D7.3

Training Materials for Release 2

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1 Executive Summary

This document, **D7.3 – training materials for release 2**, provides an overview of the training material for version 2 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, and D7.2 – Training Materials for Release 1.

D7.3 builds on D7.1 and D7.2, but is different in two ways. The first is that the training material is made available as online courses in Moodle. These materials are not included in this deliverable, but reside online in Moodle. The second is that a model for instructional design is included as a basis for the training approach: 4CID.

Making the training materials available online has the advantage that they can be updated as the tools are updated. Using Moodle also eases access to the materials, and it helps to ensure that all training is carried out using the same material. Informed by Learning Object Theory, an approach of modularisation of the material is taken. The need for modularisation arises as the roles and contexts of those that the training is directed at are highly varied. Modularised material is more adaptable, flexible and customisable to a range of situations.

There is a need for an explicit pedagogical approach to the teacher training, as well as a unified approach across the multitude of contexts that the teacher training is carried out in. Therefore, this deliverable builds a synthesis between the 4CID model for instructional design and pedagogy and the Learning Object Theory concept of modularisation. These serve as a basis for the teacher training designed and carried out for NEXT-TELL. 4CID is chosen as it represents an approach to instructional design that is geared towards training of practical skills, and towards designing for the learning of complex skills in complex use situations.

The main structure of this document is as follows: First, a summary of the previous work within WP7 is provided, along with the project reviewers’ recommendations for the teacher training. Second, a brief introduction to 4CID is provided. Third, an account of how the learning object theory concept of modularisation can inform the organisation of the online training materials is given. Finally, a short introduction to each of the tools that are covered in the training materials is presented.
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. 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 will be developed and provided within the framework of the NEXT-TELL project.

The training program being developed for the participating teachers is in English language, to provide all required materials, and to conduct the training in the participating schools. Trainings 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 and German.

The goal of D7.3 is also to provide a theoretically based unified approach to the teacher training, informed by the 4CID model for instructional design and pedagogy, and to provide a theoretically informed approach to organising the training materials as online courses, informed by the Learning Object Theory concept of modularisation. Several models for instructional design exist, and 4CID is chosen as it allows the instructional designer to focus on designing a practicable approach for learning of complex skills. D7.3 presents and explains the 4CID model and the concept of modularisation. Future work within WP7 involves utilizing the model in design of the training, and combined with the concept of modularisation, redesign the training materials.

2.2 Scope of this Document

This document describes the immediate next steps of 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.

2.3 Status of this Document

The status of this document is the final version of D7.3.

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
3 Training Materials for Release 2

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

D7.3 is divided in four sections. Section 3.1 provides a short account of the work previously done in WP7, along with the recommendations for the teacher training following the periodic reviews of the NEXT-TELL project. Section 3.2 provides an account of the pedagogical model for instructional design, to be used in training the teachers and school leaders. This builds on the 4CID instructional design model. Section 3.3 explains the rationale for organising and making available the learning materials as online courses in Moodle, inspired by the research literature on Learning Objects theory, with emphasis on modularization. Section 3.4 provides descriptions of the NEXT-TELL tools and methods in abstract form, and refers to the more detailed teacher training material in the form of the online Moodle courses.

3.1 Previous work in, and foundations of the teacher training

Deliverable D7.3 builds on previous work on establishing a pedagogical approach towards training teachers and school leaders in using the NEXT-TELL tools and methods, already described in D7.1 and D7.2.

D7.1 outlined the first training phase in NEXT-TELL, that is, the training of teachers and stakeholders in the first year of the project. The concept was that the project partner responsible for the teacher training, MTO in Germany, underwent training in the tools by the tool and software solution developers (Phase I). MTO in turn trained other NEXT-TELL partners (Phase II), who then trained participants outside of Germany (Phase III). Phase IV was planned as refreshment training. Figure 1 lays out the training concept designed in D7.1.

![Figure 1: NEXT-TELL training concept](image)

D7.2, Training materials for release 1, described the first version of the training materials for the NEXT-TELL tool. It also included an implementation guide for delivering training in schools, that is, a pedagogical approach for the training.

