ESCHOOLING: AN ICT-BASED APPROACH TO COMPETENCE-BASED EDUCATION

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ABSTRACT

We present the eSchooling project, which aims at supporting the introduction of a nce-based approach to education in schools, leveraging Information and Communication Technology. The project supports the whole teaching and learning lifecycle, from the didactic project to the assessment, to the metacognitive reflection on the learning process. It supports all involved actors: teachers, students, school directors and families. Digital competence of the actors is reinforced both in personal way and communicative interaction.

***Keywords**: Digital Competence – eSchooling - Competance-based Education – Highschool - Teaching and Learning Processes*

eSchooling: un approccio basato sulle tecnologie dell'informazione e della comunicazione alla didattica per competenze

Viene qui presentato il progetto eSchooling, che mira a sostenere l'introduzione di un approccio basato sulle competenze nelle scuole, utilizzando le tecnologie dell'informazione e della comunicazione. Il progetto si fa carico dell'intero processo di insegnamento, dalla programmazione didattica alla valutazione, alla riflessione metacognitiva sui processi d'apprendimento e punta a supportare tutti gli attori coinvolti (insegnanti, studenti, dirigenti scolastici e familiari) rafforzando la loro competenza digitale sia individualmente che nell'interazione comunicativa con gli altri.

***Parole chiave:** Competenza Digitale – eSchooling - Didattica per competenze - Scuola secondaria di secondo grado - Processi di insegnamento e di apprendimento*

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Introduction

Following the indications contained in the "Key competences for Lifelong Learning — A European Reference Framework" (European Commission, 2006), the governments of most EU countries created laws for pushing schools to introduce the notion of competence in the teaching processes. However, adopting the "competence" point of view is far from being trivial, as it involves a profound change in the teaching style and practice.

A second strong push is noticeable in today's school system: the attempt to use Information and Communication Technology (ICT) to support teaching and learning processes. Surprisingly though, there seems to be no effort to conjugate these two trends, or at least there aren't, on the Italian market, products which take into account these two complementary aspects.

This consideration is at the root of the *eSchooling* project (Chiozzi et al., 2014), an industrial research initiative aimed at facilitating and supporting the introduction and use of Competence-based Education (CBE) by using ICT. The project promotes at the same time Digital Competence and CBE for all the actors of the world of scholastic education: teachers, students, school managers and families.

The most prominent aim of the project is to facilitate the implementation of CBE by helping teachers and schools to change the way they set up their educational plans (e.g. curricula) and by helping teachers to change their pedagogic-didactical repertoire from a mainly traditional transmission model to more active didactics, based on constructivist learning theories. This is a challenge for teachers as it is easier to stick with what they know and have been doing for many years.

The project built a software prototype that aims at supporting the teachers in the formal steps that are required by the new legislative aspects, and at the same time helps them to design and implement didactic strategies suited for competence-based teaching and assessment.

The project is an initiative of Telecom Italy SpA[1] (the largest phone carrier in Italy), flanked by a publisher, Edizioni Centro Studi Erickson SpA[2], and two SMEs: Memetic Srl[3] and ForTeam Studio Srl[4]. It is co- funded by the local government (Autonomous Province of Trento) through a Provincial Law on incentives for businesses. The University of Trento participates in the project as scientific advisor. The time span of the project was 30 months, and the initiative is currently in the middle of its lifetime.

[1] www.telecomitalia.it

[2] www.erickson.it

[3] www.memetic.it

[4] www.forteam.it

The basic aims of the project *eSchooling* are:

- Defining new models of innovative teaching strongly based on the competence approach and supported by digital technologies;
- Investigating new learning practices that digital books might enable;
- Building a software prototype that supports the above mentioned methodology and practices, while providing the functionalities of a Learning Management System.

The project focuses (as of now) on high school, with a possible extension to middle school in future. In the first part of the project we analysed the normative aspects of teaching by competence, and performed a survey to understand how teachers use ICT, and how they respond to the request of using the notion of competences and a related praxis. Our survey involved approximately 300 teachers. We also run a workshop in occasion of the major Italian conference on teaching with ICT (Didamatica) to collect evidence and feedback. Approximately 50 teachers were involved in the workshop. We also drew on the experience we gathered in another Telecom Italia project, educ@tion (Chiozzi & Nassi, 2011), in which students were equipped with tablets and used them in class on a daily basis.

