# DESIGN OF FLEXIBLE ADVANCED DISTRIBUTED TRAINING FOR MILITARY AIRCRAFT MAINTENANCE

**Colonel A.C.J. (Ton) Bernards MA**
***Royal Netherlands Air Force***
***Head of Training and Education RNLAF JSF Project Team***
**The Hague, The Netherlands**
**adacjb@xs4all.nl**

**Dr. W.F.S. (Willem) Hylkema**
***Royal Netherlands Air Force***
***Head of Training Policy Branch***
***Directorate of Personnel***
**The Hague, The Netherlands**
**hsopl@dpklu.af.dnet.mindef.nl**

**Major Inge Hopland**
***Royal Norwegian Air Force***
**Training center Kjevik**
**ihopland@mil.no**

**Captain Erik Qvam**
***Royal Norwegian Air Force***
**Training center Kjevik**
**eqvam@mil.no**

## ABSTRACT

The Royal Netherlands Air Force (RNLAF) and the Royal Norwegian Air Force (RNoAF) have designed a new training program for F-16 maintenance using a constructivistic approach. The training uses a learner centered approach. The training development is based on a new interpretation of ISD. The core of the training is an emulation of the F-16. This emulation creates a synthetic maintenance environment in which learning tasks are executed. CBT and classroom training are used to create a mental model necessary, for the students to execute learning tasks. The new, to be developed training environment, should be so flexible that it can be used within different kind of learning, for example group training, self paced learning, classroom delivery, mentoring, mixed mode learning, certification, performance support and distributed training. Using SCORM guidelines will make it possible to connect the learning objects (ELO's and TLO's) to a LMS. A script is developed, based on SCORM Simple Sequencing, which describes the complete training design. This script will be used to guide the training development and production process. During this process the production of CBT will be outsourced and managed by the RNLAF and RNoAF. The script will also be translated into an eletronic textbook for students and an electronic syllabus for instructors. The script will be the "bedrock" on which the training rests. In this paper we will discuss the design of the training program and the integration of the different approaches, as conceived by the RNLAF and RNoAF. The central questions addressed are: (1) What elements are necessary to design flexible blended learning which can be used in different learning environments? (2) Is is possible to translate mixed mode learning design in IMS Simple Sequencing? (3) How do we make sure that there is compliance between pedagogical, SCORM, "shipping and handling" and the training design? (4) How do we make sure that there is compliance between training design, development and execution?

## ABOUT THE AUTHORS

**Ton Bernards** is an Air Force career officer and has an extensive operational, policymaking and training/education background. He holds a Master of Arts degree. He until recently headed the Personnel Development Branch of the RNLAF and was responsible for the overall training and education as well as management and career development of RNLAF personnel. He is project manager for implementing ADL in the RNLAF, thus leading the way for the implementation of ADL in the Netherlands Defense Organization as a whole. Presently he is attached to the RNLAF Joint Strike Fighter program, responsible for Training & Education.

**Willem Hylkema** works as a civil servant for the Royal Netherlands Air Force. He is Head of the Training Policy Branch. He also has worked at the Teacher Training College of the University of Nijmegen (the Netherlands). He holds a Ph.D. in education.

**Inge Hopland** is a Norwegian Air Force officer with technical and training/education background. He has worked as technical engineer and instructor on fighter aircraft. He is responsible for development of the RNoAF ADL centre. He holds a bachelor of technical flight engineer and a master of information & communication technology in learning.

**Erik Qvam** is a Norwegian Air Force officer with technical and training/education background. He has worked as technician at anti-aircraft missiles (NASAMS) and chief of information & technology section in the air force. He has also background as an instructor on several of the air force systems (radar, communication equipment, etc.)

