THE NATO ADVANCED DISTRIBUTED LEARNING HANDBOOK

Guidelines for the development, implementation and evaluation of Technology Enhanced Learning

NATO Training Group
Task Group for
Individual Training & Education
Developments (IT & ED)

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1 Forword by:

Rear Admiral

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Welcome to the NATO ADL Handbook, this document, published by the NATO Training Group Individual Training and Education Developments Task Group, provides information and guidance on using and developing online learning.

Since Allied Command Transformation was created in 2003, we have been tasked by the Military Committee to transform NATO's Education & Training (E&T) policies, capabilities and delivery, bringing in transformational ways of ensuring our NATO and national command and force structures are fully prepared for the mission ahead. One of these ways which has matured and grown substantially both in NATO and in the nations is e-Learning or Advanced Distributed Learning (ADL). This technological approach to delivering education and training has added capabilities to our E&T "toolbox" and continues to offer new ways to reach and educate our dispersed audience. I expect to see in the near future expanded changes in our mind-set towards residential traditional, online and blended Learning, utilising the best features of all methods and ensuring we offer the best solutions to NATO's E&T requirements.

This handbook, created and maintained by many contributing nations within the NATO Training Group, provides guidance for the procurement, implementation and evaluation of ADL

I hope this document will provide useful information to you, and you will join in our efforts to improve education and training development for our forces.

2 Background

2.1 Purpose of this handbook

This handbook provides practical guidance to organizations for the creation and/or the procurement, implementation, and evaluation of Advanced Distributed Learning (ADL). This handbook is not meant to be all-encompassing. It is an overarching look at ADL concepts and some of the tools used to develop ADL. Nations are intended to use this handbook as a starting point and supplement it with additional guidance that is applicable to their own policies and procedures.

2.2 How to use this handbook

This document is intended to be used for practical, pragmatic guidance and as a source of examples for the creation, use and implementation of ADL. This handbook can be read from beginning to end to gain a general understanding, or it can serve as an "on demand" reference manual to answer specific questions that may arise in the process of working with ADL. The document includes specific advice for Instructional System Designers (ISDs), Subject Matter Experts (SMEs), programmers and/or developers, and managers.

2.3 What is "Advanced Distributed Learning"?

ADL describes methods of teaching that do not require the learners' physical presence at a specific site. ADL also infers that the instruction uses some form of electronic and/or information technology. The NATO Bi-Strategic Command (Bi-SC) 75-7 Education and Individual Training Directive (E&ITD)[1] defines ADL as "an interactive, outcomes-focused approach to education, training, and performance-aiding that blends standards-based Distributed Learning." Bi-SC 75-7 also stipulates the delivery of instruction as electronic combined with other methods of instruction that do not require the student to be present at a specific site.

Distributed learning began as correspondence study offered by institutions and individuals. In the past century, "advanced" distributed learning was enriched by new technologies such as telephone, radio, audio, television, and video. The large-scale introduction of multimedia-capable computers to businesses and homes, followed by the widespread adoption of the Internet and mobile communication technologies, added tremendous new potential to technology-supported distributed learning.

It is important to note that electronic learning **(**commonly referred to as **e-Learning)** refers to "instruction delivered on a digital device (such as a…computer, tablet, or smart phone) that is intended to support learning." Although the definitions of e-Learning and ADL are very similar, often organizations and communities prefer one term over the other. For the purposes of this handbook, the Nations agree to the wider definition of ADL which includes Instructional Multimedia Instruction (IMI), Computer-Based Instruction (CBI), Computer-Based Training (CBT), Web-Based Training (WBT), e-Learning, and other terms associated with technology-based or online instruction. (We also recognize that ADL and e-Learning can be used synonymously.)

2.4 About this handbook

This handbook supports **NATO** and **partner countries** in producing effective ADL content for specific or shared training and education needs.

The handbook uses the Analysis, Design, Development, Implementation, and Evaluation (ADDIE) framework for the ADL development process (Figure 2-1). ADDIE is a common chain of processes to describe the creation, use, and evaluation of training materials. ADDIE presents the steps in a sequence, but the steps often run concurrently in practice. The concurrence of steps (and their sub-steps) are sometimes referred to as "agile design and development" or "successive approximation."