Schools are likely to adapt the wide range of tools available to them to suit their own needs. Training, therefore, needs to be complemented with ongoing support. Accordingly, the implementation guide consisted of the following elements or principles:
Focus on the teaching not on the software. This means that it is the instruction and teaching needs that are the centre of the attention, and the tools for teaching have to accommodate these needs. Additionally, the tools should be user-friendly and have intuitive workflows. As the training needs are subject to local needs, the training sessions should facilitate multiple formats and be flexible.

Make product development a team effort: Training should be conducted collaboratively within a team with diverse backgrounds.

Suggestions for project management during implementation: Implementation of the technology should be done in several smaller parts, each with discernable goals, to ease the implementation process.

Technical support in the Action stage: Technical support has three aspects: general technical support, user support and specific application support.

Parts of the foundations for the work in this deliverable are the recommendations made by the project reviewers in the annual project reviews. The recommendations that concern the teacher training made so far, available in the review meeting reports, are these:

From 1st annual project review meeting:
Recommendation 6.
It is recommended that the consortium should make explicit the pedagogical model that will be implemented by project partners when training teachers and school leaders, and in particular, the innovative approach to assessment that will be applied.

From 2nd annual project review meeting:
Recommendation 9: Training Materials (WP7)
Describe the pedagogical and psychological (learning theory) foundations of the design of the training materials. This is necessary so that other training materials can be designed along the same lines (according to the same explicit principles) in a way that is adapted to local and national contexts/educational cultures. An appropriate approach would be to apply the project’s theories of learning and teaching (cognitive density, classroom orchestration, task design in terms of relations between competencies) to the design of the projects own training materials.

The recommendations received each year are uniform; the teacher training for the NEXT-TELL project should make the pedagogical model that the training is based on explicit. Instead of developing a new pedagogical model, the model for instructional design called 4CID (van Merriënboer & Kirschner, 2013) will be utilised. There are several models for instructional design, but the advantage of 4CID is that it is geared towards learning practical skills, and juxtaposition and coordination of these skills in complex practice. This report will discuss the ideas for how to use the 4CID model for instructional design to design the teacher, school leader and student training for NEXT-TELL. This is done in concert with ideas on how to organise the material itself as Moodle courses informed by Learning Objects theory. Redesigning the teaching material informed by 4CID is too complex a task to be carried out within the time-span available for this deliverable, and will be subject to future work within WP7.
3.2 The pedagogical model for teacher training – 4CID

3.2.1 Introduction to and background of the 4CID model of instructional design

Recommendations from the first of two annual project review meetings, and good practice in general, suggest quite clearly arriving at and using an explicit pedagogical model for the teacher and school leader training in the tools and methods of NEXT-TELL. The teacher training in NEXT-TELL will employ van Merriënboer et al.’s (1992) 4CID (4 Component Instructional Design) approach to instructional design, as it focuses on the learning of practical skills in complex situations of use. This section provides a basic account of the main components and ideas of 4CID along with ideas of how it will be used to inform the teacher training in NEXT-TELL.

4CID (see e.g. van Merriënboer & Kirschner, 2007; Van Merriënboer, 1997; Hoogveld, Janssen-Norodman & van Merriënboer, 2011; Janssen-Noordman & van Merriënboer, 2002; Janssen-Noordman, van Merriënboer, van der Vleuten & Scherpbier, 2006; Van Merriënboer, Clark & de Crock, 2002), both a pedagogical model, and a model for instructional design, originates from an article published in 1992 by Van Merriënboer, Jelsma and Paas (1992) called Training for reflective expertise: a four-component instructional design model for complex cognitive skill. 4CID is geared towards instructional design that supports complex learning, as opposed to, for example, exclusively learning skills or knowledge. Complex learning involves knowledge, skills and attitudes, and the coordination of qualitatively different constituent skills to an activity. Furthermore, it focuses on the learning of authentic tasks, from real life: learning tasks should be representative of real-life tasks. It is also directed at designing for practical knowledge; for example, Elen and Sarfo (2007) used the model to design engineering-like subjects in a secondary school in Ghana.

