STELLAR European Research Network of Excellence in Technology Enhanced Learning

D. Gillet[1], P. Scott[2],R. Sutherland[3]

[1]École Polytechnique Fédérale de Lausanne (EPFL), CH-1015 Lausanne, Switzerland,
[2]Open University, Milton Keynes, MK7 6AA, United Kingdom
[3]University of Bristol, Bristol, BS8 1JA, United Kingdom

denis.gillet@epfl.ch[1], peter.scott@open.ac.uk[2], Sutherland@bristol.ac.uk[3]

Abstract

Starting February 1st, 2009, the European Union is supporting a new Network of Excellence in Technology Enhanced Learning called STELLAR (Sustaining Technology Enhanced Learning Large-scale multidisciplinary Research). STELLAR represents the effort of the leading European institutions and projects in Technology-Enhanced Learning (TEL) to unify their diverse community. This Network of Excellence is motivated by the need for European research on TEL to build upon, synergize and extend the valuable work we have started by significantly building capacity in TEL research within Europe, which is required to allow the European Union to achieve its goals via the Bologna Agreement and the execution of the Lisbon Agenda. The Network is executed via a series of integration instruments designed to increase the research capacity of European TEL at all levels. STELLAR's instruments act upon the backbone of an interlocking set of three Grand Research Challenge actions, themed as Connecting Learners, Orchestrating Learning, and Contextualizing Environments & Instrumentalizing Contexts. In this paper, we describe the major educational and technological research challenges tackled in the framework of the STELLAR network of Excellence, its accompanying instruments and its potential to impact higher education, and especially engineering education.

Introduction

In the framework of its Seventh Framework Programme for Research and Technological Development (FP7) in Information and Communication Technologies (ICT), the European Union is currently funding five Large-scale Integrated Projects (IP) seven Small or Medium-scale Focused Research Projects (STREP) and a single Network of Excellence (NoE) for a total of € 51 millions [TeleLearn 2009]. These projects are listed in the next subsections. Their main research topics are in accordance with the European priorities described in the yearly-updated ICT Work Programme [ICT 2009]. From an engineering education point of view, advances are especially expected in terms of personalized learning content, environments and methodologies, serious games, social learning, support for creative thinking and innovation processes, competences management, as well as reducing the gaps between professional and educational practices from knowledge and community management perspectives.

Large-scale Integrated Projects

The large-scale integrated projects currently supported by the European Union are the following:

idSPACE: Tooling of and Training for Collaborative, Distributed Product Innovation.

The idSPACE platform will improve collaborative creative learning processes and innovation by providing teams with tools for articulating, communicating and processing new ideas in product design.

ROLE: Responsive Open Learning Environments.

ROLE addresses theoretical models and associated technologies that allow learners to tailor learning environments according to their needs. The results of this research will contribute to improving adaptive and responsive learning environments for the individual learner in different contexts.

SCY: Science Created by You.

This project will deliver a system for constructive and productive learning of science and technology, based on a flexible and adaptive pedagogical approach to learning and on learning objects created by learners.

TARGET: Transformative, Adaptive, Responsive and Engaging Environment

TARGET will develop a responsive learning system with serious games at its core, that presents the learner with complex situations and results in experiences that are gradually honed into knowledge.

Small or Medium-scale Focused Research Projects

The small and medium-scale focused research projects currently supported by the European Union are the following:

80Days: Around an Inspiring Virtual Learning World in Eighty Days.

This project is concerned with theories, methodologies, and technologies for game-based learning. It will integrate models of adaptive personalized learning and adaptive interactive storytelling in gaming environments. One objective is to reduce production costs for digital educational games by developing solutions for making use of already existing learning resources.

COSPATIAL: Communication and social participation: collaborative technologies for interaction and learning.

COSPATIAL will create collaborative environments to enhance interaction and learning, addressing in particular the needs of children with Autistic Spectrum Disorders.

DynaLearn: Engaging and informed tools for learning conceptual system knowledge.

DynaLearn will build engaging tools for acquiring conceptual knowledge, with the potential to increase students' interest in science studies.

GRAPPLE: Generic Responsive Adaptive Personalized Learning Environment.

This project aims at delivering a technology-enhanced learning environment for life-long learning, able to automatically adapt to personal preferences, prior knowledge, skills and competences, learning goals and the personal or social context in which the learning takes place.

IntelLEO: Intelligent Learning Extended Organization.

IntelLEO will develop intelligent technologies to support learning and knowledge building activities in organizations.

LTfLL: Language Technologies for Lifelong Learning.

