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Specification of Research Strategy and Methodology

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1 Executive Summary

NEXT-TELL (Next Generation Teaching, Education, and Learning for Life) aims at enriching the 21st century school by providing information and communication technology (ICT) tools that support teaching, students learning, and formative classroom assessment, as well as teachers’ professional development across at least four countries (Austria, England, Germany, and Norway). To clarify how this goal is supposed to be achieved, this Deliverable delineates NEXT-TELL’s general research strategy and methodology.

Chapter 2 describes the purpose and scope of this Deliverable. Afterwards, an introduction into the project with its concepts and ICT-tools as well as into its implications is presented in chapter 3. The general research approach is described in chapter 4. NEXT-TELL will employ design-based research as research approach, because it allows theory and technology, as well as pedagogy and policy development at the same time. The crucial method in design-based research is the close collaboration of researchers and teachers who develop and implement learning scenarios that are based on ICT-tools in real-life classrooms. Chapter 5 outlines which studies are planned in which sequence to realize and empirically investigate NEXT-TELL. We will work with four types of studies that build on each other. In baseline studies we will describe the current state of the art of ICT use in schools and in teaching. After knowing the current state, requirement analyses are planned in which researchers develop in close collaboration with teachers the NEXT-TELL tools and learning scenarios comprising contents in the subject of Science, Technology, Engineering, and Mathematics but also in learning English as a second language. These scenarios are implemented in so called researcher-led design studies that investigate the impact on teaching and learning in two consecutive cycles. The project ends with so called teacher-led design studies in which teachers investigate their students’ learning. Whereas the main purpose of the researcher-led design studies are theory and technology development, the main purpose of the teacher-led design studies is pedagogical and policy development. Chapter 6 describes the studies with their focus and their data collection methods. Whereas questionnaires and interviews will be mainly employed in the baseline studies, further data collection methods like videos of teaching and learning activities in classrooms and eye-tracking methodology are planned in the researcher-(and teacher-)led design studies. Whereas video data provides insights into how the NEXT-TELL tools impact classroom behaviour, eye-tracking data provides detailed information about how users process the interface of the tools implemented in the classrooms. After these descriptions, chapter 7 informs about the challenges of integrating the results of these different studies and data collecting methods that complement each other. Furthermore, it delineates how we prevent and deal with the main risk of teacher drop-out during the next four years and gives an overview of the issues to be considered when doing research in several countries with different school systems. Chapter 8 summarizes our compliance of the ethical standards. Each member country of NEXT-TELL respects the respective national data protection act that follows the EU directive. To summarize, we are confident that our research approach provided supports the success of NEXT-TELL that is based on real-life implementations in schools.
2 Introduction

2.1 Purpose of this Document
The purpose of this document (D6.1) is the specification of the general research approach and methodology. The research approach is defined, an implementation plan is worked out and an overview on the research tooling planned to be used in the project is presented. Moreover, methodological challenges of the project are discussed.

2.2 Scope of this Document
This Deliverable presents the general approach to classroom research in this project and outlines the different studies planned. The Deliverable does not determine each study in its details, because NEXT-TELL will deploy variants of design-based research. According to design-based research, teachers' ideas and needs have to be considered and included. That is, the local context influences the individual studies. The local context not only includes teachers within their classes but also the project partners who learn from teachers' needs, and thus, develop their tools and adapt their research activities accordingly. In a nutshell, the individual studies will concretize during the course of the project.

2.3 Status of this Document
This is the final version of D6.1.

2.4 Related Documents
No other document is needed to understand this deliverable. The glossary in chapter 11 might be helpful for a quicker understanding, because it provides information about the abbreviations used in this Deliverable.
Overview of NEXT-TELL

The overall objective of NEXT-TELL (Next Generation Teaching, Education and Learning for Life) is to enrich the 21st century classroom with information and communication technology (ICT) in form of tools in such a way that teachers are supported in their teaching practices as well as their professional development and students are supported in learning and 21st century skills. To realize this idea, the software solution developed by NEXT-TELL is not a specific single application or service, but consists in the integration of various tools and services under the guidance of two methods: the ECAAD method (Evidence Centered Activity and Appraisal Design) on the level of student learning and the TISL method (Teachers Inquiry into Students Learning) on the level of teachers’ professional development. Both methods will be implemented via a mash-up web interface that provides access to the various ECAAD and TISL tools that form the NEXT-TELL platform. Although NEXT-TELL aims at impacting teaching and learning, it does not aim at prescribing what to teach (curriculum) or how to teach it (pedagogy). Moreover, NEXT-TELL also aims at including school leaders’ level by means of providing a Strategy Planner tool that supports school leaders in managing their tasks. An overview of NEXT-TELL’s objectives, concepts, tools, and impact is described in the following three sections.

3.1 Objectives and Concepts

NEXT-TELL’s main objective is to provide, through research and development, computational and methodological support to teachers and students so that they have nuanced information about learning when it is needed and in a format that is supportive of pedagogical decision making. An optimized pedagogical decision making is thought to optimize the level of stimulation, challenge, and feedback for students. The project will focus on technology tools to support classroom instruction that supports teachers (and in appropriate form also other stakeholders) to handle the information on students’ learning in real time, and to individualize and optimize the classroom learning environment while the learning process is still under way. Whereas most other research focuses on advanced and adaptive learning technologies, or on individual learning applications or services, such as an interactive simulation, or a cognitive tutorial program; NEXT-TELL will focus on how advanced learning technologies can be integrated into teachers’ practices, schools’ workflows and communication with stakeholders outside of schools (e.g., parents, potential employers). Hence, the project wants to provide a system, not a single application, in order to establish an overall learner-centred, adaptive classroom. A core objective in providing such a system is to support teachers in particular in their function as diagnosticians who have to make constantly and rapidly decisions in a highly dynamic and complex environment. Our vision of the 21st century classroom is that of a technology- and data-rich environment that supports teachers and students to use various sources of information generated in the classroom and during homework in pedagogical decision-making. To summarize, by providing such an information infrastructure we aim at improving instruction, diagnosis, workflow, and productivity as well as enhance collaboration and communication among students, teachers, and other stakeholders, especially parents.

The key concepts that should be addressed in NEXT-TELL are teaching practices (planning, diagnosing, giving feedback, negotiating, and formative assessing), which in turn, influence students learning outcomes via optimizing students’ cognitive density. NEXT-TELL aims also at influencing school leaders’ strategic planning as well as parents’ engagement or interest in their child’s learning. Although the usage and effect of the information technology (IT) tools provided depend also on situational factors and teacher characteristics, we assume that the effects on teaching practices impact students’ way of learning, because a central function of advanced learning technologies in classrooms is the optimization of cognitive density. This requires interoperability amongst classroom IT applications a services, as well as integration into teachers’ and students’ workflows and practices. Changes in students’ learning activities coincide with students’ cognitive density, and thereby influence students’ learning outcomes. Thus, besides teaching practices, cognitive density is a central concept in the project. Cognitive density describes “…the aggregate level of students’ engagement with learning materials and thinking, their progress in learning, their communication and their use of time – that is, productive activity in the classroom at any given time” [Crawford, 2008, p. 121]. Thus, cognitive density is a general attribute of a learning environment and hence not specific to any specific pedagogical intervention. Cognitive density itself cannot be directly controlled, but is a second-order effect of more controllable and
measurable constructs: communicative, content, and temporal density of the learning environment (see Figure 1).

The concept of cognitive density provides a conceptual framework for classroom technology design. The second part of the NEXT-TELL framework pertains to the operational aspect: What kind of services and information does classroom IT need to provide for teachers and students so that they can fine-tune content, temporal and communicative density with the goal to optimize cognitive density in a learning environment? While it is easy to argue that adding specific software or hardware into the school and homework learning environment will increase content density (e.g., by adding a learning management system) or increase communicative density (by using a chat tool for student-teacher communication in the laptop class for instance), cognitive density will only be optimized if these technologies work together seamlessly, integrate well into existing workflows and practices, do not interfere with the teacher's pedagogical strategy, and are actively used. Indeed, just adding a new technology can and often will be detrimental to cognitive density. From a systemic perspective, the crucial question is therefore not only which tool or service to add to the learning environment, but also which kind of information a new component needs to provide to the existing components (for interoperability) and for the users to allow them to optimize the key variable cognitive density.

This overall goal of teaching (IT-supported or not) of optimizing these densities for particular curricular or learning goals by taking into account information from individual students in a dynamically changing learning environment makes clear that the teaching impact on cognitive density depends also on situational factors and students’ characteristics. Hence, there are complex interaction processes between NEXT-TELL tools and students’ learning outcomes (see Figure 2). To best preserve this realistic complexity, we will investigate NEXT-TELL’s impacts in schools by means of design-based research (see below).
A key axiom expressed in Figure 2 is that the increase of cognitive density in learning settings (classrooms, at home, etc.) is a joint achievement of people (teachers, students) and technology. And Figure 1 helps us to appreciate that cognitive density is critically dependent of the quality of information exchange in learning settings, quality being determined by the content and the timing of the exchanged messages. Classroom technologies will be the more efficient the more they support the teacher in providing specific (read: adapted) and timely information in form of (a) suggestions for students what to tackle next and (b) feedback to students on how they did so far. Hence, ICT needs to support teachers’ decision making and diagnostic reasoning (and students’ in situations of self-guided learning), which is why NEXT-TELL focuses so heavily on formative classroom assessment.

3.2 NEXT-TELL Platform

The central concepts described above should be supported by the NEXT-TELL platform. The NEXT-TELL platform will be briefly described to explain how the above-mentioned concepts are linked with ICTs.

