THE USE OF AN OPEN SOURCE CMS IN MILITARY MAINTENANCE TRAINING

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ABSTRACT

The Royal Netherlands Air Force and the Royal Norwegian Air Force have developed an Electronic Learning Environment for F-16 maintenance training, which takes full advantage of advanced learning technology. Central in the blended learning environment is a course management system (CMS). We will discuss the differences between closed / commercial software source (CSS) and open source software (OSS) for e-learning systems. It appears that OSS has some distinct advantages, the most important are availability of source code, supplier independency and flexibility and freedom. Both Air Forces have chosen to start with a try-out with an open source CMS called Moodle. We have distinguished five key issues to be tested in the try-out. The first issue is related to security: 'Is it possible to provide military maintenance training safely on the Internet?' The second issue is related to use of different learning models: 'Is it possible to develop and implement both individual training and team training by means of the Moodle CMS? The third issue is related to the development of didactical templates: 'Is it possible to use an open, constructivist approach in which learning tasks are central to learning, and still use pre-structured templates to promote efficient content development?. The fourth issue is related to the integration of different training media in the design: 'Is it possible to combine traditional e-learning modules with the Air Forces synthetic F16 maintenance environment?' The fifth issue is related to classroom training and learning on demand. Is it possible to use Moodle as a delivery tool for new content? We will describe the process and outcomes of this try-out, both for a well-controlled laboratory setting as well as for a real situation with military personnel abroad (for instance Afghanistan).

ABOUT THE AUTHORS

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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). 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 & Smeulers, 2003). The second part, the Mechanics Technician Training Package (MTTP), will be developed in the near future. Together it will constitute the Technical Training Package (TTP). The TTP will be delivered in 2006.
The maintenance training has in general two student populations. During the initial training novice maintenance personnel is trained at the central RNLAF and RNoAF training schools. Normally all education will be done at the Air Force training schools. By using the TTP Full Aircraft Emulator (FAE) we have the possibility to training/educate the students at the Air Bases. The project should lead to a more robust learning environment in which simulations support and enhance learning and give us possibility to train complex technical training, independent of place and time.
The importance of highly trained and skilled military personnel has never been greater than today. Rising to meet this need is the capability to train personnel anywhere in the world at any time using distributed learning (Bonk, Olson, Wisher and Orvis, 2002).
The purpose of the research of Bonk e.a. 2002 was to understand how a blended or hybrid approach to e-learning affected the professional development of students in a high-level military course. The study of Bonk e.a. addressed e-learning from the perspectives of the course learners, the course advisor, and the instructors.

THE TTP F-16 MAINTENANCE CASE

An Electronic Learning Environment (ELE) is a central part of the TTP. The current ELE functions in the Air Forces training schools within a Local Area Network (LAN) environment and provides the instructor and student with the necessary courses. The only limitation is that the ELE cannot be used in a distributed setting, because the Learning Management System (LMS) is not able to distribute the FAE to students. To be able to use the FAE in a distributed setting we have to modify the ELE used at the training school. The RNLAF and RNoAF have organized some try-outs with distributed courses to test the new ELE. The distribution of training will be done mainly to the Air Forces air bases. Both the RNLAF and RNoAF are involved in military operations abroad. We foresee a functional need to provide training during missions abroad, because of operational demands.
One of the central problems for distributed training we face is to create a secure learning environment. Training has to be provided at the right time and place and also to the right person. That means Air Force training is for Air Force eyes only.
The F-16 maintainer's education consists of several courses which have to be finished before the maintainer is allowed to work at the aircraft. The courses consist of theoretical and practical knowledge. In each course we are using the FAE. We are also using other digital training aids like PowerPoint, Macromedia Flash, Adobe PDF etc.

Definition of an Electronic Learning Environment (ELE)

An ELE can be defined as a learning milieu in which full advantage is taken of advanced Information and Communication Technology (ICT). Practically, the ELE consists of the hardware, software, and personnel needed to create this learning environment. ELEs support the learning process, communication to facilitate learning and the organisation of learning with

information and communication technology. Learning Management Systems (LMS) manage the administration of training. Course catalogs, launching courses, registering students, tracking student progress and assessments are all part of managing learning. A Course Management System (CMS) supports the development, storage, and management of courseware.