# DESIGN OF FLEXIBLE ADVANCED DISTRIBUTED TRAINING FOR MILITARY AIRCRAFT MAINTENANCE

**Colonel A.C.J. (Ton) Bernards MA**
*Royal Netherlands Air Force*
*Head of Training and Education RNLAF JSF Project Team*
**The Hague, The Netherlands**
**adacjb@xs4all.nl**

**Dr. W.F.S. (Willem) Hylkema**
*Royal Netherlands Air Force*
*Head of Training Policy Branch*
*Directorate of Personnel*
**The Hague, The Netherlands**
**hsopl@dpklu.af.dnet.mindef.nl**

**Major Inge Hopland**
*Royal Norwegian Air Force*
**Training center Kjevik**
**ihopland@mil.no**

**Captain Erik Qvam**
*Royal Norwegian Air Force*
**Training center Kjevik**
**eqvam@mil.no**

## INTRODUCTION

A new F-16 Maintenance training program is being developed by the Royal Netherlands Air Force (RNLAF) and the Royal Norwegian Air Force (RNoAF) and recently the Royal Danish Air Force (RDAF) has joined as well.
The reasons to start this international cooperation are:

- Cost reduction in training development.
- Flexibility in international operations.
- Sharing of training and instructor capacity.

The F-16 Maintenance training consists of two parts. The first part, the avionics technician training package (ATTP) is already developed (Boot et.al 2003). The second part, the mechanics technician training package, will be developed in the near future. Together it will constitute the TTP – Technical Training Package.

In the Statement of Requirements for the ATTP project we described the to be developed training. The end result after the development differed from that description. Therefore we decided to make a better description of the to be developed training for the TTP and thoroughly follow the design steps of the ISD model. Our experience from other projects is that the first two phases (analysis and design) are sometimes not getting enough attention. The focus is on the development phase and design issues are solved during development. We decided to pay more attention to the design phase and to approach the design from different angles.

- The pedagogical perspective
- The SCORM perspective
- The "shipping and handling" perspective
- The design perspective

## THE PEDAGOGICAL PERSPECTIVE

Koper and Olivier (2005) describe a pedagogical model as a set of rules that prescribes how a group of learners can achieve a set of learning objectives in a certain context or knowledge domain in the most effective way. Examples of pedagogical models are mastery learning, problem-based learning, cognitive apprenticeship, learner-centred approach, etc. Koper and Olivier state that current views on pedagogical models can be summarized as learner, knowledge, assessment and community centred.
The pedagogical design of the TTP is based on a combination of the different approaches. We will discuss the most important ones.

### <u>The didactical structure</u>

Merriënboer e.a. (2003) state that recent instructional theories tend to focus on authentic learning tasks that are based on real-life tasks as the driving force for learning. One of those instructional theories is the four component instructional design model (4C/ID Model). We have used this model as a generic framework for the design of the course. This framework structures the basic scenario. We have decided to generate scenarios to describre the learning objects within the TTP. A scenario is a brief description of the pedagocial model and the flow of the learning process.

The 4C/ID Model presupposes that well-designed learning environments for complex learning always consist of four components: (a) whole learning tasks, (b) supportive information, (c) procedural information, and (d) part-task practice.

Task-oriented training is closely related to problem oriented training. Many current instructional models suggest that the most effective learning products or environments are those that are problem centred or task oriented and involve the student in a cycle of learning that involves four distinct phases (Merrill 2002): activation of prior experience; demonstration of skills; application of skills and integration of these skills into real-world activities.

Merrill's model utilizes the following steps or phases:

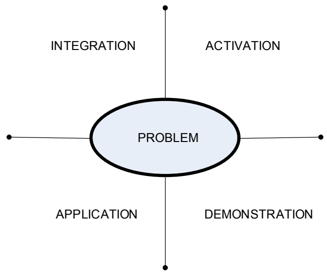


**Figure 1.** Merrill's cycle of learning

**The problem phase**: Learning is promoted when learners are engaged in solving real-world problems and their related learning tasks.
**The activation phase**: learning is promoted when existing knowledge is activated as a foundation for new knowledge.
**The demonstration phase**: Learning is promoted when new knowledge is demonstrated to the learner.
**The application phase**: Learning is promoted when the learner applies new knowledge.
**The integration phase**: Learning is promoted when new knowledge is integrated into the learner's world.
The TTP consists of an aggregation of learning objects. We consider the largest learning object as a module; each module is aimed at an authentic task. Within each module we can distinguish the following groups of learning objects.

