Gauging Teachers' Needs with Regard to Technology-Enhanced Formative Assessment (TEFA) of 21st Century Skills in the Classroom

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Abstract. Several trends in society have led to a request towards schools to integrate 21st Century Skills and technology enhanced formative assessment (TEFA) in their curricula. Although there are frameworks defined at an international level, implementation of technology enhanced formative assessment of 21st century skills at school level is seldom. This paper explores the underlying reasons for this hampered implementation by consulting and collaborating with teachers. It provides an overview of these reasons and proposes a collaborative professionalization approach to overcome detected implementation barriers and challenges.

Keywords: Technology-Enhanced Formative Assessment (TEFA); formative assessment; 21st Century Skills; teacher professionalization

1   Introduction

The fast developments in society imply the necessity of being able to deal with growing complexity, ill-structured problems and with uncertainty about the knowledge and skills needed to function competently. Changing professional and societal demands impact significantly on the requirements for education at all levels. It implies that schools integrate new knowledge and skills in their curricula and have tools to assess them. In this paper we discuss three important trends which should lead to approaches to be used in schools, colleges and universities to facilitate the learning process needed for the development of skills to live, learn and work in society: 1) the proposition of 21st Century Skills, 2) the growing attention for formative assessment and 3) the availability of tools for Technology-enhanced formative assessment. Although the

key competences and the 21st Century Skills are defined and elaborated in several international frameworks, we argue that the link to approaches to implement them is currently missing. Although these are meant to be applied and implemented in each member state, several studies [1][2] mention that, although the competences and skills are seen as important by both policy makers as well as teachers and school managers, few countries have developed implementation plans and assessment policies for them.

In this paper we describe these trends , analyse why implementation at classroom level currently hampers and how implementation could be supported. The analysis is based on Spanish and Dutch data gathered amongst teachers. These data were collected in the context of the PREATY project (**PR**oposing modern **E**-assessment **A**pproaches and **T**ools to **Y**oung and experienced in-service teachers)[1]. This project aims to equip teachers in primary and secondary schools with e-assessment strategies and tools to evaluate a number of key 21st Century Skills and competences. Opposite to the traditional test and output-focussed perspective on assessment, the project pursues to promote assessment for learning, therefore focussing mainly on the formative assessment [4, 5, 6, 7] of these skills. To analyse the reasons for the tardiness of implementation of 21st Century Skills internationally we use a framework developed by Surrey and Ely [3]. They define eight conditions that positively contribute to the implementation of instructional innovations in education:

1. **Dissatisfaction with the status quo**; beliefs on the part of the users (teachers) that things could be better or that others are doing better than themselves. Dissatisfaction can be innate or can be induced by external information about alternatives.
2. **Knowledge and skills exist**; people feel confident to introduce an innovation when they feel competent to do so. A lack of required knowledge and skills lead to immobilization and frustration; training is usually a vital part of innovations.
3. **Availability of resources**; all resources that are required to make the innovation work are provided, e.g. ICT or building infrastructure. Without them the innovation is impossible or reduced.
4. **Availability of time**; (company) time needed to acquire and practice knowledge and skills.
5. **Rewards or incentives**; rewards given for meeting an acceptable standard of performance.
6. **Participation**; the involvement of all stakeholders that are contributing to the process.
7. **Commitment**; evidence of individual support for the innovation
8. **Leadership;** support of different hierarchical levels in the organization

In the rest of the paper we first describe the three trends mentioned. Then we describe empirical results indicative for the level of implementation in schools.

In the concluding section we use the scheme proposed by Surrey and Ely [3] to link the different conditions for and their effect on implementation to the empirical data. The discussion section of the paper contains propositions to improve implementation as we explore them within the PREATY project.

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[1] www.preaty-project.eu

2 Formative assessment and technology-enhanced formative assessment

Assessment is a key aspect in any learning process. Formative assessment contributes to achieve learning goals, due to the feedback and feed-forward information it provides to learners about their performance [4,5,6,7]. Moreover, assessment shapes learning, as students tend to concentrate their efforts on those tasks that have a greater assessment weight or on faults that they made, and assessment promotes students' attitudes towards learning, as well as the tactics they employ [8]. In response to this, authentic evaluation approaches emphasize the alignment between learning goals, application contexts and assessment criteria, as well as in the participation of the students in continuous assessment processes [9].