The two main learning processes that NEXT-TELL supports are depicted in Figure XY with students’ learning workflows in the lower part and teachers’ learning (about students’ learning) workflows in the upper part. Also depicted are the components that taken together make up the NEXT-TELL platform. The software solution that NEXT-TELL will produce is not a specific single application or service, but consists in the integration/interfacing of various tools and services under the guidance of two methods: the ECAAD (Evidence Centered Activity and Assessment Design) method on the level of student learning, and the TISL method (Teachers’ inquiry into Students’ Learning) on the level of teacher learning. These tools can be accessed by users (teachers, students, parents) in various ways. The main way will be via a mash-up web interface that provides access to the e-portfolio, student model, and activity visualiser as well as to the planning tools of ECAAD and the communication tools.
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Figure 3: The classroom processes supported and the NEXT-TELL platform components

As the high-level depiction of the NEXT-TELL platform architecture in Figure 3 shows, we will provide methodological and technical solutions for all the dimensions set out in the Integration Framework. In particular, building on tracing students activities around their learning tasks using learning applications (Task Environment), pedagogically relevant information of these activities and (intermediate and/or final) products will be presented to teachers (and students in cases of self-guided learning) on an Evidence Layer, comprising visualisations of activity logs and entries into an ePortfolio. To the extent that learning products and/or activities get appraised/assessed (by teachers, students themselves, peers), the outcome of this appraisal is stored in the Learner Model layer, comprised of an Open Student Model, and optionally the school records (grades, test results). Teachers’ planning of IT-embedded learning activities and embedded assessment/appraisal is supported by the ECAAD Learning Design tool, and the development of IT-supported and –embedded assessment is supported by the ECAAD Assessment Design tool. Communication amongst stakeholders and negotiation of learning and assessment is managed via a communication infrastructure that connects the information in evidence and student model layer with users, and the users to each other. The information in these layers is also made accessible to teachers for the purpose of learning about students’ learning, which takes place in the TISL platform. Finally, the principal is integrated into workflows around teachers’ learning, in particular to communicate strategic aspects.

NEXT-TELL has two principal application scenarios: support of teachers’ and students’ work in the ICT-rich classroom, and support for out-of-classroom learning, in particular for homework. Including the latter is not only important because of the role homework play in some school systems (in particular Germany, Austria, and Switzerland), but also to account for the fact that young people have at home available a rich information ecology (provided they have Internet access) in form of web resources and social networks. It becomes, hence, increasingly important for teachers to take into account not only what students do while in the classroom, but also how they engage in learning while outside of the school.
The following Table 1 shows the main relations between components of the NEXT-TELL platform and the various density notions introduced in Figure 1 above:

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Components</th>
<th>General educational technologies</th>
<th>NEXT-TELL method &amp; technologies</th>
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<tr>
<td>Content density</td>
<td>Resource access and variety</td>
<td>Web resources; learning management systems; social networking and Web 2.0</td>
<td>Include information on students’ learning as a resource</td>
</tr>
<tr>
<td></td>
<td>Capture work process and product</td>
<td>Log files; ePortfolios</td>
<td>Combine process with product information in ePortfolios; make “out of school” activities accountable as learning work.</td>
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<tr>
<td></td>
<td>More and better student feedback</td>
<td>Quiz engines and other assessment methods integrated into LMS or stand-alone; Intelligent, adaptive learning software.</td>
<td>Support teacher in giving/managing feedback; ECAAD method and to plan for teacher and computer generated assessment and feedback. Open Learner models as resource to teachers and students. Adoption of student information display to decision situation.</td>
</tr>
<tr>
<td></td>
<td>More feedback to teacher</td>
<td>School information systems; reporting modules of LMS</td>
<td>TISL layer to support teachers to turn learning data into a decision making resource.</td>
</tr>
<tr>
<td>Temporal density</td>
<td>Automate routine procedures</td>
<td>E.g., use of LMS to manage homework assignments; use of LAMS to manage in-class small group learning</td>
<td>Automate in particular classroom assessment methods that provide high value information to teachers.</td>
</tr>
<tr>
<td></td>
<td>Reduce down time</td>
<td>Use of highly reliable cloud computing services (e.g. Google)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Differentiate task timing</td>
<td>ECAAD method and tools</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Enable timely feedback</td>
<td>Quiz engines and similar assessment technology</td>
<td>(Partially) automatized assessment; integration into a communication and negotiation framework.</td>
</tr>
<tr>
<td>Communicative density</td>
<td>Enable simultaneous channels</td>
<td>e.g. student response systems (clickers)</td>
<td>Use of modern web technologies</td>
</tr>
<tr>
<td></td>
<td>Enable message buffering</td>
<td>e.g. student response systems</td>
<td>Use of modern web technologies</td>
</tr>
<tr>
<td></td>
<td>Increase quality</td>
<td></td>
<td>Include stakeholders outside of school, parents in particular</td>
</tr>
</tbody>
</table>

Table 1: Phases and activities for conducting a design experiment
3.3 Impact Expectations

Our general expectation is that classrooms and homes will become more conducive to learning and more motivating to the extent that the cognitive density is optimized in these places. While there are many other factors affecting learning and motivation (such as teachers’ knowledge and enthusiasm), cognitive density is an indicator that can be set in relation to the use of information technologies, via the parameters content, temporal, and communicative density. Using these constructs, impact claims can be made more precise and measurable.

The most important claims are that students’ learning gets improved because of optimizing content, temporal, and communication density and that teachers’ learning will be fostered as well. Figure 4 illustrates how focussing the use of ICT on classroom assessment can trigger and enable changes at higher levels.

Figure 4: A cascading impact model

Students’ learning improves as content density is increased by providing learners with a wide variety of content, tools and social resources (e.g., classes, on-line networks). Moreover, the opportunities for students to claim interest or identity development activities as accountable and the automatically capturing of students’ work process and products optimize content density. Teachers’ decision making based on easy access to records and products of individual students will become improved because of the availability of relevant information in (almost) real-time. Furthermore, more frequent and more student-specific feedback from teachers, advanced learning technologies (given automatically), peers, and stakeholders outside of school (e.g., parents’ appraisal) will also contribute to content density. Temporal density is optimized by automating routine procedures (e.g., by outsourcing checks to software), synchronizing processes, providing timely feedback (close in time to the learning activity), and differentiating task timing according to students’ knowledge and motivation. Communication density is optimized by using simultaneous communication channels for teacher-students and student-student communication, employing a shared terminology, employing agreement upon communication patterns, and using appropriate communication technologies to include parents and other stakeholders from outside of the school. The content differentiation, feedback specificity, individualised timing of learning and feedback are impact claims regarding the individualisation of learning. As a consequence, cognitive density is optimized and thereby students’ engagement with the learning content is increased; students’ participation in classroom activities is increased; their time on task in increased; and the amount of what counts as accountable for learning is increased.

Teachers’ learning will get fostered by receiving more frequently feedback from students concerning the quality of their interventions, thereby reflecting more upon their teaching, and adapt it to students’ needs. Moreover, teachers’ assessment literacy and their capacity to include IT into teaching and assessment will increase substantially due to their continuous engagement in the planning of authentic, IT-embedded assessment that is integrated with pedagogical strategies. Furthermore, also significantly increased will be
teachers' capacity to inquire into their students' learning, to make use of rich data on students' learning, and to adapt their future teaching accordingly.

Regarding competency development and employability, NEXT-TELL will have impact in three forms: Firstly, students' capacity for self-guided learning is systematically addressed and methodologically supported, because students are allowed to plan their learning and assessment with NEXT-TELL tools and students can monitor their learning. This will increase students' employability. Secondly, as part of NEXT-TELL's approach to certifying teachers' assessment literacy and IT literacy; a competence framework will be developed. This will be an important contribution to the competency development of teachers. And finally, combining teacher-led research/inquiry with professional development and schools' strategic planning and management and supporting this combination computationally, as demonstrated in NEXT-TELL, is a very interesting model for building human capacity in the education sector, particularly because it puts continuous innovation of teaching practices (with or without IT) into the centre, instead of having teachers playing catch-up.

With regard to empowerment of learners and teachers, we expect significant impact on students' capacity to self-direct their learning (because they, like teachers, are supported by NEXT-TELL in planning for learning and for self-assessment), to provide constructive peer feedback, and to be higher motivated and engaged because of the increase of opportunities to make their interest-guided and identity-related activities relevant for school.

The increase of teachers' assessment and IT literacy combined with the NEXT-TELL open assessment methodology will lead to a sustainable contribution of teachers to the continuous innovation of classroom assessment methods, if and when supported by school leadership. This constitutes a substantial empowerment given the importance of assessment in education and the marginalized impact teachers have on assessment in many educational systems.

Finally, schools' capacity for data-driven decision making and for the continuous innovation IT-embedded teaching and assessment will increase as a result of said increases in teachers' capacities in combination with the methodology for strategic alignment that NEXT-TELL will provide to school leaders.

Achieving impact on levels of educational systems beyond the more or less directly involved target group is notoriously difficult for projects that aim at pedagogical and technical innovation. This is not only the case for technology enhanced learning (TEL) research, but also for research in Educational Psychology [Rothkopf, 2008]. In our aspirations in this project, we are guided by two principles:

1. NEXT-TELL is an infrastructural rather than an application-oriented project: It aims for providing a platform within which (classroom and formative) assessment methods can be developed and modelled, their integration into specific learning and classroom technologies can be supported, and that provides the means to support teachers in analyzing the information coming back from the application of these methods for purposes of pedagogical decision making, school development, professional development, and continuous innovation of assessment.

2. NEXT-TELL is about second-order change: changing the ways in which change is brought about. As such, it is not primarily about producing a set of ‘next generation’ assessment methods, but about a methodology to make the development of next generations of assessment methods easier and more of a democratic and continuous practice.

These principles lead us to the following core vision statement:

First and foremost, NEXT-TELL wants to provide an innovation platform: A set of methods and tools that can support (mainly) teachers in continuously and collaboratively innovating the use of ICT for Formative Classroom Assessment.

In terms of this vision, the main success measure for NEXT-TELL is this one: Teachers engage as a matter of professional practice in developing and rigorously testing new classroom assessments that make use of ICTs.
4 Methodological Approach: Design-based Research

Empirical research in NEXT-TELL serves three purposes:

1. To contribute to theory development, in particular to the concept of cognitive density and ICT-supported diagnostic reasoning;
2. To contribute to technology development around the NEXT-TELL platform;
3. To contribute to policy development by assessing the effectiveness and the impact of NEXT-TELL methodologies and technologies.

We have chosen Design-based research (DBR) as the general methodology for NEXT-TELL, because it is arguably one of the few research methodologies in the learning sciences that can be employed to address issues of theory development, pedagogy and technology development, and policy development at the same time.

4.1 Background

“Design-based research” or “design research” was proposed in the early 90s by Brown as well as by Collins as a research approach that extends existing methods and addresses the issue of theory and practice link in educational research [Brown, 1992; Collins, 1992]. Since then, design research has evolved in different directions and has been used in learning research in various forms [see Confrey, 2006]. In recent years, this approach has been the subject of extensive methodological discussions and reflections in special issues of educational journals and in books [see Barab, 2004; Kelly, 2003; Kelly, 2008; Sand保罗, 2004].

Design-Based Research (DBR) is characterized as an inter-disciplinary mixed-method research approach conducted “in the field” that serves applied and theory-building purposes. Wang and Hannafin define DBR “as a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories” [Wang, 2005, p. 6]. They identify five characteristics: (a) pragmatic (i.e. design-oriented and intervention-oriented); (b) grounded in theory and research; (c) interactive, iterative and flexible; (d) integrative; and (e) contextual.

