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1 Executive Summary

This document, **D7.4 – training materials for release 3**, provides an overview of the training material for version 3 of the NEXT-TELL tools and methods. Previous documents submitted as part of work package 7, which is about teacher training, are D7.1 – Training Concept, D7.2 – Training Materials for Release 1 and D7.3 – Training Materials for Release 2.

D7.4 builds on D7.1 and D7.2 and D7.3. D7.4 contains further development of previous work within WP7, essentially a revised theoretical approach to the teacher training, and expansion of the notion of tool training. The media in use have been expanded, and the digitalisation of the support material through Moodle courses has been further refined.

The actual training materials are made available as living documents in the form of Moodle courses, as these are subject to perpetual revision and refinement. They are accessed by logging in to Moodle from [http://sandbox.next-tell.eu/](http://sandbox.next-tell.eu/) using the account “bbrown” with the password 12345. An overview of the modules, document types and languages is presented in Table 1, in Section 8.

The main structure of this document is as follows: Section 3 provides an overview of the theoretical perspective, or inherent view on learning, for conducting teacher training in NEXT-TELL, in addition to contextualisation of the training situations as they are carried out in practice. Section 4 provides an account of a training activity for a participant school in Norway, to provide a practical example of how training is actually being carried out. Section 5 provides an example of training of a participating school in Germany. Section 6 describes the teacher certification program realised in NEXT-TELL, for preparing teachers to work independently with the advanced learning technologies and applications developed and provided within project’s lifetime. Section 7 describes the approach to designing the Moodle courses, and gives a short introduction to the content of the training materials that are available online. Several use cases have been developed in order to exemplify and provide context for the use of NEXT-TELL tools and methods, to motivate and inform teacher participation in the project. These are described in section 8.
2 Introduction

2.1 Purpose of this Document

The purpose of this document is to provide an overview of the framework adopted for developing and conducting NEXT-TELL training for teachers and principals, and how it can be applied to the training design. The training aims at enabling teachers to work with the advanced learning technologies and the applications that support appraisal and decision making (and thus improving their assessment literacy) that have been developed and provided within the framework of the NEXT-TELL project.

The training program is being developed for the participating teachers in English, German and Norwegian language, to provide all required materials, and to conduct the training in the participating schools. Training sessions will be conducted in a combination of face-to-face workshops and on-line activities for each of the major releases before they are subjected to trials in pilot studies. The on-line materials will also be made available for pre-service teacher education. For instance, lecturers in an Education Faculty in a course on educational assessment can make use of these materials in their teaching. The training materials will be available in English, German and Norwegian as needed.

The document describes a revised approach to the teacher training in NEXT-TELL, based on input from the project review board, that the pedagogical approach to the training is made explicit. Regarding feedback on the material, a training workshop is planned for the project meeting in Vienna, in February 2014, with teachers from Norway, Germany and Austria. The goal for this workshop is to investigate opportunities for sustainability of the tools and methods with respect to the training materials, supported by feedback from the teachers.

The goal of D7.4 is also to provide a theoretically based unified approach to the teacher training, informed by the concept of Zone of Proximal Development, and to provide a theoretically informed approach to organising the training materials as online courses, informed by the Learning Object Theory concept of modularisation. Two examples of teacher training workshops are provided, along with a set of recently developed use cases that exemplify and contextualise use of the NEXT-TELL tools and methods and short descriptions of each of the tools/courses. Furthermore it describes the teacher certification program realised in NEXT-TELL, for preparing teachers to work independently with the advanced learning technologies and applications developed and provided within project’s lifetime.

2.2 Scope of this Document

This document describes the on-going work with training teachers for participation in the NEXT-TELL project. It presents and explains the conceptual framework for the organisation of the NEXT-TELL training materials. The materials are not described in full detail, because each country has to adjust the materials to the needs and demands of their schools, and to each training situation. Still, a short introduction to the training materials is provided in section 8.

2.3 Status of this Document

The status of this document is the final version of D7.4.

2.4 Related Documents

Before reading this document it is recommended to be familiar with the following documents:

- D7.1. Training concept
- D7.2. Training Materials for Release 1
- D7.3. Training Materials for Release 2
3 Training Materials for Release 3

D7.4, Training Materials for Release 3, builds on and extends the work done previously within WP7, recorded in D.7.1 Training Concept, D.7.2 Training Materials for Release 1 and D.7.3 Training Materials for Release 2. The training materials refer to training materials that have been extended, refined or developed, for release 3 of the tools and methods developed for NEXT-TELL.

D7.4 is divided in seven main sections. Section 3 provides an overview of the theoretical base, or inherent view on learning, for conducting teacher training in NEXT-TELL, in addition to contextualisation of the training situations as they are carried out. Section 4 provides an account of a training activity for a participant school in Norway, to provide a practical example of how training is actually being carried out. Section 5 provides an example of training of a participating school in Germany. Section 6 describes the teacher certification program realised in NEXT-TELL, for preparing teachers to work independently with the advanced learning technologies and applications developed and provided within project’s lifetime. Section 7 describes the approach to designing the Moodle courses, and section 8 gives a short introduction to the content of the training materials that are available online. Several use cases have been developed in order to exemplify and provide context for the use of NEXT-TELL tools and methods, to motivate and inform teacher participation in the project. These are described in section 8.

3.1 The pedagogical approach to teacher training – Zone of Proximal Development

3.1.1 Introduction to teacher training in the NEXT-TELL project

Training teachers to participate in NEXT-TELL is characterised by a range of settings; institutional, national and subject matters differ from each scenario being carried out in school. To support the training in a range of settings, training materials are made available as modularised Moodle courses that can be adapted to use in these situations. The materials are primarily meant to support teachers learning the tools, but can also support those carrying out training workshops from the researchers in the project. One course has also been made available as support for students learning the tools using a combination of instructor led work in school and individual work from home.

Training is most typically carried out as workshops with project members and teachers as participants. The project members often take the role of the tutor, in a face-to-face instructional situation with the teacher. This communication-rich training setup has the advantage that questions from the teachers can be addressed directly as they arise. The training concept is that project members train the participating teachers, who in turn train their own students. The training sessions typically includes hands-on work with the tools.

Work within WP7 since delivery of D7.3 has involved translation of training material from German to English and Norwegian. The translation work has focused on OLM. A process of creating video materials for the tools has also been started.
3.1.2 Zone of Proximal Development – tutored and contextual learning

The theoretical approach to conducting teacher training in NEXT-TELL is influenced by Vygotsky’s concept of the Zone of Proximal Development (ZPD) (Vygotsky, 1978). ZPD is a specific aspect of a more general perspective on teaching, learning and development represented in sociocultural psychology.

It is not the purpose of this document to provide a treatise on sociocultural perspectives on learning, but to point to the main origins in this train of thought. Vygotsky’s general approach is based on a set of three basic principles, or general themes that run through his writings (Wertsch, 1991). The first principle is that human action is mediated by tools and signs, the second that higher mental functioning derives from social life, and the third is the need for a developmental analysis in understanding psychological phenomena (Wertsch, 1991). These general themes are highly interlinked. Vygotsky expanded Engel’s idea of the tool as a medium in human-environment interaction, to include psychological aspects of the tool; more specifically sign systems, i.e. language, writing and number systems (Vygotsky, 1978). Internalisation of externally available culturally and historically produced sign systems brought about change in the behaviour of the individual. The mechanism for individual development is thus rooted in society and culture.

The claim that higher mental functioning is rooted in social life is influenced by Marxist theory. Vygotsky wanted to affix Marx’ assertion that humans psychological nature represents the aggregate of internalised social relations that have become functions and form the individuals’ mental structure, to psychology. Cole & Engeström (1993) remark that for Vygotsky, other human beings, both those present to the senses, and previous generations play a crucial role in the forming of human cognitive capacities. This idea is contained in Vygotsky’s general genetic law of cultural development (Vygotsky, 1978).

The history of the development of signs brings forward a more general principle that directs the development of human behaviour. The principle is that the learner in the process of development begins to apply the same forms of behaviour that others applied to him or her prior to that. The learner acquires social forms behaviour and transposes those on to him or herself.

Vygotsky argues that any function in a learner appears on two planes, first on the social, then on the individual psychological plane, through the process of internal reconstruction of external operations, the process being labelled internalisation (Vygotsky, 1978). He is not claiming that humans’ psychological functions are blueprints of socially organised processes, although they are essentially social in nature, but that there is a close connection between the inter-mental and intra-mental functioning.
In relation to the social origin of psychological functions, the concept of ZPD is important. It is defined as;

"The distance between actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86).

In other words, ZPD is the difference of the learner’s individual problem solving capability, and the same capability under the guidance of a more experienced teacher/peer. Vygotsky wanted, for example, that under assessment of intelligence, to focus more on the potential level of development, thus underscoring the social nature of learning. This can be seen in opposition to the idea of proficiency as a property or characteristic of the individual, or simply a matter of talent located in the mind of the individual student (Säljö, 2000).