The TTP ELE functionalities

ELEs can vary considerably from each other in respect of the functionality they offer. This functionality is influenced by three components (Dankbaar & Hoek, 2002):

- Content component. The content component makes it possible to offer courses, learning material, assignments, and tests.
- Management and organisation component. The management and organisation of learning is done by means of a CMSand a LMS.
- Communication and collaboration component. Supporting communication and collaboration. An ELE can support communication and collaboration between teachers, students, and external experts.

Communication with teachers, presenting frequently asked questions and answers, coaching and feedback are important aspects of the learning process. If done correctly, collaborative learning can highly motivate students and contribute greatly to the learning process. There are also separate software tools available that support this communication and collaboration and which can be hooked up to an LMS. In general it can be acknowledged that the most beneficial aspect of an ELE lies in the *combination* of all the functionalities, allowing the creation of a powerful and effective learning environment. Regarding to the functionality within the components an ELE can non-complex or highly complex. An ELE can be restricted to only making texts and questions, with limited forms of interaction and supervision (just e-mail, for example). An ELE can also be an integrated system with sophisticated courses using multimedia content and links to authentic sources or databanks, whereby various forms of online testing, communication and collaboration at a distance are possible. In these learning environments, the students can record their competency development in e-portfolios and the teacher is provided with a good system for monitoring students.

The RNLAF and RNoAF ELE

The TTP ELE consists of a training portal and a course management system. The training portal is developed by a Dutch company (Stepco Group) during a 'proof of concept' project. The training portal has a number of functions.

- Authentication. This is in general the gate-keeping function of the portal. On one side the portal provides digital certificates to courses. The other side is the authentication of the student identity, for example by means of smart cards, biometrics, etc.
- Portal services. Topical links and items are loaded automatically. The user may configure according to preference from a number of external services (weather, news, shares, Frequently Asked Questions)
- Email. (A communication function). The student is able to email to groups. Disaggregation to allow replies back via original mail server. There is also a method for redirecting incoming mail as if sent from air base.
- Calender. Harvesting of calendar information from individual courses. Harvesting of calendar with Air Force events.
- Data integration can be done in several ways. First by designer interface and second by file import. Nightly batch updates are possible. Event driven update. Assessment data are exported to the Enterprise Resource Planning (ERP) system.
- Architecture. Must be server-based and should not require any software on the client machines, other than regular browser software. Seamless navigation between courses, and parts of course held elsewhere. SCORM 2004 compliant, to allow learning objects to be imported and exported. Backup and recovery. Password synchronisation across systems.

We use the open source system Moodle as CMS. Moodle is a software package for producing and managing Internet-based courses and web sites. It's an ongoing development project designed to support a social constructionist framework of education. The word *Moodle* is actually an acronym for *Modular Object-Oriented Dynamic Learning Environment.* The design and development of Moodle is guided by a particular philosophy of learning, a way of thinking that you may see referred to in shorthand as a "social constructionist pedagogy" (see http://moodle.org/). In the TTP ELE the student starts in the portal with authentication. Based on the authentication the student is redirected to a specific training domain within Moodle.

RNLAF and RNoAF courses within the TTP ELE

To get experience with distributed training both the RNLAF and the RNoAF have separately developed courses within the TTP ELE. Although different

templates and different digital training aids are used, the courses (re)use already developed TTP learning objects and TTP training devices (i.e., the Full Aircraft Emulator). The distributed setting implies that the student and instructors are physically located at different places. The student is located at the airbase and is assisted by a coach at the airbase. The instructor, as a supervisor, is located at the training school. The student and instructors use the Internet as a network facility. Communication between student and instructor is chat, forum (Moodle), e-mail and video-conferencing. Prototypical courses for F-16 Engine, Canopy and Egress have been developed.

ELE functionalities

Functionalities of course management system:

- Learning Environment. An appropriate navigation for learners is a demand. A good degree of interface customisation is possible, without compromising simplicity of use. There is administrative information about programmes/units within the portal. (Integration with modules catalogue). Student tracking is possible – we should be able to profile perfomance/grades. There is also student tracking, - we can see which parts of a course are completed. The ELE allows links to other web based resources and courses, without re-authentication. Offline Content (CD) can be integrated. Fur diagnostic purposes we can use survey tools. That means we state questions without grading.
- Assessment can be done in several ways. Multiple choice; multiplecorrect; true/false; matched pairs; ordering; fill in blank; essay. Also should be possible: adaptive assessment; diagnostic assessment and merge with offline assessment.
- Information function: by means of a “News forum the last updates about changes last changes in the course material will be communicated.

