and Training and learning in general. Based on desk research and on previous JRC-IPTS studies, this report provides a definition and classification of ICT-enabled innovation for learning that has significant scale and/or impact at system level, both within formal Education and Training and outside formal settings. A mapping framework is also proposed that can be used for an in-depth analysis of existing initiatives showing how ICT-enabled innovation is implemented on a large scale. Finally, the report provides a preliminary application of four diverse initiatives on the proposed mapping framework.

As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

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Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.