**Table 1.** Groups of learning objects

| | | Gagné Nine Events | |
|---|---|---|---|
| Activation | Introduction Case description | • Gain attention<br>• Inform learner of objectives<br>• Stimulate recall of prior learning | SCO |
| Demonstration | Presentation of supportive information | • Present the content<br>• Provide the learning guide | |
| Application | Authentic whole and part task learning tasks | • Elicitit performance | SCO |
| Integration | Reflection | • Enhance retention and transfer | |
| Questioning and testing | Questioning and testing | • Provide feedback<br>• Assess final performance | SCO |

We use a modular approach, each module has a terminal learning objective (to be able to perform a certain job task). Each module consists of three distinguishable groups of learning objects: learning objects aimed at providing theory necessary to create the mental model, learning objects consisting of learning tasks and learning objects related to questioning and testing.

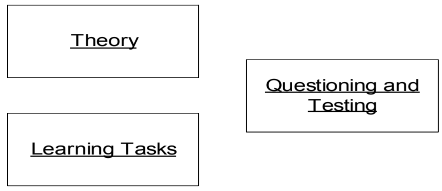


**Figure 2.** Modular approach

The learning object aimed at the theory will consist of separate assets: introduction, problem/case presentation, advanced organizer and theory. The learning tasks are placed in an ordered sequence of sets of learning tasks. A set of learning tasks represents simple-to-complex versions of the whole task. The whole task implies that the set of learning tasks is performed by the learners in a simulated or real task environment and should confront them with all the elements of the learning task. Scaffolding of support is an important element, it starts with one or more learning tasks with a high level of embedded support (e.g., comprehensive examples), continues with learning tasks with a lower level of support (e.g., completion, goal-free, or reverse tasks), and ends with conventional tasks without support. The supportive information is seen as the theory, which should lead to the mental model necessary for the execution of the learning tasks. According to Merriënboer e.a. (2003) the procedural information is presented just in time to perform the consistent, routine aspects of the learning tasks. It preferably takes the form of direct, step-by-step or 'how-to' instruction and is quickly faded away for subsequent learning tasks.

**The role of the student**

The legacy system had a focus on the instructor. For the new TTP we have made a switch to a learner-centred approach. In our legacy F-16 maintenance training the focus was on instructor and on system knowledge (what the instructor knows about the system). In general the instructor talked and the students listened. The students worked alone and the instructor monitored and corrected every student's learning behaviour. The instructor chose topics and evaluated the student learning. In the new TTP the focus will be both on students and instructor. The students will interact with the instructor and with each other. The students will work in pairs, in groups, or alone depending on the purpose of the activity. They will work without constant instructor monitoring; instructor provides feedback/correction when questions arise. The students answer each other's questions, using the instructor as an information resource.

In the instructor centred approach there is a focus on teaching, contrary to the "learner centred" approach where the learning is the primary goal of the instructor. This means that student learning should be facilitated. The instructor has to motivate the students to learn, participate, critically think and successfully perform on learning tasks. In the learner centred approach there will be a shift in responsibility. A result will be that the new instructor role is much more challenging. Keywords are facilitation of learning, motivation of students, understanding individual needs, strengths, coaching, weaknesses and learning styles. A wide array of "tools" to motivate students will be used in the TTP: cooperative learning; "real life" application of information and assignments; critical thinking, hands-on learning; graphic organizers, innovative teaching and learning mediums and venues.

**Individual learning vs group learning.** Merrill (1996) states that groups don't learn, individuals learn`. Learners may be part of a group while learning, learners may learn from one another, and the social context of a learning environment may provide support for its members; nevertheless the change in cognitive structure and the acquisition of knowledge and skill is an individual event. A student cannot learn without individual practice, which is the demonstration of their knowledge or skill.

**Performance based approach:** Performance-based training is focused on the job performance. If the performance is to troubleshoot a malfunctioning F-16, the training should teach students this performance.

The performance is not "knowing all about each part of the F-16"—it is about identifying and clarifying symptoms, recognizing potential causes, diagnosing the problem to identify and verify specific causes, etc. This approach ensures that learners master the necessary knowledge, skills, and abilities necessary for the job performance. The approach clearly defines what they are expected to know and be able to do with that knowledge. Students are periodically tested or assessed to determine their progress, and each student is given needed time and assistance to become proficient.