In the context of NEXT-TELL method and tool training while the project is running, the concept of ZPD applies because our training concept is based on personal contact, and hands-on experience for teachers right from the start. Rather than providing up-front theoretical training, in NEXT-TELL training events teachers’ goals and the resources available to them in their respective schools are taken into consideration right from the start. The teachers are working together with the NEXT-TELL representative on a set of tasks where the teachers take an active role and where their learning is scaffolded by the NEXT-TELL expert as well as peers (other teachers). Scaffolds and support are gradually removed, up to the point where the teachers can perform the task on their own.

Building on Vygotsky, all developmental situations are essentially social in nature, be they mediated by face-to-face interaction between for example teachers and researchers, or teachers making use of artefacts such as training tutorials, videos or textual documents. It is currently a guiding question how these learning scaffolds can be provided in a way that supports sustainability of the NEXT-TELL tools and methods, to support continued relevance of the ideas, tools and methods in the project.

In the next sections, we provide examples of this general approach to training, and examples of how the tool training is contextualized in various pedagogical settings. As a general principle, building on socio-cultural views of learning, we aim for presenting NEXT-TELL tools as practice mediating tools rather than as generic ICT tools.
4 ZPD – Training Norwegian Teachers in OLM and OLMlets

This section provides an account of a recent teacher-training session using ZPD as a frame of reference, which took place in a participant school in Norway during the autumn of 2013. Two teachers took part in training for a course with OLM and OLMlets – the two tools they were planning to use in a scenario with their students. In this scenario they planned to use OLM to support formative assessment, and OLMlets to determine the level of understanding by the students. Training was carried out over two 4-hour sessions, each focusing on one tool. The training was conducted with close interaction between the project members responsible for organising and carrying out the training and the teachers, and conversation tied to the tools in question mediated the interaction.

The plan for the first training session was as follows:

- Demonstrate the main tools or features of OLM, including visualisations, adding evidence and configuration, using a constructed example (get to know OLM)
- Teachers set up their own course, adding competencies and activities that are relevant for their own course. (Because of unexpected practical limitations, we added students for them later.)

First, the teachers were enrolled to the OLM course in Moodle, and provided detailed information about the training materials available there. Second, all the different tools in OLM (the different visualisations, adding evidence, communication and configuration) were demonstrated. This was done by talking about them, while visualising the interaction with the tools through the use of a projector and screen. The demonstration was focused on the most basic functionality of the tool. The teachers were logged in, and followed the demonstration by navigating the tool using their own accounts, i.e. doing the same thing they were seeing on the screen. The demonstration made use of mock data - an imaginary course in OLM, created for the purpose of the training session. After the demonstration, the teachers proceeded to learn OLM by using it in a manner that they would use it in a non-training session, with the face-to-face aid of the trainers. In the configuration part of the OLM, the teachers entered their own data under the initial guidance of the instructors, which they were to use later in the scenario with their students. In this case the data was a list of competencies available from The Norwegian Directorate for Education and Training (Executive agency for the Ministry for Education and Research), pertaining to the subject Nutrition and Health, taught as part of the Natural Science education.

An interesting example of conceptual discussion between the teachers and instructors took place during this training session, during the configuration of the OLM for the upcoming scenario in their schools. It was related to the differences between competencies (Figure 2) and activities (Figure 3). While the two aspects seemingly are easily discernible, confusion arose when the teachers were to make the actual input on activities in OLM, having already entered the competencies – they came across to the teachers as the same thing. Here, the
instructors were able to, through providing conceptual input and practical demonstrations, help the teachers arriving at the conclusion that competencies are what they want to measure and activities are the way the competencies are being measured. The instructors, acting as more experienced peers in interaction with the teachers, with OLM and conversation mediating this interaction, supported furthering their level of understanding, including their conceptual practical knowledge of the tool in question.

The plan for the second training session on OLMlets was as follows:

- Demonstrate OLMlets using an example constructed in OLMlets for this purpose. A basic run-through was provided, before the teachers answered the questions
- The teachers then add their own questions to be put to their students at a later point.

OLMlets was demonstrated in the same way as OLM in the first session – a run-through of the main parts was provided, before the teachers solved a task prepared in advance. The task prepared was about different concepts related to knitting, which was a subject the teachers had previously expressed personal interest in. Following this, they worked on creating and adding questions to their students in OLMlets (see Figure 4). They added a few questions in the training session, but because the time ran out they completed the list of questions outside the training session.
The instructors carrying out the training sessions worked as *more experienced peers*, in the sense that they initially knew the NEXT-TELL tools, methods, ideas and potential use contexts better than the teachers. The instructors carried out their roles as more experienced learners first through planning the learning trajectory for the teachers geared towards ensuring progress with a hands-on understanding of the tools, still paying attention to providing a contextual understanding of what the tools are for. Second, by being available to respond to questions face-to-face, work could be undertaken to contextualise and exemplify abstract concepts where they arose related to the tools, as explained for example in the discussion of the difference between competencies and activities.

As a final comment, the training for this scenario also involved training of students, at the request of the teachers. The basic structure for these training sessions were the same as with the training sessions for the teachers. For this purpose, a separate Moodle course in OLM for students was translated to Norwegian.
5 Addressing Holes and Mountains: training German Teachers

The work with German teachers consisted mainly of training them in the use of the OLM. Other tools addressed were the RGFA and Mahara.

The overall result is that the prerequisites for a sustained use to obtain meaningful data are generally not met. In case of the OLM, the prerequisites that appeared during the training sessions were:

- Existing knowledge and/or practice in formative assessment;
- An explicit model of learning goals, tasks or competencies;
- A classroom practice of transparency regarding the goal and means of the current activity requested of the students;
- A model of how to best obtain benefits from recurring assessment regarding the same field/subject.

The teachers had no clear notion of the benefit of structuring their pedagogical practice along the lines of competencies. Most seemed to be using a content/fact-knowledge based approach to teaching their students.

The training was therefore adapted to the need of a serious re-structuring of the teachers’ practice. A project-oriented task was chosen. The idea behind that was to create a defined time-span during the students’ learning in which this new (in the sense of not extensively conducted before) approach to teaching could be safely employed.

5.1 Employing the tools on a project task level

For the project task, the teachers were able to define a learning goal or desired outcome that they could describe using competencies (see deliverable 6.5, section 4.2.2 and section 7.3). The cases trained were:

- Teaching a basic method for visualizing information that is now made relevant for exams in German secondary schools (mind map or concept map) in the OLM;
- Designing a poster as part of a presentation for second year learning in a language (French) in Mahara;
- Presentation of a plan and the necessary accounting to run a kiosk in the school for a limited time-span in Mahara;
- Changing towards a school without grades and individualized learning as pedagogical concept (case study of a project in humanities) in the OLM.

Messages stemming from this part of the training were:

- Considerable time to let a (group of) teacher(s) work out the competencies for the tools is needed;
- Trainers should possess knowledge about competencies and methods taught to students in the respective curricula of the teachers;

After the definition of the competencies was achieved the basic how-to-tasks were achievable within a short amount of time.

Messages stemming from this part of the training were:

- Teachers are used to having a great amount of autonomy when designing their teaching materials, the same should be considered in training for the tools;
- Basic tasks for the individual tools (registering a teacher or a student, define competencies, define groups, provide feedback/assessment etc.) should be available as reference cards in an A4 or preferably A5 format;
- Dummy teachers’ and students’ accounts should be available for the trainers, with pre-defined states to set to as a bonus.
The wrap-up of each training consisted of making sure that the teachers were feeling competent enough to actually employ the tools for their teaching and in the classroom. Most were reluctant to do so without the availability of further support. This is especially important to keep in mind regarding the future of the tools. For all training sessions, the teachers were provided with the means to

- contact the trainer and the developers,
- access the manuals and training videos
- and were assured that support could be provided within the next 24 hours.
6 Teacher Certification & Professional Development:
Teacher Training Package

The main purpose of the teacher certification program realised in NEXT-TELL is to prepare teachers to work independently with the advanced learning technologies and applications developed and provided within project’s lifetime. More concretely, the resulting teacher-training package contains training materials that prepare teachers to benefit from ICT use especially in their teaching, their formative assessment practices and learning experiences. To this end, altogether, the teacher-training package will include the following seven self-contained online learning courses: i) non-numerical formative assessment on the basis of Competence-based Knowledge Space Theory, ii) ECAAD design and planning for formative assessment, iii) Portfolio-based Education, iv) Teaching in virtual worlds, v) Repertory Grid Analysis, vi) SPICE, and vii) Activity Tracking Methods and related tools.

The psycho-pedagogical model to the training delivery in the context of the teacher certification process is based on the Competence-based Knowledge Space Theory (CbKST) in conjunction with a sociocultural approach to learning, specifically informed by ZPD.

The CbKST requires the identification of threshold concepts (i.e., a set of competences, skills, abilities and understanding of concepts) underlying the set of problems and learning objects delivered in training materials and associated pre-requisite relations between them. Furthermore, in order to evaluate learner’s current competence state in said threshold concepts, the creation of appropriate assessment is also necessary. With regard to training materials used for teacher certification and delivered in context of WP7, the result of the application of CbKST is therefore a structured competence model that is enriched with corresponding learning objects and associated assessments. This procedure has a two-fold positive effect. On the one hand, this structured competence model is in accordance with or can be adapted to national curricula (as curricula are used to identify and derive underlying competencies of a specific domain); on the other this model can be adapted to different (end) user communities with diverse interests, motivations and required skills or competencies (i.e., students, teachers, parents, principals). For instance, a school principal has to be informed about the purposes for which NEXT-TELL tools are used in their school (he/she requires competencies on a more general level). However, a teacher working with these tools has to have a more detailed knowledge in order to be able to effectively use and integrate them in the classroom (he/she requires skills on a more fine-grained level).