This project will provide semi-automatic services for feedback that require no or very limited tutor-based support and are able to analyze interactions between students and textual output. A knowledge-sharing infrastructure (combining domain ontologies and social tagging) will allow for comparing and exchanging of individual knowledge, leading to new common knowledge. The project will make extensive use of language technologies to situate the learners in their domain.

xDELIA: Boosting Deliberate Practice and Handling Biases through Immersive Cognitive and Emotional Reinforcement Strategies & Tools.

xDELIA will explore novel technology-supported approaches to training and support for non-formal and informal learning tested in the domain of financial decision making. This research will increase the understanding of emotional states in decision-making processes and help handling biases.

Network of Excellence

A single Network of Excellence in Technology Enhanced Learning called *STELLAR (Sustaining Technology Enhanced Learning Large-scale multidisciplinary Research)* is supported by the European Union. STELLAR (http:// www.stellarnet.eu/) represents the effort of the leading European institutions and projects in Technology-Enhanced

Learning (TEL) to unify their diverse community. This Network of Excellence is motivated by the need for European research on TEL to build upon, synergize and extend the current achievements by significantly building capacity in TEL research within Europe, which is required to allow the European Union to achieve its goals via the Bologna Agreement [Bologna 2009] and the execution of the Lisbon Agenda [Lisbon 2004]. The European TEL agenda has been set for the last 4 years by the Kaleidoscope network (http://www.noe-kaleidoscope.org/pub/) – with a huge strength in pedagogy and scientific excellence, and the Prolearn network (http://www.prolearn-project.org/) – with a complimentary strength in technical and professional excellence. Integrating this excellence and moving on to the higher strategic formation of policy based in leading research is the key challenge for the next stage. STELLAR will move beyond the earlier networks by setting a new and critical foresight agenda for Technology Enhanced Learning. The Network is executed via a series of integration instruments designed to increase the research capacity of European TEL at all levels. STELLAR's instruments act upon the backbone of an interlocking set of three Grand Research Challenge actions, themed as Connecting Learners, Orchestrating Learning, and Contextualizing Environments & Instrumentalizing Contexts.

STELLAR brings together researchers from psychology, education, cognitive science, computer science, human factors, organizational and management science with the overall aim of focusing on advances in technology-enhanced learning that engage learners and teachers in new ways of learning in order to radically change both what it means to learn and what it is possible to learn. The emphasis is on both adapting learning to local cultural and personal situations and transforming learning into permanent and valuable knowledge assets. An important focus is the shift from learning as a focused, individual activity to lifelong learning that is interwoven in daily activities and that involves collaborative knowledge sharing and building. This type of learning has become commonplace, but is not yet sufficiently understood and supported by technology – most current learning management systems are based on individual, formal learning.

The work of STELLAR is based on the view that in today's knowledge society, people are not only confronted with classical transitions from school to university, from university to a company and so on. They are also faced with additional transitions, for example, between companies, between formal institutional learning and informal learning, between, learning for personal growth and learning for work.

The objectives of the 16 partners of the STELLAR Consortium can be summarized as follows:

- To unite the disjoint scientific communities with a virtual and distributed centre of excellence that expands the capacity of each research unit and that fits the "Grand Challenge" for the future of TEL, and that will be sustained though valuable instruments.

- To connect with policy-makers to provide a strategic direction for the integration of TEL excellence to 2012 using a grand challenge framework that explicitly relates to improving learning and educational systems.

- To reduce discipline fragmentation by promoting the integration of key European research teams through collaborative projects, research exchanges, sharing of tools, models, concepts, methods and agendas.

- To reduce community fragmentation by bringing together the key stakeholders in European TEL and stimulate ongoing knowledge exchange between them.

- To look beyond the Network partnership and actively solicit the exchange of views, knowledge, feedback and visions of key stakeholders in TEL: researchers, developers, end-users both in education and in industry.

STELLAR Grand Challenge in Technology Enhanced Learning

Informal learning is a lifelong process in which individuals learn values, skills and knowledge from daily experience and the influences and resources in their environment, from family and neighbors, from work and play, from the market place, the library and the mass media. Workers often report that they have learnt their skills from their co-workers

rather than from company-provided training. By contrast formal learning relates to learning within institutional systems from primary school through to University and also within work-based technical and professional training. The challenge now is to connect formal and informal learning practices and to 'legitimize' informal, situated learning by providing the means for virtual teams, communities and organizations to make visible their impact upon learning.