As with almost any activity in our lives, ICT has the potential to support and enhance assessment processes. This support goes beyond the first approaches to the use of ICT technologies to perform on-line tests. The Joint Information Systems Committee defined a broad concept of e-assessment as any electronic process in which ICT is used to present and perform tasks and activities related to assessment, from the perspective of any of the possible stakeholders: learners, tutors, institutions or the general public [10]. This wider concept of e-assessment leaves more space for benefiting from the potential advantages that the use of ICT may pose. As pointed out previously by the authors [11], these benefits range from a larger control on learning by the involved actors, to an improvement of the feedback quality and motivation of the learners. Besides, technology can track, store, process and visualize learners' results and actions, making these processes visible and available for different learning purposes, and more concretely for formative assessment. It also offers opportunities to differentiate amongst learners. Technology can furthermore help to shape learning scenarios with varied authentic assessment designs [18], enabling formative assessment of both products and processes learners produced and experienced.

From this broad perspective, different approaches for the use of technology to support assessment can be identified. One of them is adapting off-the-shelf tools to the needs of a particular assessment process, like the use of spreadsheets to record and calculate grades, or questionnaire-management tools to present different types of tests to students. However, this approach leaves the effort to adapt the tool to their needs in the hands of teachers. A second approach is the provision of tools designed to support specific assessment methods, and that try to implement the principles of these approaches to make them more accessible to their users (teachers, learners, etc.). In the PREATY project we focused on tools for e-Portfolios, learning analytics, enriched rubrics, and self- and peer-assessment [12]. We chose these assessment methods and tools because they are well suited for the provision of enriched feedback, making them suitable for the formative assessment of 21st Century Skills.

We carried out a survey focused on tools supporting the aforementioned assessment methods, evaluating them on criteria deemed necessary for implementation within schools [12]. This analysis showed a wide number of tools in the different categories. However, the current offer of tools did not fulfil the needs of primary and secondary school teachers and schools necessary for implementation. Most of the

reviewed tools, especially those related to Learning Analytics, are still only for researchers and positioned mostly in higher educational settings. They are potentially applicable in secondary school contexts, but it is quite difficult to make a translation towards primary schools. Moreover, they do not (yet) provide integrated environments with a usable interface. Many of the tools are at a prototype or piloting stage. Those in that situation do not provide enough stability for implementation in schools. Others are the result of research projects, which have failed to get the necessary continuation after the project lifespan. They currently lack technical support and an active community of users, which is an important drawback for application in school practices. Language is also a barrier. Since most of the reviewed tools are in English, they are not appropriate for their use in schooling contexts where English is not a native language. Exceptions are classes implementing bilingual models, international schools or those oriented to teach English as a foreign language learning.

In summary, the tools that are currently offered to support assessment methods were found to be not fully appropriate for use by primary and (partially) by secondary school teachers.

3   21st Century Skills

The need to specifically define 21st century skills is related to changing societal requirements both in terms of knowledge and cognition. But at least as important are the skills that go along with cognition, namely those needed to cope with changes and to be and stay motivated to learn. Several initiatives exist where groups of experts developed lists of competences deemed to be important for coping with the societal changes. Obviously technological-related skills, such as digital or media literacy, are represented in every list, but these skills go along with skills such as being able to collaborate, being creative, critical, self-regulative etc. Two of the most known of these lists are the key competences formulated by the European union and the 21st Century Skills formulated by a business consortium [16,17]. Both the key competences and the 21st Century Skills in these lists are formulated at a general and abstract level, although their aim is to be applied in (national) contexts and to be implemented within school curricula. However, it seems that the leap from the European to the class level is too big to allow for proper operationalization and hence implementation. That means that the skills as they are formulated do not define learning outcomes or levels of performance related to the targeted educational levels (yet). The EU key competencies are: 1) communication in the mother tongue; 2) communication in foreign languages; 3) mathematical competence and basic competences in science and technology; 4) digital competence; 5) learning to learn; 6) social and civic competences; 7) sense of initiative and entrepreneurship; 8) cultural awareness and expression [16]. The list of 21st Century Skills developed by the business consortium (sponsored by Cisco, Intel and Microsoft) covers 4 domains: 1)Ways of thinking - Creativity, critical thinking, problem-solving, decision-making and learning; 2) Ways of working - Communication and collaboration; 3) Tools for working - Information and communications technology (ICT) and information literacy; 4) Skills for living in the

world - Citizenship, life and career, and personal and social responsibility [17]. These lists with key competences are partially complementary and partly overlapping.