Learning objects as basic element in the ELE

Learning objects are the basic building blocks of the lessons. According to Strijker (2004), learning objects are defined as digital entities, available for use or reuse in different learning settings. Strijker states that these objects themselves may or may not have been originally created as learning objects; it is their use for learning purposes that makes them learning objects. Each learning object has a life-cycle. Stages in this lifecycle are obtaining an object, labelling an object, offering an object, selecting an object, using an object and retaining an object. In relation to the re-use of learning objects, Strijker states that human factors are even less easy to deal with. An example of such a human factor problem aspect is the instructor's perception that material created elsewhere does not fit well enough with the situation in his own instructional setting. (not invented here). This relates, according to Strijker, to another human aspect that influence the (re)usability of learning objects: not only must they be available and findable, but the instructor must be motivated to look for them, supported in making decisions about how to not only find them but more importantly integrate them into the rest of his course and instructional planning, and then must have easy-to-use tools that help him make this integration.

Training development within the ELE

Training development within the RNLAF and RNoAF is structured by the Instructional Systems Development (ISD) model (see Boot & Kremer, in preparation). This model is a common approach within Defence training. As didactical approach we have use a task oriented approach. The task-oriented approach we use is based on the Four Components Instructional Design (4C/ID) Model of Merriënboer (1997). Central in this task-oriented approach is the *learning task*. First, the learner is provided with supportive information (theory) necessary to perform the task. During the task performance, the learner can use CBT as just-in-time training. The training is concluded with a performance test; the student has to show that he/she has mastered the knowledge, skills and attitudes in the right way.

ADVANTAGES AND DISADVANTAGES OF USING OPEN SOURCE

Based on earlier experiences the RNoAF and RNLAF, it was decided not to use the legacy LMS. This LMS is closed source software (CSS). The main reason lies in new functional demands which this LMS cannot meet. Updating the CSS LMS accordingly would be costly. This functional demand relates to the need for use of team assignments in the blended learning environment. Moodle is able to combine individual and team training. We will address this issue more explicitly in a following paragraph.

Open source software (OSS) is software for which the source code is free and available. Closed source software (CSS) is defined as software for which the source code is not available for study, use and modification. Another difference lies in the licensing. Within the licence for OSS the intellectual property reuse of software and source code are arranged in such whey that the licence holder has rights of use, change and distribution.

Advantages of OSS

OSS proponents often claim that the use of OSS offers significant benefits when compared to commercial products. Commercial products typically favour visible features (giving marketing advantage) over harder-to measure qualities such as stability, security and similar less glamorous attributes.

The following advantages can be distinguished:

- Availability of source code. The source code is available and changeable.
- Cost efficient. Open source software is in general available free of royalties and fees.
- Supplier independency. OSS is no proprietary software as is the case with CSS. OSS creates no independency of a supplier and therefore no vendor locking.
- Community. Usually an OSS is supported and maintained by a professional community.
- Reliability. Mostly this means the meaning of the absence of defects which can cause incorrect operation, data loss or sudden failures.
- Stability. When there are no significant changes then there is no real pressure or need to change the software that is being used. With OSS the decision to upgrade is mainly a responsibility of the user and not vendor lead.
- Flexibility and Freedom. Flexibility means business flexibility, so that as requirements in the business change, solutions should not be unreasonably constrained by software. Freedom means freedom from a single vendor. Open-source software can be tailored for the way you do business. You can tailor down the OSS to the functionality you need. Nothing more and nothing less.
- Interface in own language. Most of the OSS are available in the own language. This multi language functionality creates a high interoperability. In general CSS is mostly only available in English.

