Teaching and Learning in the Cloud

Cloud based teaching and learning in rural schools

RURALSCHOOLCLOUD PROJECT

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1. Introduction

This handbook provides information on an innovative educational project carried out in 12 European rural schools, ranging from Kindergarten to upper secondary. In the schools, a combination of learning strategies were supported by a range of technology based approaches to provide rich, cost-effective solutions adapted to the needs of isolated rural schools across Europe. The project is called the **Rural School Cloud**.

The project tested the use of technology such as cloud computing, open source software and mobile devices to support project based, student centred, collaborative learning in schools.

This handbook also describes the educational and technological elements that were used, as well as the lessons learned, the impacts on the participants, and the possibilities for further development. It aims to be a practical guide to support the implementation and development of this approach in other rural or dispersed networks of schools.

Many European regions, due to their geography and history, are characterised by the high numbers of scattered and sometimes isolated communities with very small populations. Typically these will include rural, mountain or island communities.

Member states, regional and local education authorities have placed emphasis on providing access to the Internet and digital technologies as well as bridging the digital literacy gap for schools facing particular challenges, such as isolated rural schools.

National and regional educational administrations provide different solutions to ensure the right of all children from these areas to attend school and get the best education services possible. In some cases, this has meant requiring students to travel every day to larger towns or centres in order to attend school. In others, small, isolated local schools have been maintained with few students.

More than 14.4 million children of compulsory education age live in rural areas in Europe. These rural communities are given special protection in many areas of Europe, and one of the keys to this lies on the maintenance of basic services, such as education. Keeping children in local schools, at least in early schooling, assures a necessary bond between children and their home communities and help keep the rural communities alive and vibrant. This type of school, however, usually requires additional financial support from national or regional educational administrations. Due to the smaller number of children at each school, it is a challenge for educational administrations to provide a quality, rich and sustainable educational service for rural communities, within existing education budgets.

The **Rural School Cloud** project envisioned a high-quality ICT based solution to enhance the quality of school networking, teaching and learning and to reinforce the European dimension of school education. The project aimed to provide ICT learning opportunities for students, and training for teachers in small, isolated schools. The focus on developing training for teachers was to support the development and retention of professionals working in rural and isolated schools.

The project also focused on providing an active ICT based learning community for rural schoolteachers, to help them develop teachers' skills and implement appropriate methodologies.

Researchers in rural education agree that this type of school requires specific training for teachers to be able to cope with groupings of students of different ages and attainment, to maximise the opportunities for personalized education, and to enable the use of ICT for differentiation in classrooms. ICT is a key to providing support, training and collaboration opportunities among rural education teachers, enabling them to develop their careers and improve their daily teaching, and the outcomes for their students.

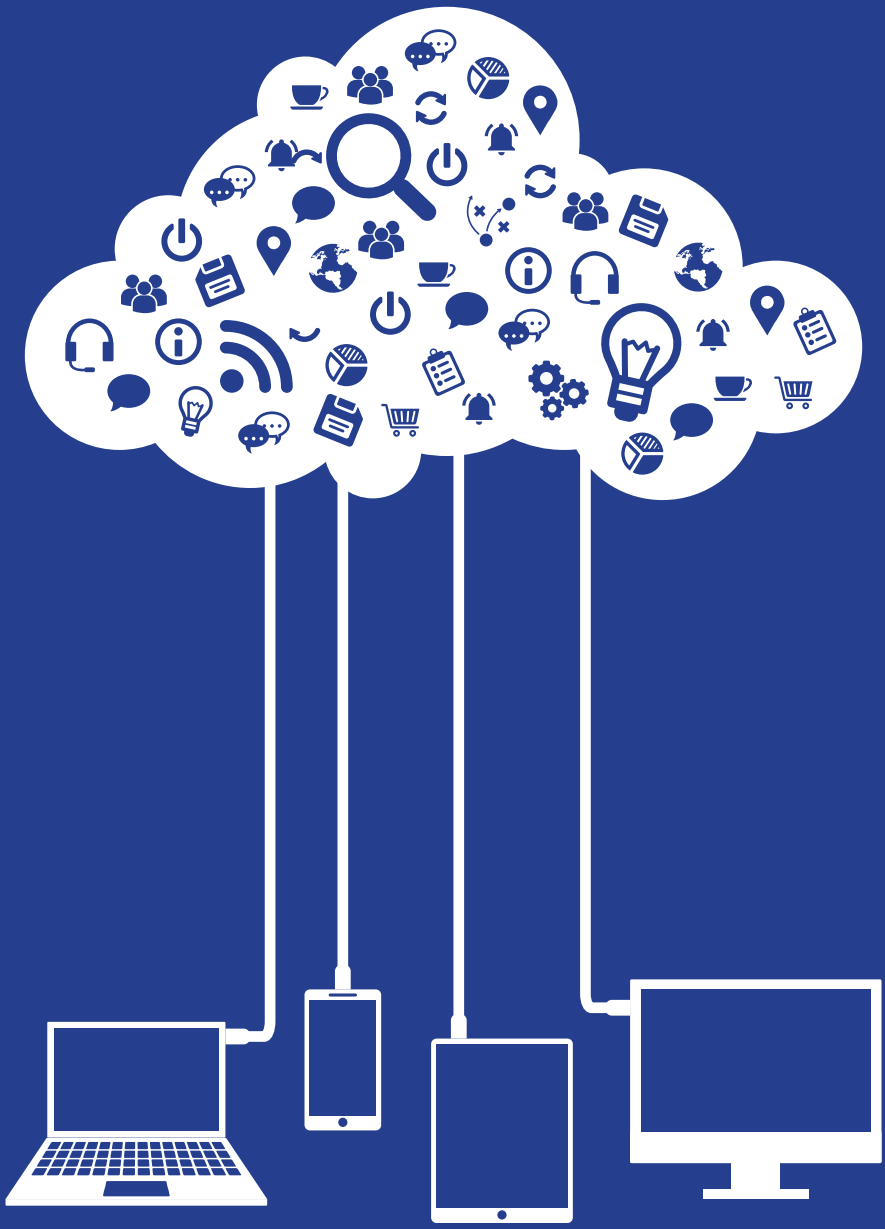
The Rural School Cloud project was born out of previous experiences in the field of ICT and education in rural and island schools from three of the partners.

1. In Galicia, Spain, CESGA had started a promising R+D pilot project in 2010 that ended in a successful implementation of an innovative ICT solution for Galician rural school networks in 2012. This was done with the collaboration of ICT Company Balidea, the Ministry of Education and ICT office from the Galician government, named "Rede de Escolas na Nube" (www.escolasnanube.net).

2. Between 2010- 2011 Danish island schools were also, involved in an ICT specific program "Interactive distance learning and distance learning - Web-based collaboration between primary island Schools". A project aimed at providing ICT resources to improve communication and resources (Nielsen & Christensen 2011).