Several studies [1][2] mention that, although the competences are seen as important, few or none of the countries have developed clear assessment policies for them. This can easily be understood, as different contexts and constellations of national issues and priorities could define other clusters of competencies as the most important ones. Overall, it seems not yet clear whether all 21st skills should be addressed and are suitable to be taken up by primary and secondary schools and if so, how (a selection of) 21st century skills should be interwoven in the consecutive curricula of primary and secondary schools and enacted in classroom practice.

4 Working together on the integration of formative assessment and 21st Century Skills

The analysis of teachers' perceptions and needs regarding the formative assessment of 21st Century Skills is a complex endeavour, which depends on institutional, school, and personal conditions. Besides this, we have shown in the previous section that the gap between existing frameworks and implementation in educational practice still needs to be bridged. We here describe the results of two approaches adopted within the Preaty project to initiate a translation towards school practices: 1) Gauging teacher needs beforehand, to inform the development of professionalization initiatives around TEFA and 21st century skills. 2) Collaborate with teachers in workshops towards translations suitable for their practice.

4.1 Gauging teachers needs to inform professionalization initiatives in the Netherlands

The Dutch partner employs various means to gauge the need of primary and secondary teachers, such as document analysis, individual and group interviews. In this paper the focus is on the results of a chat log analysis to gain insight in teachers' needs.

Foundation Kennisnet held an online seminar about 21st Century Skills[2] and how to make them explicit in education, in which various models of 21st Century Skills, reasons and manners to make them explicit and some example implementation projects were shown. During this seminar Dutch participants could discuss presented topics in a chat log. We asked Kennisnet permission to analyse this discussion, to acquire insight in participants' needs with regard to 21st Century Skills and current issues regarding implementation (such as suitable learning activities, assessment practices, technology use) in school practice. 37 seminar participants participated actively

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[2] Kennisnet is the public ICT partner for education in the Netherland, providing advice on the use and implementation of ICT s for primary, secondary and vocational education. See seminar (March 2014): http://www.youtube.com/watch?v=cYyZ3UkspyI&list=PLQI9hXCcoK1QZARMTuQ5YJTgWIYJGcQDg

in the chat, this group mainly consisting of teachers in various educational contexts, next to educational consultants and researchers. They created in total 443 text entries, which were processed anonymously. Entries which were not directly related to the content of the seminar (e.g. more practical, technical and social entries) were filtered out. The remaining 250 entries were then analysed by means of qualitative content analysis. All entries were read and re-read, a coding scheme was derived bottom-up from the chat-log content and the entries were then tagged with the coding scheme. Each entry could be labelled with multiple labels. Table 1 provides an overview of the labels derived from the chat-log entries and their definition, the label frequency as well as some example entries (in *italic*), to provide further insight in the nature of the discussion.

Label and description	Label Freq.
Implementation: Remarks about how to implement 21st Century Skills at classroom/school level, mentioning the following aspects: - **how to implement relevant learning activities**: learning activities specified top-down based on specified programmes for (integrated/specific) 21st century skills or bottom-up by means of teacher-designed learning activities; potential benefits and role of ICT in implementating 21st century skills. E.g.*: "when children would get more digital instruction the teacher saves time which can be used to support acquisition of new skills"* - **how to approach implementation**: at what level (at national, school or individual teacher level), how to gain commitment amongst teachers. E.g.*: "could implementation of 21st Century Skills happen at individual [teacher] level or can it only happen at large scale?"; "search for well underpinned information on which means/methods are most effective compared to only instructing. Not a single teacher would object to a means to help their pupils learn in the best way* - **preconditions** (and their relations) for implementation. E.g.*:" think of '4 in balans"[a dutch model for ICT implementation at school level with 4 factors]* - **time and planning issues** (estimation of implementation trajectory, time needed for acceptance of 21st skills approaches in schools, how to use time effectively). E.g.*:"what is the time line to accept the concept of 21st Century Skills as a familiar concept within education?"*	86
Understanding and conceptualization of 21st Century Skills: Remarks about : - **definition, models, background/origin, nature, positioning and critics** of 21st Century Skills. E.g.*: "on their own these skills already counted in the 20th century (think about all 'innovative schools'). To me the ICT component provides another perspective with regards to pace, scale and organization";"aim of ATCS21 (Microsoft, Intel, Cisco)is to integrate a lot of ICT within education, and their first strategy is to do so with digital tests and assessments (where in the Netherlands Cito is already busy with). I find this a dangerous development."* - **relations between and stress on skills:** which skills are currently stressed/included and which not, how do the skills relate. E.g.*: "21st Century Skills spans more than just media literacy"*	57