In NEXT-TELL a specific focus is on formative classroom assessment using CbKST as an ICT-integrated assessment method. Thus, in a first step, a first learning course within the teacher-training package focusing on the Competence-based Knowledge Space Theory and its usage in the classroom has been developed and implemented as an online learning course in Moodle. Deliverable D.5.6 “TISL Components R3” already reported the theoretical competency-based background of this course. In the following section, an overview of the course content and its single units is given. The whole course with its learning materials was embedded with the online learning management service Moodle.

6.1 Non-numerical formative assessment on the basis of Competence-based Knowledge Space Theory: Description of the course

In this course, a focus lies on preparing a teacher in applying the Competence-based Knowledge Space Theory that allows for analysing, defining and structuring the subject’s matter of any teaching lesson by identifying and structuring underlying competencies. Topics include the fundamentals of CbKST, identifying competencies, structuring learning and knowledge domains, support tools and guidelines to help applying the CbKST (see Figure 3).

The course has five main modules, which are divided in different units. The units are designed in such a way that they can be studied independently dependent on user’s interest, motivation and background. Typical learning paths for different user groups could be for instance: i) for principals/decision makers: Module 4; ii) for interested teachers: Module 1 & 4; and iii) for advanced teachers: all Modules.
Each module starts with an overview of the content, while the single learning resources provide more in detail explanation. A comprehensive glossary will support learners to get familiar with the terms related to CbKST. Interaction between participants is provided through the possibility of using online discussion forums.

Module 1: Theoretical Background

In this module, the required theoretical background, the Competence-based Knowledge Space Theory, is introduced. Thus, information is provided regarding the essential elements and concepts of this theory, especially for teachers using this theory for structuring teaching lessons.

In more detail, the following learning materials are provided to the learner:

- Competence-based Knowledge Space Theory: Overview and Basic Assumptions of CbKST
- CbKST-Terminology
  - Competence/Competency/Skill
  - Knowledge Domain; Knowledge/Competence State and Structure
  - Prerequisite Relation
- Bloom’s Taxonomy
  - Cognitive Processing
  - Knowledge Dimension
  - ACT-R Theory: Overview
- Applying CbKST in the classroom

Module 2: Constructing a learning course based on the CbKST

In this module an introduction to the single steps of how the CBKST can be applied in order to analyse, define and structure the subject matter of any teaching lesson, is given. First, two methods are presented that can be used to identify competencies. Second, information is provided regarding structuring knowledge domains. The basic concepts and procedures are explained in more detail.

This module consists of the following learning materials:

- Step 1: Identifying Competencies
  - Curriculum Analysis
  - Task Analysis
- Step 2: Competence Assignment to Problems
- Step 3: Deriving prerequisite relations
  - Curriculum Analysis
  - Semantic Analysis
  - The set inclusion principle
  - Querying expert

Module 3: Support Tools

In this module, several tools are introduced that support the identification of competences and the establishment of prerequisite relations between them.

The following tools are described in more detail with regard to CbKST:

- Concept Maps
- Flow Diagrams
- The software tool SkOwl

Module 4: Summary and Guidelines

This module is designed to give an overview of the competence identification and structuring process by providing guidelines focusing on elements, practices, and types of activities that are recommended to be part of this process. This module also includes a comprehensive glossary of related terms and definitions.
6.2 Next Steps

In the previous section, an initial learning course forming part of the teacher-training package, developed in close cooperation with WP5 in the context of T5.4 “Teacher Certification”, has been outlined. Thereby, the focus was more on describing and explaining the course content than on its origin story in terms of competence and skill identification and assignment, which is described in more detail in D5.6 “TISL Tools R3”.

In the upcoming months, appropriate assessment tools have to be and will be provided in order to allow for and to support the certification process. Furthermore, all other training materials provided by partners will be refined and professionalized in a CbKST-informed manner. The result of this process will be a comprehensive teacher-training package that supports teachers in effectively using and applying NEXT-TELL related ICT tools in their classroom not only during but also after project’s lifetime.
7 NEXT-TELL Training Materials

7.1 The courses on Moodle

The organisation of NEXT-TELL training as courses in Moodle is inspired by Learning Objects Theory (Wiley, 2002; Sosteric & Hesemeyer, 2002; McGreal, 2004). Work within the research community on learning objects, suggests organising online digital learning material with a high level of granularity. This fits well with the nature of the teacher training for NEXT-TELL, as the multitude of schools, and variance in the nature of the participation from each school suggests that a highly flexible, tailorable and adaptable teaching material is the most viable approach.

Learning Objects Theory originated from the notion of object-oriented computing, where the ideal way to build software is seen as assembling it from standardized, small and interchangeable snippets of code (called objects) (Nash, 2005; Parrish, 2002). An often used analogy to explain learning objects is that of Lego building blocks: they have a standard shape and configuration, but can be assembled in many ways, creating unique entities only limited by the available blocks and the imagination of the builder (Hodgins, 2002; Nash, 2005), although Parrish (2002) argues that this metaphor may overlook some of the problems associated with ease of interoperability between learning objects. A learning object can be defined as any digital resource that can be reused to support learning (Wiley, 2002), or, in online courses, as a “digital object that is used in order to achieve the desired learning outcomes” (Nash, 2005, p. 217), or, alternatively as a “strategy for designing digital (typically online) learning content and activities as discrete, addressable, and adaptable units, in order to achieve fine-grained accessibility and improved reusability” (Parrish, 2002, p. 52, italics added for emphasis).

Tactics that serve towards achieving this include dividing instructional content into discrete, coherent units, embedding metadata that accurately describes the content for purposes of retrievability, and using a relatively context-free design so the content can fit in several contexts (Parrish, 2002).

While some authors (e.g. Downes, 2000, cited in Parrish, 2002) argues that instructional design is much like software development, Parrish (2002) warns with good reason against taking the heritage of ideas in object oriented computing and software development too literally when applied to instructional design, as the two endeavours are very different in several important ways. An important one is that it involves the notion of modelling the learner as an information processing entity, which disregards the subjectivity of the learner. Building on a critique of the cognitive science perspective, which entailed a similar perspective, several works within technology and learning (see e.g. Cole & Engeström, 1993; Engeström, 1987; Lave & Wenger, 1991; Suchman, 2007; Säljö, 2000; Wertsch, 1991, 1998) have emphasised how learning is a phenomenon that is a highly subjective, social, contextual and situated, rather than a matter of transmitting and coding information. Hence it is recognised that the learning materials and their organisation should be viewed as a separate to the learning that results from interaction with them, and instead the focus should turn to how to best organise the learning materials to support learning. The materials are available in organised form, to be used by the instructing project members as they see most fit.

Part of the work within the research community on learning objects focus on developing taxonomies and systems for organising and retrieving content, to better facilitate reuse, while others focus on how to achieve granulised material. One example of the former orientation is Downe’s (2002) work on how to design for learning object repositories and content management systems. Another example is Longmire’s (2000) work on how learning objects can be meta-tagged to efficiently support reuse in future situations, for purposes of business efficiency. There are reasons to be somewhat sceptical towards economic arguments of reuse of learning objects in instructional design, as reuse of learning objects rely on both the ability and willingness to build on learning materials on behalf of the instructor, while there can be several obstacles to achieve this (Meyer, 2006). The aspect of taxonomies for learning objects is however not focused on in this text, as the learning materials relevant to NEXT-TELL is well known throughout the consortium – most of the researchers know most of the tools. The aspect of learning objects that is relevant to this work, however, is how to achieve granulized learning materials, in support of modularisation of the learning material.

Within the context of NEXT-TELL, we are discussing how teaching materials for each tool can be modularised, i.e. on a low level of training, although modularisation on a higher level within education in general is also
currently being discussed (see e.g. Ertl, 2002). The aspect that is focused on here is the concept of modularisation, and what the learning objects literature offers on how to organise online learning material, such as the material constructed for teacher training in the NEXT-TELL project.

Muzio, Heins and Mundell (2002) underscore the need for tying the use of e-learning objects in instructional design to sound principles of instructional design practices, which they argue is the most important aspect in building online courses through reusable learning objects. The particular approach of Muzio, Heins and Mundell (2002) to this involves specifying learning outcomes on course and unit design level, building on Bloom’s (Bloom, et al., 1956) taxonomy for the cognitive domain. Parrish (2002) furthermore specifies that learning objects could and should be used to play a supporting role in instruction that supports active learning strategies, for example, by representing information sources that support problem-based learning or representing case elements that students analyse to reach conclusions in case-based learning environments. For the training in the tools and methods of NEXT-TELL, the learning objects support an approach inspired by ZPD.