Competence Based Education

"Competence" is a term that is becoming more and more central in schools. According to the Oxford dictionary, competence (or competency) is "the ability to do something successfully or efficiently", while the Business Dictionary defines it as "A cluster of related abilities, commitments, knowledge, and skills that enable a person (or an organization) to act effectively in a job or situation. Competence indicates sufficiency of knowledge and skills that enable someone to act in a wide variety of situations".

The concept of Competence Based Education (CBE) was introduced already in the Seventies (see e.g. Grant et al., 1979), starting from the world of Vocational Education and Training (VET). The main motivation was to fill the gap between education and the labour market. The development of the concept followed relatively independent routes in Western Europe.

- The United Kingdom adopted a competence-based approach to VET to establish a nation-wide unified system of work-based qualifications in the 1980s.

- The German model, which then influenced Austria, Hungary, Slovenia and the Scandinavian countries, has its roots even earlier, in the 1960s. It was based on *Qualifikation* (i.e. the ability to master concrete -generally professional- situation requirements) and *Kompetenz* (i.e. the subject-oriented and holistic capacity of a

person to act, comprising not only content or subject knowledge and ability, but also extra-subject or transversal abilities: *Schlüsselqualifikationen,* i.e. Key Competence).

- In the new century it evolved into subject-competence (*Fachkompetenz*), personal competence (*Personalkompetenz*) and social competence (*Sozialkompetenz*).

- In France the modification of the ROME (*Répertoire opérationnel des métiers et des emplois*) in 1993 gave a central role to competence. In the nineties the state also introduced a right for individuals to have a *bilan de competences* (competence balance) undertaken to provide a basis for personal development in their occupation. It considered *savoir* (*compétences théoriques*, i.e. knowledge), *savoir-faire* (*compétences pratiques*, i.e. functional competences) and *savoir-être* (*compétences sociales et comportementales*, behavioural competencies).

Similarly to the French definition, developmental psychologists (e.g. Gelman & Greeno, 1989; Sophian, 1997) commonly break competence down into three analytically distinct components:

- "Knowledge": conceptual competence, rule-based, abstract knowledge about an entire domain;

- "Skills": procedural competence, procedures and skills needed to apply conceptual competence in concrete situations;

- "Competencies": performance competence, required to assess a problem and select a suitable strategy for its solution.

The usage of the term "Competencies" (instead e.g. of "Attitudes") as a component of the "Competence" concept seems to be unfortunate: in first place does not help grabbing the concept, but even worse it suggests a contraposition between Competence and Knowledge, as we will discuss later. The presence of ill-defined concepts in the area is also pointed out by Winterton, De La Mare-De Leist and Stringfellow (2006). They report a detailed history of the introduction of the "competence" notion in the EU countries, and summarize their long study by stating

> Competence is a term subject to such diverse use and interpretation that it is impossible to identify or impute a coherent theory or to arrive at a definition capable of accommodating and reconciling all the different ways the term is used.

In spite of these problems, there is in the EU a strong institutional push towards the transition from traditional teaching to CBE.

Traditional, *input-driven* education has usually its main focus on disciplinary knowledge development. CBE instead is a form of *outcome-based* education (Young 2009): it stresses the development of competences as integrated abilities of knowledge, skills, and attitudes required to perform relevant and often complex, multidisciplinary tasks (see e.g. Mulder 2014). CBE is also solidly grounded in constructivist theory and approaches to learning. According to this point of view, learning is an active process in which students construct their own knowledge through experience, in situated contexts and in interaction with other people. CBE should start from real-world relevant learning outcomes that are independent of a prescribed learning pathway or programme: the curriculum development is not based any more on a list of contents that the pupil must memorize. In fact, CBE challenges the traditional ILA-culture (Instruction, Learning, and Assessment) of the input-driven education (Birebaum, 2003), where the relevant educational cycle is based on knowledge transmission (I), rote memorisation (L) and standardized testing (A). In CBE the ILA cycle comprises instead learning and competence development (I), reflective-active knowledge construction (L) and contextualised, integrative, and performance assessment (A).