From the above, three initial research themes have been identified to advance technology-enhanced learning (Fig. 1): *Connecting Learners* (Connect), *Orchestrating Learning* (Orchestrate), and *Contextualizing Environments & Instrumentalizing Contexts* (Context). These research themes are investigated concurrently, but with a strongest focus first on connecting learners, then on orchestrating learning, and finally on contextualizing environments & instrumentalizing contexts, taking into account the current maturation state of the related research.

Figure 1: The initial research themes of the STELLAR Grand Challenge.
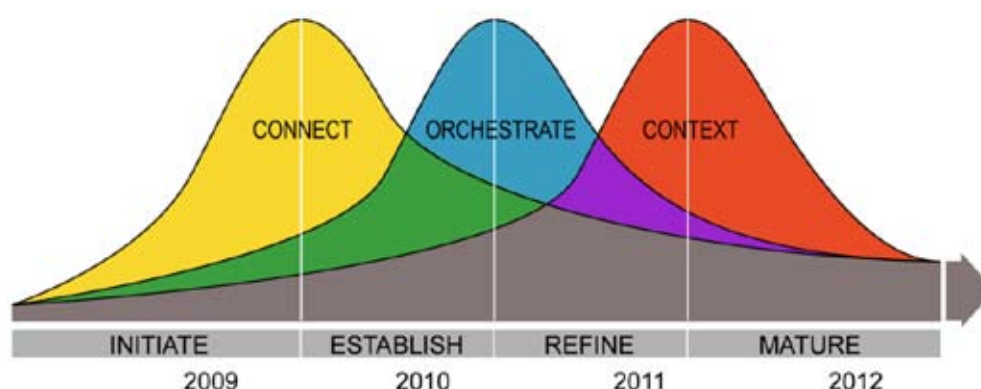
Connecting learners

On the Web, we can see that self-directed, self-managed and self-maintained communities create successful new forms of collaboration. A wide range of tools is used by these communities for knowledge sharing and building, communication, collaboration and networking. Knowledge sharing and building is facilitated by open and closed forums, Wiki pages and personal or shared blogs. Multimedia material is shared using popular tools such as Flickr and YouTube. Communication takes place using forums, annotation, tagging, chat rooms, instant messaging and video conferences. Collaboration is facilitated by shared media repositories, version management systems and collaborative text editing systems such as Google Docs. Networking portals, such as Facebook and LinkedIn, allow professionals to find, contact and keep in touch with like-minded. In a Web 2.0 world new communities bring together self-directed, self-managed and self-maintained users and, thereby, create successful new forms of collaboration. These new communities are typically open to all learners at any point in their life of learning. Within successful communities, inherent incentive mechanisms to motivate and encourage participation exist. The heart of learning and knowledge consists of people. Replacing the current centralized, static technology-push models with new interactive models that reflect the continuous, social nature of learning requires a radical shift from a focus on knowing what to a focus on knowing how and knowing who.

Within this theme key research questions are: What are key enabling and success factors for learner networks? How can individuals be supported to move between networks and simultaneously participate in several networks? How can learner networks profit from its members' participation in and expertise derived from other networks?

In engineering education, new schemes have to be investigated using Web 2.0 technologies and social networks to enable better interaction between students at various levels, between students and educators, as well as between students and alumni or community members already engaged in professional practices.

Orchestrating learning

Situated, collaborative learning clearly demands a new approach to pedagogy, didactics and assessment. Collaborative competence for using, generating and exchanging knowledge in a peer-to-peer manner is increasingly becoming an integrated part of TEL environments. Different perspectives are to be considered. For example, from the peda-

gogical perspectives, concrete problems and possible solutions offered by teaching and learning situations mediated by the use of technology are to be considered. While, from the cognitive perspective, the focus should be on what the individual can learn under certain conditions and on the new skills needed. The necessity to personalize and analyze the new key abilities and skills required in the knowledge society has become a critical issue in education. The specific characteristics induced by new technologies in the teaching and learning of disciplinary content are also important issues to be studied.

Within this theme key research questions include: What is the role of the teacher/more knowledgeable other in orchestrating learning? How can we design collaborative learning models with innovative technology in order to scaffold productive collaborative activities? From the point of view of the learner what is the relationship between higher-order skills and learning of a particular knowledge domain?

In engineering education, competences management, serious games, flexible curricula design, and personal coaching from online communities have to be further investigated in order to better align educational offers with individual and economical expectations. The trade-off between selfish university branding and philanthropic resources sharing has also to be revisited.