Based on a case study of a course in Java programming, Boyle (2003) offers three recommendations or principles for designing online learning material informed by learning objects theory. The course studied was recently redesigned to mend attendance and learning problems with a course at a university, and the approach was to change the social organisation of the existing course, along with designing e-learning materials as learning objects. The first recommendation or principle is cohesion. This means that one learning object should do one thing only, or should be based on one learning objective or learning goal. One advantage related to this principle is that it facilitates ease of reorganisation of the material for the instructional designer. The second recommendation is to achieve minimised coupling, or that each learning object should not create unnecessary bindings to other learning objects, to better facilitate reuse. The third principle is to design pedagogical rich learning objects. The challenge is to balance between the three principles to create a coherent learning experience.

The variety of roles (school leaders, teachers, ICT-staff and students) and the variety of tools affected by the teacher training, suggests that a highly modularized approach to teacher training may prove to be fruitful. The materials should hence be developed and presented in a modular way, where there is a basic independence within each object. Accordingly, teaching material will be developed with a high level of granularity and varying level of depth, allowing for customisation and adaption of the material to a wide range of needs, situations and roles.

### 7.2 The NEXT-TELL tools and methods

The following section gives a brief overview of version 2 of the tools and methods of NEXT-TELL for which learning material, i.e. Moodle courses, are provided. The materials can be accessed in Moodle by logging in as the teacher user bbrown, as specified above. For a summative overview of the material available for each tool is provided in Table 1 below.

<table>
<thead>
<tr>
<th>Tool / method</th>
<th>Modules</th>
<th>Material types</th>
<th>Languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCTP</td>
<td>Theoretical background, constructing a learning course based on the CbKST, Support Tools, Summary and Guidelines</td>
<td>Text</td>
<td>English</td>
</tr>
<tr>
<td>1X1 Ninja</td>
<td>Introduction, 1X1 Ninja: Gamifying maths, Features of 1X1 Ninja, Technical help - installation</td>
<td>Text, pictures, use case</td>
<td>English</td>
</tr>
<tr>
<td>RGFA</td>
<td>Introduction, suggestions for teachers, suggestions for students, creating an exercise, replying to an exercise, user manual</td>
<td>Text, PowerPoint, use case</td>
<td>English</td>
</tr>
<tr>
<td>LIP</td>
<td>Introduction, Overview, The Learning Diary, Administration, LIP - DEUTSCH</td>
<td>Text, pictures, use cases</td>
<td>English, German</td>
</tr>
</tbody>
</table>
### Tool / method | Modules | Material types | Languages
---|---|---|---
GDocs Analyzer | Introduction, user manual | Video, text | English
SPICE | Training in SPICE, Introduction to SPICE, The BSC-approach in schools, Strategic planning – effects on teachers, Strategic planning – effects on students, The SPICE tool | Text, pictures, video, tutorial | English, German
TISL | TISL Tutorial | Text, video, tutorial, use cases | English
ECAAD | ECAAD Introduction | Text, tutorials, video | English
Mahara | Introduction, Getting started with Mahara, User profile, The portfolio, Groups, Settings | Text, video | English
OLM | Introduction to OLM, OLM for teachers, OLM for students, OLM for elever (students) – NORWEGIAN, OLM für Lehrer – DEUTSCH, OLM für Lerner – DEUTSCH, Configuration | Text, Pictures, PowerPoint, Video, Use cases | English, German, Norwegian
OpenSIM | OpenSIM – Training Concept, Introduction, Life as Avatar, Virtual worlds pedagogy, putting on your students’ shoes, Learning Scenario Design, Analysing students’ activities with ProNIFA, Administrators corner | Text, PowerPoint, videos | English
Sonic Divider | Introduction, Sonic Divider in the classroom, Sonic Divider Highlights, Sonic Divider for the teacher, Technical details - installation | Text, Pictures | English
WAT | Overview, Webtrack | Text | English
Google Progress Tracker | Overview | Text, pictures | English

**Table 1: Overview of the training materials available on Moodle**

### 7.3 TCTP

**Overview**

In this course the focus is on preparing teachers in applying the Competence-based Knowledge Space Theory, that allows for analysing, defining and structuring the subject matter of their teaching lesson(s) by identifying and structuring underlying competencies.

**Topics include:**

- The fundamentals of CbKST
- Identifying competencies
- Structuring learning and knowledge domains
- Support tools and guidelines to help teachers applying the CbKST for their purposes.
7.4  1x1 Ninja

Overview
The 1x1 Ninja is an online multiplication-practicing tool for the primary school level that includes a set of game-like elements. In its first instance, it is based on the domain of the basic multiplication tables.

Multiplication tasks are generated randomly by the system, however, for educational reason, each multiplicand (the second integer) is presented with all multipliers, meaning that each multiplicand is performed for its entire multiplication table. At the same time, the difficulty of tasks is automatically and adaptively adjusted according to the abilities of the child by using CbKST-based adaptive features.

As a means of gamification, 1x1 Ninja incorporates a scoring and levelling feature. Additionally to this, different feedback modes are available (i.e., no feedback, visual correct/incorrect feedback, visual and audio feedback, and visual, audio, and CbKST-based formative feedback).

Main features

Online multiplication practicing tool for the primary school level including game like elements to increase pupils' motivation

- Domain of the basic multiplication table
- Randomly generated multiplication tasks
- Difficulty of tasks automatically adjusted according to the abilities of the child
- Different feedback modes depending on the setting
  - No feedback
  - Visual correct/incorrect feedback
  - Visual and audio feedback
  - Visual, audio, and CbKST-based formative feedback

7.5 Repertory Grids for Formative Assessment (RGFA)

Overview
Repertory Grid Technique (RGT) is a method for eliciting personal constructs of individuals about elements belonging to the topic of study. Within the NEXT-TELL project, for the purposes of formative assessment, we have decided to start researching RGT with an implementation of the widely adopted method of triadic sorting of elements for personal construct elicitation and subsequent five-point scale rating of the rest of the elements. Briefly put, the triadic sorting method consists of the participants being presented sets of three elements each. For a given set of three elements, the participant is prompted to select the element that is different from the other two and to state how it is different as the “opposite construct”. Then, the participant is to state how the two remaining elements in the triad are similar to each other as the “similarity construct”. The rest of the elements are then rated on a Likert-item scale ranging from the Opposite Construct (1) to the Similarity Construct (5). The participants repeat this process until all the triads of elements are sorted into different and similar and the elements for that comparison are rated. The outcome of this exercise is the Repertory Grid (RG) consisting of rows consisting of triads, columns consisting of elements with the first column being the Opposite Construct and the last column being the Similarity Construct, and the cell values consisting of the ratings given for elements.
7.6 LIP (Learning is Personal)

Overview
The training material available for Learning is Personal (LIP) is designed to support users of LIP in understanding the functions of the program and applying it optimally in their work.

- Teachers, who are using LIP in their classes, should read the complete document.
- Students, who only use LIP to document their activities, should get familiar with chapter two. Reading more is optional.
- Users supporting the data management should get familiar with chapter one and four. Reading more is optional.

The material contains a detailed user manual for users in 3 different roles, namely teacher, student and administrator.

The manual starts with an introduction into the theoretical and pedagogical background and a short overview.

- Chapter 2 focuses on the learning diary function (the core documentation task).
- Chapter 3 describes the current state of analysis.
- Chapter 4 addresses administration issues.

A brief outlook and some description about how LIP is embedded into the wider NEXT-TELL infrastructure, namely MyClass and the OLM, complete the manual.

The training material for LIP is available in English as well as in German.

7.7 Google Docs Analyzer

Overview
Google Documents can be used to capture data about students’ participation in writing assignments and project reporting. Each time a significant modification is made to such a document, the changes are logged by Google in the user’s drive, creating a new “Revision” document. Through the Google Documents API, information can therefore be accessed detailing changes made to a document across time, giving insight into the actions of the people developing the document’s content as it is revised by its writers.

The Google Doc Analyser tool from the NEXT-TELL suite enables an analysis of any Google word document to be performed, in terms of essay analysis features and their changes over time. Revisions to the document can therefore be visualised by teachers and students in the form of a set of metrics that show how readable the document is. Analysis of text documents investigates the outcome of the writing (last version of the work) as well as the writing process (analysis of the revised documents across time). The former analysis details the content of the last version of the document in terms of essay analysis features, the identity of the individual who contributed in the creation of the written work, and the number of revisions. The later shows the evolution of the document by identifying the relative magnitude of the changes made across time and revised documents.

7.8 SPICE

Overview
SPICE Planner is a web-based modelling tool that supports a methodology for aligning a school’s learning and development plans, IT strategy, and staff development goals. SPICE Planner allows illustrating schools’ strategy in a graphical (which means more user friendly!) form and to integrate it with schools’ data to monitor current status of the strategy TISL.
SPICE planning is inspired by balanced score card method and consists of following steps:

1. **Vision/Strategy**
   First, strategic variables, such as Vision, Mission and Strategy must be identified which are the entry points for defining and completing a BSC.

2. **Selection of perspectives**
   As next, perspectives are modelled, which serve as an aggregation for the main elements of BSC: strategic and operational goals, indicators and initiatives.

3. **Development of strategic and operational goals**
   For each perspective, strategic and operational goals are identified, which represents measurable goals of the school in long (strategic) or short (operational) terms.

4. **Definition of indicators**
   To be able to measure a strategy execution, for each of the goals so called key performance indicators (KPIs) must be identified, together with planned and current values.