Teacher skills, attitude and professionalization: Remarks about the knowledge, skills and attitude that teachers need to have or acquire in order to be able to implement 21st Century Skills in their classroom. E.g.*: "I think something proceeds this, namely the sense of why you would like to do it [teaching] differently (= attitude)";"do we, teachers, actually have these skills ourselves? To say it with other words, how can you teach pupils something, that you don't master yourself?";"kids need to learn how to solve problems, teachers need to learn to leave this to the kids";" many teachers lack knowledge about the digital world"*	39
Relations between 21st Century Skills and curriculum/content/domain: Remarks on: - whether **skills can be learned separately from content** or whether they should be learned interactively/combined with content and with each other. - whether **skills are transferable from one domain** to another or domain-dependant. E.g.*: "these 21st Century Skills are typically presented if they are not about any content. That's quite interesting, as education is just about content."; "several skills, like research skills and collaboration, are definitely not domain specific";" domain specific content can as well stay like it is, skills are just another didactic approach"*	34
Outcomes/output: Remarks on the objectives and potential results of introducing 21st Century Skills in schools. E.g.*:" are there already objectives that need to be reached by education?"; "are these objectives smart [specific, measurable, acceptable, reachable, time specific] ?"; "core learning objectives are also well achievable by means of different didactics. That we already know decennia from research. Think for example about collaborative learning"*	32
Good practice, examples and guidelines: References to good practices, examples, thoughts, guidelines and tips that are usable or provide background and inspiration for implementing 21st skills. E.g.: *"I lately bumped into the initiative www.jeelo.nl, interesting and 21st century... project-oriented learning"*	31
Policy: Remarks on decisions and developments around 21st Century Skills at policy level. E.g.: *"From the ministry of education and the curriculum institute nothing is fixed yet, isn't it? Differently than in Flanders where by means of the diamant-model several core competences (that show a large overlap with the skills) are in the curriculum"*	26
Assessment: Remarks on objectives, methods of and issues around (formative and summative) assessment of 21st Century Skills. E.g.: *"are there already tools or instruments available that can measure the 21st Century Skills of pupils/schools?";"measuring is from the old paradigm. We have to think how learners can picture/capture their own development. This goes more towards portfolio learning"; "to me it appears useful to assess the state of affairs, so that you can undertake goal-oriented interventions and adapt your teaching. If this is possible with a portfolio it is fine, but then still you need to analyse*	22

it"	
Target group: Remarks on 21st Century Skills in relation to a specific target group. E.g.:*I do see many programmes in media literacy for primary education, but not for secondary education!"; "in secondary education it is mainly about learning pupils to recognize self-regulation and that in the long term they can manage this themselves"*	21
Tools/instruments: Remarks on concrete (ICT) tools or instruments that support teachers, students and schools to (start to) work with 21st Century Skills. E.g.: *"maybe a Kijkwijzer (observation indicators/pointer checklist) is a good way to support teachers, but that you further assess pupils by means of a portfolio and competences"*	18
Research: Remarks on scientific research around 21st Century Skills. E.g.: *"is there any sound research about 21st Century Skills available?"*	12
School management: Remarks on the contribution at school management level with regards to introducing 21st Century Skills in schools. E.g.: *"what does it mean as a manager for policy and team development?"*	12

Table 1. Overview results qualitative analysis of chat log about 21st Century Skills and how to make them explicit in education.