One of the main motivations behind DBR is to make learning research more relevant for classroom practices. It has been often argued, that most learning research conducted by educational researchers, psychologists and cognitive scientists in university “lab” settings is not known to educators, and does not, for the most part, affect teaching practices or educational policies. One of the reasons is that teachers find it difficult to implement learning innovations as the lab setting where the learning innovation has been established is too different from the demands and constraints of the classroom. This, for example, may concern the alignment with curriculum, standards and assessment requirements, teachers’ and students’ time, logistical and technical constraints [Fishman, 2004].

This unsatisfactory state of affairs has led researchers such as Ann Brown [Brown, 1992] to suggest a form of learning research that does take place to a large extent within the authentic setting, involving close cooperation with teachers and students. The expectation is that research that yields its findings in close proximity to real schools will eventually be more easily and rapidly implemented in classrooms in general.

Common characteristics of design studies are their relatively extended duration – weeks and months – and the close involvement of the researchers and developers with the study participants. Data acquisition and analysis has to be (close to) continuous in order to drive forward multiple cycles of testing and design optimization. It is rather typical for DBR that not only students’ understanding changes as a result of the pedagogical innovation, but also researchers’ conceptions change as a result of what they observe in the learning setting. There is no strict separation between theory development and theory testing; rather, the two are interwoven in a manner reminiscent of grounded theory [Glaser, 1967]. An important variant of DBR is teacher design research where teachers are ‘driving’ the research into the effects of design and where teachers’ learning and professional development are integral elements [Bannan-Ritland, 2008].

The notion of “theory” plays an important role in DBR; and, differently from some variants of qualitative research, DBR aspires to produce explanatory accounts that are not solely descriptive accounts. Theory in DBR
is closely related to practice and this link has its roots in the origins of the approach. Namely, Ann Brown introduced design research as a means to increase the relevance of theory (that at that time came from cognitive science laboratories performing experiments on learning) to practice (in classrooms) [Brown, 1992]. Allan Collins introduced design science as a means to increase the impact of best teaching practices on theories of learning [Collins, 1992]. Both views of the theory-practice relationship are still relevant.

4.2 Steps in Conducting a Design Study

DBR is not a specific data collection and analysis method, but rather a framework that orients the use of other specific methods and techniques, such as video, verbal data, and statistical analysis. Given the goal to not only learn about learning (and contribute to a research community’s knowledge), but to also support the development of particular forms of learning (thus contribute to students' knowledge); the methods also comprise ways and procedures for designing specific elements of learning environments: tasks, materials, tools, patterns of communication and interaction, instructional sequences. Given that a design study addresses students' learning in a substantial manner, there is always an element of teaching involved. Sometimes the researchers directly interact with individual students or take the teacher's role in a classroom. In other cases, they might cooperate with teachers to implement a specific design in classrooms.

A range of specific research activities are compatible with the DBR paradigm. Table 2 summarizes key DBR phases and typical activities. To provide a sense of how a (proto-) typical design study is conducted, this section reviews briefly each activity and illustrates the main aspects using the terminology provided by Cobb and Gravemeijer [Cobb, 2008]. The methodology as suggested by them distinguishes three phases: preparation, experimentation, and retrospective analysis. Design experiments can involve a 'control group', but since they are conducted in real educational settings over longer durations, this can raise ethical as well as practical concerns. For instance, 'treatments' cannot easily be confined to a specific group of participants due to the interactions between students on the school ground. The prototypical design experiment is, hence, not of the control-group type, but employs 'within-subjects' comparisons.

<table>
<thead>
<tr>
<th>Phases</th>
<th>Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1: Preparing the experiment</td>
<td>• Clarifying the instructional goals</td>
</tr>
<tr>
<td></td>
<td>• Documenting the instructional starting points</td>
</tr>
<tr>
<td></td>
<td>• Delineating an envisioned learning trajectory</td>
</tr>
<tr>
<td></td>
<td>• Placing the experiment in a theoretical context</td>
</tr>
<tr>
<td>Phase 2: Experimenting to support learning</td>
<td>• Collecting data in cycles of design and analysis</td>
</tr>
<tr>
<td></td>
<td>• Applying interpretive frameworks</td>
</tr>
<tr>
<td></td>
<td>• Formulating and testing domain-specific instructional theories</td>
</tr>
<tr>
<td>Phase 3: Conducting retrospective analyses</td>
<td>• Explicating the argumentative grammar</td>
</tr>
<tr>
<td></td>
<td>• Establishing trust in the findings</td>
</tr>
<tr>
<td></td>
<td>• Ensuring repeatability</td>
</tr>
<tr>
<td></td>
<td>• Ensuring generalizability</td>
</tr>
</tbody>
</table>

Table 2: Phases and activities for conducting a design experiment

4.2.1 Preparing the experiment

Since a design experiment aims to contribute to improving learning, clarifying the instructional goals to be addressed is pivotal. This can be done by relying on curricular documents and goals, but given the effort required for a design experiment, researchers need to make sure that the instructional goals will provide as much leverage as possible. This requires an in-depth analysis of the curricular documents, and often
reformulations to identify central domain concepts around powerful ideas [Roschelle, 2009]. Documenting the instructional starting points involves identifying students’ current level and learning in terms of their prior instructional histories. This might require creating assessments and other diagnostic procedures to probe into what students typically learn in the context of standard instruction. For example, Cobb and Gravemeijer recommend such methods as interviews with individual students and whole-class performance assessment using video rather than written forms of assessment for evaluating students’ reasoning in their study [Cobb, 2008]. This might require creating assessments and other diagnostic procedures to probe into what students typically learn in the context of standard instruction.

The next essential step is delineating an envisioned learning trajectory. The research here will “...formulate testable conjectures about both significant shifts in students’ reasoning and the means of supporting and organizing these shifts.” [Cobb, 2008, p. 70]. This requires formulating a process model of learning – how learning unfolds over time – which in turn necessitates mobilizing theory. This process model needs also to spell out the materials, tasks, and technologies that support students’ learning trajectory – the design. The trajectory model will need to take into account factors that affect the enactment of the design, such as classroom norms and the nature of classroom discourse. The model further needs to be explicit about the teacher’s role. Given the central mediating role of teachers in classrooms, this often means designing tasks and materials (including software) as a resource in the hand of the teacher, and to involve teachers as co-designers early on in the research planning.

The requirement to conjecture a plausible learning trajectory provides a natural link to placing the experiment in a theoretical context. Theories most useful for the purpose of developing a process model are of the domain-specific, mid-range type. ‘Grand’ theories of learning might play an orientating role, but to spell out a process model more specific theories or models are needed. Placing the experiment in a theoretical context helps to produce knowledge that will be useful in providing guidance to others as they attempt to support similar learning processes.

### 4.2.2 Experimenting to support learning

The focus of experimenting in DBR is on supporting learning; the purpose is not to show that the learning trajectory “works”, but to improve the envisioned design by testing and revising conjectures about both the prospective learning process and the specific means supporting it study [Cobb, 2008]. Data collection will need to be carefully planned so that the data acquired speak to the conjectures and do so in a manner that later retrospective analyses with a potentially wider theoretical framework can be performed rigorously. Data collection should not only cover data on students’ learning and classroom practices, but also cover the learning process of the research team. That means that the process of conjecture testing and revising taking place amongst the researchers and usually the teacher(s) should be recorded with video or audio, and carefully documented in textual format. For example, Edelson suggests keeping compiling a log of ongoing interpretations, conjectures, decisions, and so forth [Edelson, 2002].

Because of the different kinds of data collected in design studies – most of them taking an open format, e.g. classroom discourse, answers to semi-structured interviews, non-standard classroom assessments – and because of the tentativeness of applicable theoretical models, making sense of the data is typically a highly inferential, interpretative, and cyclical process. Furthermore, these interpretations and the decisions based on them will profoundly shape the development of the design. This necessitates articulating carefully the key constructs that were used making interpretations and decisions. The interpretive framework will hardly stay static over the course of a design experiment, hence articulating, critiquing, and refining the framework need not only to be practiced, but also to be documented.

Theories that come out of a design experiment or a series of design experiments that relate to the same learning goals are domain-specific and instructional. Such a theory consists of a description of a learning trajectory that leads to achieving significant learning goals in a particular domain as well as the demonstrated means of supporting the learning process [Cobb, 2008]. The theory needs further to capture the rationale for the design decisions it entails. With these components in place, such theories are useful because they allow others to customize the sequence of activities and resources to their settings. The contribution of the design study or a series of studies to theories of learning, in addition to instruction, can be achieved by retrospective analysis, which is considered next.
4.2.3 Conducting retrospective analyses

While for the purpose of improving learning the development of a domain-specific instructional theory is sufficient, most learning researchers (as distinct from educational practitioners) will aspire to make contributions to general or, at least, domain-specific learning theories. This requires placing a specific study into a broader theoretical context, by framing it as a paradigmatic case of a more encompassing phenomenon. As in all approaches, methodological concerns regarding the trustworthiness and generalizability of findings as well as the repeatability of the design need to be addressed. These questions are well discussed in the literature. For example, Cobb and Gravemeijer provide a short treatment of these aspects specific to DBR [Cobb, 2008], Yin for case studies [Yin, 2003], and Miles and Huberman for qualitative methods in general [Miles, 1994]. At a deep conceptual level, satisfying these concerns ultimately depends on the logic of the method, or its argumentative grammar: (a) what it legitimates as evidence; and (b) how evidence is related to inferences and conclusions.

4.3 Design-based Research in NEXT-TELL

As will be further detailed in Section 6, NEXT-TELL will conduct two variants of DBR: a researcher-led variant (RDS), and a teacher-led variant (TDS). RDS will essentially be conducted along the model outlined in Section 4.2 above, while TDS will largely follow the model proposed by Bannan-Ritland [Bannan-Ritland, 2008]. The main purposes of the RDS variant are theory and technology development, while the main purpose of the TDS is pedagogical and policy development. In particular, we will develop capacity to conduct TDS in participating teachers, and to profit from TDS in participating schools, thus addressing issues of sustainability (How can an educational innovation be sustained after the researchers leave the school site?) and scalability (How can an innovation or meta-innovation be spread beyond the "inventors"?).
5 Outline of the Project Studies

To provide an overview of the overall research approach in NEXT-TELL, the studies outline of the project is presented in this chapter. Figure 5 depicts the planned course of design-based research studies during the four periods of NEXT-TELL. The months framed in colours visualize the possible studies times to collect data in schools. Each study phase ends at latest two months before the official report on it is due.