3. The Italian Scuola@Appenino project, which was implemented in all rural schools in Emilia-Romagna region, provided the schools with teacher training and new equipment including tablets, interactive boards and laptops (http://scuola.regione.emilia-romagna.it/).

All three projects provided a valuable base to support the development of the **Rural School Cloud**.



2. What is cloud computing?

Developments in technology always create new opportunities for teaching and learning. Changes today are rapid and global. Developments in ICT frequently introduces education changes, which impact on teaching methods and tools and create new learning opportunities (Christensen, et. al., 2008). The use of ICT becomes more systematic and impacts in all areas of the everyday school operation.

The emergence of cloud computing is such a case. It appeared in the last decade and it is still evolving. It concerns a brand new way of allocating computer resources (e.g. digital space and computing time), and also of converging information infrastructures, with the aim of homogeneous economies of scale (NIST, 2011). At the beginning, it was based on proposals of companies that make extensive use of Internet services (Amazon, 2006). But the increase in wired and wireless connections, Internet speeds (download and upload) and home based end users gave cloud computing a decisive boost. The existence of the cloud can facilitate cooperation, minimize the cost and speed of information retrieval, and lead to the development of ubiquitous learning environments. Inside these environments, users can have access to huge digital repositories and interact with others using rich information flows (Jones & Jo, 2004). Transposing the basic information processing operations to a remote, common platform, where anyone can easily log on, using any fixed or mobile device, makes all tasks faster and more efficient.

To generalise, **cloud computing** is an Internet "metaphor". Inside it, big computation "farms" are hosted, serving a variety of users and business operations (Armbrust et. al., 2010). Cloud resources are distributed worldwide in these 'farms'. The computational power is therefore available to all who have access. For most applications, the interface is a single window of a web browser. So cloud computing offers the advantages of mobility, collaboration and computational outsourcing.

Some of the well-known cloud computing services belong to large IT companies. Microsoft has implemented OneDrive, offering large amounts of Gigabyte space to its clients free of charge. Google has embedded in its cloud platform a variety of software programs that enable users build anything from simple websites to advanced data management systems. Amazon Web Services also offers a range of services in the cloud. These are just a few examples of the cloud services that are available from many other competing providers.

In an educational context the cloud has the potential to create virtual, pervasive environments, support the development of learning, student portfolios and information repositories, provide supercomputer-like resources and help the convergence of digital devices (Chen et. al., 2008). At the same time, there are a considerable number of issues that need to be addressed as cloud computing develops. Some of these issues include user safety, security, anonymity and confidentiality of information in the cloud.

3. Cloud computing in school. Why is it needed?

Why is cloud computing in education needed? What does it add to traditional designs?

The **Rural School Cloud** project aims to develop teaching & learning in rural and isolated areas. The digital empowerment of the population in rural areas is a priority for most European countries (OECD, 2009; OECD 2011).

By integrating cloud based ICT tools in educational designs, students in isolated rural areas are able to access to the same resources and information available to students elsewhere. In this project, cloud based ICT tools can be thought of as resources to enhance equality and reduce the gap between the well-resourced and developed urban and the isolated rural school environments.

The changing culture and society of the 21st century

It is important to consider the ways in which culture and society has changed in the 21st century and the challenges that this poses for the education of children and young people.

The dominance of books and the written word is being challenged by other visual media. People increasingly access information about the world through digital media rather than through newspapers or books. At the same time we produce an ever increasing amount of user generated text in our everyday life through social media. Those texts are increasingly multimodal, in that they consist of more than one mode, e.g. text, sound and moving pictures.

The diversity of new information sources away from the dominance of books and hardcopy texts has dramatically improved access to information and allowed the knowledge base to constantly evolve and change; Wikipedia is often used as an example of this constantly evolving knowledge base. Knowledge is negotiable and every aspect of the world can be perceived from different viewpoints. This constructivist view of the world challenges education to put students in situations where they are asked to access a wide range of sources, sift information and apply knowledge using a range of media. It is essential to ensure that students and teachers in small, isolated rural schools are not insulated from the pace and range of these rapid changes.

Impact on student learning

Educational research has identified key skills required by the 21st century student. (Fullan & Scott, 2014). These skills include creativity, thinking and acting with a global outlook, personal character building, collaboration, communication skills and critical thinking. The project aimed to enhance these skills for the participating students.

The **Rural School Cloud** project has explored how the different applications can enhance student learning, both in specific subjects and across the wider curriculum. The project focussed on three particular areas of impact:

- **Building virtual learning communities** - Cloud computing applications make it possible to involve the world outside the classroom. For example, the Internet and video-conferencing allows students access to information and knowledge and opportunities to contact the world outside school and outside of the region where the students live. In the project schools, teachers and students from different countries were paired to explore the opportunities that this provides. (see chapter 4)

- **Challenge and development** - Cloud computing applications can be used in pupil-centred learning approaches that engage and challenge the students. Modern educational theory puts emphasis on approaches to learning where students work on specific project based tasks in order to develop their knowledge and skills. Working in this way the students are asked to experiment and test hypotheses in order to gain knowledge and skills related to different areas of the curriculum. For example, text editing applications, such as Google docs, allow students to work with different text genres.

- **Access and affordability** - Cloud based applications allow students within schools, and across many different schools, to work collaboratively on the same task. Collaboration involves high level communication skills where students negotiate meaning, ask questions and comment on contributions from others. Students are able to work, not only from school, but from anywhere with Internet access. The Rural School Cloud project made use of, and developed, open source software, so that software costs did not impact on the student's ability to work in school or from home.

Cloud computing for school networking and teachers professional development

The open, cloud-based, & Web 2.0 approaches and materials used in the project can also support the development and networking of teachers. Teachers working in rural schools may miss out on the range of professional development, collaboration and networking opportunities that are available to colleagues in urban areas. This could be due to travel times associated with rural isolation, access to centres for professional development such as universities, or the small number of teachers in an area with similar development needs. Cloud computing gives the teachers' new possibilities to communicate and develop practice and resources with peers locally, regionally, nationally or internationally.

When teachers collaborate with other teachers on developing approaches to learning or curriculum projects, they inevitably discover possibilities for improving the quality of learning and teaching in their classrooms. The teachers can communicate synchronously or asynchronously using the web 2.0 multimedia resources, hold virtual conferences, discuss professional and practical issues relating to their classes. Developing teaching and learning collaboratively gives teachers the potential to explore, adapt and improve their practice.

In this project, the teachers have been supported with some design guidelines and challenges that their teaching activities and plans should reflect. The guidelines ask teachers to ensure that learning activities are:

- pupil-centred, with a high level of student activity
- promoting interaction with other students from different schools
- project based and collaborative
- involving multimedia production and communication – including a mixture of sound, images and text
- involving and developing communication competencies
- involving the world outside the classroom and relating to "the real world"
- allowing teachers to communicate easily with parents, and "extend" the educational curriculum outside the classroom to involve families in their children's learning.