In performance-based assessment, students are expected to show what they know and what they can do with their knowledge, skills and abilities. Students show their basic knowledge and understanding through a variety of activities that demonstrate their level of proficiency.

This kind of assessment not only requires thorough knowledge of the basic skills, but also demands that students demonstrate their knowledge through projects, performances, experiments, research, essays, critiques, and other practical ways.

**The role of the instructor**

The new learning environment for the TTP will have consequences for the role of the instructor. In the pedagogical approach we already have mentioned that there will be a shift from the instructor centred approach to a student centred approach. The cognitive apprenticeship approach will support us in understanding this shift.

**Cognitive apprenticeship.** According to Conway (1997) Cognitive Apprenticeship is a method of instruction aimed primarily at teaching the processes that experts use to handle complex tasks. The focus of this learning-through-guided-experience is on cognitive and meta-cognitive skills, rather than on the physical skills and processes of traditional apprenticeships. Applying apprenticeship methods to largely cognitive skills requires the externalisation of processes that are usually carried out internally. Collins e.a. (1989) states that students can learn more skilfully on their own by observing the processes by which an expert listener or reader thinks and practices these skills.
With regard to the TTP this method implies:

1. Modelling -- involves an expert carrying out a task so that students can observe and build a conceptual model of the processes that are required to accomplish the task. For example, the instructor might model an example of a F-16 Fault Isolation process by demonstrating it in the F-16 Cockpit Emulator, while verbalizing the thinking processes (summarize what he just read, what he thinks might happen next).
2. Coaching - consists of observing students while they carry out a learning task and offering hints, feedback, modelling, reminders, etc.
3. Articulation - includes any method of getting students to articulate their knowledge, reasoning, or problem-solving processes.
4. Reflection - enables students to compare their own problem-solving processes with those of an expert or another student.
5. Exploration - involves pushing students into a mode of problem solving on their own. Forcing them to do exploration is critical, if they are to learn how to frame questions or problems that are interesting and that they can solve (Collins, e.a. 1989, 481-482).

**The use of authentic learning tasks.**

It is important to motivate the student as much as possible. The basic idea of the 4C/ID model is to see the learning task from a whole task perspective and to introduce the whole task as soon as possible. Students start doing the "real thing" when they are ready for it. This implies that technicians will start maintaining, drivers will start driving. Before and in between the practical exercises (learning tasks) the required supportive information will be delivered to take performance to a higher level. There are training situations were the learning tasks do not provide sufficient opportunity to practice the recurrent aspects of the highest-level skill. In that case part-task practice should be used. Part-task practice serves to diminish workload, i.e. if a trainee masters a recurrent skill at an automated level he is supposed to have more spare capacity for the non-recurrent aspects. Related to the TTP this means that for instance "safe for maintenance training" will be a candidate for part-task practice. Other examples are special procedures for the execution of an engine run, the use of the break procedures. Part-task practice will lead to a certain level of automation. If this automation is not present, it can increase workload.
The whole-task approach implies that recurrent aspects of performance are not trained separately but only practiced in the context of whole learning tasks. In whole-task practice a complete complex skill is being trained in such a way that practice aims at:

- job-realistic goals, and
- realistically varying task contexts.

This will support the trainee in building up a job-oriented concept and a mental model of the task as soon as possible, thus reducing the undesirable effect of the training producing skills that appear to have no use in the real job (Merriënboer e.a. 2003).
It is difficult for students to deal directly with the full complexity of the professional tasks. A step-by-step approach is therefore necessary. Learning tasks are sequenced in such a way that the learning process is natural and smooth, but still enable the trainee to build up his or her picture of the job as realistically as possible from the start.
Next to the whole task approach we also distinguish part task practice. Some recurrent aspects of the task need to be trained in isolation to a very high level of automation.

An example of part task practice is for instance safety procedures for maintenance. According to the 4C/ID Model, additional part-task practice starts only after the learners have been introduced to the recurrent aspects in the context of the learning tasks, so that part-task practice takes place in a fruitful cognitive context that allows learners to identify the activities that are required to integrate the recurrent aspects in the whole task (Merriënboer e.a. 2003).