5.1 Overview

The project is divided into four periods (period 1, period 2, period 3, and final period) and four types of studies (baseline studies, requirement analyses, researcher-led design studies, and teacher-led design studies). Moreover, we distinguish between four cohorts (cohort 1a, cohort 1b, cohort 2a, and cohort 2b). Each cohort is made up of a group of teachers and respective school leaders who enter the project at a specific time in the course of studies and who ideally participate until the end of the project. Ideally, a cohort starts with the ECAAD methodology and adds the TISL methodology and strategy planner some time later. However, it is also possible to a certain limit that groups of teachers and/or school leaders form an extra cohort, if they are all interested in working only with a specific tool in a limited sense, because the NEXT-TELL tools (ECAAD platform, TISL platform, and strategy planner) can be used on their own and do not necessarily need to be used all together. Teachers participating in the project teach classes from class level 7 to class level 9 in STEM and/or TESL. We concentrate on these grade levels, because students should be old enough to work with ICT on their own and understand feedback visualizations but are not yet in graduation classes.

In period 1, a baseline study (BS) will be conducted to gather information about the current status quo of ICT in schools across at least four countries (Austria, Germany, England, and Norway). Afterwards follows a requirement analysis (RA), in which teachers and researchers work together to develop teaching-learning scenarios that will be implemented during the studies in period 2 of the project. About half of the teachers will be STEM teachers forming the STEM strand of the project, the other half will be TESL teachers forming the TESL strand of the project. The two study cycles in period 2 will be researcher-led design studies (RDS). Whereas cohort 1a takes part from the very beginning, cohort 1b joins the project first for the second RDS. In period 3 and 4, the RDS are replaced by two teacher-led design studies (TDS) with both cohorts a and b taking part. In TDS, teachers collaborate together to investigate their students’ learning according to their interests, needs, and/or the school leaders’ advice. This overall cycle of BS, RA, RDS, and TDS with cohort 1a and cohort 1b will
be repeated with cohort 2a and cohort 2b respectively. The second studies cycle will start after a time lag of about 1.5 years, and thus, only contains one TDS. The depicted studies outline is especially adapted to countries like Austria and Germany that are not yet used to TDS. Countries like England or Norway that have already experiences with TDS are free to introduce TDS as soon as possible to meet the individual needs of the school systems.

The overall design enables comparisons concerning four different issues:

- Working with STEM and TESL teachers enables us to investigate whether NEXT-TELL-related constraints and affordances differ between domains.
- Working with teachers who help to develop together with the researchers the scenarios for their classes (cohorts 1a and 2a) can be compared with teachers and classes who just adapt the scenarios developed by others (cohorts 1b and 2b), thereby enabling us to investigate how important the teacher engagement is in scenario development.
- The timely reduced and delayed but identical studies cycle of cohort 2a and 2b enables us to learn from the first studies cycle of cohort 1a and 1b as well as to compare whether and how different situations alter the implementation and results.
- Working with teachers across different countries enables us to investigate the differences among different school systems.

The next paragraphs detail the course of studies and their meaning within the project.

5.2 Period 1

In Period 1, a baseline study (BS1) and a requirement analysis (RA1) will be conducted which were planned in the preceding planning phase.

5.2.1 Plan

The following study concepts which will be conducted throughout the next four years were planned during the first three project months (September 2010 – December 2010). For designing the first two studies (BS1 and RA1) WP6 generated questionnaires for WPs2-5 to collect and structure information about important issues and questions of the WPs concerning the current teaching status and how the different WPs plan the collaboration with the teachers in RA1. Furthermore, WP6 will develop research instruments (questionnaires and (semi)-structured interviews) to collect the data of interest in the BS1 and BS2.

5.2.2 Baseline Study 1

During project months 5-6 (January 2010 - March 2011) there will be the first BS in at least four countries (Austria, England, Germany, Norway). Possibly, some more other countries (e.g., Denmark) will be involved in BS1. There should be at least about 16 teachers across eight schools who take part in this study. Ideally, there will be at least two teachers teaching the same subject at the same class level in one school to enable teacher collaboration. At the moment, the partners are acquiring the teachers in the respective countries. About half of the teachers acquired teaches STEM, the other half teaches TESL, thereby building two study strands that pass through the same studies but differ in the domains. The teachers and schools joining the project in BS1 should be highly motivated, because they should ideally stay until the end of the project in 2014, that is a duration of about 3.5 years and includes taking part in RA1, RDS 1, RDS2, TDS1, and TDS2. These teachers with their classes and school leaders form cohort 1a and represent at minimum the in-depth analysis of the current status quo of ICT in school teaching across the different countries. Hence, the output is an overview of the current state of teaching practices and the use of ICT in teaching and learning in at least four countries (Austria, England, Germany, and Norway). This information will help the NEXT-TELL researchers to plan the RA1.

5.2.3 Requirement Analysis 1

During project months 7-10 (March 2011 - August, 2011) the RA1 will take place with cohort 1a. According to designed-based research approach the researchers of WP2-WP7 will work closely together with the 16
teachers of cohort 1a to develop and adapt two STEM and two TESL scenarios and the NEXT-TELL tools to the individual teachers’ needs. The outputs of RA1 are two executable scenarios. Whereas the first scenarios will be implemented within the ECAAD platform in RDS1, the second scenarios will be implemented within ECAAD in RDS2. To qualify the teachers in using the ECAAD platform and non NEXT-TELL learning applications (e.g., GDocs, OpenSim) WP7 will conceptualize respective trainings for teachers. NEXT-TELL tool developers will instruct and train the people of WP7 in using the tools. Based on this information, WP7 will develop trainings, which they will teach to the responsible trainers in all countries, so that the participating teachers and school leaders are trained just in time in how to use the respective tools.

5.3 Period 2

Period 2 is two-fold. On the one hand, the first and second researcher-led design study (RDS1 and RDS2) will be conducted. RDS involves typically (at least) two development cycles. The first RDS should be used to give feedback to the second RDS concerning the re-design of scenario 2 developed in RA1. On the other hand, a third cohort (cohort 2a) is acquired

5.3.1 Researcher-led Design Study 1

In project months 13-16 (September 2011 – February 2012) the first researcher-led design study will take place with the 16 teachers of cohort 1a with one of the two scenarios developed in RA1. The different research questions concerning how (1) the ECAAD platform with its different tools influences teaching and learning practices and (2) how the technology is used and accepted will be addressed.

5.3.2 Researcher-led Design Study 2

In project months 19-22 (March 2012 – June 2012) the second researcher-led design study will take place with the 16 already experienced teachers of cohort 1a and with 16 additional teachers forming cohort 1b. The group of teachers forming cohort 1b will be similar to cohort 1a. Teachers of at least four countries will partake. Half of them teaches STEM and the other half of them teaches TESL. At least two teachers teaching the same subjects and in the same grade level should be found in the schools taking part. Because cohort 1b is not yet familiar with the ECAAD platform, these teachers will be trained in it in project months 18 and 19. The scenario 2 developed in RA1 will be implemented with the re-design concerning the feedback of RDS1. Again, the different research questions concerning how (1) the ECAAD platform with its different tools influences teaching and learning practices and (2) how the technology is used and accepted will be addressed.

5.3.3 Baseline Study 2

In project months 19-20 (March 2012 – April 2012) the second base line study (BS2) will take place. About 24 teachers of about 12 schools will take place forming cohort 2a. The teachers from the schools will be selected according to the rational of cohort 1a and 1b. The teachers of cohort 2a with their classes and school leaders will represent the in-depth analysis of the current status quo of ICT in school teaching across at least four countries (Austria, Germany, England, and Norway). As with BS1 the output will present an overview of the current state of teaching practices and the use of ICT in teaching and learning in at least four countries (Austria, England, Germany, and Norway) about one year later than BS1. This information will help the NEXT-TELL researchers to better plan the RA2.

5.3.4 Requirement Analysis 2

In the project months 21-23 (May 2012 – August 2012) the NEXT-TELL developers will work closely together with the teachers of cohort 2a to develop new scenarios for RDS3 and RDS4. Although researchers have the experience of BS1, RA1, and RDS1 to that point, it is important to know which scenarios and how other teachers develop their teaching-learning scenarios. Depending on teachers’ knowledge and skills with non-NEXT-TELL learning applications (e.g., GDocs, NetLogo), these teachers might be trained in such applications like it might be necessary with the teachers from cohort 1a and 1b.
To qualify the teachers of cohort 2a and 2b in using the ECAAD platform and non NEXT-TELL learning applications (e.g., GDocs, OpenSim) WP7 will adapt the existing trainings. Depending on further tool releases and changes, NEXT-TELL tool developers will instruct and train the people of WP7 in using the tools. WP7 will update the responsible trainers of the different countries if necessary.

If not already happened before, parallel to the mentioned studies in Period 2, the strategic planning tool for school leaders will be developed as well as a strategy of establishing a network of school leaders.

5.4 Period 3

Period 3 is two-folded. Whereas the first teacher-led design study (TDS1) will be conducted with cohort 1a and cohort 1b, two researcher-led design studies (RDS3 and RDS4) will be conducted with cohort 2a and one (RDS4) with cohort 2b. In teacher-led design studies, teachers themselves work on a kind of research project in a self-guided fashion. Teachers alone or teachers in collaboration with their school leader or principal identify a local issue that is linked to the school’s respective strategic goals, and then use elements of design, implementation, and data analysis to address the issue in an evidence-oriented manner as empirical researchers would do. WP5 will develop a methodology how to best implement TISL. The TDS will be supervised by project persons to facilitate teachers’ professional development and to investigate the implementation of the TISL methodology.

5.4.1 Teacher-led Design Study 1

In project months 25-34 (September 2012 – June 2013) the first teacher-led design study (TDS1) will take place with the 32 teachers of cohort 1a and 1b. The teachers will be trained in TISL before-hand, if they are not yet familiar with the TISL methodology and the TISL platform. School leaders of teachers from cohort 1a and cohort 1b will be asked to use the strategy planner. The research questions concerning TISL will be addressed.

5.4.2 Researcher-led Design Study 3

In project months 25-30 (September 2012 – February 2013) the third researcher-led design study (RDS3) will take place with the 24 teachers of cohort 2a. This is the third scenario implementation for the project but the first one for the teachers of cohort 2a. Thus, the study resembles RDS1, although the NEXT-TELL researchers are already experienced. The different research questions concerning how (1) ECAAD with its different tools influences teaching and learning practices and (2) how the ECAAD tools are used and accepted, will be addressed.