These guidelines are based on the 21st century skills described in the previous section, and can be used as a way to challenge the quality of the collaboration between teachers.

4. Our experience and the lessons learnt?

Rural School Cloud carried out pilot projects in elementary, primary and secondary schools from 5 countries. The project included schools from a diversity of contexts, sizes, educational models and ICT resource backgrounds. Many lessons were learned during the two year period of the project between December 2013 and November 2015.

The positives:

- Participant teachers showed a positive attitude to learning new ICT skills. Some of them already had experience in using cloud and mobile technologies with their students. These teachers were a great help made a significant contribution to supporting the development of other teachers. Sometimes this help was not technological, but organisational, providing educational strategies for using cloud based IT. These teachers greatly supported the success of **Rural School Cloud** pilot projects.

- Collaborative projects were proposed by participant teachers and led by them. This ensured a high degree of relevance to their own curriculum needs and suitability for their students' age groups. The approach ensured that the project work was largely part of current teaching and not seen as an additional workload for the teachers.

- Cloud based videoconferencing was used to coordinate and carry out some learning activities between schools. Most of the videoconferences involved whole groups of students from different schools. Videoconferencing was a key aspect in establishing relationships and maintaining effective collaboration between groups through other media.

- The open source software used was flexible enough to adapt to teachers' needs. It resulted in a specialised cloud desktop and virtual operative system which responded well to the particular needs of the pilot projects. The software provided on and offline access to shared files with synchronized updated copies of each file maintained by the system. This facility allowed work to continue even when online connection was not available for a variety of reasons.

- Cloud resources and tools in the project were always available from any device, computer, tablet or mobile. The tools and resources always remained synchronized and updated for all users. This ensured that system issues did not affect user operation and this in turn developed user confidence and encouraged familiarity with the tools and software.

- The provision of easily accessible and rapidly responding technical support was extremely important for the teachers during the project. Readily available support ensured that any technical issues that arose did not have a lasting effect on the educational outcomes. Direct access to technical support was implemented as well as access to self-help through video tutorials.

- Participant teachers highlighted the significance of this project in their professional development. Working with other teachers through ICT was recognised as a key approach to developing new competences and strategies. The project made a significant impact on reducing professional isolation and developing practice for participating teachers.

The challenges:

- Collaborative activities carried out over the Internet require careful planning to support teachers with little experience in collaborating using ICT tools. When starting this type of activity additional time is required for participants to establish the skills and working practices needed

- Participants considered that it would be desirable to extend the period of the project to enable the collaborative projects to obtain further results and allow groups to explore further possibilities in taking cloud computing to their classes. The diversity across the pilot schools and their experience in ICT meant that projects developed at different rates. Future projects would be more effective working over a longer timescale.

- Internet connectivity and speeds in isolated rural schools tends to be worse than in their urban counterparts. This was sometimes due to a limited broadband connection, and sometimes due to internal WIFI restrictions. Intranet policy was often too limited to allow the best use of sharing through mobile devices. A reliable broadband connection and effective support is needed in rural schools to implement cloud computing projects.

- Language can pose a significant barrier when collaborating internationally. English was the common language for this project. Some participant teachers did not have enough competence in communicating in English to enable effective communication with their peers in other schools. This made communication slower and added complexity to their collaborative project.

For this reason, some of the schools decided to limit their collaboration to other schools using the same language.

- Understanding the concept and the possibilities of the cloud computing Operative System and desktop as being a highly flexible and customisable tool caused some confusion among users. Resolving this required face to face training. While required, it is very challenging to provide face to face training across national and international projects.

- Open standards are highly advisable for video, audio, text formats in this type of project to avoid technical issues and user frustration. We experienced some problems with mobile devices, such as tablets, with certain types of multimedia content (mainly Flash based contents in iPads). Most issues were solved with further improvements to the cloud computing software or "workarounds", such as using a flash enabled browser.

5. What was the impact on teachers and learners?

The most important part of any project is the impact that the outcomes have upon their intended audience. For this project, the audience was both students and teachers with the outcomes defined at the start of the project. Did they achieve what was expected or prove to be more far reaching than originally planned?

> "Good evaluation does not need to be complex: what is necessary is good planning and paying attention to evaluation at the outset of the professional development programme, not at the end" Thomas Guskey

What always proves fascinating in a project relating to professional development is that however carefully the project is designed and the outcomes are planned, we never really know what will happen as the project unfolds in the dynamic and rapidly changing culture of schools.

In addition, a clarity of the degree of impact needs to be considered and which aspects of the project are of value. Is immediate impact of interest? Motivation, excitement and potential are traits that have to be measured against the longevity of a project. Is time the most important factor?

In education systems where accountability is paramount, sometimes we lose the fine detail of change as it happens and only count the quantifiable final aspects of school development. Whilst acknowledging this is important, the qualitative value of this project both short and long term has been manifold.

The picture presented overleaf is a snapshot in time of the impact of this project and whilst it presents a positive picture, and is both encouraging and successful, it hides the underlying strength of resolve, imagination, integrity, determination, fun, challenge and concern that lay behind it. If these aspects could be captured within this presentation, then the ongoing possibilities and real impact can be transposed across so many other aspects of the work we do.

The following are considered to be the main impacts of the project:

➔ Networking

Rural School Cloud significantly improved and developed collaboration and sharing among partner schools. Partner schools actively shared expertise, resources and ideas and these had a significant impact on the learning experiences of students across all schools. Addressing problems encountered during the project led to shared solutions and the empowerment of small schools in overcoming issues collaboratively.

"Thanks for visiting Ermington School and St. Andrew's. I think that it's always interesting lo learn from other work context (different but similar). Best regards."

➔ Connectivity

Opportunities have been established for the use of a wide range of technology including tablets, broadcasting, touch screens, visualisers and videoconferencing. In using these technologies, both pupils and teachers have been able to interact and share resources, leading to improved learning opportunities and outcomes for students.

"Link:"
http://escoladebertolavilaboa.blogspot.com.es/2014/11/almorzomixto.html

➔ Pupils learning

"There was a real excitement behind the project. It opened my eyes to another world." (Year 6 student). The experience of using a new platforms and sharing in the work of others helped to build new skills and improve the confidence of students to try something new. The students in the project developed creative and critical approaches to their work and there were opportunities to learn and embed key skills.

"I love being able to cast my work directly from my tablet to the classroom screen, sharing with my classmates"

➔ Enriched curriculum

RSC has provided excitement in new themes that linked innovative technologies in everyday practice, which reflected 21st Century life. It has developed language, interest and ICT skills across all countries. It provided opportunity to talk through and share outcomes with everyone; parents, local schools and educational partners.

"Do you have a football pitch in your school?"