Contextualizing virtual learning environments and instrumentalizing learning contexts

As learning has become an integrative part of our life, and as it takes place in different learner communities, the tools, resources and systems that are used need to be contextualized. Complementarily, the interplay between formal and informal learning in formal and informal contexts has to be instrumentalized through the use of physical artifacts, mobile devices and the configuration of physical and virtual space, in order to create learning opportunities beyond the traditional institutional boundaries. Technologies for learning must be designed for culturally mediated settings, which include the co-design of technology and pedagogy for situated learning, simulated environments and support for mobility. Traditional classroom learning is founded on an illusion of context stability, by setting up a fixed location with common resources, a single teacher, and an agreed curriculum, which allows a semblance of common ground. But if these are removed, a fundamental challenge is how to form islands of temporarily stable context to enable meaning making from the flow of everyday activity.

Within this theme key research questions include: How can new forms of contextualized learning enable novel experiences for learners and for development of human competences? How to support the mobility of the learner in distributed and multi environment learning settings, like the transition between real and virtual contexts? Which standards are needed to achieve interoperability and reusability of learning resources in this field? How to harmonize the existing learning standards?

In engineering education, the transition from closed learning management systems (LMS) to open personal learning environments (PLE) better supporting, creativity, the versatility of the new learning schemes and the disappearing IT boundaries have to be investigated. In such environments, the support for professional-like knowledge management services, concurrent design facility accesses and opening to the whole Internet of Things (sensors, agents, labs) will be made easier and will better prepare the learners for the real professional life and for lifelong learning.

STELLAR Integration Instruments in Technology Enhanced Learning

The critical intervention strategy of STELLAR involves matching a need for long-term integration via capacity building at a level of TEL research with a set of sustainable "instruments" designed for that level. Instruments have been selected to allow the building of research capacity at a level matching the STELLAR objectives and which can be sustained beyond the funding of the Network. Table 1 illustrates a set of capacity building and integration instruments that can operate to reduce fragmentation on four levels of TEL research.

The first group of STELLAR instruments (Meeting of Minds and Podcasts) aims at providing opportunities for national, European, International, governmental, institutional and industrial policy makers to point out grand challenge research themes and share their prospective vision and strategic direction at the highest level.

The second group of STELLAR instruments (Theme Teams, Incubator Programme and Rendezvous) aims at building a *Distributed Center of Excellence* unifying the TEL scientific community to refine, tackle, and inform on the

TEL grand challenge activity.

The third group of STELLAR instruments (Doctoral Community of Practice and Doctoral Consortia, Doctoral Schools and Doctoral Scholarships) aims at expending the critical mass and the excellence of the TEL doctoral scientific community with future TEL faculty members and entrepreneurs able to work closely with the stakeholders outside the classical academic silos.

The fourth group of STELLAR instruments (Community Channels, with and the Open Archive & Science 2.0 Mash-up Platform) aims at ensuring the cross-fertilization between the policy makers, the scientific community and the stakeholders representing the all knowledge society (from the bottom up). Unlike the previous European networks of excellence in TEL, STELLAR will aim to harmonize the views of the more technological and the more pedagogical communities. STELLAR will provide a new Science 2.0 platform to support research integration that will be sustained beyond its funded work. Its management and leadership will find a consensus in research strategy at each capacity layer that has been missing in the field; and will bring in many new STELLAR 'Associate Partners' into the work via its interconnected instruments.

Table 1. Increasing Capacity in European TEL Research.

Capacities	Instruments	Target Groups
Leadership	Meeting of Minds	Learning executives, policy makers, senior researchers
	Podcasts	Integrative
Researcher	Theme Teams	Mid tier research staff
	Incubator Programme	Early stage researchers
	Rendezvous	Integrative
Doctoral Academy	Doctoral Community of Practice and Doctoral Consortia	Mid stage PhD students
	Doctoral Schools and Doctoral Scholarships	Early stage PhD students
Community Level	Community Channels	Stakeholder Network
	Communication infrastructure: Open Archive & Science 2.0 Mash-up Platform	Integrative

Concluding Remarks

From teacher oration to social learning through constructivism, from the library of Alexandria to Google, from the native tom-tom drums to today smart phones, advances in education and communication are impressive. However, classroom teaching is still the main activity at all school levels and most citizens are immerged in technologies for their daily activities, but learning. STELLAR is one of the current European tentative to integrate the fragmented research community in Technology Enhanced Learning as a single and strong actor for engaging all stakeholders in closing the many existing social, institutional, political, methodological, and technical gaps for (re)appropriation of education by people (as individuals and communities) in our knowledge society.

Acknowledgements

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