5.4.3 Researcher-led Design Study 4

In project months 31-34 (March 2013 – August 2013) RDS4 will be conducted with the 24 teachers of cohort 2a and with 24 additional teachers forming cohort 2b. The teachers are selected according to the rational applied with the other cohorts. Like teachers of cohort 1b the teachers of cohort 2b will be more unfamiliar with the ECAAD concept and tools than cohort 1a and cohort 2a, and therefore will be trained before-hand. Again, the different research questions concerning (1) how ECAAD with its different tools influences teaching and learning practices and (2) how the tools are used and accepted will be addressed.

5.5 Final Period

In the final project period, the second and third teacher-led design study (TDS3 and TDS4) will be conducted.

5.5.1 Teacher-led Design Study 2

In project months 37-43 (September 2013 – May 2014) TDS2 will take place with the 32 teachers of cohort 1a and 1b. The respective school leaders are asked to use the strategy planner to support the teachers. As TDS2 is the second cycle of a teacher-led design study, adaptations according to the feedback of TDS1 will be incorporated. The research questions concerning TISL will be addressed.
5.5.2 Teacher-led Design Study 3

In project months 37-43 (September 2013 – May 2014) TDS3 will take place with the 48 teachers of cohort 2a and 2b. TDS3 is the first teacher-led design study for these cohorts. The cohorts will be trained beforehand. The school leaders will be asked to use the strategy planner and to support the respective teachers. The research questions concerning TISL will be addressed.

After TDS2 and TDS3 are conducted the overall integration of all RDS studies and all TDS studies will be completed. In the end, about 80 teachers of about 40 schools should have participated in the project.
6 Studies Descriptions

Whereas chapter 5 presented an overview of the course of the studies in NEXT-TELL, chapter 6 details the concepts on what the project studies will investigate and how this will be done. The four types of studies are described according to their sequence in the overall course of studies.

6.1 Baseline Study

The purpose of the BS is to collect information on the current state of the art of ICT in schools and teaching practices. The results will inform the project partners about the schools’ technical equipment as well as teachers’ and students’ experience level with ICT. Furthermore, the results of the BS provide first information on how teachers currently plan lessons, monitor and diagnose students’ learning, give feedback, and assess students. Hence, the project partners get a detailed picture about the sample of teachers with whom they will work together. A detailed BS is planned for cohort 1a and cohort 2a. We also try to incorporate as much from the BS in the starting phases of cohort 1b and 2b to gather the same information from teachers joining the project at these entry points. In the BS, the following seven main topics with several sub-issues are of interest: (1) general information of schools and teachers, (2) schools’ infrastructure, (3) ICT experience, (4) attitudes towards ICT, (5) teaching practices, (6) learning practices, and (7) teachers’ professional development. Data will be collected by (online-)questionnaires and (semi-structured) interviews. The following tables present an extraction of which data will be collected concerning our topics of interest.

### 6.1.1 General school and teacher information

This type of demographical information about schools and teachers is necessary for later data analyses investigating whether there are differences in the impact of the implementations depending on these data. Table 3 gives an overview about the general information that will be assessed within NEXT-TELL.

<table>
<thead>
<tr>
<th>Level</th>
<th>Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>• Country</td>
</tr>
<tr>
<td></td>
<td>• District</td>
</tr>
<tr>
<td></td>
<td>• Type of school</td>
</tr>
<tr>
<td></td>
<td>• Type of subject strand (focus on language, music etc.)</td>
</tr>
<tr>
<td></td>
<td>• Number of students</td>
</tr>
<tr>
<td></td>
<td>• ICT-plan</td>
</tr>
<tr>
<td>Teacher</td>
<td>• Gender</td>
</tr>
<tr>
<td></td>
<td>• Age</td>
</tr>
<tr>
<td></td>
<td>• Teaching experience</td>
</tr>
<tr>
<td>Student</td>
<td>• Gender</td>
</tr>
<tr>
<td></td>
<td>• Age</td>
</tr>
<tr>
<td></td>
<td>• Mother tongue</td>
</tr>
</tbody>
</table>

Table 3: General information

### 6.1.2 Schools’ technical infrastructure

Information about the schools’ technical infrastructure is interesting because it demonstrates how well the technical aspects are already implemented in schools and whether schools are already equipped with the necessary technique needed to implement NEXT-TELL. These data can be collected by questionnaires...
administered to the responsible IT-person at schools. Table 4 gives an overview about the questions assessing schools’ technical infrastructure.

<table>
<thead>
<tr>
<th>Category</th>
<th>Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware and software</td>
<td>• Pupils per computer</td>
</tr>
<tr>
<td></td>
<td>• Quality of computers</td>
</tr>
<tr>
<td></td>
<td>• Operating system</td>
</tr>
<tr>
<td></td>
<td>• Software types</td>
</tr>
<tr>
<td>Computer locations</td>
<td>• Computers per student</td>
</tr>
<tr>
<td></td>
<td>• Computer labs</td>
</tr>
<tr>
<td></td>
<td>• Notebook-classrooms</td>
</tr>
<tr>
<td></td>
<td>• Students’ access to computers</td>
</tr>
<tr>
<td>Networks and services</td>
<td>• Internet access</td>
</tr>
<tr>
<td></td>
<td>• Bandwidth</td>
</tr>
<tr>
<td></td>
<td>• Server</td>
</tr>
<tr>
<td></td>
<td>• Webserver hosting</td>
</tr>
<tr>
<td></td>
<td>• e-mail service</td>
</tr>
<tr>
<td></td>
<td>• Service/person in charge</td>
</tr>
</tbody>
</table>

Table 4: Schools’ technical infrastructure

6.1.3 ICT experience and use

The ICT experience and use of teachers but also of students and of school leaders in the context of teaching and learning as well as in other contexts will be investigated by (online-)questionnaires and structured interviews. Table 5 gives an overview about the questions assessing ICT experience and use.

<table>
<thead>
<tr>
<th>Category</th>
<th>Issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>General experience</td>
<td>• Qualifications</td>
</tr>
<tr>
<td></td>
<td>• Sense of familiarity with ICT in general</td>
</tr>
<tr>
<td></td>
<td>• Familiarity with digital online curriculum</td>
</tr>
<tr>
<td>ICT in teaching and learning</td>
<td>• Use of platforms: teaching/learning platforms (e.g., moodle), teacher platforms</td>
</tr>
<tr>
<td></td>
<td>• E-learning: use of local programs, web-based programs, internet resources (e.g., Wikipedia), cognitive tutors, simulations</td>
</tr>
<tr>
<td>Purpose of ICT use</td>
<td>• Improving learning</td>
</tr>
<tr>
<td></td>
<td>• Increasing students’ engagement</td>
</tr>
<tr>
<td></td>
<td>• Supporting 21st century skills</td>
</tr>
<tr>
<td></td>
<td>• Delegating teaching responsibility to ICT</td>
</tr>
<tr>
<td>ICT in other contexts</td>
<td>• Use of e-mail</td>
</tr>
<tr>
<td></td>
<td>• Web-games</td>
</tr>
<tr>
<td></td>
<td>• Community platforms (e.g., facebook)</td>
</tr>
</tbody>
</table>
6.1.4 Attitudes towards ICT

Attitudes often affect the way how persons interact with technical tools (e.g., engagement, joy, length, frequency). The utilization of ICT, however, influences the effects of ICT on the output that is produced with it (e.g., teaching and learning activities). Hence, we also want to investigate the attitudes of teachers and students towards ICT in general and towards the NEXT-TELL tools in specific. We will start to develop measurement tools on attitudes towards ICT in general during the BS and continue the measurement during the requirement analyses and throughout the different periods of the project to also measure attitudes towards NEXT-TELL tools in specific. Attitudes towards ICT are influenced not only by experience but also by the assumptions of what can or should be done with ICT or by positive or negative expectations. We want to assess attitudes by means of a variant of the Repertory Grid Technique [Fransella, Bell, & Bannister, 2004; Kelly, 1991]. According to a variant of this technique we start developing the measurement tool by interviewing a smaller amount of teachers and students to identify their personal constructs on ICT. Their main constructs can later be used as the basis for a survey that can be administered to all participating teachers and students in NEXT-TELL.

6.1.5 Teaching practices

Besides the above-mentioned focus on ICT, we are also interested in current teaching practices not necessarily connected with ICT to investigate teachers’ activities without NEXT-TELL tools. By means of structured interviews we gather data on teachers’ teaching practices. The interview will concern different topics trying to capture for instance the concept of cognitive density in relation with teachers’ diagnosing. Table 6 gives an overview about the questions assessing teaching practices.

<table>
<thead>
<tr>
<th>Topics</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>How do you plan your lessons concerning content and students’ assessment?</td>
</tr>
<tr>
<td>Diagnosing</td>
<td>How easy is it for you to diagnose students’ learning activities and progress during giving classes?</td>
</tr>
<tr>
<td></td>
<td>On which data do you rely your estimates?</td>
</tr>
<tr>
<td></td>
<td>How easily can you adapt your teaching to individual needs?</td>
</tr>
<tr>
<td>Feedback</td>
<td>When, how often, how, to whom, and on what do you give feedback?</td>
</tr>
<tr>
<td>Assessing</td>
<td>What do you assess (domain knowledge, behaviour, 21st century skills, qualitative vs. quantitative issues)?</td>
</tr>
<tr>
<td></td>
<td>How do you assess?</td>
</tr>
</tbody>
</table>

Table 6: Teaching practices

6.1.6 Learning practices

We are also interested in how students experience their own learning. Because in-depth interviews are not possible with many students, we will only interview a few students and then develop questionnaires that are easily to answer by students. The questions should be formulated in such a way that they can be adapted and administered in the RDS. Table 7 gives an overview about the questions assessing learning practices.

<table>
<thead>
<tr>
<th>Topics</th>
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</tbody>
</table>

Table 7: Learning practices
### D6.1 Specification of Research Strategy and Methodology

#### 6.1.7 Professional development and strategy planning

Teachers will be interviewed about their former and current ways of professional development and need for certification. Moreover, school leaders will be interviewed on how they currently manage their school leading tasks. These interview guides will be developed mainly by WP5 with support of WP6.

