Are CSCL and Learning Sciences research relevant to large-scale educational reform?

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Abstract: Many scholars have contributed efforts to improve education in schools. A major motivation for learning scientists to develop design research as a methodology is to contribute to theory and educational practice through rigorous research without avoiding the complexities and messiness in authentic educational settings. There are many examples of successful implementation of collaborative, knowledge-construction oriented pedagogies using socio-cognitive and socio-metacognitive tools in formal and informal educational settings as well as in teacher professional development. However, there are many challenges to scaling up such innovations beyond small-scale implementation, including that of developing into "fatal mutations" (Brown, 1992). This symposium provides an opportunity for discussion and reflection on the impact that CSCL and Learning Sciences researchers have made on large-scale education reform and what, if any, may be done to extend this impact by bringing together a set of papers describing some large-scale education innovation initiatives in Asia and Europe.

Introduction

Many of the CSCL and Learning Sciences researchers work in Faculties of Education, and they often conduct their research in naturalistic classroom settings rather than in special experimental arrangements. This is particularly the case for researchers engaged in design-based research. There have been many advances in learning theories and learning technologies in the past two decades resulting from such research (e.g. Sawyer, 2006), but are these developments making impact on educational practice at large? Collins and Halverson (2009) arrive at the conclusion that the transformative potential of ICT for education is not likely to have impact on publicly funded education because of the inherent conservative nature of these schools. Studies of large scale education reforms and scaling up of innovations have mainly been the concerns of researchers in the field of educational administration and management (e.g. Fullan, 2008, 2010; Hargreaves and Fink, 2012), and much of that literature does not pay specific attention to the learning theories or technologies underpinning the changes involved other than as a contextual variable. Arguably, it is this latter literature that has so far been much more successful in capturing the attention of school leaders and education policy makers, rather than the work of the learning scientists.

Immediately preceding the CSCL 2011 conference in Hong Kong, CITE (the Centre for Information Technology in Education at the University of Hong Kong) took advantage of this global gathering of to bring together top learning scientists and policy leaders in a forum on how to restore learning as the core of education policy concerns, and to make sure fore-running research results on learning will inform policy-making and impact education (http://backtolearning.cite.hku.hk/). There was agreement at this forum that while there is much that research on learning has to contribute to the focal concern of current education policy to nurture 21st century skills in learners, the impact of such research on the practice of education professionals or on the understanding of the wider community about education is still very limited. This symposium is organized to explore the following questions:

(1) How relevant is CSCL and Learning Sciences research to large-scale education reform?

(2) What unique contributions can research on learning make to the sustainability and scalability of ICT-supported learning innovations in schools?

(3) Are there ways through which the CSCL and Learning Sciences community can increase their social and professional impact?

The symposium presenters have all engaged in studies on the implementation and scaling up of research-informed ICT-supported learning innovations in mainstream school education in Asia and Europe, while the discussant has similarly rich experience in the US. They will share with participants their insight on the above questions based on their work.

Paper 1: From e-Learning Pilot Scheme to Scalable e-Learning Innovations: Wishful thinking or reality?

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The Hong Kong Education Bureau launched a three-year e-Learning Pilot Scheme in September 2011 with the aim to identify good models of integrating ICT in the school curriculum to bring about effective interactive learning, self-directed learning and/or to cater for learner diversity, and to build models of change conducive to the sustainability and scalability of the innovations piloted. To this end, an evaluation project, both formative and summative in nature, was commissioned to start when the scheme was launched to identify if the intended goals were achieved and to summarize the lessons learnt. At the time when the CSCL 2013 Conference takes place, this scheme would have completed its second year of operation. This paper draws on data collected from the evaluation study to explore whether, and for what reasons, this e-Learning Pilot Scheme can be a successful mechanism for system-wide, scalable e-Learning innovations.

All publicly funded primary and secondary schools were invited in May 2010 to submit innovative e-Learning project proposals for funding. The goal was to make use of the pilot schools as test beds to help the Bureau to develop, try out and evaluate when and how e-Learning works best (i.e. using the scheme to build up knowledge about successful e-Learning pedagogical models) No specific learning theory or model of e-Learning was prioritized nor discouraged—as long as the project was learning focused and student-centered, and the call did not reference any local or international experiences.