The core of CBE lies in stimulating authentic and self-directed learning (De Bruijn & Leeman, 2011), which implies a role change for the students, who need to become more self-directed in steering their own learning and development. Obviously therefore, outcome-based education such as CBE requires different didactical approaches and different kinds of learning tasks (see e.g., Biemans. Nieuwenhuis, Poell, Mulder, & Wesselink, 2004). The teacher must become a facilitator of this process, providing students with a variety of relevant and authentic learning experiences and stimulating students, who often work in groups, to use these experiences to build their own understanding and to develop competences.

CBE hence requires a cultural change for the teachers, which is difficult to accept and to achieve, as for all paradigm shifts. In fact, the CBE adoption path is full of hurdles: learning to put in practice theoretical concepts such as reflection or coaching proves to be difficult for teachers (De Bruijn & Leeman, 2011; Biemans et al., 2009). It involves changing the beliefs about knowledge, teaching, learning, and assessment (Gulikers, Biemans, Wesselink, & Van der Wel, 2013) and requires the adoption of a new and broader didactical repertoire.

Of course, not everybody agrees with a competence-based approach: as examples we mention Boutin and Julien (2000) who speak of "*L'obsession de la competence*" and Crahay (2006) who writes about "Dangers, incertitudes et incomplétude de la logique de la competence".

Moreover, there are additional barriers for a wider adoption of the concept: due to its historical development, many educators perceive it as pushed by companies and industries, and hence as something which is not real "*culture*", and is therefore unsuited for "*nobler*", i.e. non vocational, education systems (such as e.g. lyceum). Also, the shift away from "content based" education is often perceived as a *diminutio.* Many teachers perceive CBE as an approach that focuses only the ability of "doing things" as opposed to "knowing", ignoring

that possessing a competence means "be able to perform (and demonstrate) activities (relevant to the real world) by applying what one knows": without knowledge there is no competence. Possessing knowledge is a necessary, but not sufficient, condition for competence. In spite of this simple fact, a strong resistance against CBE is based on the prejudice that possessing knowledge would not be considered important any more. Of course, the change in the didactical approach has a relevant impact on the *quantity* of content that is presented to the student. Time devoted to students' activity is subtracted from the total available time, and hence less time than usual is available to cover the whole "program" (intended as list of contents). Supporters of CBE argue that, on the other hand, most of the material presented in traditional, frontal teaching is memorized only long enough to pass the assessments, and then in large part forgotten.

In spite of these difficulties, CBE has gained popularity in many countries, not only in Europe but worldwide (Mulder, Weigel, & Collins, 2007). At present, the concept of competence is institutionalised both in (professional) organisations as well as education and (national) educational systems, for example in the European Qualification Framework (EQF) and thereby in the national qualification frameworks of EU member states.

Competence Based Education in the Italian context

In 2006 the EU Member States developed the provision of "key competences for all" as part of their lifelong learning strategies. To this aim, "Key competences for Lifelong Learning - A European Reference Framework" was developed and approved as Recommendation of the European Parliament and of the Council in 2006 (European Commission, 2006). It defines eight key competences and describes the essential knowledge, skills and attitudes related to each of these:

- *Communication in the mother tongue*, i.e. the ability to express and understand concepts, thoughts, feelings, facts and opinions in both oral and written form and to interact linguistically in an appropriate and creative way in a full range of societal and cultural contexts;

- *Communication in foreign languages*, which apart of comprising the same skills of the previous point when using another language, adds the ability of mediation and intercultural understanding.

- *Mathematical competence and basic competences in science and technology*. i.e. the ability to develop and apply mathematical thinking in order to solve a range of problems in everyday situations, plus the mastery to use and apply of knowledge and methodologies that explain the natural world.

- *Digital competence* involves the confident and critical use of information society technology (IST), which relies upon skills in information and communication technology (ICT);
- *Learning to learn* is related to the ability to pursue and organize one's own learning in accordance with one's own needs, being aware of methods and opportunities;
- *Social and civic competences*: Social competence encompasses all forms of behaviour that equip individuals to participate in an effective and constructive way in social and working life, i.e. personal, interpersonal and intercultural competence. It is linked to personal and social well-being. Civic competence equips individuals to engage in active and democratic participation;
- *Sense of initiative and entrepreneurship* is the ability to turn ideas into action. It involves creativity, innovation and risk-taking, as well as the ability to plan and manage projects in order to achieve objectives.
- *Cultural awareness and expression*: appreciation of the importance of the creative expression of ideas, experiences and emotions in a range of media (music, performing arts, literature and the visual arts).