#### 6.2 Requirement Analysis

According to the approach of DBR the RA provides the opportunity for NEXT-TELL’s researchers, technology developers, and teachers to plan, design, and develop the learning scenarios and ECAAD platform. The project workers collaborate closely with the respective teachers during the RA to come up with important information and ideas about teaching and learning activities (with a focus on formative assessment) the NEXT-TELL tools are supposed to support. The RA is a central phase in the project, because project workers and teachers develop the first versions of the learning scenarios and executable ECAAD (and to some extent TISL) platform that build the base of RDS1 (and TDS). Because the output of RA1 (RA2) are the implementation scenarios of RDS1 and RDS2 (RDS3 and RDS4) that need developmental input from WP2, WP3, and WP4, the main steps of work are summarized according to the WPs. WP5 will work in parallel with (selected) teachers on the development of the TISL platform. WP6 will focus on investigating the collaboration with regard to positive and difficult phases in this process of design-based research. The general activities of the WPs are summarized. If possible, an assignment of the basic methodology and/or software on which the researchers and tool developers build on is provided.
6.2.1 WP2: ECAAD Method Development and Tooling

Activities. WP2 is divided into a TESL and a STEM strand. In both strands several steps have to be taken to develop the two scenarios that will be implemented in the RDS. First, the ICT tools and a selection of possible media as well as learning scenarios in STEM and TESL will be provided to the teachers of cohort 1a (in the second main cycle to the teachers of cohort 2a). Second, teachers select with the advice of the project workers which media and learning scenario they want to work with in their class. Third, the scenario is adapted to the curricular and pedagogical needs of the teachers. Fourth, teachers and researchers decide together which log file data and other activities and products of students’ behaviour reflect students’ learning progress and which data might best support teachers’ diagnosing of students’ learning progress and cognitive density, adaptive teaching, and assessment activities. During these discussions teachers should learn how to use the ECAAD platform. Fifth, teachers and researchers decide which artefacts should be produced by the students and be assessed by the teachers and how. Sixth, teachers and researchers might decide which students’ activities and artefacts might be assessed by peers and in which way. The sequence of steps may change and repeat during the process.

Methodological baseline. To support teachers’ assessment WP2 will start with a general modelling method for the design of summative assessment that was developed by the PADI project at SRI. This method will be extended into formative classroom assessment for STEM and TESL disciplines. Another baseline is the CbKST assessment framework that will be applied to both STEM and TESL scenarios as conceptual approach for domain analysis and domain modelling as well as the subsequent support of teachers in planning, assessing and negotiating assessment outcomes.

Software baseline. EduWeaver is a web-based course design tool that builds on Partner BOC-AT’s Advisor™ process modeling framework. NEXT-TELL will build on these platforms for both the ECAAD Learning Design Tool as well as the ECAAD Assessment Design Tool.

6.2.2 WP3: Capturing Student Learning Activities

Activities. WP3 will be informed which data should be logged according to the decisions made in WP2 and WP4. Researchers work on how to transform these data technically to make them useable for the visualizations of the OLM managed by WP4 and for the TISL platform managed by WP5.

6.2.3 WP4: Modelling Student Learning

Activities. WP4 will develop two aspects of the OLM: (1) visualization types presented on ECAAD’s Evidence Layer to provide feedback on students’ process of knowledge acquisition (learning activities), learning outcomes and other students’ activities teachers are interested in, as well as the handling of students’ artefacts for the e-Portfolio system, and (2) the negotiation tool to enable and stimulate during the RDS discussions between teacher, students and possibly parents on the assessment outcomes. WP4 and WP2 will further work on the ethical issue of which information about students’ activities can be governed by the students themselves (e.g., who is allowed to see which information) and which information is automatically accessible for teachers in order to assess the student.

Methodological baseline. The baseline is the SMILI framework for developing Open Learner Models by Partner BHAM [Bull, 2007]. This framework will be extended to capture non-cognitive aspects of learners (e.g., 21st century skills, epistemological beliefs, self-efficacy) and temporal parameters.

6.2.4 WP5: Teachers Learning and Strategic Planning

Activities. WP5 works on how to design the TISL platform for teachers’ professional development and research into students’ learning as well as teacher certification, and the strategy planner for school development. Topics that are important to solve in this project phase will be addressed and discussed with the teachers and/or school leaders. This process might be very selective according to the interests and experiences of the teachers and their school system. The same holds true for the developmental process of the strategy planner designed for school leaders.

Methodological baseline. For TISL, Bannan-Ritland’s Teacher Design Research Model [Bannan-Ritland, 2008] and Partner IOE’s Ecology of Resources Model [Luckin, 2010] build the baseline. NEXT-TELL will extend both
6.1 Specification of Research Strategy and Methodology

models by IT support to empower teachers to study students’ learning in greater detail and more effectively. For leadership and school development, the methods used by Partner MTO in workshop-based leadership development and the Baldrige National Quality Program will be extended to develop leadership education that targets the development of schools’ strategic IT plans and the integration with school teaching and learning plans.

Software baseline. AdoScore™ is a tool developed by Partner BOC-AT to support Balanced Score Card based strategic planning processes. This tool will be customized in such way that it can be used for the development of teacher capacity planning in schools.

6.2.5 WP6: Pilot Studies and Evaluation

WP6 will develop questionnaires to evaluate each meeting of teachers and project workers. Teachers and project workers will be asked, for instance, about the objective and subjective effectiveness of each meeting, about (subjective) difficulties they encounter with the scenarios and tools, solutions of difficulties, and professional learning experiences.

6.3 Researcher-led Design Studies

NEXT-TELL will employ the variants of researcher-led (RDS) and teacher-led (TDS) design studies as two variants of DBR. During the first (and third) RDS the learning scenarios and ECAAD platform developed in RA1 (and RA2) are implemented in the classrooms. According to the rational of RDS that involves typically at least two development cycles, a second (and fourth) RDS will follow that incorporates the feedback from the first classroom implementations and respective re-design of the scenarios or tools. Rich data on teaching and learning with the NEXT-TELL tools under realistic classroom conditions will be gathered during these implementation phases.

NEXT-TELL’s ECAAD platform is supposed to support different aspects of teaching activities, and as a consequence, to increase students’ learning outcomes. On teachers’ side, we will investigate how at least four teacher activities are influenced by the use of the ECAAD platform: (1) planning, (2) diagnosing, (3) providing feedback, and (4) assessing. On students’ side, we will investigate how the mentioned teacher activities are perceived by the students and how the ECAAD’s OLM influences students’ activities. We further investigate how students’ cognitive density (including content density, temporal density, and communicative density) is influenced by the implemented learning system, and whether cognitive density becomes more optimized within the system (including ICT tools as well as teaching activities and learning activities). The distributed nature of cognitive density makes it challenging to measure in any straightforward sense. Any measurement will require combining measurements of individual proximal indicators (subjectively felt engagement and ‘flow’, motivation to continue, objective measures such as activities/unit of time) with indicators that describe the social interactions in the classroom and their distribution. At this stage, no measurement framework for cognitive density exists. It will be part of the research in NEXT-TELL to develop one. One promising avenue seems to build on work in motivational psychology to measure peoples’ flow experience [e.g, Csikszentmihalyi, 1987; Csikszentmihalyi, 1990; Webster, 1993]. Moreover, an interesting issue to investigate is parents’ interest in their child’s learning activities, artefacts, and learning outcomes as presented in the ECAAD platform.

We will investigate how NEXT-TELL technology influences the above-mentioned concepts in teaching and learning by means of different methodologies, because in order to develop an understanding of how and why technology is used, misused, and appropriately applied requires an in-depth approach to research. Hence, data will be collected by (1) questionnaires, (2) interviews, (3) videos, (4) eye tracking methodology, and (5) log files. These five measurement methods differ in the quality of information they can provide, because the information provided differs in the objectivity and the scope of interpretation.

- Questionnaires (e.g., developed by means of the Repertory Grid Technique) and interviews provide subjective information of stakeholders, and thereby are an important tool to measure persons’ personal constructs [Kelly, 1991] and attitudes. If stakeholders would not accept the NEXT-TELL technology or encounter difficulties with it, self-reports are an efficient way to communicate this. Nevertheless, questionnaires usually provide answer options, thereby limiting the option to give other answers not provided in the questionnaire. Interviews provide room for individual answers but are
more resource consuming. Subjective data are more or less direct information of persons, and need no further interpretation. However, these data can only be recorded offline, that is, before or after activities took place. Although information of persons’ subjective experience is important it might be distorted to some extent by memory processes.

- Videos of teaching scenes, eye tracking data, and log file data provide objective information about stakeholders’ online activities on different levels. Therefore, teachers and their classes, who give the permission, will be filmed. Results of video analyses are supposed to offer insights into what is going on in the classes on the non-technological level but on how the use of the technology influences this level. Videos show teachers’ and students’ online activities in the classroom that allows for rather direct interpretations, if the behaviour can be coded directly. Although standard video analyses by hand are very resource intensive, we will use analyzing methods that are partially automated. Partner JRS will build on existing video annotation tools that allow describing the structure as well as persons, places, and objects in video. The tool makes use of automatic analysis components in the backend that provides coarse structuring of the video.

- Another important information source in investigating how specific and visually complex NEXT-TELL tools (e.g., the communication and negotiation tools) are used by the multiple stakeholders is stakeholders’ focus of visual attention. According to the field of Human-Computer Interaction (HCI) a successful way of investigating which information presented on the computer screen stakeholders really perceive and process is by means of measuring stakeholders’ visual attention by eye-tracking equipment. Eye tracking data perfectly describe where and when stakeholders looked at and how long, however, these data need some more interpretations concerning the question how stakeholders processed the information cognitively, affectively, and motivationally. Eye tracking data combined with cued-retrospective recall are a powerful method to support the data interpretations [Van Gog, 2005]. Such information will be very helpful in developing and re-designing which information is presented in the OSM and how it should be best presented to elicit important cognitive processes in stakeholders [Bull, 2007].

- Log files are another important data source in NEXT-TELL. They are objective measures of what is going on during teaching and learning concerning the use of ICT. However, there can be more or less room for interpretation depending on the type of data. Whereas answering a knowledge test item correctly allows rather few room for interpretations, the time of how long a document is opened allows more room for interpretations, because it is not clear whether students process its information mindfully. Finding log file data that represent students’ learning processes and that support teachers’ diagnosing and assessing activities is therefore an important measurement issue in NEXT-TELL.

In a nutshell, each method has its advantages and limits. The methods complement each other rather than compete with each other. Hence, we will work with a combination of these methods for the in-depth analyses of NEXT-TELL’s impact on teaching and learning.