Another objective of the pilot scheme was to build knowledge about sustaining ICT-enabled learning innovations. An underpinning project assumption is that engagement and support from the private sector (e.g. e-Learning resources providers, publishers, learning technology companies and Internet service providers) is of critical importance in order to evolve a viable business model for e-Learning. Hence all submitted proposals must include some partnership arrangements with the private sector, and schools were also encouraged to partner with other organizations such as tertiary institutions, NGOs, etc.

Altogether 21 pilot proposals were selected for funding, involving a total of 61 primary, secondary and special education needs schools (details from http://edbsdited.fwg.hk/e-Learning/eng/index.php?id=3). Because of the atheoretical stance taken by the scheme on learning, the pilot projects were selected to achieve maximum variations in school and curriculum contexts as well as in partnership arrangements. Some of the pilot projects simply focused on developing graded, self-accessed learning materials while others target the development of inquiry, collaborations and information literacy skills. Twelve of the projects involve collaboration among two or more schools while the other nine involve a single school each.

Due to the lack of a common pedagogical theory underpinning the different pilot projects and the large diversities in the innovation foci and school contexts, a generic, multilevel framework was developed by the project evaluation study to conceptualize how ICT-using pedagogical practices contribute to students' learning outcomes within the bigger context of overall pedagogical practices found in schools, which are in turn influenced by the teachers' characteristics as well as school and system level factors. Indicators for each of the identified contextual factors were developed to chart how these influence (1) the effectiveness of an e-Learning pilot project in enhancing students' information literacy and self-directed learning skills, and (2) the sustainability and scalability of the innovation. These indicators, both quantitative and qualitative, are derived from data collected at four levels: classroom, school, project and system levels. Quantitative data are collected through surveys to principals, ICT coordinators, teachers and students in the pilot schools. Qualitative data include interviews with different stakeholder groups and documentary records of the pilot projects such as the project proposals and project annual reports. The most important source of data to shed light on the ICT-using pedagogical practice and the associated students' learning outcomes at the classroom level was collected through two instruments, to be submitted by a nominated teacher from each project on one curriculum unit of their choice: (1) a curriculum design cover sheet to describe the targeted learning outcome(s), the curriculum activity(ies) designed, the role of technology in the process and how these are connected, and (2) samples of students' authentic work generated during the course of the curriculum unit that can demonstrate different levels of outcomes achieved (high, middle and low) in the areas of information literacy and self-directed learning. These two instruments were developed on the basis of similar instruments used in the Microsoft Innovative Schools Program, (Shear et al., 2009)).

End of year 1 evaluation results reveal that most of the curriculum examples submitted by teachers are largely very traditional and content focused, and the samples of students' work collected generally show little evidence of information literacy or self-directed learning skills being exercised. For the few cases where such outcomes were evidenced, some common characteristics the associated e-Learning pedagogical practices were

observed: the students had direct access to use ICT for tasks that had some levels of openness, and they had opportunities to observe the work of peers and to receive feedback.

While it is not possible yet to draw conclusions on the sustainability and scalability of the 21 e-Learning pilot projects being evaluated after just one year of operation, we find large diversities in the progress made in project implementation and the extent to which pedagogical changes were observed in the process. Only in a few of the pilot projects were rapid cycles of learning and advances in pedagogical designs and ICT use observed. In all these cases, the projects have built-in organizational infrastructures (e.g. co-planning teams, peer observations of teaching and debriefing sessions) to facilitate and scaffold interaction, communication and sharing of ideas among teachers and the leadership team. Changes in practice are most evident in those cases where there are mechanisms to make adjustments and changes to school and/or classroom routines such as timetabling, staffing or resource allocation priorities as discussed in Spillane, Parise and Sherer (2011). This presentation will reflect on the findings, particularly on the apparent lack of progress at the system/policy level in learning about what constitute the primary pedagogical characteristics of e-Learning practices that foster 21st century skills or what features of innovation implementation would be conducive to scale and sustainability, despite the many reform efforts implemented over the past 15 years.

Paper 2: Restoring "how people learn" as the core of educational reform in Japanese classrooms

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In Japan, there have been a good number of educational reforms utilizing collaborative learning, based on many different "theories" of how people learn. Some have evolved from strong beliefs about learners' self-construction of "hypotheses" about what they experience, imagine and think, and to discuss these with classmates through carefully ordered series of scientific problem solving, often by observing sequences of experiments (Itakura, 1971, Hatano and Inagaki, 1991). There is also a long history of creating learner-centered practices, some of which, like the "lesson study" movement (e.g. http://www.wals2011.com/) and the Japanese Association for the study of Cooperation in Education (http://jasce.jp/indexe.html), have attracted international attention. Yet these often lack direct conversation with policy makers, which hinder their expansion beyond certain points in their scale.