5. **Definition of projects and initiatives.**
   Finally, existing or new actions must be described to reach planned goals.

### 7.9 TISL

**Overview**

TISL Planner is a web-based tool that enables teachers to bring together theory (the 5-step TISL method) and practice in a systematic, goal-oriented way. TISL Planner offers different functionalities for different roles:

**For teachers**

Teachers can browse TISL plans available in a repository in order to reuse them for their own purposes or make their own project.

**Technical experts**

Technical experts can configure teachers’ projects by adding technical details to the TISL project. After this, the project can be executed, e.g. in order to automatically collect and analyse data from different sources thus allowing teachers to analyse various aspects of teaching.

### 7.10 ECAAD

**Overview**

ECAAD planner is a web-based tool to support teachers in planning for students’ learning activities realised with IT available in the classroom/to students. ECAAD Planner offers different functionalities for different roles using the system. For example, teachers can browse ECAAD plans available in repository or make a draft of their own plan that can be further developed by technical experts. Eventually, finalized plans can be released und used for teaching in the classroom.

The process to be supported by ECAAD methodology and tools has the following main steps:

- Decide on what to teach
  - Based on curriculum goals and content standards
  - Based on a domain analysis
- Decide on a sequence of teaching/learning activities
  - Based on existing plans
  - Based on hypotheses about students’ learning trajectories
- Decide on what and when to assess formatively
Based on hypotheses about students’ learning trajectories

- Decide on how to assess
- Decide on criteria (triggers) for when to adjust teaching

7.11 Mahara

Overview
Mahara is an open source ePortfolio. An electronic portfolio or ePortfolio is a generic term encompassing a wide range of types and products as there are reasons for using them. The simplest starting point is to consider an ePortfolio as an extension of the paper-based portfolio, bringing with it the obvious benefit of making a portfolio of evidence portable and shareable anywhere that you have Internet access.

In fact, an ePortfolio has a much broader scope as an online collection of reflections and digital resources (such as documents, images, blogs, résumés, multimedia, hyperlinks to user’s files stored in the cloud service like Google Docs and contact information). Learners and staff can use a Mahara to demonstrate their learning, skills and development and record their achievements over time to a selected audience.

Main features
- For students: flexible assessment environment used to provide evidence of the learning activities and demonstrate new skills/competencies acquisition
- For Teachers: used to structure, record and share professional development
- For Teachers: used to assess the evidence of the learning activities created by the students

7.12 OLM

Overview
The NEXT-TELL open learner model (OLM) shows learners’ current understanding about a range of competencies defined by the teacher. The presentation of the learner model adaptively changes, to present the current knowledge state of the learner. Learner models are built up over time and information may be gathered from a variety of sources (e.g. teacher input, student self-assessments, other assessment tools, quiz results etc.) The learner model may be inspected by teachers, student and their peers. The tool is internet-browser based.

Main features
Viewing the learner model may be useful for:
- Identifying student strengths, weaknesses, and misconceptions
- Focusing learning and planning future learning
- Promoting metacognition (reflection, planning, (self-) monitoring)
- Encourage learner independence
- Facilitating interaction between learners, teachers, and peers
- Supporting assessment, providing formative assessment opportunities
- Increasing the accuracy of student understanding
7.13 OpenSIM

Main features

- Set up real-world-like tasks in an engaging 3D environment: from tasks as simple as asking for the way to the railway station up to complex quests
- Let your students meet people, which they could not so easily meet in real life: their peers from a partner school, native speakers of a language they study, experts in various fields of expertise
- Use the fascination that virtual worlds have on young people for your teaching
- Track students activities and behaviour for retrospective analysis and discussion

This set of training materials consists of 6 modules plus one chapter with IT-administrator-related issues.

The modules are:

<table>
<thead>
<tr>
<th>Title</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Introduction</td>
</tr>
<tr>
<td>B</td>
<td>Life as Avatar</td>
</tr>
<tr>
<td>C</td>
<td>Virtual world’s pedagogy</td>
</tr>
<tr>
<td>D</td>
<td>Putting on your student’s shoes</td>
</tr>
<tr>
<td>E</td>
<td>Learning scenario design</td>
</tr>
<tr>
<td>F</td>
<td>Analyzing student’s activities</td>
</tr>
<tr>
<td>X</td>
<td>Administrator’s corner</td>
</tr>
</tbody>
</table>

Table 1: Modules in OpenSIM teaching material

Typical learning paths would be:

- Students: A B D(?)
- Teachers (basic): A B C D
- Teachers (advanced): A B C D E F
- Decision makers / school leaders: C F
- IT Administrators: A X

Some general remarks:

- Training people in the usage of a virtual environment needs them to use it on their own. Indeed the whole course (each single module) can be perfectly delivered in an online setting using the virtual world itself as a meeting place.
- All training requires technical infrastructure – before the training starts we must make sure that it is available. Each module contains a section that points out which infrastructure is minimally needed.
• Working with immersive environments needs some time “to get used to”. At the beginning participants tend to feel very strange. However after a couple of hours in-world it becomes very natural to them.
• The training is intended to be delivered by an instructor (either face-to-face or online), however, the material is comprehensive enough to be used as self-study course as well (at least for people who are reasonably tech-savvy).
• Each module contains a text document, describing the “rundown” of the module in a table format. Additionally there might be other documents like slides or checklists. Don’t forget to take a look at the slide’s remarks – there you will find some background info to the shown slide.
• Training can be delivered in exactly the same way for SecondLife or any other immersive environment – here we only describe it for OpenSim
• The person who delivers the training should have some teaching experience in a virtual environment – otherwise s/he won’t be able to give the trainees the necessary amount of confidence that this really works. There is nothing as convincing as true experience!

7.14 Sonic Divider

Overview
The Sonic Divider is a simple but fun tool for the primary school level, concrete for a target audience of 7 to 9 years of age. It allows for practicing written division and its underlying sequences. The tool is based on the domain of basic fractions of the nature 854/4; the divisor is always a single digit number and fractions do not have a remainder.
Overall, the whole tool, i.e., its interface and the feedback function using smileys, is kept very simple in order to allow also young children to use it easily and without help.
A special highlight of the tool is the feedback mechanism which allows formative, competence-based feedback in real time. Additionally to this, a scoring mechanism is added which incorporates game-like elements.

Main features
• Allows learners to practice mathematics in a game-like interface
• Facilitates teaching and learning of written division and its underlying sequences
• Facilitates immediate feedback to the learner

7.15 Web Activity Tracker (WAT)

Overview
In order to capture the Web activities of a student we have developed a real-time web browsing history tool. This tool allows gathering information on webpages (URIs) visited during a session and also captures search terms used. To maximize user acceptance and respect the user’s privacy, data is only captured when the user/student explicitly confirms to have data captured. Visual user interface elements also inform the user whenever data is being captured. No hidden data capturing takes place.
The real-time web browsing history is available as add-on for the Firefox browser. Upon activation by the user (clicking the “REC” button) the browser add-on collects information on the URIs visited. On the client-side a special filter software technology is integrated to delete any sensitive data before sending it to the NEXT-TELL web browsing logging server to maximize security and minimize the risk of misusing the collected data. Cleaned information about the pages visited is securely transmitted to a NEXT-TELL server and is available for later analysis. Data is stored securely with tight access control monitoring.
Main Features

- Tracking what users/students do on the Web
- Collects information about web sites visited
- Full privacy protection: data only recorded when user explicitly turns on the data collection, user is in the control of what to share
- Analysis of web sites visited, search terms used to find information, navigation
- Allows to investigate how a student searches for information on the Web

7.16 Google Progress Tracker

Overview

When assigning a writing task, teachers can monitor the progress of each student in real-time and provide assistance when needed. This feedback by the teacher can be given online through the collaboration tools where the teacher can even point to specific sections of a document and guide the student to better results.

For tracking the activity and progress of students, we have implemented adapters to the Google Docs API that allow providing the teacher and student with detailed information. For teachers an overview of current task progress has been developed that gives an overview of the progress of all students with the possibility to get more details on a single student.

Main features

- Current word count.
- Teacher can assign a writing task with the goal of writing a specific amount of words.
- Real-time follow how far each student has progressed towards the goal.
- Commands made from other students are listed.
- Get semantic metadata form OpenCalais over multiple documents
- Links to the documents.
8 NEXT-TELL Use Cases

The following sections describe different use situations of the NEXT-TELL tools and methods, with emphasis on contextualisation. The use cases are also available in the Moodle courses, tied to the relevant tools as a resource. The aims for the use cases are to help make visible to teachers the potential use situations of the NEXT-TELL tool ensemble, outside the functional capabilities of the tools.

8.1 TISL: Using iPods for formative assessment

*Technology is often motivating for students, but does it improve learning? Use a structured process to explore and demonstrate the effectiveness of new tools for formative assessment*

Claire is a secondary school teacher in the UK. Claire is currently teaching programming to teenagers. She uses a short quiz to assess their learning of basic concepts. The results of the quiz help her plan the following lessons. Students often complain that the test is on paper, because they would prefer it to be online. So Claire decides to administer the quiz online, using iPods. She knows that students think they will be more motivated to do the quiz online, but she doesn’t know whether they will actually be more motivated or whether an increased motivation will improve their performance. She needs a way of assessing this. She wants to be able to explore this question for two reasons: a) to decide whether she should use online materials more in the future, and b) to show her supervisor how she is improving her practice.