### 6.4 Teacher-led Design Studies

The second variant of DBR which will be employed in NEXT-TELL is TDS. In TDS, teachers themselves are the innovators, and work on a research project in a self-guided fashion. Teachers identify a local problem or issue they want to solve, ideally linked to their school’s respective strategic goals, and then use elements of design, implementation, and data analyses to address the problem in an evidence-oriented, rigorous manner. In NEXT-TELL, three long-term TDS will be run that build on two approaches, (1) the Teacher Design Research [Bannan-Ritland, 2008] and (2) the Ecology of Resources of Partner IOE [Luckin, 2010]. These studies will address the schools’ needs as well as the research questions concerning the project.

Concerning teachers’ professional development, WP5 and WP6 will introduce and accompany teachers in doing their own inquiries into students’ learning. Both WP5 and WP6 will develop a research concept that includes teachers according to the participatory design approach [McKenney, 2006]. All five data collecting methods already applied during the RDS can be used to investigate and evaluate the impact of the TISL methodologies and platform on teachers’ core ideas, beliefs, self-concept of their teaching practices and their teaching practices themselves as well as on teachers’ collaboration with their colleagues. For example, it is suggested
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that teachers make videos of their own teaching. Partner JRS’s video annotation tool will be provided to the teachers in an easy to understand web-based interface, so that teachers are motivated to film, analyze, and discuss their own teaching activities with their colleagues. This method should stimulate teachers to reflect and develop their teaching practices, so that they reach a better understanding of what is going on in students’ learning depending on their teaching practices. To get information about the relation between teaching practices and students’ learning teachers will have to analyze students’ data like i.e. learning outcomes, absent times or whatever they are interested in. Project researchers will support teachers in the planning and analyzing phases of the studies. Feedback from TDS1 will be incorporated in TDS2 and TDS3.

Concerning leadership development, WP5 and WP6 will introduce and accompany school leaders in implementing the strategy planner. The impact of using the strategy planner on school leaders managing practices and their collaboration with their teaching stuff and other school leaders will be investigated.
7 Strategic and Methodological Challenges

This chapter provides information on central strategic and methodological challenges in NEXT-TELL. It is important to anticipate and be aware of these challenges in order to be prepared and to react to them appropriately and in time. The main challenges concern the integration of the results of several studies over a long period of time as well as the factors affecting the studies’ validity and implementation.

7.1 Integration and Consolidation of Studies’ Results

One challenge in NEXT-TELL is to investigate the use of ICT in the open and complex system ‘classroom’ in a meaningful way. The complexity of NEXT-TELL is based on the fact that NEXT-TELL platforms work on three inter-related levels:

- students’ learning by supporting teachers in developing and implementing formative e-assessment methods in the classroom within STEM and TESL (ECAAD platform),
- teachers’ professional development by supporting teachers in investigating their students learning of STEM and TESL and in developing innovative teaching and assessment approaches (TISL platform), and
- school leaders’ development by supporting their management practices concerning strategic goals (Strategy Planner).

This project complexity is necessary to meet schools’ real life complexity in which the three levels interact with each other in many ways. To cover this complexity from a research perspective the approach of DBR will be applied. DBR allows complex data gathering which will be realized in two ways. First, NEXT-TELL’s research plan comprises eleven studies of four types (BS, RA, RDS, and TDS) that differ with regard to the focus they set on the three inter-related levels. Second, a variety of measurement methods that will be used to investigate the system (comprising ICT, students, teachers, and school leaders) provided by NEXT-TELL in schools comprehensively.

Whereas the studies build on each other according to both the information needed to start and proceed DBR as well as the inter-related levels, the data gathered by the different methods (questionnaires (repertory grids), interviews, video analyzing, eye tracking methodology, and log-file data) complement each other. The methods provide performance data and process data that help to describe the complex processes of ICT-based learning, teaching, and school leading.

For a comprehensive understanding of the project and its impact, it is necessary to relate the different data types of one study with each other but also to integrate the data collected across the studies with each other. We will work out dimensions of interest that describe the practices (e.g., teaching practices and student learning on the level of theory and tool development) NEXT-TELL aims to impact. These dimensions will be investigated across the different studies with similar research methods and tools to ensure a certain level of comparability. Figure 6 depicts (in)direct relations across the studies (arrows) and the general levels of impact the studies aim at (coloured boxes).
7.2 Risks and Contingency Plan

The consortium has world-leading partners in all areas of expertise needed in the project and contains the right mix of research institutions and technology providers, and has well established access to a set of schools and to the right stakeholders, the success of the project is highly guaranteed. Nevertheless, there are several risks in an international research project as NEXT-TELL, particularly if it is running over a relatively long period of 48 months, and it has several multinational partners and different disciplines integrated in the project. It is of paramount importance that potential risks are identified and assessed, and that the project prepares for cover-up actions if required.

7.2.1 Pedagogical needs

The teachers provide the pedagogical concepts for their lessons, and are a major cooperation partner in all phases of the project. Thus, we can ensure that pedagogical aspects are sufficiently integrated in our technological developments, which makes them acceptable and ‘performing’ in the educational setting. The consortium will make sure that final delivered tools and methods will adequately cover all the necessary pedagogical aspects. Psychological issues will be also taken into account for evaluating the usability of the platform, and more specifically the ‘cognitive cost-benefit ratio’ in using the NEXT-TELL tools for individual teaching and learning, as well as the motivational involvement of end users in adopting an environment for adaptive teaching and effective learning.

The problems and risks that might arise in practice will be reported and documented to feed back the lessons learnt to the other partners in the same or other countries and into the community.

7.2.2 Stakeholders’ engagement

Because NEXT-TELL does only come to life, if teachers and school leaders integrate the NEXT-TELL platform into their teachings, teachers’ commitment and engagement in the project is crucial. Thus, a risk in NEXT-TELL is the unwillingness of teachers to participate and/or the drop-out over the project duration of four years of teachers or school leaders already taking part. As can be seen in the outline of the studies course, the shortest participating duration of a teacher is ideally about 1.5 years including at minimum one researcher-led and one teacher-led design study within cohort 2b and the longest participating duration is ideally about 3.5 years including at maximum two researcher-led and two teacher-led design studies within cohort 1a. We identified potential risks concerning stakeholders’ engagement and developed respective contingency actions.

7.2.3 Entering

The research with stakeholders will include formative evaluation, ensuring high quality of evidence and monitoring schools’ and teachers’ engagement continuously, so that we are able to react immediately to
problems arising during the studies. MTO for example, can rely on a consolidated network of schools in Germany and enjoys full confidence of the respective school authorities. Thus, we are confident that we will motivate enough schools to participate in research, so that we are able to cope with school- or teacher-drop out during the project. Because participating in a study does not only mean learning additional skills for teachers but also insecurity about what should happen and uncertain workload, teachers might hesitate to enter the project. Therefore, we inform interested teachers before-hand about the project and its phases with their estimated workload to give them a rational basis on which they can ground their decision. Such information not only creates transparency but also more security in teachers’ decisions.

7.2.4 Drop-out

To minimize the drop-out of participating teachers, we try to best meet teachers’ individual needs by selecting motivated teachers and allowing as much adaptation to their individual needs as possible.

Voluntariness

The participation in the project is voluntarily. Only teachers, who decide voluntarily to participate in the project, and thus, show enough motivation for the project, will be selected. To find motivated teachers more easily, there was already a pre-selection of schools that announced their interest in taking part in NEXT-TELL (see letters of support in the official proposal) during the preparation phase of the project. Further acquisition of teachers during the project will be necessary. Teachers who will be acquired in later phases of the project will be also informed and only selected, if they want to participate voluntarily (not because of school leader’s order).

Adapting to individual needs

As already mentioned, teachers will be informed about the whole project before-hand. They get the opportunity to join the project at different phases depending on the time of acquisition. We offer four entry points to the project: the start of cohort 1a, 1b, 2a and 2b. Teachers can decide, depending on the time when they are asked, when they want to join, and thus, how long they want to take part. This self-selection process should help to minimize the drop-out of teachers.

We also seek to adapt to individual needs concerning the experience in ICT-use. The baseline studies and requirement analyses should help to better estimate and adapt to teachers’ (and schools’) current ICT-use in teaching. There will be differences in how experienced teachers are in handling ICT. We meet these differences by two offers. Firstly, ICT-inexperienced teachers will be trained by WP7 not only in NEXT-TELL tools but also in non-NEXT-TELL tools which are necessary to make students work with (e.g., OpenSim, GDocs etc.). Secondly, teachers will be provided with the TISL platform as soon as technically possible, if they already work with parts of the TISL concept (e.g., schools in England).

Drop-out analysis

All teachers leaving the project will be interviewed about their reasons. The reasons will be analyzed and if project-based issues (in contrast to personal issues) are the reason, the project workers will try to meet the teachers’ individual needs if possible. As a general rule, we will work with multiple teachers in each school, to reduce the risks due to career changes etc.

7.2.5 Selected Sample

If only highly motivated teachers participate in the study, we run the risk to investigate a very specific sample that differs from the average teachers. This overall risk is unavoidable, because we work with volunteers. Nevertheless, we will investigate how serious these differences are to better estimate the generalization of the project’s results. We try to find teachers who were asked but will have decided against the project and are willing to give information why they decided against it. Furthermore, the teachers participating in the project will also be asked for the reasons why they decided to participate. This information helps to investigate differences among participating and non-participating teachers without running the risk to lose too many teachers during the project because they were entering the project unwillingly.
7.3 Country-Based Specifics

The major benefit that several European countries take part in NEXT-TELL, is also one of the strategic and methodological challenges in the project. As a first comparison of school types and systems of the different countries involved in the project studies (at least four countries: Austria, Germany, England, and Norway, and if needed as fifth country Denmark) clearly indicated, there are several issues that differ between the countries, for example, the types of school, the system structures, the exams, the assessment structures, the timing and the length of lessons, the timing of holidays, the available resources, or the curriculum. These differences are addressed within the project and lead to different approaches in different countries.

A first point, that is already relevant at the beginning of the project and given by different hierarchical structures within the schools regarding school leaderships and teacher employment, is that different approaches in acquiring the schools will be needed in the different countries. The teachers participating in the project were acquired in different ways depending on the country. There will be top-down as well as bottom-up approaches. In Germany the school acquisition will be a top-down process, starting with the responsible regional boards and the local education authorities. In England and Norway the school acquisition will rather be a bottom-up process, starting directly with asking individual teachers.

As a second important point, given by the different annual timings between the countries, the times of data collection will vary across the countries. The general dates of the different studies (BSs, RAs, RDS1-4, TDS1-3) were described in the outline of the project studies (chapter 5). The exact dates within these months will differ among countries because of the specific country-based time schedules. However, to be aware of these time restrictions and of course also to be able to acquire knowledge about the country-based specifics, there are already declared persons in charge for each country. Until further notice, these persons are Michael Kickmeier-Rust (TUG, for Austria), Katharina Gieler (MTO, for Germany), Wilma Clark (IOE, for England), Eli Moe (Uni Research, for Norway), and Ravi Vatrapu (CBS, for Denmark).