Disadvantages of OSS

- Knowledge and skills of specialists are necessary. Often specialists are necessary to maintain or adapt the OSS to the needs of the organization. With the help of those specialists it is possible to tailor the system to the functional needs. This kind of specialist support is often outsourced.
- Documentation falls behind. It's general known that documentation is sometimes the weak link in the OSS. On the other hand communities who support the OSS in serious way will make an effort of documentation.
- 'Free riders' or 'leechers' who do not contribute. Sometimes there are too many free riders who leech on the work of the front runners. It's a fact of life that has to be accepted.
- The security implications of open source software. Some people believe that OSS creates open doors. To protect themselves organizations try to secure their interest by secrecy. Mostly secrecy has meant security. By locking up (you door, car, valuables) you can try to protect your interests. Whitlock (2001) states that open source is the only real option for secure systems. For one thing, closed source applications and operating systems can't be examined and verified for secure coding.
- Low quality and limited in performance. Important is the strength of the community. This means that you have to reach a critical mass of users.
- Restrictiveness of licence. Commercial companies are sometimes reluctant to invest in OSS because they believe that their investments will pay back commercially. It would be uneconomic to participate in communities with no guarantee of financial reward. But there is another commercial interesting trigger for participation. Commercial charges for support and distribution costs can be interesting commercial returns.
- Too risky because the application may cease to exist. Open source projects which are supported by a large community will stay in the market. On the other hand CSS is in itself no guarantee for "lifetime" existence.
- Lacks gloss, hard to sell to management. While "gloss" may appear to be important, it is the robustness, stability and performance of software applications that are crucial (Wyles, Clayton 2004). It is fairly easy to provide software with "gloss", but to make it robust is another story.
- No support from a vendor. Support for an OSS can be realized in different ways. It can be done by the user, the community or a commercial contractor. On the other hand there are a lot of examples of CSS which have vendor support.

Open source in military training

In a report commissioned by the United States military (report by Mitre Corporation (2003) it is stated that open source and free software should play a greater part in the infrastructure of the world's remaining superpower. It works best, notes Mitre, when people find the software and not vice versa. It rejects making it mandatory and notes that

when users were "force fitted" to use a free software product for ideological reasons- the gcc compiler features in an example cited - the result might not be satisfactory.

Open source software used in the TTP ELE

We already mentioned the use of the open source Course Management System Moodle. Next to course management software we also use authoring software in the ELE. One of authoring tools used in the project is eXe. This is open source software for authoring of courseware. eXe is a result from the eXe project. The eXe project is developing an open source, web-based tool that will enable teachers and academics to create professional-looking web content specifically designed for online learning without needing any knowledge of HTML or XML mark-up technologies. The templates we developed can be divided in different levels. First we have the course level. These templates structure the courses in modules and lessons. Second within Moodle we structure the lesson in sub-steps. The last level is the didactical structure of the lesson. This is at micro level, it is the way the content is presented to the student.

SECURITY

One of the main issues is the security of the ELE. In relation to this issue we will discuss first the security implications of open source software within the ELE. Second we shall discuss the measures we took to protect our ELE.

Security measures in the TTP ELE

We want to provide Air Force personnel military and technical training without being concerned about security issues. Security is attained in several ways, first at the training portal and CMS level by means of log-in procedures. Security is also attained in a technical sense. This will be further described in the paragraph dealing with virtualization. In the TTP ELE we (will) have at several locations electronic classrooms at Air Force bases were students are trained in the necessary skills, knowledge and attitudes. In each classroom there are different student stations available. Each location also possesses a local server. The server and workstations are protected by a firewall, intrusion detection system, virus scanner, logging and auditing mechanism. This protection is realized with Commercial-of-the-Shelf (COTS) software. For the local connections a 'dedicated' network is used, which is not connected to the defence network infrastructure. The different locations are connected to a central server park. It has to be decided who will maintain this server park. This can be outsourced.