The University of Tokyo launched in 2009 an initiative strongly grounded in the learning sciences to contribute to this movement of renovating Japanese education with two important strategic orientations. One is to bring university research closer to policy makers at the Ministry of Education, Culture, Sports, Science and Technology (MEXT) and in boards of education throughout Japan, so that what has been researched and developed in universities would have direct influence on schools. The other is to base the renovation on the conversation between universities and business sectors, so that the needed educational reform could be supported by the entire society. To implement this, the Consortium for Renovating Education of the Future (henceforth CoREF; http://coref.u-tokyo.ac.jp/) was founded at the University of Tokyo, in conjunction with one city-level board of education and four other leading universities. This project is one of the rare cases where learning science research is adopted seriously to guide the renovation in classroom practices using a concrete framework (Miyake, in press) and with the joint efforts of regional boards of education. This initiative is also unique in spanning all subject areas taught at all school levels, including vocationally oriented tertiary education (high school level). As the administrative leaders at the school and board of education levels as well as the participating teachers are learning the sciences of how people learn, not in abstract forms but through implementing them in classrooms, they are also building up the capacity to scale up the initiative by themselves. Promising outcomes have been observed in the better designed classes in developing students' 21st century skills: higher levels of learning gains, higher motivation to extend learning outside of school into homes, and a stronger sense of "learning" among the students.

Relevance of CSCL and learning sciences

CoREF has started to work with prefectural and city/town boards of education, to develop learner-centric teaching curricula using a concrete form of collaborative learning named Constructive Jigsaw (Miyake, in press), based on research findings on how people change their concepts (c.f. Vosniadou, 2008; Sinatra & Pintrich, 2003), The key focus of the renovation is to change teacher practices from being teacher-centric to learner-centric, by working collaboratively with teachers to create a new set of curricular that allows learners to learn in collaborative, knowledge-constructive ways. Another focus is to work with members of the boards of education from the start to research on ways to support the renovation, and to share experiences with other boards of education through networked support systems for both novice and experienced teachers. A further focus is to enhance the natural adoption of ICT. The teachers involved in this project are learning quickly to

take advantage of being networked, and are encouraged to identify uses of ICT natural to the learners that would enhance the quality of learning in the new curricular.

This reform started in 2000, involving 3 prefectural boards of education covering some 300 high schools and 18 city/town education boards covering some 80 elementary and middle schools. More than 600 teachers have developed some curricula, with some also having changed the main part of their practices into the new pedagogical form. The developed curricula cover almost all subject areas in all school types, including language art, math, science, humanities, English as second language, art, music, as well as some part of special education. Encouragement through the project has prompted participating teachers to actively exchange the teaching plans and teaching materials they developed, localizing them to fit each class context, and to co-examine the class activities and outcomes. Because these collaborative efforts take place across different boards of education, Internet connectivity plays a critical role.

Assessment and Outcomes

The key learning outcomes targeted in this renovation are assessed using three criteria: outcome portability, dependability and sustainability (Miyake, et al., 2007). Concretely, each individual student is assessed on whether s/he is able to (1) express their understanding of the subject matter through "justification with acceptance," (2) demonstrate confidence in collaborative knowledge construction, and (3) show increase in motivation to continue and expand what they have learned, both at the end of each class as well as through longer periods of half-a-year to two or three years. Preliminary analyses at the end of the second year show a very favorable pattern. Of the 527 elementary and 461 middle school students surveyed, more than 85% considered the reformed classes they attended as "enjoyable because we understand", and more than 78% preferred their next class to be taught in the reformed fashion. For the 1556 high school students surveyed, the corresponding percentages are 73% and 54%. The learning outcomes achieved showed a greater variability, but their sustainability, that is, how well students can remember and reconstruct what they have learnt, hovered around 80% in cases where this information was made available to us. The teachers' reflective comments are also in favor of this new renovation. The project has also been identified as an implementable model for senior professionals to work together with teachers to improve the curricular quality.