Looking at the most mentioned themes we can see that that the participants are, mostly at an individual level, struggling to make sense of 21st Century Skills and how to implement them in their classroom. They state that there are no clear national agreements, policies, guidelines and frameworks (yet) that can be used to guide their implementation at school curriculum level. It is for example unclear whether 21st Century Skills should be taught in combination with domain-related content and learned 'on the fly' or whether they should be taught, practiced, stressed and evaluated more extensively and expressively. Although teachers foresee a role for ICT to support and enable implementation of 21st Century Skills, next to being part of one of the skills in itself, it is not clear what use would be most beneficial. Teachers also wonder whether they have the required competences to guide the introduction and implementation of 21st Century Skills in their class, especially with regards to the ICT componetn. Also the manner to look upon assessment of the 21st skills, e.g. in a (combination of a) formative or summative way, is yet to be defined, still even at a conceptual level. In short, teachers and schools are still in a searching and explorative phase with regards to 21st Century Skills implementation.

4.2 Collaborating with teachers to translate the needs to their practice in Spain

The Spanish partner designed and set up two teacher training workshops. The first

workshop (WS1) was conducted at a primary school reckoned for its innovative character, especially regarding the integration of ICT in their classes [13]. The 25 participant teachers attended the workshop in the context of the continuous formative assessment plan of the school. Therefore, they did not volunteer to assist to this workshop. The second workshop (WS2) was organized at the University stances. Seven primary school teachers volunteered to assist to the three sessions, which were organized right after WS1 had finished. The goal of these workshops was to offer teachers conceptual and practical tools that enabled them to reflect on their assessment practices, show them procedures to integrate the assessment of competences, and eventually, help them apply e-assessment approaches presented at the workshop in their practice.

Evaluation instruments and methods

The workshops provided valuable initial evidence about teachers' needs regarding the assessment of 21st Century Skills, and the role that ICT tools can play to support them. The evaluation instruments and methods used were initial and final questionnaires, observations and group discussions (see Table 2):

	Workshop 1	Workshop 2
Initial questionnaire	[Init-Quest-WS1]	[Init-Quest-WS2]
Formal observations	[Obs1-WS1] [Obs2-WS1] [Obs3-WS1]	[Obs1-WS2] [Obs2-WS2] [Obs3-WS2]
Final discussion	[Diss-WS1]	[Diss-WS2]
Final questionnaire	[Final-Quest-WS1]	[Final-Quest-WS2]

Table 2. Instruments and methods used to collect data in the Spanish workshops, with the labels used to refer to them.

Like every needs analysis also this one has limitations. As mentioned beforehand, we adapted the pace and content of the sessions to the needs of the participants, which were not always relevant to our research goals. Time restrictions were also strong. An example of this is the short time we could devote to the final discussions, due to the time we had to dedicate to previous activities. In response to this limitation, we plan to complete the data-gathering phase by organizing further group discussions with a selection of teachers.

Findings
The first two issues we had to face while designing the workshops were related with how to present the participants methods for the integration of 21st Century Skills in the curriculum, and the selection of the most appropriate e-assessment methods and tools to present at the workshops.

The integration of 21st Century Skills into the curriculum of Primary schools in Spain has not been sufficiently developed at the official level. In spite of some efforts

[14], teachers have not received sufficient directions about how to integrate these skills in the curriculum, even less about how to assess them. There are very few examples of schools that have carried out this endeavour [15]. While designing the workshops we used the experience of a secondary school teacher as an example. He is an active innovator himself, who had already faced this problem, and had a vast experience as trainer in teacher workshops. He had designed a process that defined how to map these competencies to assessment criteria, and how to include them in the learning activities proposed in his classes (supported or not by technology). At the workshops he explained his experience and how he had managed to bridge the competencies with assessment criteria, and these with the learning activities. Then, the participant teachers were asked to fulfil an activity plan where they could put in practice these procedures.

It turned out that the intervention of this teacher was one of the most valued aspects of the workshop, as recognized in the final evaluation questionnaire (“*I appreciate that everything was based on the experience of a colleague that has already applied it*” [Final-Quest-WS1]. However, being a secondary school teacher, some participants still questioned whether the examples where applicable to their classes. (“*The assessment instruments are too detailed for the application I foresee in the classroom*” [Diss-WS1]; “*Time in classes is very limited, we do not have time inside or outside the class to reflect on the students' advancement*” (this is related to the formative evaluation) [Obs3-WS1]. This calls clearly for the need of documenting yet more meaningful examples, and to the need of adapting the assessment criteria to match the context of primary school teachers.