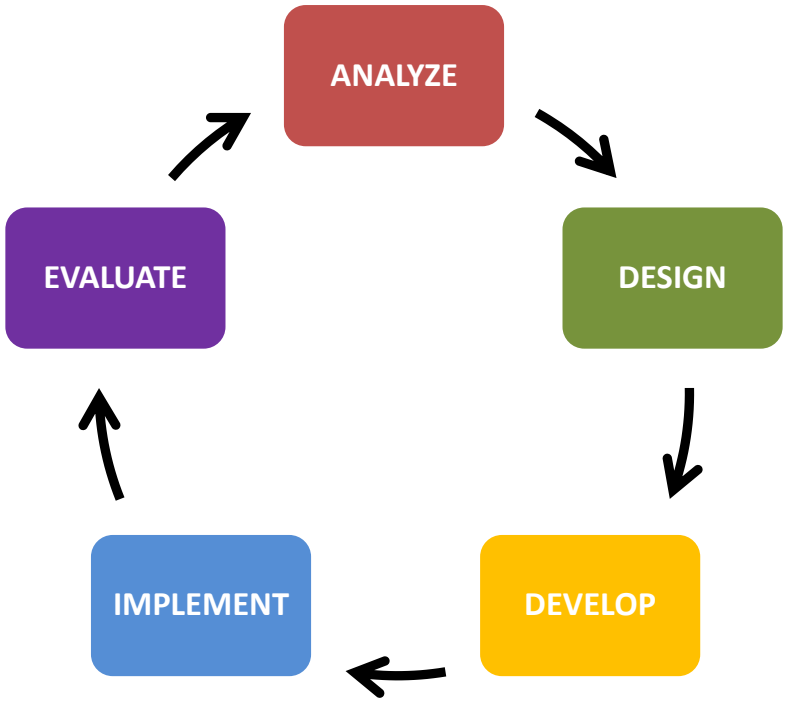

Figure 2-1. ADDIE Process

Some of the information found in this handbook is based on the **ADL Content Production Kit**[2]. The kit was created by the Partnership for Peace Consortium's (PfPC) ADL Working Group (WG), comprising NATO and non-NATO professionals in the field of ADL. We recommend these documents, which include "how-to" instructions as well as worksheets/checklists for day-to-day work.

The **NATO Bi-SC 75-7 E&ITD** is an important reference document for comprehensive training and education solutions, and also includes information on the Training Needs Analysis (TNA) required for any strategic NATO project. The latest version was endorsed on 10 September 2015, and it is available through NATO Transnet.

2.5 There is more than one way to succeed!

Please keep in mind that due to the many types of ADL projects, the wide range of possible goals and content, and the widely differing project constraints, there is no "one-size-fits-all" process. However, by

using this document and its recommendations, you may identify critical issues to help you improve your project.

2.6 Contributors

This handbook is a compilation of numerous nations working together under the umbrella of the NATO Training Group (NTG) Individual Training & Education Developments (IT&ED) working group.

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3 Analysis

3.1 Scope

This chapter provides an overview of considerations that should be the basis for all instructional planning and development of ADL. There are many differing opinions on the "correct" way to conduct analysis and the order in which steps should be taken. There are also many different types of initial development efforts (e.g., starting from scratch, updating "old" courses, and conversions to ADL from established classroom courseware). In the latter two cases, there may already be well-defined learning objectives, media, quizzes, etc. Whatever the situation, before we create an ADL solution, it is important to confirm that an initial gap analysis has been completed.

3.2 Introduction

Education and Individual Training (E&IT) is often the first recommendation put forward when we have a "problem" or a gap between the desired state of performance and the current state of performance. It is a best practice to verify that the root cause (or causes) of the performance gap can be addressed through education and training. You may have heard the adage, "An ounce of prevention is worth a pound of cure." Mature organizations will assess the cause of the performance discrepancy and generate a list of possible causes that have resulted in, or may yet cause, the performance shortfall. Some common reasons for a performance gap arising are illustrated in the figure below. Within the NATO context, this analysis takes place during the development of the Strategic Training Plan (STP) and the follow-on Training

Requirements Analysis (TRA). These reports can be accessed through NATO Transnet: https://portal.transnet.act.nato.int/Pages/home.aspx.