One of the final goals was to have comparable competence assessments so as to facilitate workers mobility across the nations. In spite of the common aim, every state has customized the implementation of the competence concept in order to adapt the framework to its specific cultural tradition; also the Italian legislator gave his own interpretation. A Ministry Decree (DM 139, 2007) introduced in the school system the key competences, but introduced a relevant variation. After several years, a change in didactical practices is hardly detectable, at least in the Italian high schools, which are the focus of our interest. There are several reason for this fact: we will try to explain the situation by entering into some details. In first place, the decree provides some recommendations, but then it leaves to the schools and to the teachers much freedom about how to implement them.

The competence body was split into two sets: "*Assi Culturali*" (AC) (cultural dimensions) and eight "*Competenze Chiave di Cittadinanza" (CCC)* (citizenship key competences). AC broadly cover four disciplinary areas: languages, science and technology, mathematics, and history. Each of them is articulated in three to four competences, so that the total number of competences foreseen by the Italian law is 22 (12+8) (against the 8 European ones).

The following table attempts to map the four AC and the eight CCC against the eight EU competences.

<table>
<tr><th>Recommendation of the European Parliament and of the Council – Dec.2006</th><th colspan="3">Italian D.M. 139, 22 agosto 2007</th></tr>
<tr><th>Key competences for Lifelong Learning</th><th colspan="2">Cultural axes</th><th>Citizenship key competences</th></tr>
<tr><td>Communication in the mother tongue</td><td colspan="2" rowspan="2">Languages Axis</td><td rowspan="3">Communicate</td></tr>
<tr><td>Communication in foreign languages</td></tr>
<tr><td rowspan="2">Digital competence</td><td rowspan="3">Scientific and technological axis</td><td rowspan="3">Mathematical axis</td></tr>
<tr><td>Mathematical competence and basic competences in science and technology.</td><td></td></tr>
<tr><td>Social and civic competences</td><td colspan="2" rowspan="2">Historical axis</td><td rowspan="2">Collaborating and participating</td></tr>
<tr><td>Cultural awareness and expression:</td></tr>
<tr><td rowspan="3">Learning to learn</td><td colspan="2" rowspan="3"></td><td>Learning to learn</td></tr>
<tr><td>Acquiring and interpreting information</td></tr>
<tr><td>Finding links and relationships</td></tr>
<tr><td rowspan="2">Sense of initiative and entrepreneurship</td><td colspan="2" rowspan="2"></td><td>Inventing and designing</td></tr>
<tr><td>Problem solving</td></tr>
</table>

Table 1- Comparison between the EU key competences and the Italian framework (Zanchin, 2012)

The underlying message is somehow odd, as it suggests that the competences related to the cultural axes are strongly linked to a disciplinary approach, and have nothing to do with the other areas, while the EU spirit is the opposite: e.g. *every* teacher should be able to evaluate the ability to communicate in the mother tongue! Also, the EU version mixes math and science, while the Italian one takes them apart, and digital competence has completely disappeared from the Italian declination. Rather than pushing for an interdisciplinary approach, the hidden message reinforces disciplinary teaching. Even the wording is ambiguous, as the axis notion hides the competences in the details, leaving them in full evidence only in the CCC.

The law (DM 9, Jan 17, 2010) prescribes that the (base) competences must be certified at the end of the 10-years period of compulsory schooling. Oddly, the end of compulsory schooling does not lead to obtain a title (titles are given at the end of the 8th and of the 13th years). The competence certification is a due act, but it is performed in parallel to the classical, yearly student evaluation, which is typically based on the *knowledge* acquired by the student.