NEXT-TELL offers a process called TISL (which stands for Teacher Inquiry into Student Learning) that structures the process of evaluating changes in teaching practice. The process involves 4 simple steps, each of which is guided by questions. Through the process Claire easily identifies: a) what it is she is changing in her practice and why, and b) how she will evaluate the impact of this change. Claire decides she is investigating two questions: are the students more engaged with an online quiz compared with a paper one, and does the online quiz lead to higher performance. Claire decides she will gather evidence about students’ engagement during the test, she will ask them for feedback after the test, and she will compare their scores with those from previous years.

Claire produces an online version of the paper quiz using Google Forms. She gives the quiz to students and observes them while they do the quiz. She then asks them a few questions about their experience of doing the quiz online. Later, she looks at their scores and compares them with the scores of quizzes from previous years. She finds that students were very focused during the quiz, they report they enjoyed the experience more, and their average scores are much higher than those from paper based quizzes. She keeps her notes so that she can refer to them the next term when she uses the quiz again. The NEXT-TELL method has given her a template for saving her evaluation of her practice.

8.2 TISL II: Making collaborative decisions about formative assessment

*Technology offers a variety of ways for evaluating student learning to suit individual student needs. Some decisions are made by groups of teachers. Use a structured process to collaboratively explore and demonstrate the effectiveness of new tools.*

Mark is a secondary school science teacher in the UK. Mark is currently participating in a project to support cross-curricular learning in Science, Technology, Engineering and Maths. This is an innovative approach to learning, but will it be more effective in supporting student learning? Mark and his fellow STEM teachers need a method to assess student learning during the project. This is an innovative new approach and they are looking for ways to improve the design of learning experiences within the project. This is not only about Mark’s teaching practice – it involves many teachers in Science, Technology, Engineering and Maths. Therefore, Mark
and his colleagues need a method for evaluating learning that facilitates sharing of evidence and ideas between teachers. NEXT-TELL offers a process called TISL (which stands for Teacher Inquiry into Student Learning) that structures the process of evaluating changes in teaching practice. The process involves 4 simple steps, each of which is guided by questions. Through the process Mark identifies: a) what it is the new STEM project is changing in his practice and why, and b) how he will evaluate the impact of this change. He wants to encourage learners to reflect on their own learning so he uses audio to record students talking about key concepts. Mark and his colleagues will collaboratively identify the key concepts. The students will work in groups during the project, therefore, Mark decides to conduct the formative assessment in the same groups. He and his colleagues will record students’ reflections and then they will collaboratively listen to them and assess student learning.

After the students’ reflections have been collected, Mark and his colleagues upload the audio to SoundCloud and collaboratively annotate segments. Because they have previously decided on the key concepts, they have a common reference point. The collaborative analysis sessions helps them discuss the effectiveness of the project with reference to the project as a whole rather than only their individual sessions. This enables Mark and his colleagues to improve the structure of the project work with clear reference to the students’ learning process across the entire project.

8.3 Chatterdale: Meeting virtually: Learning English in OpenSim

Virtual worlds such as OpenSim are great places to meet and to learn. This is particularly true for language learning. However, the downside is that it is hard for a teacher to monitor and assess what is going on in the virtual world. NEXT-TELL offer tools to use virtual worlds meaningfully!

Gerhilde is an English teacher in Germany and Cecilie teaches English in Norway. Gerhilde and Cecilie meet with their English classes in Chatterdale, an isolated island in OpenSim that is tailored to educational purposes. They have designed a little quest that requires communicating, listening, reading, and understanding English texts. In total 20 children from Germany and 18 from Norway enter the virtual island and spread all around the little town Chatterdale. Also Gerhilde and Cecilie are logged in and move through the town, aiming at supporting and guiding the children in case they need help. In general, however, they cannot exactly monitor the activities and, more importantly, they cannot directly assess learning activities and outcomes.

NEXT-TELL offers a simple tool, the Chatlog Analyzer that allows taking the log file from such an OpenSim session (or any environment that produces log files) and aggregating, analysing and visualising the data. In Germany, Gerhilde is interested in communication density and the type of communication. The Chatlog Analyzer provides Gerhilde with the chat intensity (e.g., the number of chatted words) over time summarized for her entire class. In addition Gerhilde can immediately see the log-in times and the amount of communication of each individual student. Gerhilde is also interested whether her students used certain phrases and she wants to control if the children used swear words. Gerhilde applies simple filters that highlighted predefined phrases in one colour and swear words in another.

In Norway, Cecilie is rather interested in learning performance with respect to pre-defined standardized language skills (CEFR). She defined simple rules for the little quest, for example, the rule “when a student reads a text and understand the details, and when the student follows the hidden instructions within a certain period of time, this is an indicator that this student has a certain language competence”. The Chatlog Analyzer parses the log files for a number of such rules and for all the students in Cecilie’s class. After a couple of seconds, she receives the likelihoods for the predefined CEFR competencies for each of her students in form of easy to understand bar charts. Also, Cecilie can access the text chatted by each student and she can adjust the competency level manually with a slider control. With a button click, the outcomes of the OpenSim session can be transferred to Cecilie’s Open Learn Model account, where all achievements of her students are archived and visualized.
8.4 MyClass: a small but effective and flexible class book

Usually neither students nor teachers are continuously in front of a computer. To enable activity tracking, note taking, and the adjustment of competency levels – tailored for mobile devices – NEXT-TELL offer the MyClass platform.

Marco is a teacher in a junior high school; he is teaching physics and geography. Marco’s school is not equipped with sophisticated technical devices but there is a computer in each classroom and a computer lab. For the geography class Marco is using software tools from time to time, e.g., to do tectonic simulations or educational games (e.g., the geography game Feon’s Quest developed in the European 80Days project). Most of the time, however, there is conventional classroom education, sometimes Marco is even making excursions out into nature. Marco wishes he could gather and link the information coming from the software tools he is using and, more importantly, Marco wants to be able to realize activity tracking and taking notes on learning progress event outside the school.

NEXT-TELL offers a simple yet flexible online platform named MyClass; the tool can be accessed by all sorts of devices but it is tailored for tablets and smartphones. When using the system in class, Marco has a tablet on the front desk. With a simple touch Marco can record activities for his students such as demonstrating great insight, having good homework, or perhaps when a student comes late or is disturbing the lesson. At home, Marco is wrapping up the school day and correcting homework; he is using his laptop to access MyClass and he is taking notes and adjusting the learning process on competency level for each of his students. When doing excursions, Marco is using his smart phone to continue the activity and competency tracking. At the end of the semester Marco receives complete aggregations of his recordings and visualizations about the learning progress of each of his students. With a single click, Marco can generate the report cards and circulate them to the students and parents.

8.5 MyClass II: Training in increasing social and moral competencies

Using an activity-tracking tool to support pupils in developing their social and moral competencies

Marion is a teacher of Religion at a primary school; in her teaching, she considers it important to also teach non subject specific skills in the classroom: pupils should learn (besides intellectual skills) to understand others and how to use this understanding to become responsible and respectful members of society. Thus, they need to develop and to practice the skills required. With this in mind, Marion has organised a monthly meeting where teachers and pupils come together in order to exchange views on how to improve pupils’ social responsibility. In a first meeting, they define a number of specific skills that would enable young people to communicate and act in a way, which demonstrate their understanding and respect for others. Such skills are for instance being on time (as a display of respect) or demonstrating respect to other classmates (particularly if shared opinions differ). Throughout the duration until the next meeting, pupils should practice those skills in different contexts, for example, in conversation with a friend at lunchtime or in the classroom while working in pairs or groups.

Here the MyClass tool comes into play – MyClass is a simple and flexible online platform running on all devices but especially tailored for smartphones and tablets. In class, Marion has a tablet running MyClass that allows her to record activities of her students by simply clicking on different buttons. In this way, she is able to track effectively and objectively all kinds of students’ behaviours - such as whether pupils are coming too late or their overall behaviour while working in groups or in small teams (for example, whether they show cooperative behaviour, respect for others and the property of other, etc.). Additionally to this, Marion has the possibility to take notes on special incidents that may occur. During school break, Marion could continue to track pupils’ activities, meaning their interaction behaviour, by using her smart phone.

Towards the end of a learning and practicing phase, Marion receives complete aggregations of her recordings and visualisations about the skill acquisition progress of each of her students. The resulting reports and visualisations that Marion has circulated to the students provide an opportunity for pupils to receive feedback
on their progress in mastering the skills and to further discuss it with their peers in small groups. In the next meeting, pupils articulate and discuss with teachers how they have used or could use the reports provided by MyClass in order to improve their skills.

Towards the end of the semester, after several meetings had taken place, MyClass is able to aggregate all students’ activity data gathered during the semester, to analyse and to visualise them. In the resulting learning curve giving a long-term view to students skill development, Marion can see that the skill acquisition is not a steady process – skill development involves periods of rapid progression (directly after a meeting) with regression followed by plateaus. These plateaus are broken up by the monthly meetings, where pupils had the possibility to continuously assess their current state of development and their potential weaknesses. This procedure allows for gearing pupils’ practice towards the areas in which they are struggling – over time, from meeting to meeting, this consequently leads to large increases in skill acquisition.