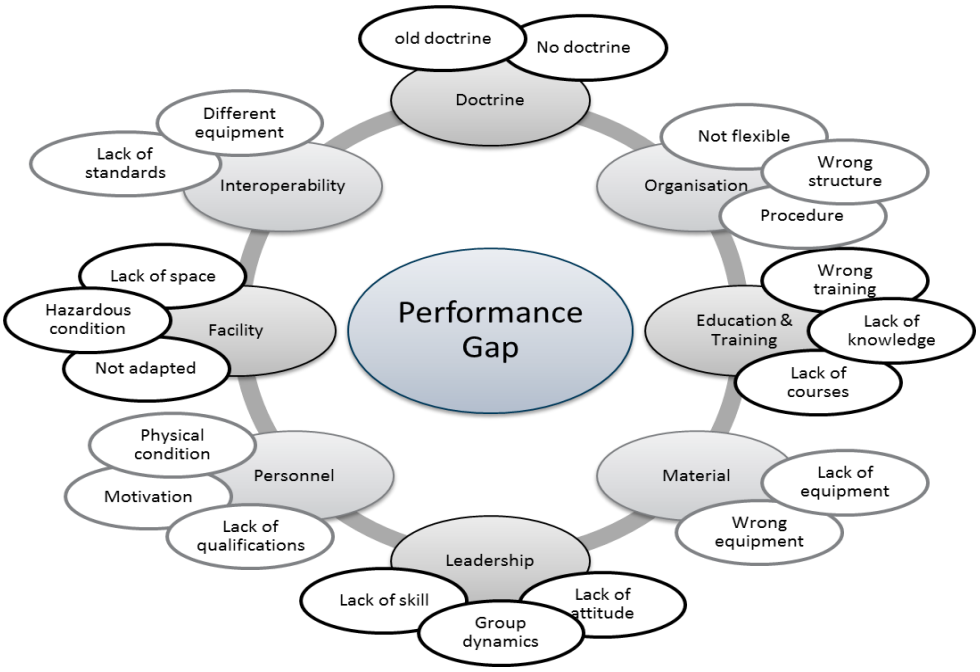


Figure 2-1. Performance gap causes and considerations

Once the root cause(s) of the performance gap are confirmed, and E&IT is identified as a viable solution to close this gap, the NATO Systems Approach to Training (SAT) is used. The NATO SAT is an iterative and interactive sequence of activity, which leads from identifying a need for E&IT training to defining, developing, and implementing effective and efficient learning solutions to satisfy the need. It is important to note that the NATO SAT is an Instructional Systems Design (ISD) model, and it is often synonymous with the ADDIE model. The NATO SAT consists of five distinct phases and includes a feedback loop at the conclusion of each phase. (See figures below).