➔ Staff confidence

Staff have seen and utilised more opportunities to link ICT into others areas of the curriculum. The reluctance to use new technologies has visibly decreased as its value has been recognised.
Staff confidence, capability and enthusiasm has significantly increased through the opportunities provided by RSC. *"It provided a real world purpose for computing for our rural schools."*

"The project drew a change in my practice"

➔ Innovation

Teachers' sought innovative approaches for the use of technology which included its use in both the classroom and the outdoor environment. *"It was amazing to see technology being used so purposefully and creatively to support the curriculum, whilst enhancing learning opportunities for children."* (Headteacher). Augmented reality, QR codes and video editing are now commonplace in lessons.

"Letting go of the teacher led learning and watching the children explore new avenues has been fantastic"

➔ Problems

Technical problems that occurred during the project were mostly due to the infrastructure within schools, but through determined efforts most of these issues were resolved. Perseverance has been modelled well by both staff and pupils.

➔ Developing and Sharing Best Practice

Links to other areas of the curriculum and sharing best practice in teaching and resources has become evident through the use of the platform. *"After watching video clips from other schools it inspired me to incorporate new skills and technology in my teaching."* (Year 4 Teacher).

"Two new videos from St. Andrew's in the 'short videos' folder, one a presentation of our school grounds and the other showing use of QR codes around our school grounds"

➔ Equipment and resources

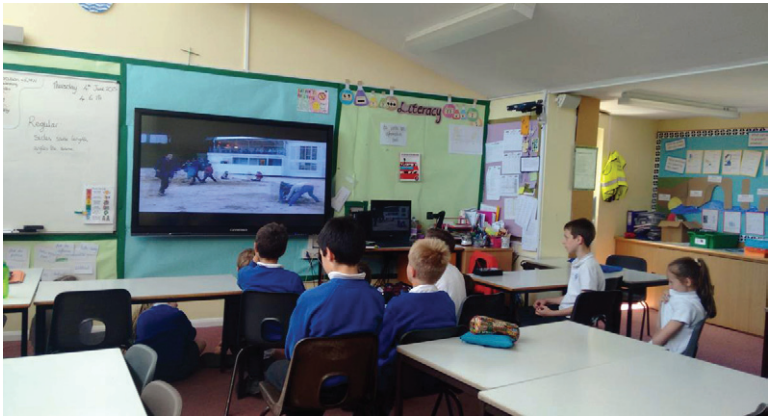
The project offered rural schools the funding and opportunities to explore and utilise a range of new technology with real purpose. Teachers are now able to access a shared list of vibrant and rich resources.

"Build a school in the cloud - view this excellent TED talk. Enter the shared area."

6. Is it sustainable? Can our school afford the change?

Increasing demands by teachers, parents, and students, combined with ongoing budget constraints, are driving the IT focus and investment at schools, in new directions.

Cloud computing is a new field in Internet computing that provides novel perspectives in Internet working technologies (Pallis, 2010), a sector that schools could benefit from a great deal.



Cloud computing is one of the new, most talked about, technology trends likely to have a significant impact on the teaching and learning environment. It is highly scalable and creates virtualized resources that can be made available to users (Fadil et al, 2015). (i.e . students, teachers, parents, school administrators). Users do not require any special knowledge about the concept of Cloud computing to connect their computers to the server where applications have been installed. They can use them and can communicate through Internet with remote servers.

Firstly and foremost, cloud computing reduces and rationalizes IT capital expenses. This means that it is an excellent alternative for schools, under budget pressures, to operate their information systems effectively without spending any more capital. Educational institutions take advantage of available cloud-based applications offered by service providers and enable their own users/ students to perform educational tasks. (Tuncay, 2010). As Cloud services are available on demand, they can be used as much or as little as needed, and are billed according to use. Schools that currently store their software and data locally, can benefit from moving to the cloud while allowing them to spread IT costs through flexible subscriptions (**www.tabletsforschools.org.uk**). There is also the advantage of lower environmental impact, as Cloud computing enables educational institutions to reduce their own electricity consumption by optimizing power usage (IITE, Unesco, 2010).

The cloud is becoming an important strategic resource because it has the potential to deliver Education as a service. The cloud is spawning a vast ecosystem of educational resources that will make it easier to deliver education itself "as a service." Educational content is increasingly digital in nature and consumed on cloud-ready devices. Emerging learning platforms are delivered as, or make heavy use of, cloud-based services, providing the characteristics of on-demand convenience, self-service simplicity. Cost effectiveness of cloud services will be a major goal of the next generation of technology-enhanced education. (Contact North, 2012)

In the framework of collaboration, as cloud computing is in an interactive learning environment, it can be offered to anyone, anytime and everywhere (Cisco, 2013). As a result, users can benefit from an education without boundaries and expand collaborations and synergies inside and outside the school environment, and with peers from all over the world.

In summary, cloud computing is a significant alternative in today's educational landscape. Students and teachers have the opportunity to quickly and economically access various application platforms and resources through the web pages on-demand. This automatically reduces the cost of organizational expenses and offers more powerful functional capabilities (Tuncay, 2010).As a result, teacher and student collaboration is being enhanced, as the connection between them is instant, easier and more effective.

It is clear that the cloud is shifting the balance of computational power beyond traditional school boundaries. The time is ripe for school education to begin thinking about the cloud as a strategic resource and to recognize that it presents new ways to make education financially and environmentally more sustainable, to improve institutional agility, and to enhance learning. Therefore, teachers need to learn about cloud computing's possibilities and consider how to seize the opportunities for the sake of modernization and effectiveness of education.

Open Source software. A great asset for cloud computing education

Our project used Open Source software, and promoted its use to reduce the cost of digital resource accessibility, as well as enhancing its possibilities.

Open-source software (OSS) is "computer software with its source code made available with a license in which the copyright holder provides the rights to study, change, and distribute the software to anyone and for any purpose"
(St. Laurent, Andrew M. (2008). Understanding Open Source and Free Software Licensing)

There are many reasons for using Open Source software in education, these include:

- **Freedom.** Open Source users are in control to make their own decisions regarding what they want to do with the software. No hidden licenses limit their use.

- **Flexibility** and **sustainability**: Open source software is typically much less resource-intensive,

meaning that you can run it well even on older hardware extending its life and avoiding new costs. This is especially interesting for rural schools with heterogeneous computer resources.

- **Interoperability:** Open source software is much better at adhering to open standards than proprietary software is.

- One of the main advantages of Open Source is **customization.** Developers can take a piece of open source software and adapt it to suit their needs. In our case, we could adapt to the needs and preferences of our pilot teachers.

- There are vibrant user communities surrounding each piece of software that can give **support** for modifying or improving any open source software. It is a sharing culture, supporting values that are very much like the ones we want to promote in education.

- There is a large community of developers and users working to improve the **security** and **quality** of open source software, so are there just as many innovating new features and enhancements to those products. All the OS software is open to public view. Developers and testers can check the source code and find and fix bugs immediately.