The process of assessing competencies requires tools that support teachers in the creation of instruments that operationalize the assessment criteria (control lists, rubrics, etc.). The e-assessment approach that best matches this need are electronic rubrics, and therefore, we focused the workshop on this approach.

We chose Evalcomix[3] out of six other tools that had been analysed previously in the context of the Preaty project [12]. Evalcomix was selected based on a set of criteria referring to the usability, stability, support, language, price, user-friendliness and integration in a VLE. Regarding this last criterion, the teachers in the workshop demanded a tool that could be integrated in Moodle, which was their institutional VLE [Init-Quest-1]. Evalcomix supports the design and management of assessment instruments, such as checklists, rating scales and rubrics. It offers English and Spanish versions, and can be integrated in a VLE (Moodle or LAMS) to assess learning activities. The fact that teachers in this school already used Moodle for their lessons added potential value to the choice of Evalcomix. At the workshops, it was employed to show the participant teachers how to define and apply a checklist, a rating scale and a rubric. The participants worked on assessment criteria defined in a previous activity, and used these and the tool to develop assessment instruments.

However, and in spite of the fact that Evalcomix complied with the selection criteria listed above, it showed important limitations for its use by the primary school

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[3] http://evalcomix.uca.es/

teachers. As noted by one of the teachers in the final questionnaire *"The product itself, Evalcomix, needs to be improved. These improvements should be done in two directions: on the one hand, making all the system more intuitive, it should not require more than 10 minutes to learn; on the other hand, the labels should go hand in hand with the (educational) design, words like "attributes" are not in our teachers vocabulary"* [Final-Quest-WS1]. Another teacher in the second workshop raised the question of what was the benefit of using Evalcomix instead of another off-the-shelf tool, such as Google Forms. In the discussion that followed this comment it was agreed that these tools are useful if integrated in a VLE used by the students (not only by teachers, as it is the case in many primary schools) [Obs2-WS2]. In fact, Evalcomix only exploits its full potential in complex evaluation processes, involving not only the teacher but also the students, in peer-assessment and self-assessment. These approaches to assessment are not normally used, especially at the first courses (*"The main problem for us as primary school teachers, is ... that the students cannot use the resources autonomously due to their age"*; *"The lower levels (referring to 6- and 7-years old) are not able to create their own resources"* [Obs2-WS2].

Of course, technology itself is still seen as an obstacle (*"We cannot depend on technology (it may happen that the connection does not work, and my computer is very slow"*) [Obs3-WS1]. When asked about which were the main problems to adopt the approaches studied in the workshop, two groups of teachers pointed out this issue: *"Internet access and the command of computer and technical issues"* [Diss-WS2], *"[the main problem is] The lack of technological resources in the school, the fact that we sometimes do not know how to use them ..."* [Diss-WS2]. In fact, we experienced this kind of technological hazard in the first workshop, the one run at the primary school instances. Several issues related to the configuration of the lab, and of the access to the Moodle server used for the course, caused us many problems *"We have dedicated 5-6 minutes to explain them how to enrol in the new course"*, *"The server* [where the Moodle course with Evalcomix is installed] *breaks down. We try to export the instruments to import them later on, and it does not work either. I phone B. [in charge of the unit that runs the Moodle server] to get a number to call to"*; *"We are obliged to finish the session now* [15 minutes before expected]*"* [Obs2-WS1]. As mentioned beforehand, this happened in a school that has been acknowledged to have the highest level of ICT-integration[4]. Schools need more reliable resources to enable a more natural use of technology.

Some teachers expressed their concerns that these methods require them to be in front of the computer all the time [Obs3-WS1], which is not the way they usually work. Therefore, an issue for further reflection is to see whether current ICT-based assessment methods are of value for these classrooms, which are not (yet) implementing the one-to-one computing paradigm. In these contexts, most of the activity is still

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[4]   The Regional Administration of Education in Castilla y León has established a 5-level certification system to determine the quality of the integration of ICT at schools. This accreditation takes into account the use of ICT according to the resources available, the quality of the didactic proposals put in practice, and the permanent teacher training proposals accomplished in the school

done off-line, with no intervention of computers, and therefore, the role of ICT-based tools is restricted.