### 8.6 1x1 Ninja & Sonic Divider: Primary Level Math Training

*Using a gamification approach to motivate students rehearsing basic math skills and receiving detailed performance information for formative feedback*

Helga is a teacher of a primary school class in Vienna. Helga is presently teaching basic multiplications and fractions in 3rd grade. The basics are done, now the children need to practice and stabilize their math skills. That unfortunately means repeating the tasks over and over again. In order to motivate the children and keep them on task with focus and enthusiasm, Helga wants to use games or gamification of math tools. But Helga wants to be informed in detail about the children’s achievements and in particular potential competence gaps or specific weaknesses in order to provide formative feedback and assign exactly such support that is actually required by a particular student.

NEXT-TELL offers two example tools for primary level math training. First a web-based multiplication trainer named 1x1 Ninja, tailored for the use with tablet computers or smart phones. Helga asks her students to accomplish three 5-minutes sessions of multiplication tasks as homework. Depending on the children’s multiplication skills and the working speed a certain score can be achieved. As a motivator, Helga offers a small award for the highest score. The next day, Helga retrieved a detailed summary on a competency level about the performance of her students. Based on the visualizations, she can easily identify the low performers and, more importantly, which competencies are lacking. As an example, Helga could identify that Jason, one of her students, has difficulties in multiplying in the number rows 3 and 7, but not in rows 2 or 9. And, in particular, Jason has difficulties when the multiplier is larger as 6. That way, Helga can select tailored exercises for Jason. A couple of days later, Helga and her class are in the computer lab. Helga asks her students to accomplish a set of tasks in their math book. Those children who finish early are allowed to use the Sonic Divider on the computers. This tool is a division trainer that allows practicing the formal sequence of written divisions using a gamified approach. The children receive smart, competence-based feedback from a smiley face and they can collect points and the children can compare their scores later on. By applying this tool, Helga could keep the children focused and quiet whilst slower ones continued to work through their tasks, but in addition, Helga had a motivating and fun way to learn the formal procedures of written division.

### 8.7 ProNIFA: Training in data visualisation and data comprehension

*Using online (math) tools to deepen knowledge in the area of data visualization and comprehension and receiving detailed performance information for formative feedback*

Siegfried is a teacher of Math and Geography in a secondary school class in Austria. In this school year, his pupils should learn how to read and interpret information from different types of graph, and how to construct these graphs. Additionally they will learn how to determine which graphs are appropriate for a given set of
data. After giving a theoretical introduction to the class, pupils need to practice their graph skills. For that purpose, Siegfried wants to use Google spreadsheets as it is a freely available online tool that allows for entering, sorting and analysing data, and creating different types of charts in an easy way. However, Siegfried wants to keep informed about whether pupils are on task or need clarification. Knowing how students are progressing and where they have troubles, Siegfried is able to provide students with (formative) feedback that helps them advance their learning and to make necessary instructional adjustments (e.g., re-teaching, offering more opportunities for practice, etc.) to meet student needs.

NEXT-TELL offers a tool named ProNIFA that allows for collecting and analysing all learning activities from pupils while they are working with Google spreadsheet. Siegfried asks his students to practice their graph skills by editing different tasks in Google spreadsheet as homework. The next day, Siegfried receives a detailed visualized summary on a competency level about the performance and achievements of his students. This visualization allows him to diagnose where students are in learning and to find gaps in knowledge and understanding. For instance, based on ProNIFA's visualizations, Siegfried could identify that Paul, one of his students, had problems differentiating different types of graphs, although he is able to work with Google spreadsheet at a technical level. Knowing that Paul already do not what type of graph to use with what type of information, Siegfried can offer specific learning materials and exercises for Paul.

8.8 LIP: individualized and open learning and teaching

Primary school teacher Mary is convinced of "individualised open learning and teaching", which means allowing the students to chose the topics they want to work on and the way they work on them (this is very much inspired by Montessori pedagogy). However, one big challenge with this teaching style is keeping track on students' progress: To know what students are doing and finding meaningful next steps for them as well as to know how they are progressing in terms of improving their competencies. Mary spends a lot of time with creating and analysing documentation - most of it in the afternoon.

Mary uses LIP mainly for the following 3 purposes:

- Keeping an overview of what is going on in her "humming beehive"
- Mitigating herself being the information bottleneck
- Integrating the students into the steering of their learning process

LIP is designed for tracking data "on site" - alongside the working children. This is possible because its user interface is extremely simple and also allows for scanning of materials via QR tags. LIP doesn't require the human user to do an explicit assessment - the documentation of what's actually going on is enough; all deductions about competencies are done in the background. Because of this, students can be integrated in the documentation process, and this is one of Mary's (and her students) favourite features. Via doing the documentation, the student immediately reflects on what s/he is doing, how long s/he is doing it and with whom. Another favourite feature is the peer assessment: If students work together, then each of them can designate the student whose contribution was most meaningful.

Having all the data in real time at her fingertips, Mary can quickly decide next steps or necessary interventions for individual students or groups of students - and having the documentation of students' activities created "on the fly", she saves a lot of time in the afternoon.

Mary does not see that after her school day, the newly entered data is propagated to ProNIFA (where updates of competencies are computed) and further into the OLM - but she is very happy to be able to use the OLM's sophisticated features for in-depth analysis of her student's learning.
8.9 OLM, OLMlets & RGFA for Natural Science

*Sandra and Ben teach Natural Science in an upper secondary school in Norway. When introduced to the NEXT-TELL tools, they were in the start of presenting one of six units in the curriculum to their students – Energy for the Future.*

The unit *Energy for the Future* specifies six different learning goals (universal to the Norwegian school system). Some of these were familiar to the students from previous teaching, in addition to being a theme that is often generally discussed. Sandra and Ben wanted to see what the students already knew, and what they might misunderstand. In order to do so, Sandra and Ben used the above-mentioned tools.

Sandra and Ben wanted to gain detailed knowledge about the students’ competence. At this point they were not interested in the students’ achievements, but rather in their understanding, and in revealing general competence gaps or specific misconceptions in order to know what to focus on in the learning activity. Using RGFA and OLMlets, Sandra and Ben were able to study the results, which in a quick way visualised student and class level. This helped them to provide formative feedback and scaffold both single students and the group.

For the RGFA, Sandra and Ben defined different elements (terms or pictures) that they wanted the student to know more about. They arranged the terms in triads (lists of three different words), where the students were to select one element from the triad, and explain why this was different from the other two. There was not necessary a correct answer, but the task gave Sandra and Ben an overview of their students’ choices, and the reasoning behind their choice. Sandra and Ben retrieved a detailed summary on the students’ answers. As an example, Sandra could identify that Jon, one of her students, had difficulties in understanding the differences between solar traps and solar cells. Sandra then tailored questions connected to the different misconceptions for the new activity: the OLMlets. The students and the teachers were then able to log into OLM and see a visualised model of their competences. In OLM, Sandra and Ben had put in the six different competence goals in the *Energy for the Future Unit*. For each time students did an activity towards the different competences, the results were entered to OLM in order for teachers and students to see how the knowledge related to the competencies developed. Sandra and Ben could also see what competencies different clusters in the class were struggling with, and then design informed learning activities for each student and group, i.e. arrange students in groups related to the goals that they had problems with.

8.10 OLM II: Students helping each other in Economics

*Establishing formative feedback between students to get them to help each other and identify strengths and give guidance at eye level*

Teaching senior classes, especially economy, can be quite hard, Mr. Hornung told. They really love to argue about their work and always find a reason why something, which was not delivered as good as expected, was not entirely the fault of their own.

He tried discussing work results in classroom, intensive grading with long comments on how to improve, which both failed to substantially improved his students’ results. He also found 1-on-1 talks with everyone totally unmanageable in the sparse time allotted for his course.

Facing this obstacle, he tried to get the students to criticize each other in a constructive and formative manner. As this can take up a lot of time in the classroom and all kinds of personal affairs tend to get into the way, he used a NEXT-TELL tool.

For this, he is using the OLM (Open Learner Model), which allows students and teachers to establish to the point formative feedback. Also, it informs them about the state of their learning.

After giving them a task well established in his class (to make a mind map, this time for supply-side economics), he let them upload their work with the simple procedure provided by the tool.
First, they provided a self-assessment of the quality of their own work. They then took a look at each other’s products and get an idea about what the others delivered. After flipping through the other’s mind maps, they then rated them in comparison.

Following and most importantly, they wrote short comments on the strengths of the results of the co-students and gave them hints about what they themselves did not understand or what could have been done better.

Finally, Mr. Hornung looked at the comments and ratings and added his own remarks and ratings for the mind maps.

Right now, he plans to compare two courses with this tool. At one course, giving feedback via the tool is mandatory to get your own work graded. At the other, feedback is optional. In this way, he can test different styles of teaching and preserve the results for the future.

8.11 OLM III: OLM light for Geography and History

Thomas is a teacher in Geography and History in an upper secondary school in Germany. As the secondary schooling time was reduced from 9 years to 8 years some years ago in Germany, the students in the graduation classes have become younger. Thomas has realised that his students not only are younger, but also less self-reliant when it comes to learning and preparing for the graduation exams.