Competence evaluation does not have any impact on the student's career, up to the point that many schools comply with the norm, but the competence certificate is not even delivered to students and families, ending up in an archive! In such scenario, most teachers are not eager to dedicate much time to this activity, so that in the end the "competence" evaluation is (almost always) nothing but a trivial mapping from the result of traditional, content-based assessments onto the "competence box". We collected several anecdotal observations of such behaviours.

As if it was not enough, CCC are not part of this certification. Again, the perceived message is that "they're not really important": what matters is the disciplinary approach: so nothing changes with respect to the old school…

Another important element emerging from various focus groups we run with a few teachers groups is the fact the final exam ("*maturità*", at the end of the 5 years of highs school) still has an old-fashioned imprinting and is definitely not based on competence, but rather in large part it assesses the acquisition of knowledge: hence teachers obviously feel obliged to prepare students for that.

On the other hand, in the midst of this "let's pretend to" setting, teachers are constantly told that they should incorporate competences in their teaching. A Decree of 2012 says "The EU key competences framework is the horizon at which the Italian school system aims" (DM 245 2012). Written and non-written indications are vague and contradictory: those who attempt to get a deeper understanding often end up being lost and confused. Moreover, as Pelleray (2010) states, a suitable semantic and operative framework is lacking. Teachers understand that they are requested to adapt to a new paradigm, yet they do not understand how to get there, and often not even where is "there". Bottani (2007) even mentions a "pedagogical tsunami" caused by the big but largely incoherent amount of work done on the notion of competence.

The eSchooling project approach

The Communication of the EU Commission to the Parliament "Opening up Education" states that

> Technology allows for new ways of learning and assessing, focussing more on what the learner is capable of doing rather than on the mere acquisition of information or on what the learner is capable of repeating. (European Commission 2013)

It is, once more, a strong endorsement of the CBE. Surprisingly however, it seems that no relevant effort has been dedicated to using ICT to favour and support CBE. ICT development seems to have largely ignored the strong push of the EU Commission in this direction. Over the last two decades, several ICT systems such as e.g. Learning Management Systems and Learning Object Repositories have been developed and deployed in schools. To our best knowledge, none of them has explicitly considered and prioritized the need of

supporting a transition to CBE. Moreover, the impact of the application of ICT in schools has often been largely below the expectations, and in some cases it has even gone in the wrong direction. For example, in the case of Interactive Whiteboards, behind the showcase of glittering innovation, technology has not driven or favoured pedagogical innovation, but rather reinforced traditional teaching methodologies (such as frontal lecturing).

The *eSchooling* project aimed at filling the existing gap in ICT for education by creating a system that supports CBE. Unlike other ICT systems designed for the school, its focus is on supporting and favouring the transition from traditional didactics to a competence-centred pedagogy. The ambitious projects goals were to deliver, deploy and experiment in schools a cloud solution to support all the actors (teachers, students, families and school managers) in the transition to and in the application of CBE. It was an industry-led effort, supported by an interdisciplinary research team comprising pedagogical and learning theories experts and computer scientists and technologists.

The software produced by the project (which has the same name of the project itself) is a web app living on the cloud. It does not need to be downloaded and installed on the teacher (or student) PC, nor it tight to a particular operating system or to a specific hardware device. This enables a BYOD - Bring Your Own Device approach, and the use of mobile technologies. It also includes an experimental tool for collaborative annotation of eBooks, which is discussed elsewhere (Hwang et al., 2014)

Its main goal is to support schools to develop a CBE strategy, and facilitate teachers to make the transition from traditional teaching to an innovative CBE approach.

The *eSchooling* solution covers the whole spectrum needed by all actors to favour the transition. It guides **teachers** in a **simple way.** In particular, it accompanies them while:

a) defining learning objectives related to Key Competences to guide their teaching

b) planning competence teaching;

c) designing and assigning activities in the CBE spirit;

d) accessing and sharing educational resources;

e) accessing and sharing best practices;

f) performing competence evaluation (and – when required – competence self evaluation);

g) cooperating with colleagues.

The initial idea was very simple. We started from the observation of what happens in the schools we could monitor. We found that at high school level, and in particular during its first two years, competences play a role due to legislative constraints:

- For every class, every teacher has to prepare, at the beginning of the school year, an overall plan of what they intend to do. The plan must include the competences they intend to develop.
- At the end of the second year, a competence balance document has to be prepared for each student (this is the document we mentioned as the one, which is going to be archived often even without a communication to the family).