In spite of the limitations observed, the teachers also envisioned some of the potential advantages of these approaches. Interestingly, they stated that they are appropriate to assess group learning (The answered "*To assess group learning*" to the question about which possibilities they saw for these methods and tools) [Obs3-WS1, Diss-WS2]. They saw the potential provided by this kind of systems to share evaluation instruments ("*These instruments can be useful to share with other colleagues*") [Obs3-WS1-3], although, as noted by one participant, "*it is difficult to reach consensus about the indicators with the rest of the teachers*" [Diss-WS2]. Some teachers noted the potential for reutilization ("*It takes time to elaborate them, but it is worthy at mid-term. It can be applied in multiple occasions with slight modifications*") [Diss-WS2].

5 Conclusions

Holding the results of the two studies presented against the Surrey and Ely model with eight conditions (C's) that positively influence implementation of innovations in education [3] we can draw several conclusions regarding what is possible to advance implementation. We see that teachers do in fact **experience a sense of urgency and dissatisfaction** (C1) with the status quo. Many are at an individual level wrestling with the question 'How can I implement 21st Century Skills in my classroom?'. However, this urgency seems to be mainly caused by external factors (namely due to policy and societal influence) to do something with 21st Century Skills in their classroom, and it is yet unclear whether teachers are in fact at an individual level **committed** (C7) to the introduction of 21st Century Skills in their classroom.

Apparently, teachers currently experience that **the basic conditions and resources** (C3) for implementation are lacking or insufficient and the overall guidelines for implementation are absent or vague. No practical, implementable educational models, methods, assessment indicators and instruments, ICT-tools or guidelines were supplied with the frameworks for 21st Century Skills to make the process of implementing learning activities and assessment practices straightforward. Teachers experience this lack of educational methods as a drawback, although they are actively searching themselves for good practices, tools and instruments that they could use. Lack of clarity about implementation is also related to uncertainty about the definition of skills. The lists of skills are not recognized as new or as indispensable for students to learn, except for the realization that ICT is an integral part of being competent in the skills. Although they do realise that it is important to have instruments to assess the skills, no relation is made with technology-enhanced formative assessment as a new pedagogical approach that can contribute to implementation of 21st century skills. Also the trouble-free use of the ICT-infrastructure at primary and secondary schools (e.g. in terms of secure and stable wireless network access, sufficient number of devices for a 1-to-1 computing approach, the connection with an overarching Virtual

Learning Environment (VLE) and the use of a VLE by both teachers and learners) cannot be taken for granted when introducing TEFA for 21st Century Skills.

Teachers are also unsure about their own **knowledge and skills** (C2) and especially outspoken towards the lack of ICT skills; here the duality between their own lack of skillfulness and the need to train students in this field continues to exist. In addition, they do not experience sufficient participation and leadership by either the ministry nor by school management (C6 and C8). In both studies nothing was mentioned with regard to the **availability of time** (C4) to acquire knowledge and skills and available **rewards or incentives** (C5) for teachers.

Despite the detected conceptual and practical challenges teachers stills see the advantage of integrating 21st Century Skills in their classroom practice and at curriculum level. However, they feel that they need to be facilitated on a more practically oriented level to achieve this in the future. Based on these findings, the Preaty project adopts the following approach to support the implementation of 21st Century Skills with technology enhanced formative assessment at classroom level in primary and secondary schools:

— a collaboration/'joint venture' developmental approach with teachers, by means of collaborative professionalization, to develop a translation from overarching frameworks towards practically implementable solutions and to gain further insight in their commitment at individual level. This approach should also result in further exploring and intertwining 21st century skills and formative assessment approaches and the use of technology to support and enhance formative assessment practices in schools.

— using formats that connect to and elaborate upon a teachers' experience, that provide tips and guidelines for implementing them in classroom practice, that highlight potential practical benefits (such as sharing with teachers and re-utalization) and that stimulate teachers' own reflection on their practice (e.g. by (multi-media) story-telling of other teachers' experiences and problems, concrete lessons or good practices and case descriptions of schools).