All these reasons were of utmost importance when we designed our technical and educational solution for Rural School Cloud Project. Any school district could implement the software without the need to pay for expensive software licenses, and adapt it to respond to their needs and preferences.

7. How can we implement?

If you think this approach can be useful for your educational community, you may wonder how to put it into practice. This section highlights the most important aspects to take it into account, both from an educational and a technical point of view.

7.1 From an educational point of view

The **Rural School Cloud** project has been developed with the goal of building a flexible educational methodology that can respond to the specific needs of European rural schools. Although there are differences, related to the size and location of these schools, generally speaking they are characterized by:

- Villages and sometimes towns, at a considerable distance from urban areas. This brings the need to consider pedagogical alternatives which take full advantage of all possibilities for learning and supporting teaching processes.

- Having different organisational structures, derived from their particular teacher and student typology. Some of them include teaching staff who have to work across several small schools, therefore having to travel every day to carry out their teaching roles. In addition different ages being grouped together, due to small numbers of students in each school, has its own advantages and disadvantages. These situations require strong leadership, coordination and collaboration between all school staff, as well as flexible student grouping.

These particular characteristics bring important challenges, such as the need to provide rural schools with specific technological resources, as well as implementing methodologies and organisational structures which improve and facilitate collaboration of the daily practice of teachers. We must also consider the possibilities that exist to strengthen the educational process at home, as well as the development of context-specific didactic materials. The knowledge of geographic, cultural and the human environment as cross-curricular learning contexts, will also enrich the standard curriculum.

These objectives focused the methodology developed in the **Rural School Cloud** project, which relies on a tailored technological solution, based on cloud computing and open software. It was important to consider the pedagogical dynamic which stands on 4 principles that all teachers should consider when implementing it in their contexts:

1. Project-Based Learning

The first decision to be adopted is to define the core contents which will serve as the centre that all educational processes will revolve around. This decision can be looked at from different angles:

- **Educational levels** - organising a cloud desktop according to student's ages and curricula. *For example, creating a cloud desktop for elementary education, and then another for the first level of primary education.*

- **Curricular content** - organising the cloud desktop regarding curriculum topics. *For example, creating a cloud desktop for maths, another for history or music.*

- **Project based** - broad subject matters that allow curricular subjects to work in an integrated way around a certain topic. *This option was the most appropriate one chosen by the Rural School Cloud project, taking into account the diversity of participant schools. In the project, under the main idea named "Through our windows", four broad topics were selected: "everyday maths", "nature", "local traditions" and "everyday news".* Topic choice and definition of individual projects was made by the educational team who wanted to implement this methodology and were connected to the interest areas of both students and school educational project.

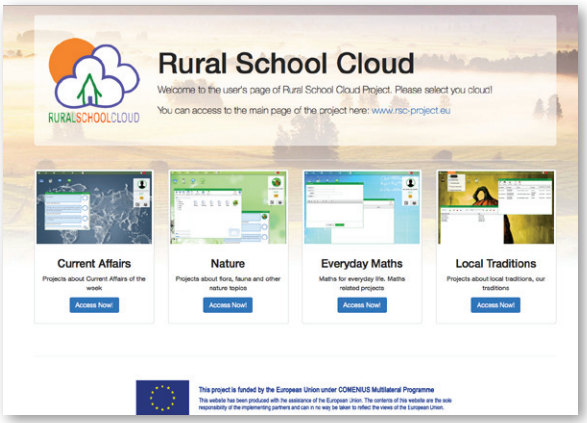


Image: Main access to the 4 cloud desktops for the projects in RuralSchoolCloud

2. Quality Digital Educational Content

Together with the technological solution, digital tools and content are the requirements to start the cloud experience in a school. A meticulous selection of both digital tools and materials to integrate in the cloud desktop should be carried out. In Chapter 8 of this handbook, we will refer to some the contents selected and developed in the project in detail. However, it should be noted that implementing a project like this in your school requires a clear focus on the learning objectives. Two elements to be combined are, *digital tools which allow you to carry out learning tasks within the cloud environment* (image, text, video editors, digital calculators, simulators); together with *hypermedia and multimedia materials*, which are generally available in online repositories, along with self-produced learning materials and resources, created by teachers and/or students throughout the project.

It is crucial that both digital content tools selection and their creation are aimed towards the educational goals. Minimum quality standards should be observed. In the **Rural School Cloud** project, the consortium agreed on a common template aimed at helping teachers in this process. This template has been included in Chapter 8 as a reference.

3. Teacher collaboration

Collaboration among teachers does not always happen spontaneously. However, as we have mentioned before, due to the particular organisational structure and characteristics of some rural / isolated schools, collaborative work is essential. Throughout the two years of the project, we had to address this issue by questioning first whether we would work in internal school projects or aim to work in collaborative projects between different schools. This decision was directly influenced by the adoption of a project-based learning strategy. We designed **Rural School Cloud** online desktop to allow users to work at several different levels, with different groupings and types of collaboration: teachers and students from one or several schools, teachers and student from different educational levels from one or several schools, from the same or different regional, national or country contexts.

The more the diversity in the groupings, the greater the complexity to carry out the collaborative experience, although in some circumstances it can a become more enriching. In our project, educational projects were developed by students and teachers from different schools, educational levels and countries. Once the educational projects were defined, by the teachers themselves, schools joined them according to their interests and the proximity of these projects to their educational vision of their own schools.

To encourage teachers' and students' involvement, it is important that the starting idea is clear and detailed but also, open and flexible enough to integrate everybody's contributions and ideas. This allows autonomy and flexibility for each individual school and class group. It is also crucial to identify the common rules to exchange these ideas using multi-conferencing or other collaborative tools such as email and messaging.

Each project had a teacher leader, who coordinated the experience, helping in its development and solving issues. Collaborative tools were available including collaborative online docs, initially in Google Docs, and then within the **Rural School Cloud** desktop own solution to enable schools to work together, define activities and materials for each project. Technical support was always available for teachers, so they could get used to the cloud desktop and address any other matter related to digital content and tools creation.

4. Active and collaborative learning

Student's engagement in a project like this is critical , impacting the degree of significance of the learning activities that are proposed. Student's involvement cannot be secured just by using ICT in class. Technology can bring a motivational component to learning, but we need a precise pedagogical approach to maximise this. We started from a participative and active approach supported by different teacher guided activities, together with appropriate learning resources. This learning should be acquired by actively doing things, solving problems and creating digital productions collaboratively with other students.

The four broad topics of **Rural School Cloud** project "everyday maths", "nature", "local traditions" and "everyday news", included educational activities which combined these characteristics: collaboration among teachers, students, families, different educational resources, such as manipulative, digital or printed materials, creation of own video productions, where detailed process guidelines and orientation by teachers is necessary to allow the development of student experiences and learning.