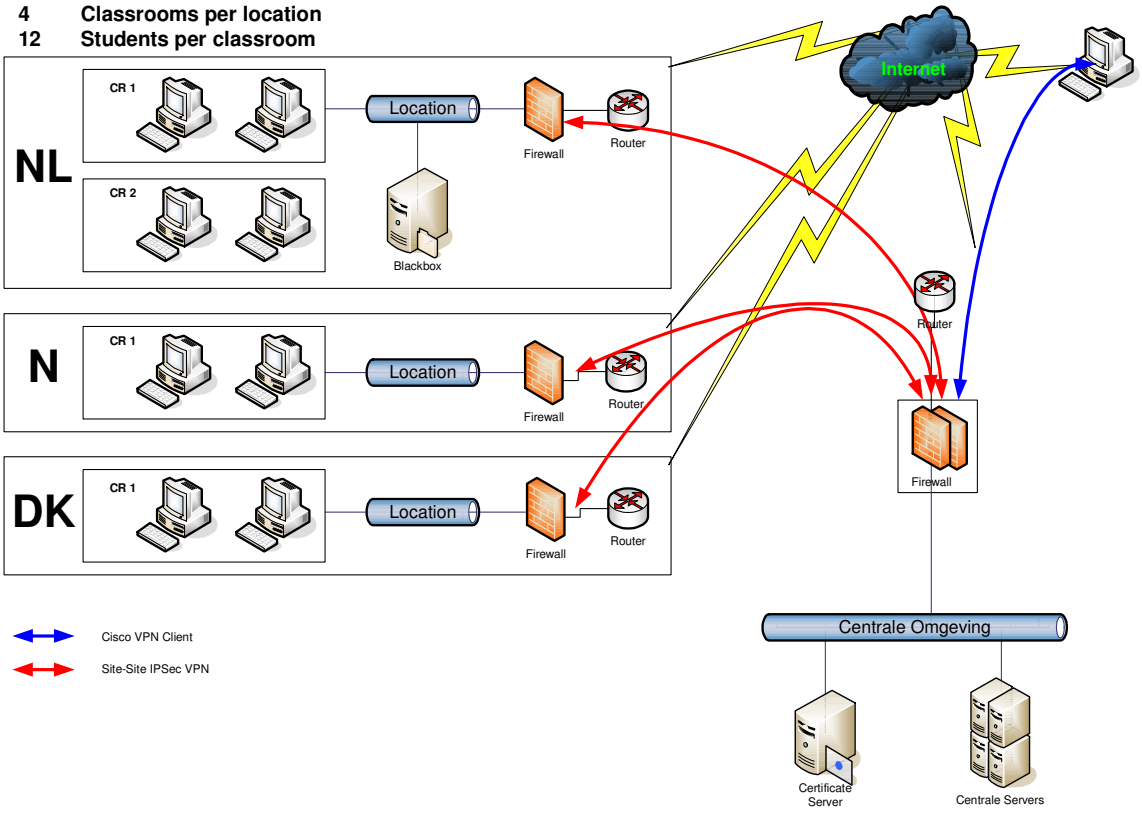

Figure 1. The distributed e-learning environment

In case it is outsourced, the external maintainer also has to implement the mentioned security measures. The connection between the different locations and the central server park can be realized in several ways. As shown in Figure 1 we can use internet. It can also be realized through the use of the existing intranet. From security perspective an intranet solution is preferable. But when we use the internet we will use Internet Protocol Security (IPSEC). With the help of IPSEC we can create so called 'tunnels'. In this case IPSEC is a standard for securing Internet Protocol (IP) communications by encrypting and/or authenticating all IP packets. According to the Wikipedia, IPSEC provides security at the network layer. IPSEC is a set of cryptographic protocols for (1) securing packet flows and (2) key exchange. The main purpose of IPSEC is to optimize the exclusivity and integrity of the transported data within the tunnelled network traffic. The availability of the network connection is not affected. Within the IPSEC protocol, it is agreed which algorithm will be used to encrypt the data. Usually the encryption is realized by a mixture of software and hardware. If there is a requirement that only hardware encryption should be used then there will be a potential problem. In conjunction to the connection between the electronic classrooms and the central server park, there is also a connection between the server park and students at other locations. A student should be able to login from a mobile stand-alone learning place.
From a security perspective the ELE can be divided in two separated units. The first unit is aimed at providing, with a limited bandwidth, a training device to many users. The second unit is consists of a transparent "security cloud", which should make it possible to run the first unit on a public network like the internet. The "security cloud" is independent of the presented training device and if necessary could be omitted when the network has a sufficient security level.

INDIVIDUAL TRAINING AND TEAM-TRAINING

The military mission and tasks that services personnel of the RNLAF and RNoAF are required to perform have changed radically, with increasing emphasis on operations other than war, such as peacekeeping. These changes have different needs in terms of training. The RNLAF and RNoAF need versatile, adaptable and rapidly deployable squadrons to meet these needs.
We believe that Advanced Distributed Learning (ADL) is able to fulfil this need. Advanced Distributed Learning is organized in the context of "network centric warfare".

Education and training must enable personnel and units to be ready for different kind of operations at short notice, taking advantage of capabilities offered by the equipment. Moreover, it must be provided cost-effectively, making full use of emergent training technologies and techniques.
The ELE contains different kinds of instruction. We can distinguish:

- Individual, self-paced instruction.
- Individual practice and individual assessment.
- Collective practice and collective assessment.
- Collective instruction and collective assessment.