6 References

1. Ananiadou, K., Claro, M. (2009). "21st Century Skills and Competences for New Millennium Learners in OECD Countries", OECD Education Working Papers, No. 41, OECD Publishing. doi: 10.1787/21852526115
2. Gordon, J., Halasz, G., Krawczyk, M., Leney, T., Michel, A., & Pepper, D. (2009). Key competences in Europe: Opening doors for lifelong learners across the school curriculum and teacher education (pp. 1–328). Warsaw, Poland. Retrieved from http://ec.europa.eu/education/more-information/doc/keyreport_en.pdf

3. Surry, D. W., & Ely, D. P. (2007). Adoption, diffusion, implementation, and institutionalization of instructional innovations. In: R. A. Reiser, & J. V. Dempsey (Eds.), *Trends and Issues in Instructional Design and Technology* (2nd ed.) (pp. 104-111). Upper Saddle River, NJ: Pearson Prentice Hall

4. Busuttil-Reynaud, G. Winkley, J. : JISC e-Assessment Glossary, Bristol (2006)

5. JISC: Effective Assessment in a Digital Age. A guide to technology-enhanced assessment and feedback. Bristol (2010)

6. Black, P.J. Wiliam, D.: *Developing the theory of formative assessment.* Educational Assessment, Evaluation and Accountability (formerly the Journal of Personal Evaluation in Education), 21 (1). 5-31 (2009)

7. Wiliam, D., Thompson, M.: Integrating assessment with instruction: What will it take to make it work? In: Dwyer, C.A. (ed.) The future of assessment: Shaping teaching and learning, pp. 53–82. Mahwah, NJ: Erlbaum (2007)

8. Chan, C.C.K, van Aalst, J.: Learning, assessment and collaboration in computer supported environments. In: Dillenbourg, P. (Series ed.), Strijbos, J. W., Kirschner, P. A., Martens, R. L. (Vol. eds.), Computer-supported collaborative learning: vol. 3, What we know about CSCL: And implementing it in higher education, pp. 87–112. Kluwer Academic Publishers, Boston, MA, (2004)

9. Gulikers, J.T.M., Bastiaens, T. J., Kirschner, P.A.,: A five-dimensional framework for authentic assessment. Educational Technology Research and Development, 52(3), pp. 67-85. (2004).

10. JISC: Effective Practice in e-Assessment. An overview of technologies, policies and practice in further and higher education, Bristol (2007)

11. Rusman, E., Boon, J., Martínez-Monés, A., Rodríguez-Triana, M. J., & Retalis, S. (2013). Towards the Use of New Methods for Formative e-Assessment of 21st Century Skills in Schools. In Technology Enhanced Formative Assessment (TEFA) workshop (http://www.kbs.uni-hannover.de/fileadmin/institut/pdf/TEFA2013-Paper_1_Rusman-et_al.pdf) at EC-TEL 2013 (http://www.ec-tel.eu/index.php). September, 17-21, 2013, Paphos, Cyprus

12. PREATY project: D1.1.:State of the art report on modern assessment approaches and tools. Public deliverable (2013)

13. Prieto, L.P., Villagrá-Sobrino, S., Jorrín-Abellán, I.M., Martínez-Monés, A., Dimitriadis, Y.: Recurrent routines: Analyzing and supporting orchestration in technology-enhanced primary classrooms, Computers & Education, 57(1), pp. 1214-1227, (2011)

14. CNIIE, Guía para la formación en centros sobre las competencias básicas (in Spanish) (2013)

15. Atlántida project: http://www.proyectoatlantida.net/ (2014) Last access: 27/03/2014.

16. European Communities. (2007). *Key Competences for Lifelong Learning - A European Framework.* Luxembourg

17. Binkley, M., Erstad, O. et al. (2012). *Defining Twenty-First Century Skills.* In: P. Griffin, B.McGaw & E. Care (Eds.). Assessment and Teaching of 21st Century Skills, pp 17-66. Dordrecht: Springer. ISBN 978-94-007-2323-8 e-ISBN 978-94-007-2324-5, DOI 10.1007/978-94-007-2324-5

18. Whitelock, D. (2010). Activating Assessment for Learning: are we on the way with Web 2.0? In M.J.W. Lee & C. McLoughlin (Eds.) Web 2.0-Based E-Learning: Applying Social Informatics for Tertiary Teaching. IGI Global.