An example to illustrate this methodology, using one of the projects carried out: "harvesting", within the topic "local traditions", by elementary and primary school students in Galicia (Spain) and Parma (Italy): This project involved some students' family members who visited their schools with traditional harvesting implements and tools and demonstrated how they were used to harvest the crops. In addition to preparatory lessons and post activity discussion and work, parental engagement helped students understand the 'harvesting' process in their particular context as well as deal with geographical and history curricular contents. As an outcome students created video productions explaining the process. The project goes beyond the classroom; students not only acquiring knowledge by listening or reading information, but exploring the context, asking their relatives, etc. and finally producing relevant material which shows real knowledge on the subject matter as well as learning new ICT skills and application.

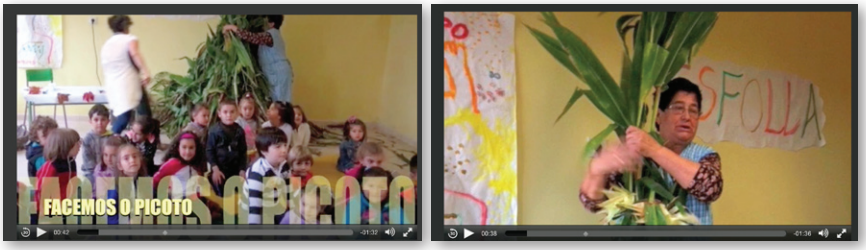
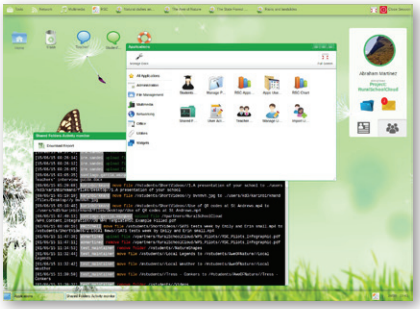


Image: Screen captures from a Video produced in "Harvesting" project. Local tradition cloud desktop.

7.2 From a technical point of view

Rural School Cloud technical solution is hosted in a cloud infrastructure at the Galician Supercomputing Centre, and includes a number of software solutions which provide the access to all project users through a web browser.



Our piloting shared cloud desktop (a virtual Operative System) is a web platform built from different Open Software (OS) tools and software packages. It looks like a regular offline desktop where you can access menus and programs, drag

and drop files, etc. This solution takes into account the need to find a very friendly "usable" solution for both teachers and students by incorporating a very graphical, familiar approach to its user design. Technology should be used to improve the way teachers apply their educational strategies, not getting in the way and requiring too much effort to obtain advantages.

Technical Checklist

- Internet availability: do all schools have sufficient Internet bandwidth to be able to work with the tools and resources (1 Mb minimum)?
- Do the schools have access to system administrators who can analyse and carry out the necessary development and adaptation for the cloud solution in schools?
- Where will the software be hosted? What are the associated costs of hosting, maintaining and developing the software?
- What existing ICT devices do the schools have? How can they access and benefit from the cloud solution? What resources do students have at home or, for example, local libraries?
- Are there appropriate security policies in place to avoid possible problems?
- Is there a training plan in place for all teachers, as well as multimedia support materials and the availability of helpline and face to face support?

Rural School Cloud technical infrastructure used:

From the technical point of view, the platform is based on the well-known LAMP architecture: a collection of OS software packages like Apache web server, PHP scripting Language, and MySQL database, running on a Linux x86_64 Virtual Machine (VM). On top of that we used a Web Desktop Framework, named EyeOS, a cloud storage and synchronization solution called Owncloud and a multi-conference tool (OpenMeetings).

The project then had to code and adapt many parts of these tools in order to guarantee the interoperability and allow a seamless integration of the main components like an all-in-one GUI (graphical user interface) resembling a traditional computer desktop.

In order to replicate the **Rural School Cloud** platform in your school district infrastructure, you will need to analyse your resources and requirements and then decide a deployment approach: for example 1 VM per school or 1 VM per 4-5 Schools. You should check it with your Cloud Infrastructure Administrator, because of the performance impact. Some cloud infrastructures perform better with many VMs (1 VM per school approach). In this chapter we describe the first approach (1 VM per School).

Hardware/Virtual Machine

The hardware requirements for the RuralSchoolCloud platform may vary depending on the estimated number of users, the usage patterns and the users behaviour.

We will take as a model a typical scenario for 1 school in which we have:

- About 500 active users on the system
- Each user will have access to one cloud desktop, using one mobile device and a web browser from his/her computer to log into the system
- Users can access the platform on a 24/7 basis
- Users are limited to 1GB storage quota in Owncloud (file storage system) and 1GB in Oneye (cloud desktop).
- It is a regional location, all schools / users being in one time zone (all the access at the same time)

The **Rural School Cloud** software, available from our project website or in the digital resource package which comes with this booklet, has as a fully functional Virtual Machine (VM), ready to be deployed in any cloud platform or hypervisor (VM-Ware, Open Nebule, Open Stack, Cloud Stack, Xen, etc).

For this scenario it is recommended to assign the following resources to the VM:

- 2 VCPUs
- 2-3 GB of RAM
- 10 GB of disk space.

If more space is required for a production environment, ask your cloud administrator to increase the size of the VM image to the desired final space. Usually, for the above scenario, 250GB should be enough. If your users are planning to upload many videos or heavy files, then probably increasing it to 500GB would be advisable.

Remember you need to count on an experienced system administrator in order to install, adapt and maintain this solution!

Open Software tools

Our platform is based on several Open Software tools, mainly: Oneye-0.9 Owncloud-7 and Openmeetings-2.1.0 tools, although major work was carried out to integrate them seamlessly into what looks like an offline operating system desktop, similar to Windows, MacOX or Linux user desktops.

Owncloud also allows RuralSchoolCloud desktop (based on Oneye) to synchronize all students' and teachers' files with mobile devices through the Owncloud App.

OpenMeetings provides videoconferencing capabilities to the desktop, allowing teachers to easily organize videoconferences or multi-conferences without having to leave their cloud desktop (in our project, it was decided that individual students were not allowed to use videoconferencing in their cloud desktops). Presently, 'OpenMeetings' use is limited to computer desktops, as it relays on Flash plugin to work. We hope that in the near future, an update is released which allows it to be available for tablets.

Installing the RSC VM

The RuralSchoolCloud VM is fully functional and comes with the three tools (oneye+owncloud+openmeetings) plus modifications made during the project.

You will only need to deploy the provided VM in the cloud infrastructure of your choice and assign an IP address to it and you're ready to go.