In the middle, i.e. during the school year, there is a wide, empty space.

This means however that at least some (administrative) work has to be done on competences. The idea was to give teachers a tool to facilitate their work regarding point 1, and to use that as a hook for filling the empty space between point 1 and 2. *eSchooling* provides a taxonomy of competences, starting from the European Key competences and decomposing them into lower granularity competences (sub-competencies). The taxonomy is not hardwired into the system, so it can be customized by single schools or, e.g., by regional governments. Teachers can select the competences from the taxonomy and import them into a document, which becomes the skeleton of their plan. By the way, this helps creating such plans "competence first", rather than attaching competences after having defined the plan framework.

Once this operation is complete, the system "knows" the teachers' declarations, and can support them in performing class activity.

In particular, it can assist them preparing activities, which typically span over several hours. They are reminded the competences they declared as a target, and are suggested to plan an activity. A wizard helps in this phase, and requests the teacher to identify sub-competencies related to the activity. An activity usually includes educational resources, which can be accessed over the Internet or through the *eSchooling* repository. New resources added to the repository have some metadata automatically generated from the context, to facilitate future retrieval.

In general an activity ends with an assessment. *eSchooling* knows about the sub-competencies related to the activity (since they were declared in an earlier phase) and proposes rubrics, which are an evaluation technique especially suited for competence evaluation (Goodrich, 1996; Panedero & Jonsson, 2013). These rubrics can be used as they are, or modified by the teacher. Teacher valuation of the rubric is kept in the *eSchooling* databases. (We'll see later how they are used). Standard rubrics favour the comparison between different classes, or even schools: a hot topic today, as shown by the fervent discussion on the Common Core Standards in USA (Porter et al., 2011).

The activity wizard has also some other features worth mentioning: through an association between tools and competences, it can suggest some types of activities, which could be well suited. Also, in the long run, accumulating relations between topics, competences, activities and resources the system could suggest activities performed by other teachers in similar situations. This will promote re-use and allow a personalized adaptation of existing content to meet the teacher's specific requirements. The sharing of contents and learning materials is enabled by a common library with a relatively flexible policy of accessibility levels, that may list and link not only files physically stored in the system library, but also contents (e.g. Open Educational Resources) linked from learning object repositories, tools, web sites, etc.

In order to provide an aid to properly address the students' different learning styles, *eSchooling* presents an experimental feature implementing a functionality to self-evaluate each student learning style according to the Kolb (Kolb, 1985) or Gardner approach (James & Gardner, 1995). It is based on a simple sets set. The vision was that on this basis the system could proactively suggest a set of ready-to-use lesson formats/templates specifically designed to best address the different self-assessed learning styles. The outcome of the Kolb test can be used to stimulate metacognitive reflection in the students (the *eSchooling* performed experiments confirmed the intuition) As far as metacognitive processes are concerned, Kolb test can help to reflect about learning methods (Antonietti et al., 2015) and to know psychological lexicon and theory of mind (Goldstein &Winner, 2012). Also, it may be useful for composing groups (both in the case when one wants homogeneous groups, or balanced ones).

At the time of the final competence balance, the system can automatically provide a "draft" based on the collected evidence. Of course teachers are free to integrate and correct it, but the provided base sensibly cuts the time spent in lengthy meetings.

The data constantly gathered (competence evaluations, performed activities, learning style profiles) become an important asset and an enabler for relevant processes. For instance, since competences are assessed independently by different teachers (since they are transversal, and not linked to a single discipline), it may happen that a student gets discording evaluations on the same competence. In such case, the system proactively solicits and triggers interaction among the involved teachers, indicating the problem. Rather than discovering such discrepancies at the official overall evaluation meetings (at mid year and at the end of the school year), when it would be too late, they are reported immediately, soliciting an interaction among the involved teachers. Such interactions will be face to face, but their results and taken action could be recorded by the system (even though this particular feature was not implemented into the *eSchooling* prototype due to time constraints). This breaks the isolation in which teachers typically work. The system favours hence cross-disciplinary cooperation among teachers and the production, sharing and reuse of educational contents and of best practices.