**Synthetic Task Oriented Training**. Learning tasks should be authentic. By creating a realistic synthetic maintenance environment we are able to present the student with authentic learning tasks. The core of the synthetic maintenance environment is an emulation of the F-16. This emulation creates a synthetic maintenance environment in which learning tasks are executed. CBT and classroom training are used to create a mental model, necessary for the students to execute learning tasks.

**Learning objects as building blocks.** Learning objects can be seen as building blocks that can be combined in nearly infinite ways to construct collections that might be called lessons, modules, courses, or even curricula. The design team will make the decision in advance which learning objects to assemble into the TTP collection (http://www.wbtic.com/trends_objects.aspx).
The shareable content object (SCO), the ADL name for a learning object, is the building block of a topic, a lesson, or a course. SCORM defines an API for a learning management system (LMS) to manage and communicate with SCO's and for SCO's to communicate with the LMS. SCORM is a model for designing an interoperable, durable learning system. It does not specify a programming language, authoring tool, or operating system; however, you will find most implementers using XML, Java, JavaScript, and HTML. Furthermore, SCORM does not (currently) address instructional design issues, nor does it prescribe specific functionality for LMS's (http://www.wbtic.com/primer_standards.aspx#scorm).

As object model for the TTP we have used the Navy Content Object Model (NCOM). The NCOM is a data drill down that gives meaning to the Learning Object Aggregation (LOA), Terminal Learning Object (TLO), Enabling Learning Object (ELO), and the Asset that make up the NCOM hierarchy. The NCOM seamlessly correlates to the SCORM. The NCOM's hierarchical objects are defined as:

- LOA - top level grouping of related content; the LOA is also called the organization that contains TLO's and ELO's
- TLO - an aggregation of 1 or more ELO's, it satisfies one terminal objective and correlates to a SCORM aggregation
- ELO - an aggregation of 1 or more Assets, it satisfies one enabling objective and correlates to SCORM SCO
- Asset - the base building block of ELO's and TLO's. It is either a representation of text or a media element (e.g., web file, assessment object, video, and other data elements)

Between the NCOM and SCORM there is a one on one relationship.

## THE SCORM PERSPECTIVE

SCORM 1.2 has been criticised on several points. The first criticism relates to the learner model. SCORM 1.2 is about the "individual learner" and the "instructional model" (Kraan and Wilson, 2002). One the 'chief architects' of ADL's SCORM, Dan Rehak of Carnegie Mellon's Learning Systems Architecture Lab, stated: "SCORM is essentially about a single-learner, self-paced and self-directed. It has a limited pedagogical model unsuited for some environments."
This is mainly a consequence of the needs of the main initiators of SCORM: the US federal government in general, and the Department of Defence in particular. Their needs are mainly in the area of training for specific systems and situations by people who are not generally fully enrolled in an educational program. This need is addressed very well by the specification, but SCORM does not deal with collaboration. (http://metadata.cetis.ac.uk/content/20021002000737).

We can aggree that this is a fair criticism, but SCORM can, according to Stiles (2003), be used on multiple levels and with different intentions. SCORM type content can be used in different ways; one way is to use it as supporting resources to larger, more pedagogically active learning experiences. SCORM concentrates on packaging content, launching it, and communicating the learner's interactions with the content (tracking the learner). Meanwhile the SCORM 1.2 guideline is succeeded by the SCORM 2004 guideline.
IMS[1] Simple Sequencing (IMS SS) is now part of the guideline. The IMS SS will make it possible to design the learning path of the learners through the content.

[1] The original name of this initiative was the Instructional Management Systems (IMS) project.

A learner could, for example, start out with a mandatory introductory activity, on completion of that be presented with a choice of two other activities, and only after completion of all three be presented with a test, sequenced in the same order in which the learner wandered through the content bits. Other nice features include the ability to suspend and resume the activity- no need to finish everything there and then. Also, the spec explicitly enables the embedding of activities in other activities, making it possible to provide learning experiences that are either very fine-grained, extremely extensive or both. IMS SS is a specification used to describe paths through a collection of learning activities. Integrating IMS Question and Test Interoperability (IMS QTI) with IMS SS enables sequences of learning activities to be influenced through the outcome of tests, creating schemes of formative assessment. Alternatively, IMS SS can be used to aggregate the results of many individual IMS QTI items into schemes of summative assessment.