Van Merriënboer and Kirschner (2007) regard 4CID as a holistic approach to instructional design, aimed at overcoming the problems of knowledge transfer that students may experience when what they have learned from formal education has to be applied in complex real-world settings, for example in their professional employment. According to Van Merriënboer and Kirschner (2007), a holistic instructional design approach is seen as the opposite of atomistic design, rather than an approach covered against all critique. Atomistic instructional design implies reducing instructional design into ever diminishing elements of tasks and knowledge. Holistic design aims at dealing with complexity without loosing sight of the separate elements and their interrelations (Van Merriënboer, 2007).

A holistic approach to instructional design can furthermore assist in avoiding the instructional problems of compartmentalization, fragmentation and the transfer paradox. Compartmentalization implies focusing on one particular domain of learning, for example the cognitive or the affective or the motoric aspects. Fragmentation means breaking a subject matter into isolated parts, teaching one limited constituent skill at the time. It is only at the end of instruction that the learner gets the opportunity to practice the whole of the complex skill. Fragmentation is well suited if each skill is very difficult to acquire, or if little coordination between them is required (Van Merriënboer & Kirschner, 2007). Problems can arise, however, if the task taught requires interactions between various aspects of the task (see e.g. Clark & Estes, 1999; Perkins & Grotzer, 1997; Spector & Anderson, 2000), as is often the case in modern work situations. To counter these problems, holistic design aims to achieve integrated sets of objectives, and importantly the coordinated attainment of those objectives in real-life task performance. The transfer paradox arises from atomistic instructional design, and refers to how teaching methods that are the most efficient in enabling students to reach limited objectives, are not the most efficient in enabling them to reach the overall objectives. A holistic approach is directed towards the overall learning objectives.

The 4CID model consists of four components, along with ten steps that correspond to the components (see Table 1). While the 4CID model is analytic and descriptive in nature, the ten steps represent the practical application of the 4CID model into instructional design. The ten steps are prescriptive and practicable, and aim to support instructional designers and teachers in their work, and can be adapted in the sense that not all steps are necessarily required in any instructional situation (Van Merriënboer & Kirschner, 2013). The following sections explain the four components, and each of the ten steps for complex learning.
3.2.2 4CID / Ten steps to complex learning

Table 1 provides an overview of the connections between the four elements of the 4CID model and the ten steps to complex learning. This section provides a brief account of the four components of 4CID and the Ten Steps to Complex Learning.

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<tr>
<th>Blueprint components of 4CID</th>
<th>Ten Steps to Complex Learning</th>
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<td>Learning tasks</td>
<td>1. Design learning tasks</td>
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<td></td>
<td>2. Develop assessment instruments</td>
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<td></td>
<td>3. Sequence learning tasks</td>
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<td>Supportive information</td>
<td>4. Design supportive information</td>
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<td></td>
<td>5. Analyze cognitive strategies</td>
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<td></td>
<td>6. Analyze mental models</td>
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<td>Procedural information</td>
<td>7. Design procedural information</td>
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<td></td>
<td>8. Analyze cognitive rules</td>
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<td></td>
<td>9. Analyze prerequisite knowledge</td>
</tr>
<tr>
<td>Part-task practice</td>
<td>10. Design part-task practice</td>
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**Table 1: The Ten Steps to Complex Learning related to the four basic components of 4CID (Van Merriënboer & Kirschner, 2013)**

**Components of 4CID**

The concept and metaphor of blueprints in 4CID refers to blueprints in design in general, for example a technical drawing of an airplane, and how they are not only schematic drawings, but also contain a “detailed plan of action, scheme, program or method worked out beforehand to achieve an objective” (van Merriënboer & Kirschner, 2013, p. 11). In 4CID, the blueprints for any learning situation consists of the elements learning tasks, supportive information, procedural information and part-task practice, described in further detail below:

- **Learning tasks** is a generic term that refers to for example a case study or problem to be solved by students. They should be authentic experiences, based on real-life tasks, and aim at integration of knowledge, skills and attitudes. They should display a high degree of variability, be organized in simple-to-complex task classes, and exhibit diminishing learner support within each task class.

- **Supportive information** represents information that is helpful for learning and doing the problem solving, reasoning and decision making aspects of the learning tasks. It explains how a particular domain is organized and how to think about problems in that domain. Supportive information is provided by task, is always available, and should serve as a bridge between what the learners already know and what they need to know to work on the tasks with success. It is thus geared towards helping students performing non-routine aspects of learning tasks.