Evaluation results are reported in various graphs. Radar plots offer simple and easy to understand evidence of competence performance for each pupil and, in aggregated views, for each class or even school. Also the temporal evolution of competence performance can be observed, as well as individual results against the aggregated ones.

This becomes a powerful tool for the various actors. Teachers have quick representation of the results of the activities they perform, but can get a quick idea also of what their colleagues are doing and on how they are evaluating the different competences for the shared pupils/classes.

Students can reason on their individual performance, on their strengths and weaknesses. Unlike in traditional education, where they get aggregate evaluations (such as you're not good at math, but you perform well in history), here they get evaluations, which are decomposed into smaller granularity. Metacognitive reflection on these data, either spontaneous, triggered by discrepancies between self-evaluation and teacher evaluation, or stimulated by the teachers, has a great value and can be the spark for starting an attitude and performance improvement process.

It was planned that families could get access to an easy-to-understand dashboard. Based on the same data, it would allow an early and detailed diagnosis of students' successes or shortcomings, allowing for timely remediation actions if needed. The family module was planned, but not implemented due to a lack of time.

School managers have at hand indicators, which allow them to oversee the students performances at individual and at different aggregation levels, and monitor the adoption of CBE by the teachers, e.g. in terms of use of the proposed competence-model, number of competence evaluations tracked, activities recorded into the system, etc.

In general, having collected data enables using learning analytics techniques, which could even go beyond the scenarios we have envisioned and depicted above.

Discussion

The project was about developing a concept: creating a tool to offer support and stimulus to CBE. The study of the state of affairs in the Italian schools world, the subsequent definition of the requirements took longer than we initially expected. It was however a fruitful work. We were comforted and quite surprised when the European Project Keyconet - Key Competence Network of School Education released, in December 2014, its final recommendations, based on a three years study which involved several European Nations (Looney & Michel, 2014). In fact, the ideas on which *eSchooling* is based turned out to be in a surprisingly excellent accord with Keyconet final recommendations. We extract here some of the most relevant Keyconet statements:

- *"Teachers need to have clear guidelines, access to appropriate tools and materials, and exemplars of effective practice."*

- "*ICT should address both the technical and pedagogical aspects in depth. Investments in research and development as well as in identifying effective support tools will be important.*"

- Among other factors, CBE "*involves:*

    - *A greater emphasis on interactive learning environments, presenting learners with open ended problems and challenges. Learners may debate and test ideas, work in teams, access online platforms for collaboration;*

    - *New approaches to assessment, including classroom-based formative assessment and summative assessments that provide information on learners' understanding of interconnections and processes (rather than fragments of knowledge), or ability to perform complex tasks;*

    - *Relevant use of ICT to support collaborative work, provide access to educational resources, track learner progress and assess higher-order thinking.*"

- "*Teachers are often isolated in their classrooms and have few opportunities to exchange ideas and insights. Teacher networks (…) may support the development of learning communities and may also stimulate innovation.*"

- "*Qualitative and quantitative data on learner and school performance will help school leaders to identify what is working well, and where adjustments may be needed.*"

Also, the *eSchooling* approach turns out to be coherent with most of the educational design principles for CBE, as outlined by Wesselink et al. (2007) and later on Sturing et al. (2011), although at design phase we were not aware of these papers (we found them at a later stage). Some of these principles are:

- the identification of labour market/society relevant competences and representative (vocational) core problems, inherently often multidisciplinary, as a starting point for curriculum design;

- monitoring competence development via ongoing assessment for example by using assessment rubrics;

- designing and learning in authentic learning tasks both in and outside school that integrate knowledge, skills and attitudes;

- stimulating self-reflection and responsibility for students;
- requiring teachers to adopt a variety of teacher roles, that is, the teacher is not only a knowledge expert in a specific discipline, but also a coach of student learning, and, finally, paying explicit attention to a lifelong learning attitude and stimulating learning to learn.

In our opinion, therefore, the *eSchooling* concept is a relevant step ahead in the direction of supporting CBE both through ICT and though a series of processes and a methodology.

A relevant question is: how far was the project actually able to reach its objectives, as far as implementation and user testing is concerned? We try to respond in detail to this question in a companion paper (Mana et al., 2015), which addresses the teachers feedback and the analysis of the system logs.