The criticism on SCORM could lead to the decision to use an alternative approach. IMS Learning Design (IMS LD) could be an acceptable alternative. IMS LD addresses the issues we have found problematic in SCORM. But one important problem is that implementation of LD seems to be under specified, which dilutes the strength of any standardization aspect.

We can conclude that one of the major strengths of SCORM is that it provides a set of specifications that covers many aspects of design and deployment of digital learning material. It is highly specific and not so difficult to implement, but therefore impose severe restrictions with regard to expressivities. LD on the other hand is unrestrictive, but more difficult to implement.

We can conclude that one of the major strengths of SCORM is that it provides a set of specifications that cover many aspects of design and deployment of digital learning material. It is highly specific and not so difficult to implement, but therefore imposes severe restrictions with regard to expressivities.

**IMS Shareable State Persistence guideline.**
One of the problems we face is the integration of emulation in SCORM 2004.

**The repository model**
Ashlock e.a. (2005) describe the use of the repository model. The model envisions an instructor or content developer working within a SCORM/CORDRA-conformant LMS who wishes to create a curriculum by assembling a series of SCO's. Ashlock e.a. state that first, he or she uses the LMS to search for a SCO addressing a specific task or topic. The SCO is found by identifying elements of its metadata, and it is located on a proponent's repository server. Instead of copying the SCO from the repository server to the local LMS server, a reference pointer to the SCO is made in the LMS's database. After finding several SCO's, including instructional blocks, exercise blocks, and test/evaluation blocks, the instructor/developer uses the LMS's tools to organize the SCO's into a SCORM-conformant learning experience by saving them as a Content Organization Template. This template is simply the form of an IMS manifest existing in a LMS database, either imported from a SCORM PIF, or made in the LMS, and able to be exported as the manifest of a new SCORM package if required.
When the instructor or content developer has completed assembling the courseware, it is represented to the student as a courseware table of contents. The links on the table of contents screen may point to a SCO housed locally on the LMS or to a SCO housed in a remote repository server. A user clicking on the remote SCO's launch link will launch the SCO from the repository server. The user's interaction data with the SCO is stored by the SCO utilizing the SCORM API provided by the repository server, which then relays the interaction information to the LMS for permanent storage.
Developers of the SCORM anticipated the launching of remote SCO's by allowing fully qualified URLs to be used for a SCO's launch link within a package manifest.

## THE "HANDLING AND SHIPPING" PERSPECTIVE

**Flexible training**
The new, to be developed training environment, should be so flexible that it can be used within different kind of learning, for example group training, self paced learning, classroom delivery, mentoring, mixed mode learning, certification, performance support and distributed training.

What elements are necessary to design flexible blended learning that can be used in different learning environments? In our model we are focused on the following elements: IEEE LOM, IMS Question and Test Interoperability, simple sequencing and navigation, IMS E-Portfolio and IMS LIP**.** In this area there are still many questions, but we want to test some elements that are important for a future learning environment.

**IEEE LOM.**
Learning Object Metadata or IEEE LTSC LOM is the only formal e-learning standard so far. LOM

gives us a basic specification for web-based training.
Other current interest metadata systems are: Dublin Core, ARIADNE and profiles to LOM: CanCore, UK.
We need customisation of a standard to meet the needs of particular communities of implementers with common applications requirements. The LOM standard has over 90 elements and 9 categories.
We will not use all 90, but we will choose some of the elements that we seem important.
We will cover the following categories:

- General. This contains the general description of the learning object such as title, language, keywords etc. In the TTP this will be a category we will use.
- Lifecycle. Gives us the information about whom and what has been done with the learning object.
- Meta-Metadata. Data about the learning object data.
- Technical. Technological requirements for the learning object.
- Educational. Pedagogical and educational information about the learning object.
- Rights. Information about the user and rights source of the Learning object.
- Relation. The relationship between the learning object and other learning objects.
- Annotation. Information about how to use the learning object and whom has commented the learning object.
- Classification. Describes the learning object in relation to a specific classification system. We would see if there are any links to the EASA system and the EASA classification system.