- **Procedural information** enables students to perform routine aspects of learning tasks. Procedural information specifies exactly how to carry out routine aspects of a task, and should be available just-in-time, or when a learner needs it. It becomes less important as the learner gains expertise.

- **Part-task practice** items are items that support learners in gaining a high level of automaticity for routine aspects of a task, and typically involve repetition in volume. Yet, it is only introduced after the routine aspect has been declared as to how it fits into a whole, meaningful learning task.

The 4CID model has a notation for schematic instructional design, as can be seen in Figure 1, which corresponds to the four components. The **learning tasks** are the large circles in the model. Learning tasks should offer whole-task practice confronting the learner with all or almost all of the constituent skills important for real-life task performance, together with their associated knowledge and attitudes (van Merriënboer &
Kester, 2008). The spacing between the circles indicates sequences (here; 1-3-4-1) of learning tasks. The dots in the circles indicate variability in the learning tasks, as real-life tasks also are varied, for example in domain, context or media. The learning tasks are grouped together in task classes, indicated by the dotted squares around the circles (see Figure 3), which represent different variations of a task with a particular complexity. Learners require different levels of support and guidance for coordinating the different aspects of their performance. Support refers to providing assistance with the task elements involved in training and is product-oriented, while guidance refers to providing assistance with the processes that lead to solving the task, and is hence process-oriented. The coloring within the circles indicates the level of support and guidance provided.

4CID distinguishes between procedural and supportive information. Supportive information is seen as important for those of the constituent skills that are non-recurrent, such as explaining to learners how a domain is organized, and how to think about problems in that particular domain, i.e. it is information about something. Supportive information is indicated by the L-shaped gray areas below the circles. Procedural information is important for the constituent skills that can be seen as recurring, and instructs learners how to perform routine tasks often in the form of step-by-step explanations, i.e. information on how-to do something. Procedural information is indicated by the black lines with arrows pointing to the different learning tasks, positioned below the circles.

As already mentioned, the learning tasks only provide whole-task practice, where the full complexity of a task is touched upon in one form or another. Yet, situations can arise where it is important to focus on only aspects of a learning task, for example when it is desired to reach a high degree of automation in a practice, involving a lot of repetition. Within 4CID this is referred to as part-task practice, and is provided for aspects classified as “to-be-automated recurrent constituent skills” (van Merriënboer & Kirschner, 2013, p. 21, italics in original). In Figure 2, part-task practices are represented by a series of small circles within a rectangle, with arrows pointing between tasks. Each series of small circles refers to a practice item.

Figure 2. Components of 4CID modeled (van Merriënboer & Kirschner, 2013)
Ten Steps to Complex Learning

While the model described in the previous section is analytical in nature, 4CID also provides a practical approach to the process of instructional design, called “Ten steps to complex learning”, where each step corresponds to an aspect of the model depicted in Figure 2. Figure 3 illustrates the relationship between the ten steps and the 4CID model.

Van Merriënboer and Kirschner (2013) points out that in order to carry out instructional design in practice, the steps are referred to as design activities in the design process rather than as steps. This is because in real life design situations it is often difficult to follow ten steps chronologically or in a predefined sequence, and instead it may be necessary to switch between activities. The learning tasks are regarded as the center of the learning process, however, and consequently the instructional design process starts with designing the learning tasks. The Ten steps to complex learning are described in further detail below, and consist of the following design activities:

1. Design learning tasks
2. Develop assessment instruments
3. Sequence learning tasks
4. Design supportive information
5. Analyze cognitive strategies
6. Analyze mental models
7. Design procedural information
8. Analyze cognitive rules
9. Analyze prerequisite knowledge
10. Design part-task practice
Figure 3: Schematic overview of the ten steps to complex learning as they relate to the 4CID model for instructional design (van Merriënboer & Kirschner, 2013).