The TTP is a training system which is able to combine individual training with group activities. Group activities are educational things to do. They include, for example: discussing a topic in a forum, submitting an assignment, or completing a test or exercise. Group activities are more than just letting learners work together; they are structured learning environments (http://groups.physics.umn.edu/physed/Research/CGPS/trdvscoop.html).
Only under certain conditions we can expect cooperative efforts to be productive (Johnson e.a 1991). The conditions are:

- Clearly perceived positive interdependence.
- Considerable promotive (face-to-face) interaction.
- Clearly perceived individual accountability and personal responsibility to achieve the group's goals.
- Frequent use of the relevant interpersonal and small group skills.
- Frequent and regular group processing of current functioning to improve the group's future effectiveness.

Case description: individual and team training
One of the prototypical courses we developed, in which individual and group assignments were included, was the "Crew Escape and Safety Systems". This course consists of two modules; a theory module and a practice module. In the theory module the student starts with a pre-test with a series of questions about the canopy. After the pre-test the student will find the theory explanation available to find out the answers to the questions. After finishing the first module, the student enters the practice module. In this module, the student is asked a series of questions about corrective maintenance of the canopy. The student can use the FAE to find out the answers to the questions. At all times the student can use the resources to assist him/her in finding the information. The resources are the Forum: discus with other learners the questions. The second resource is the Instructor:

mail or chat with your instructor about the questions. The third resource is a knowledge system which is integrated in the Training Portal.

During working in the theory and practice modules, the student is also free to use the paper based Technical Orders (General System and Fault Isolation guides).

THE USE OF TEMPLATES FOR TRAINING DEVELOPMENT

The ELE for distributed training is a flexible training instrument. The flexibility implies that in a short notice, quality training has to be provided. The larger part of the training demand is predictable and can be obtained from earlier developed initial courses. But there will be specific training needs for specific situations. The desired level of flexibility can be attained by means of using templates. We therefore have need for authoring tools which can be used by Air Forces own non-professional developers. The use of templates should make it possible that the non-professionals are enabled to develop courseware and templates should also reduce the development time and production cost of multimedia applications.
According to Robertson (2003), templates are an effective way of authoring relatively simple and highly structured topics. They work particularly well when there are a large number of topics that have an identical page layout and design, but different text (such as a product catalogue). Templates are used to shape learning objects in the desired form. An important element in the shaping of learning objects is the recognition of structure, content and layout. The distinction between course, unit and module is an example of a structure. The decision to use a task oriented approach has consequences for the structure. The content, shaped in the form of a learning object, is directly related to the course material. The layout of courseware can be a great problem when hardware with different resolution is used. Flexibility can have a negative influence on the quality of the layout. The use of content based on a structured database and stylesheets can make it possible to generate different layouts for different devices.

Templates used in the TTP ELE

In the TTP ELE we have developed templates different kinds of training. An example of a template for problem oriented training is:

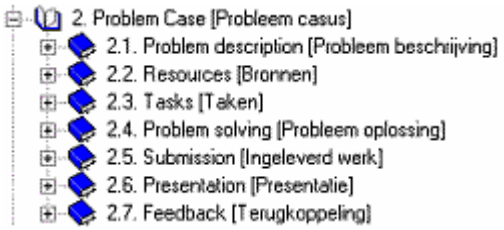

Figure 2. Problem Case Template

For task oriented training we use the following structure:

Figure 3. Task Oriented Training Template

A template for computer based learning is:

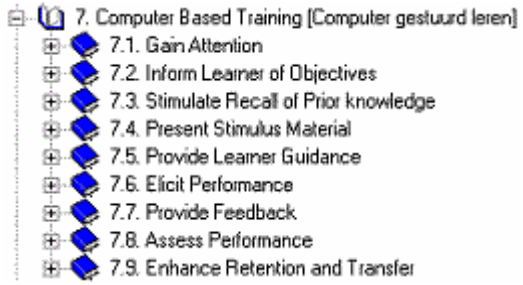

Figure 4. Computer Based Training Template

THE (RE)USE OF TRAINING DEVICES

The F-16 Maintenance Total Training Package (TTP) is developed for use within a Local Area Network (LAN). The LAN's are implemented at the both schools of the RNLAF and RNoAF. The FAE functions as the central element of the TTP.
As we already mentioned in both Air Forces there is a need to provide F-16 maintenance training in a distributed way. This training need has created a challenge to provide the TTP including the Full Aircraft Emulator to the student at the airbases. The test the possibility of providing the Full Aircraft Emulator by means of internet we decided to start a