Purpose of Tool Use

Thomas’ wish is to increase his students’ accountability and self-organisation of their learning by involving them actively in the assessment process of their competences. He hopes that this stimulates his students to become more pro-active learners and thereby also increase their knowledge and understanding in Geography and History. The NEXT-TELL OLM seems to perfectly fit his idea because it allows students not only to see how the teacher estimates students’ competences, but it also offer students the possibility to assess themselves.

Tool Use

In order to use the OLM Thomas first needs a structure of learning goals. He thinks about the competences that the students should show at the graduation exams. He identifies three main competencies with several sub-competencies respectively:

In both subjects students need to be able to

1. Identify the problem structure of a task
2. Apply different techniques to extract information from the resources given and to analyse the information
3. Assess and evaluate solutions suggested to a problem stated or even to generate and evaluate own solutions.

As Thomas has never made these competence goals so transparent to his students before, his first step is to explain and discuss the competences with his students. To do so he makes a poster for each subject that contains the specific questions that should help to solve the task corresponding to a competence (e.g. what are the key terms? Which spatial structures can be applied?). He pins the posters at the wall, so that students can use it for their orientation. In correspondence to the questions on the posters, Thomas formulates the self-rating scales in the NEXT-TELL tool for each competency in so-called “I can statements …” (e.g., I can identify the key terms). Subsequent to this set-up, he then enters an activity into the tool each time he starts with a new one (e.g., task during a lesson, a homework or a test). According to the usual pacing of his assessment procedure, he rates the selected students and provides his assessments in the respective rating scales and asks his students to enter their self-assessments. Whenever possible Thomas provides some suggestions what a student might change in order to improve.
Over some time and different activities Thomas gets a visual overview over the competence development of his classes. He likes to get a quick overview of his parallel classes to see whether and where they differ. Although the assessment procedure is very similar to what he had done before, now his students also get a visual overview of his/her own competence development. Usually Thomas’ ratings and students’ self-ratings are rather similar, even though students rate themselves a bit better then he does. However, in some cases, Thomas realizes a great difference between his assessment ratings and students’ self-assessments. Such deviances have shown to be a good basis to talk with the respective students more closely about the topic and their performances and their perspectives.

And the more time passes, the more often students start by themselves to ask and discuss what their competences are, what they have understood and what not. Realizing this greater involvement of students in thinking about their learning, Thomas thinks that it might be time to move his feedback culture forward and allow peer-feedback in the tool for some tasks because he often asks his students to discuss problems in pairs or small groups. Hence, the students might have or might develop an impression of the strengths and weaknesses of their peers.

8.12 RGFA for international trade relations

Making use of repertory grids for the pre- and post-instructional assessment of students’ knowledge mapped by the OLM

The original idea of the teacher was to use the tools to get a better insight into what part of his teaching worked and which did not. He teaches an exam relevant subject, economy, in the final years of the K-12 education system in Germany that decides whether his students are in a position to freely choose their university or if they have to use a very limited freedom of choice. This motivates him to get the most out of his teaching.

He put together three very short repertory grids, each consisting of about four key words out of the field of international trade relations. These grids were presented prior to any lesson in this field to his students, who arranged the key words according to their knowledge.

The resulting map of words allowed him to tailor his lessons closer to the knowledge already existing in his courses and also fine tune single units of work so that they fit his students better.

After the unit of international trade relationship, he presented the three repertory grids again. The resulting knowledge map was used by him as a hint to give the students advice on what to learn to be prepared for their final exams.

All this time, he used the OLM to keep the students’ eyes on the relevant competencies he tried to teach them during his lessons, give them a forum for feedback and get instructional advice to them during the ongoing unit of lessons.

8.13 RGFA II: Detecting student misconceptions: Energy for the future

Using a set of tools to detect students’ misconceptions as part of teaching and learning activity.

Frida is teaching Natural Science, in an upper secondary school in Norway. At the moment she is presenting one of the six units in the curricula, Energy for the Future. The unit comprises six learning goals, and although some of the learning goals should be slightly familiar for the students from previous years as the theme has often been discussed in general, Frida would like to see what the students already know, and what they might misunderstand concerning this unit. In order to do so Frida would like to use a tool where the students have to distinguish between the different terms used in this unit. In addition to being an activity for the students, Frida would like to be informed in detail about the students’ competence level. At this point she is not interested in the students’ achievements, but in their understanding, general competence gaps, and specific misconceptions...
in order to know what to focus on in the next learning activity. Being able to study the results, in a quick way where results are visualised student by student and at class level, would help her provide formative feedback and scaffold single student and the group.

NEXT-TELL offers three tools, which used in combination, can support her needs. First the web-based Repertory Grid for Formative Assessment (RGFA) tool for eliciting personal constructs of learners about elements belonging to the topic of study, second the OLMlets tool for identifying individual student’s misconceptions, and third an Open Learner Model (OLM) that visualises the learners’ progress towards various competence goals.

To prepare the RGFA tool for the students, Frida identifies important elements (concepts, pictures of concepts, or videos) from the unit grouping them in various triads. Using RGFA the students select one element from each triad, and explain why this element is chosen and why it differs from the other two. While there is not necessary a correct answer, the student’s explanations give Frida an overview of her students’ choices and the reason why, giving her insight into their knowledge level for the unit.

From RGFA Frida retrieves a detailed summary on the students’ answers. For example, Frida could identify that Jon, one of her students, has difficulties in understanding the differences in solar traps and solar cells. Using this information Frida then makes questions tailored to identify this specific misconception and uses the OLMlets tool to develop a quiz that students can use to identify their own misconceptions. For each misconception Frida defines a related feedback that tells the student that it is suspected that they have this misconception. After taking the quiz the answers are visualised for the students, helping them identify specific areas where they need further work. Frida can easily identify which students had which misconception and she is able to tailor her teaching to deal with the misconceptions.

As the students answer the questions using the OLMlets tool, the Open Learning Model (OLM) is building/updating a competence model based on their answers. The students and Frida are able to log into the OLM in order to see their competence models. As part of her preparations for the unit Frida has prepared the OLM by identifying six different competence goals that are addressed in the Energy for the Future unit. She also has defined a number of learning activities for the unit, one of which is the OLMlets, which will feed evidence towards the different competences as the student carry out the activities. As they complete the activities, the student can log onto the OLM and see a visualised model of their learning, and how their different competences are developing. The visualisation gives the student information regarding which competences they need to work on and gives Frida the ability to identify which competences individuals or different clusters in the class are striving with. This enables her to design her teaching or further learning activities for clusters or for individual students (e.g., she can place the students in different groups in order for them to focus on the goals with which they may have problems).
9 Conclusions

This deliverable has, based on a presentation of the previous work and foundation, presented an approach to instructional design and for designing the teacher training for NEXT-TELL. The teacher training material is made available as courses in Moodle, in concert with this deliverable, where they reside as living documents, which can be updated as the tools change, and provide a basis for assembling materials for courses adapted to a range of roles, level of detail and a multitude of context, which are part of the conditions for the training activities in NEXT-TELL. It is furthermore suggested that an approach informed by sociocultural perspectives on learning can provide a useful basis for designing the training to take place, for reasons of repeatability and consistency in the training.

Experiences from training sessions and feedback from participating teachers indicate that support during working with the tools in classrooms with their students is desired. Future work involves finding a way of providing this support in a meaningful way for the teachers, to ensure that the tools are being used.

The goal for D7.4 was to provide a framework for instructional design, synthesised with the Learning Objects theoretical concept of modularisation, along with making the training materials available as courses in Moodle. Future work within WP7 involves further developing the support base for training, represented in developing material available in different media, such as video.
10 References


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<th>Reference</th>
<th>Title</th>
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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>Cobenham 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>LL</td>
<td>Lattanzio Learning 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>
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<tr>
<td>BOC-PL</td>
<td>BOC Information Technologies Consulting SP.Z.O.O., PL</td>
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<tr>
<td>MTO</td>
<td>MTO Psychologische Forschung und Beratung GmbH, DE</td>
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Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<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>
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<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>
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<tr>
<td>ENA</td>
<td>E-Network Assessment</td>
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<tr>
<td>ESL</td>
<td>English as a Second Language</td>
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<tr>
<td>HCI</td>
<td>Human Computer Interaction</td>
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<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>
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<tr>
<td>RDS</td>
<td>Researcher-led Design Study</td>
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</table>
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.

**Abbreviations**

- **SRI**: Stanford Research Institute
- **STEM**: The Science, Technology, Engineering, and Mathematics
- **TDS**: Teacher-led Design Study
- **TEL**: Technology Enhanced Learning
- **TESL**: Teaching English as Second Language
- **TISL**: Teachers Inquiry into Students Learning

**NEXT-TELL partners responsible for generating tools and methods**

- **BOC-AT**: ECAAD
- **BOC-PL**: SPICE
- **LL**: Moodle
- **JRS/ LL**: Google Docs and Google Spreadsheet
- **TALK**: OpenSim
- **CBS**: Rep5
- **JRS**: EVE
- **LL**: Mahara ePortfolio
- **BHAM**: OLM

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