The Goal of LOM is interoperability and system operability and taxonomy. We will have special focus on taxonomy in this process. Our experience with projects without a common understanding often fails. We will use the LOM definition and explanation for the test. We will probably use 18 parameters in the TTP case. Use of XML is a main business in this test. RDF and OAI are also formats that we are looking into.

**IMS Question and Test Interoperability, (QTI).**
The QTI is not part of the SCORM but we see this as essential to a flexible learning environment. The IMS QTI specification does not limit product designs by specifying user interfaces, pedagogical paradigms, or establishing technology or policies that constrain innovation, interoperability, or reuse.
In the TTP we want to carry out how we can take care of the student's answers in an easy way and give the students feedback when necessary. The QTI specification concerns itself with three distinct functions that are suitable for our test. The actual format of a question, the format of a bunch of questions in a test, and the format and processing of the answers that come back.
Though questions on their own are pretty useful bits of learning material in their own right, we want to use them in conjunction with other e-learning formats such as IMS Simple Sequencing, SCORM and IMS Learning Design. For the TTP test we want to use the following questions type:

- Standard True/False (text-based options) - choice-based rendering;
- Standard Multiple Choice (text-based options) - choice-based rendering;
- Standard Multiple Choice (image-based options) - choice-based rendering;
- Standard Multiple Response (text-based options) - choice-based rendering;
- Multiple Choice with Single Image (image-based options) - IHS-based rendering;
- Standard Image Hot Spot (single image) - IHS-based rendering;
- Standard Multiple Fill-in-Blank - FIB-based rendering;
- Standard Short Answer (text required) - FIB-based rendering.
- Standard Drag-and-drop (multiple images) - object-based rendering.

The specification enables the exchange of items, assessment and results data between Learning Management Systems, as well as content authors and content libraries and collections. In our test we will use two LMS's for testing purposes: IBM learning management system and Moodle.

**Additional relevant specifications (IMS ePortfolio).**
From an individual perspective and an organizational perspective, information about a person's performance and achievement, as recorded in an E-Portfolio, need to operate across institutions and countries throughout their lifetime. In our test we want to see the possibilities of an E-Portofolio in our countries and if possible to be used between our countries.

In our E-Portfolio test we want some parts to be included and excluded when we are using the E-Portfolio. In our test E-Portfolio we want the following parts to be included:

- The activities in which the subject has participated, is participating, or plans to participate;
- The competencies (skills, etc.) of the subject;
- The subject's goals and plans;

- The results of any test or examination of the subject;

**Sequencing: <u>IMS Simple Sequencing</u> and navigation.**
In all education and learning it is important to describe how a learner can progress through on-line learning activities. Our thought is that every student should have different possibilities for choosing the "road of learning". Simple Sequencing enables what learning activities a learner will be presented with, in what order and circumstances. In our TTP test case we want to make an activity tree which adapts to our pedagogical approach.

We want to test features that include the ability to suspend and resume the activity- no need to finish everything there and then. Simple sequencing is not the answer for everything.
There are things that Simple Sequencing won't do. Most significantly is that it has no notion of role. It only assumes one person in the role of learner, and anything else is outside of the scope. For our test of the TTP we don't see this as a problem. Learning Design can be used for training that involves a social online context. In case of the TTP IMS Simple Sequencing is sufficient as a means to describe the learning flow and use training technology. We will make an activity chart that gives the students different possibilities to reach the goal.

## THE DESIGN PERSPECTIVE

The design perspective unites the pedagogical, SCORM and "shipping and handling" perspective. The design of the TTP is described in the scenario.

**<u>UML modelling of the TTP scenario</u>**
**The TTP scenario.** In the design phase a pedagogical model is constructed to guide the design activities. This pedagogical model is translated into an UML diagram. An UML diagram is often used with the learning design approach to make the significant variables of the training design visible. This UML diagram is a sequential and precise description of the lesson flow.