Unique Contributions of ICT for Scaling-up and Enhancing Social/Professional Impact

The plan for scaling-up is to form a large community to work with MEXT by networking small networks that are currently emerging among teachers, schools, and boards of education. Each network may consist of about 5 to 10 active members who share common interests and goals. A teacher or an education leader could participate in several networks, according to their motivation, needs, energy and time. Some networks may enjoy the power derived from the participation of senior professionals from industries and governments. CoREF has just started to investigate the possibility of connecting remote learners in very small schools scattered in many parts of Japan, through remotely operable robots acting as learning classmates and mediators to cloud resources. It is hoped that this network will be research-oriented, with strong learning sciences underpinning, working directly with practitioners and education policy makers.

Paper 3: Scaling up rapid collaborative practices in Singapore schools

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One characteristic of education research in Singapore is the close partnerships between researchers and practitioner communities. The Singapore government has funded educational research at the National Institute of Education (NIE) of the Nanyang Technological University (NTU) over the past decade, including the setting up of the Learning Sciences Lab in 2004. This support is intended to not only advance the body of knowledge about designing, implementing and supporting educational innovations, but also to help inform educational policy and practices.

Since 2007, researchers from NIE have carried out a programme of research introducing rapid collaborative knowledge improvement (RCKI) practices using a technology called GroupScribbles (GS) to many schools in Singapore (Looi, So, Toh and Chen, 2011). The first school we worked with was a primary school. In the second year, the research was extended to two secondary schools. Because of the success from these research interventions, the Ministry of Education (MOE) has worked with another six schools to bring in GS as a "deep" intervention. Separately, other schools have adopted and adapted these innovations on their own.

Through the research work with schools, 109 GS lesson plans have been created in various subjects (Math, Science, English and Chinese language), and 146 GS lessons have been enacted, observed and studied. The research team has conducted numerous professional development sessions for teachers.

Two workshops were held during Jan-Feb 2010, reaching out to 50 teachers from more than 20 schools. In NIE itself, which trains pre-service teachers, the GS pedagogy was introduced to many cohorts of in-service teachers doing the leadership programmes, and to pre-service teachers taking the core Instructional Technology modules over the years.

Much CSCL and Learning Sciences research have focused on understanding or deriving design principles for learning, while others are intervention studies. There is a gap between such contextualized studies and the imperatives of large scale education reform. One approach to reducing the research-practice gap is to do implementation studies that systematically study an intervention to understand the conditions for successful implementation. Penuel, Fishman and Cheng (2011) put forward a compelling argument for a new form of implementation research termed as "Design-based Implementation Research (DBIR)", which comprises four elements: (a) a focus on persistent problems of practice from multiple stakeholders' perspectives, (b) a commitment to iterative, collaborative design, (c) a concern with developing theory related to both classroom learning and implementation through systematic inquiry, and (d) a concern with developing capacity for sustaining change at the system level. In the sister disciplines of medicine and public health, DBIR has a robust infrastructure and a clear focus on the interdisciplinary challenge of bringing about large-scale improvements to complex systems (Fixsen et al., 2005).

In our reflective analysis of the GS intervention study in Singapore schools, we have incorporated elements of DBIR, by working closing with schools to bring about the routine adoption of PCKI learning practices in the classroom. In our role as academics, we seek to identify and refine design principles and our theoretical understanding through our research. What have we learned about design principles through our iterative RCKI work in schools using a DBIR approach? Face-to-face classroom situations can host a broad variety of pedagogical patterns involving student-student and student-teacher interactions that go beyond IRE. However, the prevailing modularity of class periods, in chunks of between 40 and 90 minutes, constraints the adoption of pedagogical approaches whose characteristic timescales are measured in days or months or even years. Of particular interest to teachers and school administrators are pedagogical patterns that would carry the burden of scaffolding students to learn content (e.g. science, mathematics, language learning) as well as enhance participating students' development of so-called 21st century skills, such as communication, collaboration and critical thinking skills. RCKI refers to a collection of evidenced-based pedagogical patterns in which the learners brainstorm and contribute ideas, and build on each other's ideas to derive better ideas. It is a set of design principles that seeks to harness the collective intelligence of groups to learn collaboratively in a dynamic live setting (Looi, Chen & Patton, 2010; Wen, Looi & Chen, 2012).

We make the case that some research in the CSCL and learning sciences community must address issues of intervention and implementation study to understand the conditions for adaptations and sustainability of innovations in different contexts and settings – towards contributing to reducing the research-practice gap conundrum in education. We consider the complex interplay of multiple dimensions of education reforms, and approach our programme of research from a systemic change perspective that recognises the micro, meso, and macro levels of educational systems (Looi, 2011; Looi, So, Toh, & Chen, 2011).