The first three steps aim at developing a series of learning tasks that serve as the backbone for the educational blueprint. Step 1, designing learning tasks, represents the complex skill that the learner will be able to perform having taken part in the instruction, making it clear from the beginning what the training is to help the learner to achieve. Step 2, developing assessment instruments, is about arriving at and articulating the standards that the learners must reach to be able to carry out the tasks in acceptable manner, in order to determine whether the standards have been met by a learner, and, equally importantly, to be able to provide the learners with feedback on the qualities of their performance. Step 3 involves sequencing the learning tasks, which involves ordering tasks in a way that optimizes the learning process. This is done by sequencing for increasing complexity of the tasks, and at the same time decreasing the level of guidance and support, in order for learners to gradually become able to perform independently.

Steps four to six are about designing and developing supportive information. Step 4, designing supportive information, may often consist of organising teaching material that already exists, and if so steps five and six can be ignored. If not, Step 5 is carried out in order to analyse which cognitive strategies are employed by proficient task performers in order to solve problems in the domain. Step 6 is carried out in order to analyse the mental models that describe how the domain is organised. Steps four to six provide the background and basis for designing procedural information.

Steps seven to nine are analogous to steps four to six, and are about designing procedural information, that is, information about how to carry out recurring tasks. As with steps four to six, these steps can be a matter of organising already available information and material, and linking them to the appropriate tasks, neglecting
steps seven and eight. If material does not exist, it must be designed (Step 7). Step 8 is about analysing the cognitive rules that specify condition-action pairs that drive routine behaviour. Step 9 is about analysing the knowledge that is prerequisite to the use of cognitive rules.

Under certain circumstances it is necessary for the learner to develop a high level of automaticity for some aspects of a complex skill. An example can be CPR (cardiopulmonary resuscitation) for an ambulance driver, or correcting unusual nose positions for an airplane pilot. In this case, Step 10, designing part-task-practice, is carried out. Step 10 can often be informed by the analysis in Step 8.

### 3.2.3 Implications for training in NEXT-TELL

Using 4CID is beneficial to the NEXT-TELL teacher training in several ways. First and foremost it is a fully developed model for instructional design based on an articulated perspective on learning, which supports consistency in development of the training in the NEXT-TELL tools and methods. Rather than relying on bits and pieces of knowledge, 4CID represents a coherent approach that is applied from the beginning to the end of the training process.

The approach inherent on building on an existing model for instructional is augmented by keeping the teaching material at least in some sense separate from the use of them, although the two are also highly interrelated, as the training material (or supportive and procedural information, in 4CID terms) can be changed without changing the approach to delivering the training.

4CID is useful in highlighting the practical aspects of practice and doing. This suits the needs of NEXT-TELL training, which aims to enable teachers to use tools and methods for strategic planning of learning and informed use of formative feedback. This use of digital tools is partly informed by knowledge and attitudes towards learning and feedback, but also has a practical side of doing something with technology.

Training of NEXT-TELL tools and methods will take place in several different institutional contexts, across multiple countries and subject domains. Using a coherent model for instructional design and training may support integration of feedback about the training sessions across these multiple school contexts. Data gathered about one training session in one country, context or subject domain, should in this situation be more applicable to training sessions carried out in another country, context or subject domain.

The next section provides a perspective on how to organize online training material for instruction, a perspective influenced by Learning Object Theory. Learning Object Theory is not a theory of instruction or learning in itself. Using it as such may imply a reductionist approach to the learning process, although several authors recommend that it may prove fruitful when used alongside a model of instructional design, such as 4CID. The aspect of Learning Object Theory that is highlighted as useful for the teacher training in NEXT-TELL is the concept of modularization, which is described below.

### 3.3 The Moodle courses and Learning object theory

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 aspects. The most 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 phenomenon, 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.

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 4CID.

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.

3.4 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 goal for D7.3 is to make the training materials available as courses in Moodle. A future goal for WP7 is to redesign the training materials with respect to the theoretical concepts presented in sections 3.2 and 3.3 of this report. As an example of how this can be done, however, see section 3.4.6 on OpenSIM.

3.4.1 SPICE

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.

3.4.2 TISL

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.

3.4.3 ECAAD

ECAAD planner is a web-based tool to support teachers in planning for students’ learning activities realized 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 and 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

3.4.4 Mahara

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

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.