proof of concept project. The training portal is a result of this project. As we already mentioned the training portal is part of the TTP ELE. The architecture of the training portal makes it possible to launch the simulation. The architecture makes it also possible to monitor the student's performance in the simulation. The training portal also communicates the results of the student's performance in the simulation back to the LMS or CMS. In the ELE a simulation is treated as a Shareable Content Object (SCO) asset to perform an assessment of trainee performance limited by the context of the simulation. To be able to run the Full Aircraft Emulator in a distributed setting we started with server-based computing (SBC). SBC is another way of providing the user with software (courseware in our case). Instead of installing on each computer the courseware, SBC uses one or more servers on which the courseware is installed. These servers are usually placed in a secure environment. Users get their own workspace on the server and are able to run the courseware by use of the network.
The proof of concept project, which was conducted in cooperation with the Dutch Stepco Group, showed that SBC was not able to provide the student the full functionality of the full aircraft emulation. An important element of the emulation is a 3D-model in which the student is able to open F-16 panels. SBC was not able to run this 3D model smoothly.
The follow-on project switched to a different approach. It was decided to use Application Virtualization. Application virtualization decouples applications from the operating system and enables them to run as network services. In general, the purpose of application virtualization is to separate application code from the restrictions of individual servers, operating systems and clients.

EXPERIENCES WITH THE USE OF THE LEARNING PORTAL

We have conducted some trials to test the TTP ELE. Other trials will take place soon. The results of the trials are as follows.

The use of the TTP ELE.
In the TTP ELE we use a Training Portal in combination with the CMS Moodle. One of our research questions is "Is it possible to use Moodle as a delivery tool for new content"? After the trials we can answer that question in a positive way. In general there is a overlap in functionality between the Training Portal and the CMS. An example is the communication function. Moodle has an email functionality and the Training Portal also.
We still have discussions in the project about the integration of SCORM 2004 and the use of the FAE. We see the scenario, which is used to perform a learning activity, as a learning object. But a SCORM SCO can also be seen as a learning object. The problem is that we can interface a SCO with the LMS functionality of the ELE. But interfacing a scenario learning object with a SCORM compliant LMS is difficult. In Moodle we bypass this problem by using the instructor as the one who reports success or failure to the LMS.

The use of OSS in the ELE
In the ELE both OSS and CSS are implemented. During the trials the interfacing between the Training Portal (CSS) and the CMS Moodle (OSS) functioned smoothly. The only problem is sometimes were to place a desired functionality.

Security. 'Is it possible to provide military maintenance training safely on the Internet?'
We made sure that the course content had no classification. But still an F-16 maintenance course is for Air Force Maintainers eyes only. The trials have shown that we are able to provide students with courseware in a secure way.

Individual training and team-training
'Is it possible to develop and implement both individual training and team training by means of the Moodle CMS'?
Based on operational needs we have developed training which is a mixture of individual and team-training. The TTP ELE has shown that it is able to host such kind of training.

The use of templates for training development
'Is it possible to use an open, constructivist approach in which learning tasks are central to learning, and still use pre-structured templates to promote efficient content development?'To obtain the utmost flexibility it is necessary that training can be developed at a short notice. This is realized by re-using existing learning objects and by using a template based approach. This may look like a quick and dirty approach, but we were able tot develop sufficient quality training at a short notice.

The (re)use of training devices
'Is it possible to combine traditional e-learning modules with the Air Forces synthetic F16 maintenance environment?

The TTP ELE at the school is able to create a synthetic maintenance environment in which the novice maintainer is able to learn the trade. The use of the TTP ELE for follow-on training in a distributed way is aimed at a more experienced audience. We are able to create a comparable synthetic maintenance environment for the experienced maintainer. The main difference lies in the complexity of the learning task and the amount of theory provided. An experienced maintainer needs to be confronted with more complex learning task and the theory has the function of refreshing existing knowledge.

As mentioned earlier other trials will take place soon. We want to investigate further the use of shared repositories based on Cordra. Another issue is the possibility to use videoconferencing as medium to provide theory lessons in specific courses. Then it will be possible to use a Norwegian instructor to teach Dutch students F-16 supportive information.

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