Furthermore, concerning the STEM and TESL strands, there will be also differences between the countries. For obvious reasons, there will be no TESL scenarios developed in England. Therefore, in England there will be only STEM teachers involved. It might be the case that in the other countries, there will be more TESL teachers than STEM teachers involved to compensate for this fact.
8 Ethical Issues

It is beyond the scope of this document to describe all ethical standards in detail. Therefore, we provide an overview of the most important aspects concerning the ethical issues in NEXT-TELL.

8.1 Overview of Ethics Compliance

The NEXT-TELL project consortium recognizes the importance of ethical issues related to IT research and technological developments. It will fully respect ethical principles such as data security, the right to privacy and the protection of private virtual spheres. The project partners will respect and strictly adhere to current national and international regulations and laws while conducting the research with students, teachers, and other human participants. In particular, the consortium partners will respect and strictly abide by the ethical principles expressed in the *Charter of Fundamental Rights of the European Union*, ethics guidelines provided by the federal states participating in the project, and those provided by the school authorities supporting this project.

The project will follow a responsible approach regarding all subjects, especially students and teachers involved in the conduct of the research. The classes, students and teachers chosen for active participation within the project all participate on a basis of voluntariness in the respective study and evaluation process. The researchers are aware that volunteers have the right to remain anonymous and will implement anonymized participant identification mechanisms through data collection, data storage, data analysis, research dissemination and exploitation.

From an ethical point of view, the project does not introduce any new sensitive ethical issues that are not considered by already running research projects on learning with new media and knowledge transfer. The project does not undertake deception or subterfuge. Also, the project does not adopt invasive technologies, it does not make use of sensitive personal data like personal health data or genetic data, and it does not involve bio- or nano-electronics with a potential for misuse.

We will emphasize through the administration of an informed consent form that participation in the NEXT-TELL research is voluntary, and as such, the participant may withdraw from the research process at any time. Some of the partners even run their own ethics commissions (for example KMRC) that have in some cases even stricter regulations but are always in line with national standards. The consideration of ethical issues by the consortium will be assured through all cycles of activities.

8.2 Special Provisions for Research Involving Children and Youth

When research involves children under the age of twelve, full informed consent will be obtained from parents or those 'in loco parentis'. Where a parent or someone 'in loco parentis' gives consent and the child clearly withholds consent or shows distress, the wishes of the child will prevail. For research involving youth between the ages of thirteen and eighteen, the need for obtaining consent from parents or those 'in loco parentis' will be determined on a case by case basis, after assessment and evaluation of the risks and harms to youth participating in the research without parental consent is made. The informed consent of children and youth who participate in the research will also be obtained, after discussion and explanation is given in terms that children and youth can understand.

We will ensure researchers who interact with children and youth during research with NEXT-TELL will have undergone the appropriate background checks, including criminal records checks, to ensure the safety of children and youth. We will also ensure that those who interact with children and youth during the research will have the appropriate training and expertise.

During the research, if the researcher becomes aware of issues that seriously endanger the well-being of the child participant, and the harm is inflicted by another person, the researcher will contact the appropriate local agency to discuss the case and obtain professional advice on how to best proceed in the best interest of the child participant.
8.3 Privacy of Personal Data within NEXT-TELL

Within the NEXT-TELL project personal data will be collected during the piloting activities from students, teachers and other stakeholders as they use and demonstrate the NEXT-TELL solutions. This data is essential for developing and validating key technology developments as well as empirically answering the key research questions and hypotheses of NEXT-TELL. All users of the NEXT-TELL solutions within the project will be informed that this data will be collected in advance of their participation and their written authorization requested (see above). This private data will be used for the purpose of the project only and restricted to the members of the consortium who need this data to successfully complete their tasks and developments. Further:

- Most data collected about students for the research is also intended to directly benefit the participants by furthering their learning, and benefit future comparable user groups. Therefore participants are expected and intended to gain from participation. Therefore, their teachers and other stakeholders should also benefit.
- There will be no negative consequences for a student’s learning if they withdraw from the project. All information intended to support their learning will remain available to them and their teachers where this is part of their normal study; only any research-specific data will be destroyed should a student withdraw from the project.
- The data that is needed by teachers for the learning interaction and future planning needs to be personally identifiable where that data is intended to be used by the teacher in that way. However, this information need not and will not be personally identifiable by the researcher.
- There is a legal and moral right for individuals to see electronic data held about themselves.
- NEXT-TELL will respect and adhere to this right to access of one’s own personal data.
- Data should be securely stored for 5 years after completion of the project, or after any publication resulting from the data, whichever is later.
- Debriefing is required, and will be conducted such that it is necessary, sufficient and appropriate.
- All information will be treated confidentially. In any publication resulting from the research, no individual can be identifiable.

8.4 Data privacy in exploitation phase of NEXT-TELL

NEXT-TELL will plan its exploitation in line with the national data protection acts. Data privacy is under threat when data are traced back to individuals, i.e. they are identifiable and the data can be abused. NEXT-TELL systems provide filtering that is compatible with the data privacy policies of the end-user organisations.

We see it as a matter of course that all project partners respect the data protection laws (which follow the EU directive, see Table 8) of the EC member states taking part in NEXT-TELL.

<table>
<thead>
<tr>
<th>Member state</th>
<th>Law</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Datenschutzgesetz 2000</td>
</tr>
<tr>
<td>Denmark</td>
<td>Data Protection Act (Lovtidende 2000)</td>
</tr>
<tr>
<td>England (UK)</td>
<td>Data Protection Act</td>
</tr>
<tr>
<td>Germany</td>
<td>Bundesdatenschutz and federal laws</td>
</tr>
<tr>
<td>Norway</td>
<td>Personal Data Act 2000</td>
</tr>
</tbody>
</table>

Table 8: Overview over data protection acts that apply in the EC member states taking part in NEXT-TELL
9 Conclusions

We are confident that the research strategy and methodology provided above supports the empirical research on NEXT-TELL’s impact on the infrastructural ICT use in schools by providing an innovation platform, that is, a set of methods and tools than can support (mainly) teachers in innovating the use of ICT for formative classroom assessment.
10 References


D6.1
Specification of Research Strategy and Methodology


11 Glossary

Terms used within the NEXT-TELL project, sorted alphabetically.

Partner Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>JRS</td>
<td>JOANNEUM RESEARCH Forschungsgesellschaft mbH, AT</td>
</tr>
<tr>
<td>Uni Research</td>
<td>UNI RESEARCH AS, NO</td>
</tr>
<tr>
<td>KMRC</td>
<td>Medien in der Bildung Stiftung, DE</td>
</tr>
<tr>
<td>TUG</td>
<td>Technische Universität Graz, AT</td>
</tr>
<tr>
<td>CBS</td>
<td>Cobenhagen Business School, DK</td>
</tr>
<tr>
<td>BHAM</td>
<td>The University of Birmingham, UK</td>
</tr>
<tr>
<td>IOE</td>
<td>Institute of Education, University of London, UK</td>
</tr>
<tr>
<td>EXACT</td>
<td>eXact Learning Solutions SPA, IT</td>
</tr>
<tr>
<td>TALK</td>
<td>Verein offenes Lernen, AT</td>
</tr>
<tr>
<td>BOC-AT</td>
<td>BOC Asset Management GmbH, AT</td>
</tr>
<tr>
<td>BOC-PL</td>
<td>BOC Information Technologies Consulting SP.Z.O.O., PL</td>
</tr>
<tr>
<td>MTO</td>
<td>MTO Psychologische Forschung und Beratung GmbH, DE</td>
</tr>
</tbody>
</table>

Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS</td>
<td>Baseline Study</td>
</tr>
<tr>
<td>CbKST</td>
<td>Competence-based Knowledge Space Theory Training Course</td>
</tr>
<tr>
<td>CBT</td>
<td>Computer Based Training</td>
</tr>
<tr>
<td>DBR</td>
<td>Design-Based Research</td>
</tr>
<tr>
<td>ECAAD</td>
<td>Evidence Centered Activity and Appraisal Design (builds on the ECD)</td>
</tr>
<tr>
<td>ECD</td>
<td>Evidence Centered assessment Design (PADI project eg)</td>
</tr>
<tr>
<td>EFL</td>
<td>'English as a Foreign Language'; EFL refers to learning English in a non-English-speaking region, such as studying English in an Asian or Latin American nation. Typically, EFL is learned as part of a student's school curriculum or for career purposes if working for an international corporation.</td>
</tr>
<tr>
<td>ENA</td>
<td>E-Network Assessment</td>
</tr>
<tr>
<td>ESL</td>
<td>English as a Second Language</td>
</tr>
<tr>
<td>HCI</td>
<td>Human Computer Interaction</td>
</tr>
<tr>
<td>ICT</td>
<td>Information and Communication Technology</td>
</tr>
<tr>
<td>IT</td>
<td>Information Technology</td>
</tr>
<tr>
<td>LEPP</td>
<td>Longitudinal Evaluation of Performance in Psychology (2nd generation e-portfolio)</td>
</tr>
<tr>
<td>NEXT-TELL</td>
<td>Next Generation Teaching, Education and Learning for Life</td>
</tr>
<tr>
<td>OLM</td>
<td>Open Learner Model</td>
</tr>
<tr>
<td>PADI</td>
<td>The PADI project aims to provide a practical, theory-based approach to developing quality assessments of science inquiry by combining developments in cognitive psychology and research on science inquiry with advances in measurement theory and technology.</td>
</tr>
<tr>
<td>RA</td>
<td>Requirement Analysis</td>
</tr>
<tr>
<td>RDS</td>
<td>Researcher-led Design Study</td>
</tr>
<tr>
<td>SRI</td>
<td>Stanford Research Institute</td>
</tr>
</tbody>
</table>
### STEM
The Science, Technology, Engineering, and Mathematics (STEM) fields are collectively considered core technological underpinnings of an advanced society, according to both the National Research Council and the National Science Foundation.

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDS</td>
<td>Teacher-led Design Study</td>
</tr>
<tr>
<td>TEL</td>
<td>Technology Enhanced Learning</td>
</tr>
<tr>
<td>TESL</td>
<td>Teaching English as Second Language</td>
</tr>
<tr>
<td>TISL</td>
<td>Teachers Inquiry into Students Learning</td>
</tr>
</tbody>
</table>

Acknowledgement: The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 258114.