Singapore's Third Masterplan of ICT in Education (mp3) seeks to enrich and transform the learning environments of students and equip them with the critical competencies and dispositions to success in a knowledge economy (mp3, 2009). While mp3 has an explicit focus on helping students develop competencies for self-directed and collaborative learning through the effective use of ICT as well as become discerning and responsible ICT users, the policies are couched from the perspective of policy makers. The challenge for school principals and teachers is how to implement technology-enabled pedagogies that foster self-directed and collaborative learning. This is where university researchers come in as meso-level actors who work with school leaders and teachers to interpret collaborative learning outcomes and processes in the context of the needs of a particular school. This re-contextualization of the pedagogic discourse is a "meso-level" mechanism. By approaching this pedagogy-driven reform at the macro, meso and micro levels, we seek the alignment of systemic forces at work to provide a buttress for sustainability. Thus we, as researchers working as the meso-level actors, help the school practitioners understand and interpret policy imperatives and translate them into classroom teaching and learning practices in ways that are informed by research and learning theories.

In many countries and regions, education authorities are keen for their reform initiatives to be well received by various stakeholders, namely: district-level leaders, school leaders, teachers, students and their parents. Typically, these stakeholders have different notions of scaling from researchers, such as holding a more top-down view of scaling and a linear progression model of research interventions. The learning sciences community can be part of this conversation towards articulating different models of

evidence-based scaling that work in different socio-political-cultural contexts and contributing towards creating more existential examples of sustainable and scalable innovations.

Paper 4: eTwinning: a European Network Community for Teachers to support cross-border school collaboration

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This contribution presents a study into the process of scaling up eTwinning, the community for schools in Europe (www.etwinning.net). By early 2013, the eTwinning community has attracted more than 100,000 schools and close to 200,000 teachers from 33 European countries to participate in international school collaboration through the use of Information and Communication Technologies (ICT). The initiative is one of the most successful actions under the European Union's Lifelong Learning Programme in the school sector. The participation amounts to more than 3% of all primary and secondary teachers who are eligible for participation.

Core to eTwinning is an online platform that offers participating teachers three types of activities:
1. Partner finding activities to create cross-border school collaboration projects using ICT;
2. Various continuing professional development (CPD) activities such as online Learning Events (distance courses) with formal certification and some more informal ones such as Online Interest Groups and Teachers' Rooms on various topics;
3. Social networking using tools that include profile pages with personal and professional information.

In the beginning, eTwinning was supported through the Pedagogical Advisory Group (PAG) comprising experts from teacher training, school inspection and pedagogical research. Its role was to analyse, reflect and comment on the eTwinning activities, and to develop a theoretical framework to ensure the lasting pedagogic value of the eTwinning activity in schools. Now in its 9th year of operation, eTwinning has evolved from simple school collaboration projects into more complex ones that impact not only on the level of innovative pedagogical practices in the classroom (Galvin, 2009) and students' involvement (Wastiau et al., 2011), but also impinge on institutional factors and the organisational climate of the whole school (Vuorikari, 2013). eTwinning also provide many CPD opportunities to teachers through formal and informal upskilling activities, and through teacher participation in networks (Vuorikari et al., 2011, Vuorikari et al., 2012). Similar results were reported in a large external study on the impact of eTwinning (European Commission, 2013).

To complement the above-mentioned qualitative studies on eTwinning practices and their impact, a number of longitudinal studies using data extracted from the platform have also been conducted. The eTwinning Analytics framework was created on the basis of OECD's indices for teachers' co-operation (OECD, 2009) to identify emerging behaviours and patterns within eTwinning. It operationalizes various activities for measurement and monitoring purposes. For example, the activities carried out while conducting school collaboration belong to the category of *teachers' professional development,* which can be seen as enhancing teachers' professionalism and self-efficacy.

To experience a full range of professional development activities in eTwinning, and therefore to take full advantage of it, a substantial time investment is needed. From our studies, it is clear that eTwinning has a potential to engage its users over a long period of time. Evidence was found that one eTwinner in six, who registered on the platform between 2005 and 2006, still returns to it.