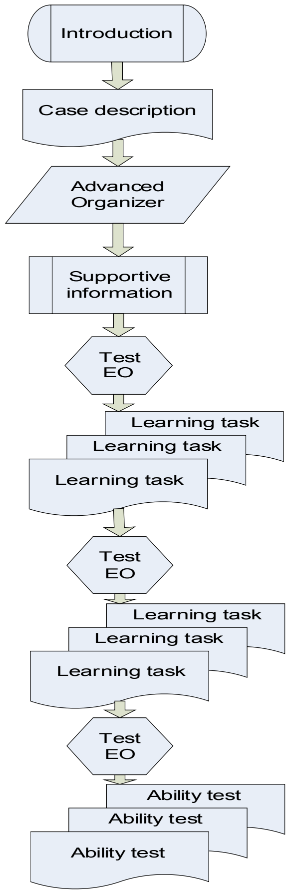


Figure 3. UML diagram of the lesson flow

**The translation of the scenario into SCORM 2004**
Two considerations are important in the scenario development:

- The possibility to capture the whole scenario
- The acceptance and implementation of the guidelines.

## COMPLIANCE BETWEEN TRAINING DESIGN, DEVELOPMENT AND EXECUTION

As we have stated earlier we are using an ISD approach for the development of the TTP. We see the ISD process as an iterative process. The scenario that is developed during the design process will provide guidance and direction to the developer and producer during the development phase. This implies that the quality of the scenario has to be high. That is one of the reasons we have chosen to use UML modeling for the TTP scenario. An UML model is "understandable" and "readable" for the courseware and software developer. We expect that a scenario that is written in a natural language can create confusion. There can be discussions about semantics etc.

**CONCLUSION**

In this article we have addressed four central questions. We have stated that the design of flexible training should be done from four different angles: First from the pedagogical perspective, secondly from the SCORM perspective, thirdly from the "shipping and handling" perspective and last but not least from the design perspective. We believe that it will be possible to translate mixed mode learning design in IMS Simple Sequencing. Using the design perspective we will make sure that there is compliance between pedagogical, SCORM and the "shipping and handling". By using an UML modelling approach for the TTP scenario, we expect to make sure that there will be compliance between training design, development and execution.

**REFERENCES**


Ashlock, N., Majors, W., Nilsen, D., and Paschetto G. (2005) Meeting Armor Requirements with SCORM Reuse within the Scope of Content Repositories from http://lttf.ieee.org/learn_tech/issues/january2005/#_Toc98674997

Boot, E and Smeulers, W.J. (2003) The Blended Learning Environment within the Royal Netherlands Air Force. In search for a systematic, integral development approach. *Interservice/Industry Training, Simulation and Education Conference (I/ITSEC).*

Collins, A., Brown, J.S. & Newman, S.E. (1989). Cognitive apprenticeship: Teaching the craft of reading, writing and matematics. In L.B. Resnick (Ed.), Knowing, learning and instruction: Essays in honor of Robert Glaser (pp. 453-494). Hillsdale, NJ: Erlbaum.

Conway, J. (1997) Educational Technology's Effect on Models of Instruction from http://copland.udel.edu/~jconway/EDST666.htm

Merriënboer, J. J. G. van, Kirschner, P. A., & Kester, L. (2003). Taking the load of a learners' mind: Instructional design for complex learning. *Educational Psychologist*, 38(1), 5-13.

Merrill, M.D., Drake, L, Lacy and J. Pratt, M.J. Reclaiming Instructional Design, from http://www.ittheory.com/reclaim.htm

Merrill, M.D. (2002) A Pebble-in-the-Pond Model For Instructional Design. *Performance Improvement Journal.* Volume 41 / Number 7.

Merrill, M.D. (2001) *First Principles of Instruction Utah State University.* Retrieved June 23, 2005, from http://www1.moe.edu.sg/itopia/download/abstracts/Applying%20First%20Principles%20of%20Instruction%20to%20Technology-Based%20Education.pdf

Stiles, M. (2003) How does content standardization impact on staff support in the use of VLE's. Learning Development and Innovation Information Services Staffordshire University