In summary, we can state that the *eSchooling* software was completed (except some minor portions yet to be implemented, as mentioned in a few passages above), even though the user interface is not as simple, consistent and friendly as we originally wished. It is worth underlying that the objective of the project was to study an innovative ICT solution, to develop and test a significant *prototype*, and to this extent the project objective was fully accomplished).

The project plan included a validation of both the ideas and its implementation. To this aim, the project included a testing phase to be run over an entire school year in 10 high schools, each involving at least two teachers. This was the most difficult and least successful part of the project, for several reasons. Foremost is the fact that testing went on while the system was being developed. The long initial phase delayed the implementation, so when the school year 2014-15 started only the portion dealing with the plan was ready. During the year the other parts followed with subsequent software releases, but this meant that only towards the end of the year (in the last two months) teachers had the full vision of the software capabilities. Although we tried to mitigate the problem by trying to pass to them the overall picture, it was not the same as having the full instrument in place starting from "day one". This is reflected in a low usage of the system, which apart from a small number of notable cases, was essentially accessed to get an idea but not really used. In spite of this, most teachers liked the overall idea, as it turned out from focus groups and interviews. Their high interest is demonstrated by the fact that some schools have decided – as mentioned above – to extend the trial to the next school year (2015/16), so as to have the possibility to try the complete platform with all the teacher of some classes.

Another problem we faced is that some of the teachers were appointed as testers by their school manager, without a real personal drive towards the project, or were participating to

other initiatives, which took most of their available time. Both these categories sooner or later "disappeared" from the test groups.

Also, a mistake was not to create homogeneous context. Having a single teacher, or at most two in a class adopting the *eSchooling* approach defeats at least in part some of the advantages offered by the system, such as automatic notification, interdisciplinary aspects, and even the possibility of harvesting the final competence balance. The reason of our mistake is that originally we tried to involve only Math and Italian Language teachers, as these disciplines are common to all schools (again, the whole competence taxonomy wasn't ready at the beginning).

In essence, we think that the partial failure in having an extensive testing as we originally wished came from the delay in the development of the tool, due to the unexpectedly long initial phase. On the other hand, such phase was absolutely necessary to successfully sharpen the project focus, and we believe that what we consider a real success in terms of developed idea and framework, as we tried to demonstrate above, has its root in the initial detailed and comprehensive analysis.

We also learned that it would be a good idea to have a two-level system, with a very essential interface and guided procedures for novices and/or teachers with a low level of familiarity with ICT technology, which are unfortunately still a relatively high percentage of the total in Italy (Avvisati et al., 2013). A more advanced interface, exposing all the functionalities and giving freedom to expert users for rubrics and model customizations, should be reserved for more ICT-savvy teachers.

Conclusion

We presented the concept developed in the *eSchooling* project, which aims at lowering the barrier that makes it difficult for the teachers to adopt the new CBE paradigm. It helps teachers in making a step-by-step transition to CBE practice. The processes embedded in the ICT tool help teachers to change their Instruction, Learning, and competence Assessment practices and to apply theoretical concepts in their own classrooms by guiding them through the right steps in the right order (i.e., starting with identifying the Key Competences as learning goals, then selecting appropriate learning activities for developing these competences, on-going monitoring of student learning via rubrics, etc.). The system strongly stimulates using ICT for teaching, sharing resources and working in interdisciplinary groups. It also offers them easy opportunities to continuously monitor students' competence development via assessment rubrics and to stimulate students' self-reflection and self-assessment. Such monitoring can be useful for individual teachers, class coordinators and school managers. We showed how the concept is fully in-line with the current mainstream of pedagogical ideas about CBE. We also reported the main shortcomings of the experiment run on the field. From these, and from the overall *eSchooling* experience we learned a lot. In the meantime, the *eSchooling* experience continues with a second experiment and, in parallel, with an

evolution of the *eSchooling* software specially designed for VET end with an emphasis on Problem Based Learning.

Of course, the wide adoption of a CBE approach is a complex political and cultural issue, that *eSchooling* can support and facilitate but that cannot be solved without the commitment of the national school systems and the full engagement of all the teachers.

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