3.4.5 OLM

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

**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.

### 3.4.6 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 Introduction</td>
<td>Basics: How does it work? What can it be used for? How do we use it?</td>
</tr>
<tr>
<td>B Life as Avatar</td>
<td>Avatar’s basic skills: navigation, communication, viewing, …</td>
</tr>
<tr>
<td>C Virtual world’s pedagogy</td>
<td>How can virtual worlds be used? What has to be considered when using one for your class?</td>
</tr>
<tr>
<td>D Putting on your student’s shoes</td>
<td>Solve the “Chatterdale mystery”!</td>
</tr>
<tr>
<td>E Learning scenario design</td>
<td>How to create your own learning scenario: pedagogically, organisationally, technically</td>
</tr>
<tr>
<td>F Analyzing student’s activities</td>
<td>ProNIFA allows us to analyze an automatically created logfile. What can we use it – and what can we learn about student’s learning?</td>
</tr>
<tr>
<td>X Administrator’s corner</td>
<td>How to prepare your local IT environment, so it’s ready to be used by teachers and students.</td>
</tr>
</tbody>
</table>

Table 2: 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!

3.4.7 Sonic Divider

Main features:

- Allows learners to practice mathematics in a game-like interface
- Facilitates teaching and learning of written division and it’s underlying sequences
- Facilitates immediate feedback to the learner

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.
3.4.8 Webtrack

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

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.
4 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 4CID can provide a useful basis for designing the training to take place, for reasons of repeatability and consistency in the training.

The goal for D7.3 was to provide a framework for instructional design, represented in 4CID, synthesised with the Learning Objects theoretical concept of modularisation, along with making the training materials available as courses in Moodle. The training material available for OpenSIM serves as an example for this. Future work within WP7 involves redesigning the training materials for all the tools based on the example of OpenSIM, and to applying the model of 4CID to the design of the training.
5 References


6 Glossary

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

- **BSCW**: The document store used in NEXT-TELL used for storing internal documents
- **Document store**: see BSCW
- **EuresTools**: The reporting tool used in NEXT-TELL
- **PM**: Person month
- **T**: Task
- **WP**: Work package

Partner Acronyms

- **JRS**: JOANNEUM RESEARCH Forschungsgesellschaft mbH, AT
- **UniRes**: UNI RESEARCH AS, NO
- **KMRC**: Medien in der Bildung Stiftung, DE
- **TUG**: Technische Universität Graz, AT
- **CBS**: Copenhagen Business School, DM
- **BHAM**: University of Birmingham, UK
- **IOE**: Institute of Education, University of London, UK
- **EXACT**: eXact Learning Solutions SPA, IT
- **TALK**: Verein offenes Lernen, AT
- **BOC-AT**: BOC Asset Management GmbH, AT
- **BOC-PL**: BOC Information Technologies Consulting SP.Z.O.O., PL
- **MTO**: MTO Psychologische Forschung und Beratung GmbH, DE

Abbreviations

- **BS**: Baseline Study
- **CbKST**: Competence-based Knowledge Space Theory Training Course
- **CBT**: Computer Based Training
- **DBR**: Design-Based Research
- **ECAAD**: Evidence Centered Activity and Appraisal Design (builds on the ECD)
- **ECD**: Evidence Centered assessment Design (e.g. PADI project)
- **EFL**: ‘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.
- **ENA**: Epistemic Network Analysis
- **ESL**: English as a Second Language; refers to learning English in the target language environment
- **HCI**: Human Computer Interaction
- **ICT**: Information and Communication Technology
- **IT**: Information Technology
- **LEPP**: Longitudinal Evaluation of Performance in Psychology (2nd generation e-portfolio)
- **NEXT-TELL**: Next Generation Teaching, Education and Learning for Life
- **OLM**: Open Learner Model
<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<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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<tr>
<td>SRI</td>
<td>Stanford Research Institute</td>
</tr>
<tr>
<td>STEM</td>
<td>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</td>
</tr>
<tr>
<td>TDS</td>
<td>Teacher-led Design Study</td>
</tr>
<tr>
<td>TEL</td>
<td>Technology Enhanced Learning</td>
</tr>
<tr>
<td>TESL</td>
<td>Teaching English as Second Language</td>
</tr>
<tr>
<td>TISL</td>
<td>Teachers Inquiry into Students Learning</td>
</tr>
</tbody>
</table>

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