Paper 5: Mainstreaming ICT-enabled innovations in Education and Training in Europe: Challenges and Opportunities

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This paper presents results from a European-wide research project, running from December 2011 to June 2013, on up-scaling ICT-enabled innovation in Education and Training (E&T), titled Up-Scaling Creative Classrooms in Europe (SCALE CCR). The aim of this project is to establish a sound understanding and evidence-base on ICT-enabled innovations *for* learning which has significant scale and/or impact at system level and to identify policy recommendations for the further mainstreaming of ICT in E&T in Europe. In addition to an in-depth literature review, a number of case studies are being undertaken (1:1 learning initiatives, Boccini et al. (2013)), eTwinning, Hellerup School and Asia/Europe exchange), which will have produced final results before the CSCL 2013 Conference. Also, consultations with a wide spectrum of experts will have been undertaken with regard to the policy recommendations.

In order to investigate the sustainability and scalability of Creative Classrooms (CCR), we need to capture the complexity and richness of these learning ecosystems (Law et al., 2011). A multi-dimensional concept for CCR comprising eight encompassing and interconnected dimensions is proposed (Bocconi, et al., 2012) to capture the essential nature of these learning ecosystems: *Content and Curricula, Assessment, Learning Practices, Teaching Practices, Organization, Leadership and Values, Connectedness,* and *Infrastructure.* A set of 28 reference parameters have also been developed for policymakers, researchers and practitioners, which depict the *systemic approach* needed for the sustainable implementation and progressive up-scaling of Creative Classrooms across Europe. This holistic framework (see Figure 1) takes into account the key characteristics of innovative pedagogical practices at organizational, curricular, and assessment levels, and articulates with the systemic capability involving practices at classroom, school and whole community levels (i.e. at micro, meso and macro levels).
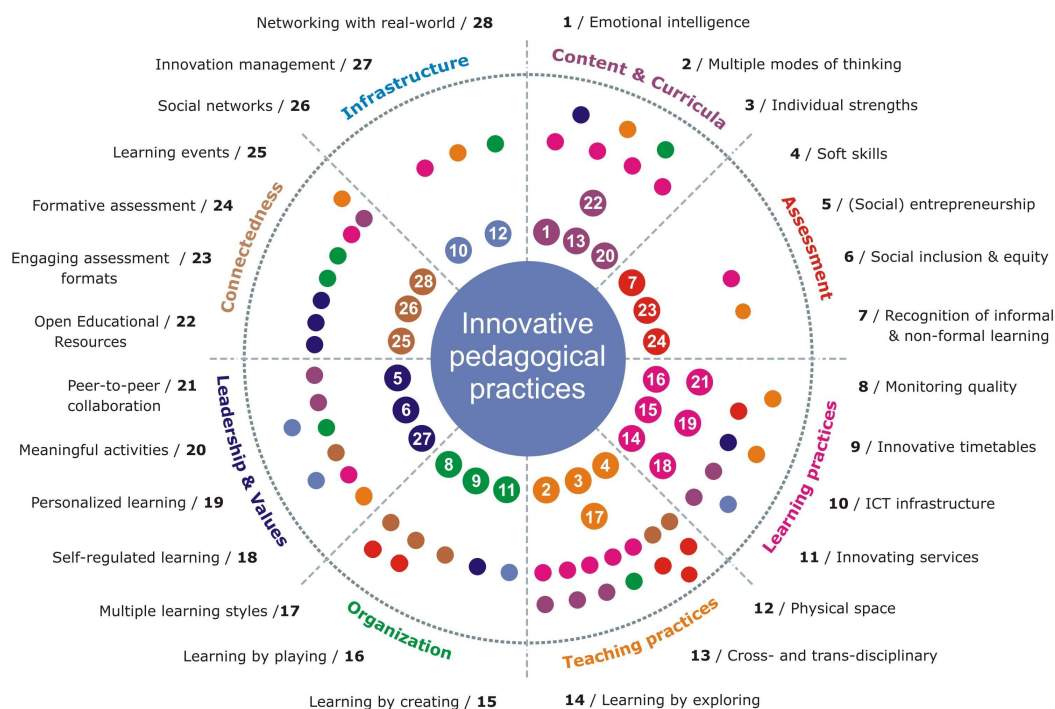
Figure 1. Bocconi, S., Kampylis, P. & Punie, Y. (2012) Innovating Teaching and Learning Practices: Key Elements for Developing Creative Classrooms in Europe, *eLearning Papers*, No. 30, September, http://www.elearningeuropa.info/sites/default/files/asset/In-depth_30_1.pdf, p. 3.

Figure 1. Key dimensions and building blocks of Creative Classrooms

This paper will draw on the key findings from the SCALE-CCR project to address the three focal questions for this symposium, highlighting the multi-dimensional and holistic nature of ICT-enabled innovations in learning.

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