The list of OS software installed in the VM which the **Rural School Cloud** suite provides:

- PHP 5.3+
- Apache 2.2+
- MySQL Server (MySQL 5.1+)
- JRE 7 (JRE 6 is not supported!)
- ImageMagick for enabling image uploads and imports to whiteboard
- GhostScript and SWFTools of importing PDFs to whiteboard
- OpenOffice-Service to allow imports of .doc. docx. ppt to whiteboard
- FFMpeg for recording and importing videos

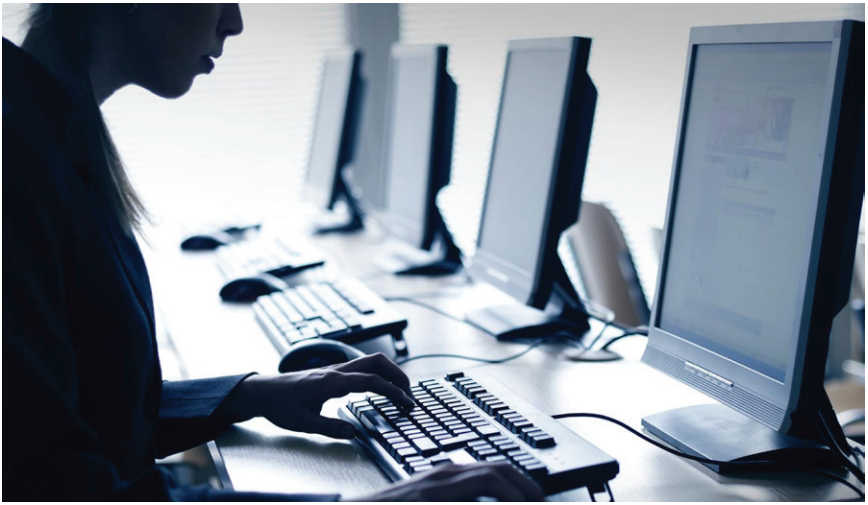
Clients (Web Browsers)

Browsers need to be standard-compliant and support CSS. This includes the most common modern browsers:

- Mozilla Firefox
- Google Chrome
- Internet Explorer
- Opera

Older versions and other browsers may also work, but some features may be missing or the appearance may look less usable. Therefore, we strongly recommend the use of Mozilla Firefox or Google Chrome to be able to use all platform potential and features.

8. Resources made available



Pedagogical orientation in RuralSchoolCloud project was based on the assumption that educational resources are not products that can be used right away, but products that are borne from the class activity itself, and therefore need to be contextualized and adapted. We believe that teachers are not just consumers of already designed resources, but also designers of their own educational resources. In this process, students are also recognised as creative agents, designing their own educational productions, which are a highly valuable result from the learning-teaching process.

Some of the online tools used in **Rural School Cloud** project, as well as its produced materials, could be useful to reuse or transfer the experience to other context. We believe that any school that wishes to start a similar project needs to carefully select its own digital resources, taking into account its own objectives and educational projects. Some of the tools and resources available in **Rural School Cloud**, can be useful to carry out general tasks (such as translators, editors, social software, etc.) but again, each individual educational project will require a precise definition of the digital tools needed, a specific search for these tools / resources as well as their design / adaptation by students and teachers.

We describe here, general guidelines that will help teachers define digital resources for cloud desktops, such as the one used in **Rural School Cloud** project (search, adaptation or self-production). Then we highlight some of the resources used in the pilot experiences of the project as examples. If you are interested in accessing this information in more detail, you can download a detailed list of resources used (10-20 per country) in our project website (Products section).

Identifying types of materials to integrate in Rural School Cloud desktop

There are a large variety of digital formats and resources available to users. What type can we use in a cloud based desktop? We need to consider the following matters:

1. **Potential users:** students, teachers, family (depending on project, roles and purpose envisaged). If we aim at continuing the learning process at home, it is important to consider families as potential users.

2. **Type of materials:**

- **Web 2.0 tools** (i.e. browser based video/image editors, multimedia presentations, timelines, infographic creators, etc.)
  - Glogster (http://edu.glogster.com/)
  - Edublog (http://edublogs.org/)
  - Pixlr (https://pixlr.com)
  -
- **Repositories / educational resource centers**
  - European Schoolnet OER (http://www.eun.org/teaching/resources)
  - INTEF (http://educalab.es/intef)
  - Galician Education ministry OER (https://www.edu.xunta.es/espazoAbalar/)

- **Educational multimedia materials** (as links or uploaded to the cloud desktop)
  - SOPA DE LETRAS DE PLANTAS AROMÁTICAS (http://www.educaplay.com/es/recursoseducativos/1779874/plantas_aromaticas__medicinais.htm)
  - Mostra etnográfica Cavana di Lugagnano (https://it.wikipedia.org/wiki/Mostra_etnografica_Cavana_di_Lugagnano)
  - Διδακτικό υλικό μαθηματικών. (http://mosxosyliko.blogspot.gr/)

- **Formats:** interactive activities, multimedia and hypermedia resources, collaborative resources, tutorials, webquests, infographics.

- **Languages:** Depending on the scope of the project, user needs and objectives, resources in different languages can be included.

Where can we find these materials? Some examples

Educational materials can be self-produced or found from a wide variety of sources. Besides professionally created learning resources, which are easy to integrate in Open Source cloud platforms such as in use in the Rural School Cloud project, there are many other open educational resources (OER) that are available to teachers and students.

This list below shows some examples self-produced resources from RuralSchoolCloud pilot projects.

NAME	DESCRIPTION
St. Andrew's C.E Primary school, Buckland Monachorum, Devon.	This RSC resource shares problems encountered in maths across everyday life leading to shared solutions and empowerment for children to overcome issues together. This video demonstrates how children have used tablet computers to support their learning.
LINK	http://rsc.cesga.es/nature/ https://www.youtube.com/watch?v=dZRaFl6b5Tc&feature=youtu.be
ICCORNIGLIO. Web escolar de recursos de Corniglio	A project that includes research about our territory and local history, with the aim to learn to communicate and publicise on the web, using different tools, as RSC Platform, Wikipedia, Google Sites (Italy)
LINK	http://www.iccorniglio.gov.it/2015/07/23/progetto-adotta-una-parola/
ESFOLLAR E VENDIMIAR	Video produced by students and teachers from "CRA Nosa Señora do Faro" school in Spain, as part of the collaborative project "local agriculture". This was the final product of a process to present and understand harvesting in Galician rural tradition. Students, teachers and parents participated in this project.
LINK	http://www.pizarramaxica.craescuela.net/actividades/nube/conv_brantuas.mp4
The School Party	The Digital School platform is a service created from the Greek Ministry of Education under the European funded program "Education and Lifelong Learning". The platform serves as a digital education platform and a repository for learning resources. It contains all official school books of every class in a digital format, enriched with digital content that enhances interaction of students and better understanding of the curriculum. The digital content includes exercises, tests, animated images and videos. This initiative is a dynamic approach of learning that help students gain skills and competences.
LINK	http://ebooks.edu.gr/new/classcoursespdf.php?classcode=DSDIM-D
Short videos about daily life	The students from Samsoe School, Denmark, produced videos about their school and their everyday life. The collaboration between the schools where based on four subjects. 1: Local News, 2: Favorite subject at school, 3: Food at your school, 4: Your spare time. Finally, the students could download the videos and remix them into Breaking News with a mix of the four subjects from the participating countries.
LINK	(hosted in cloud-based platform)
PLANTAS AROMÁTICAS Y MEDICINALES	Interactive book developed by students and teachers from CRA Vilaboa and CRA Boqueixón-Vedra schools in Galicia, Spain. It was part of the collaborative project named "Nature". It is a multimedia guide with medicinal and aromatic plants in the areas from both schools in Spain.
LINK	https://dl.dropboxusercontent.com/u/6712010/PLANTAS%20AROM%C3%81TICAS%20Y%20MEDICINALES/plantas_arom_aticas_y_medicinales.html

Descriptive form to select / identify digital learning resources

This template can help teacher/s identify the suitability of a digital resource for an educational project. It is also useful as a form of self-evaluation to assess its relevancy.

Section 1: Identification of the digital material

1. Project for which the material is proposed. Educational level.
2. Description of the material (short paragraph: what it consists of).
3. Language in which it is written.
4. Author / Institution / Identification data.
5. Location (http://)
6. Availability/requirements of use: (it can be downloaded, the link is readily accessible, does it need installation of software, etc.).
7. Type of material. (Web 2.0 / Video / Video-presentation / Images-Album / Print-Documents / Wiki / Social / WebQuest / user-friendly software application. Others (please specify).

Section 2: Pedagogical/didactical use

8. For what reason/how is the material going to be used?
9. Relation to the aims of the thematic project (Current affairs, Nature, Everyday maths, Local traditions).
10. Relation with the activities of the thematic project.
11. Does the material include activities, exercises or tasks?
12. Will the material be adapted in any way?
13. Who will use it (Teachers - Students - Family)?

14. Please indicate which one of the requisites this material fulfils (in each section write down the letter which corresponds to the requisite):

Related to the pedagogical dimension:

a. that it responds to the educational aims of the project
b. that the material is well structured and organized (tables of contents, summary)
c. that it presents content in a comprehensive way and linked to real-world experiences or contexts
d. that concepts are clearly introduced
e. that contents include examples, graphic art, simulations, etc.
f. that the interaction encourages meaningful learning
g. that it promotes information search and research
h. that practical case studies are provided that allow students to take decisions to resolve them
i. that it promotes different approaches and debate
j. that it promotes attitudes and ethical values

k. that it provides different levels of interactivity
l. that the progression of the level of difficulty is smooth and logical
m. that the activities require different ways of approaching knowledge and its application
n. that it encourages students´ creativity
o. that it offers activities for practice and repetition
p. that it allows group interaction
q. that it offers guidance and reinforcement to students
r. that it allows students to work independently and promotes student engagement in an individual and critical manner
s. that it provides follow-up activities and a deeper knowledge of contents
t. that it promotes students to take the initiative, plan and self-learn
u. that, should it be the case, the feedback provided should be immediate and positive
v. that it provides elements for student self-assessment and self-expression

Related to the content:

a. that it be current, accurate and relevant and supports the aims and contents of the educational project in which the teacher who proposes it takes part (Current affairs, Nature, Everyday maths, Local traditions)
b. that the level of difficulty is appropriate for the age of the students taking part in the educational project in which it will be used (capacities, interests, needs,…).
c. that it is attractive or of interest to students because it relates content to their previous knowledge and is meaningful to them
d. that it allows or includes activities and proposals of interaction for active learning (interaction, help, levels of difficulty, progression and follow-up, etc.)

Related to its technical design:

a. that it is an attractive and increases understanding (legible)
b. that it is easy to use (accessible)
c. that the site is navigable and intuitive (navigation system, icons)
d. that it includes some type of multimedia element (graphics, animation, video...) with an appropriate speed, technical quality and adequate aesthetics
e. that the text can be read easily, that it does not have errors in spelling or grammar nor negative and/or discriminatory messages
f. that it includes links or recommends other sources of information

Pedagogical dimension/s	Content	Technical design
(see dimensions above)	(see above)	(see above)

15. Key and transversal competences that it allows to work with students:

Key competences	**YES/NO**	**Transversal competences**	**YES/NO**
Communication in the mother tongue		Oral communication	
Communication in foreign languages		Team work	
Mathematical competence and basic competences in science and technology		Critical thinking	
Digital competence		Creative thinking	
Learning to learn		Information processing	
Social and civic competences		Decision making	
Sense of initiative and entrepreneurship		Problem solving	
Cultural awareness and expression		Self-learning	

Other. Which? Please specify.

9. Summary

The RuralSchool Cloud project is a highly ambitious project, aimed at a specific, yet diverse, target group: rural and / or isolated schools in Europe. Over the 2 year life of the project, we had the opportunity to analyse the very different contextual reality of educational situations and contexts of 6 European regions with rural schools (ranging from elementary to secondary education). We then built up an educational ICT solution based on open source and cloud computing technology. This was augmented by our combined experiences and development in ICT education initiatives, as well as from the feedback from participant teachers. The latter proving to be the best asset, where their experience, wholehearted engagement, their creativity, hard work and patience provided rich outcomes and impact to the project. We are deeply thankful to all of them. Below is the list of schools who participated at some point in our experience:

- **Spain:** CRA Boqueixón – Vedra, CRA Vilaboa, CRA Amencer, CRA Nosa Señora do Faro
- **Denmark:** Samso school, Sejeroe school
- **Italy:** IC Borgotaro, IC Valceno, IC Corniglio, IC Berceto
- **Greece:** 5th Lyceum of Karditsa, 18th Primary school of Karditsa
- **United Kingdom:** St. Andrew's school, Buckland Monachorum, Ugborough Primary school, Ermington Primary school
- **FYROM:** Kiril Metodisj school, OOU Goce Delcev school, Maunsh Turmovski Or Miril I Metodij

Although you can read our main highlights and findings in previous chapters, we want to emphasize the importance of teacher collaboration in improving the learning models, ICT cross-curricular integration and self-training in a school environment. Isolated schools can greatly benefit from ICT as the key that allows this to happen. However, it is not just a technology issue. The main difficulty teachers found at the beginning of pilot experiences, was to establish a common ground and a shared understanding of how to work collaboratively in a project. When technology (and a foreign language) are not in the way, teachers can really show their potential to be creative and produce powerful and meaningful environments for their young learners.

We want to highlight the potential of Open Source technologies to be the foundation of sustainable ICT development in education not only because of their license costs, but because of its adaptability and possibilities for growth in the future. This project has produced a set of materials and code, which is included in the attached CD (and also available at http://rsc-project.eu). It can be reused and adapted. We encourage you to engage with this initiative and enhance it with your adaptations, new contents or ICT components. You are most welcome to contribute them to our website and RSC community as well.

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