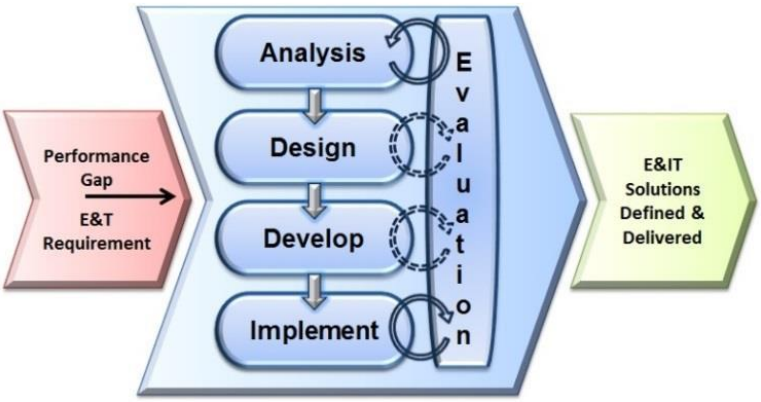


Figure 2-2. Performance gap to E&IT solutions

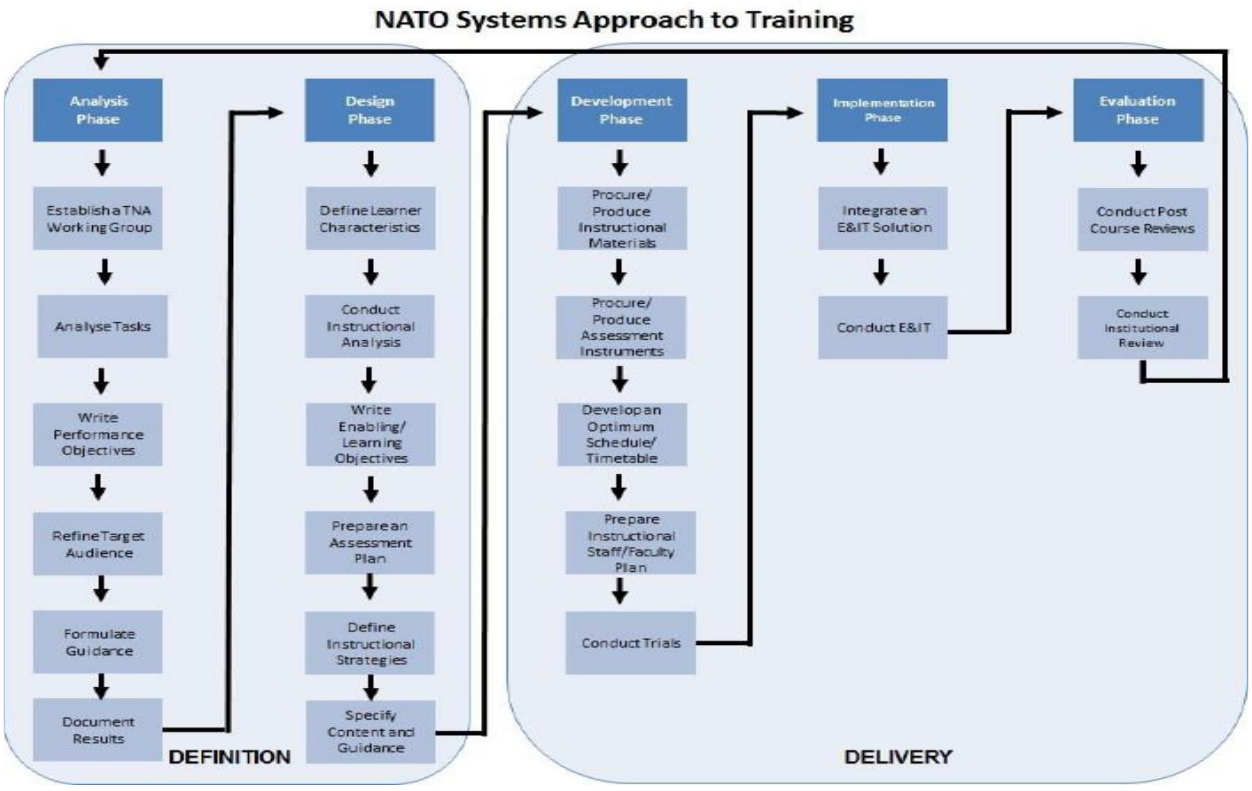


Figure 3-3. NATO Systems Approach to Training

3.3 NATO SAT: Analysis Phase

The purpose of the Analysis Phase is to generate clear and precise **Performance Objectives** (POs). POs are designed to address a performance gap and identify the intended outcome. POs are expressed in terms of the required job performance proficiency to be achieved. During this process we attempt to answer the following key questions:

a. Why train?

b. Who must be trained?

c. What must be trained, to what level, and under what conditions?

The Analysis Phase often relies on a Working Group (WG) to systematically analyze, select and organize the specific tasks that require E&IT. The WG requires inputs from a community of interests including command staffs, the originators of the training requirement, end-users, Subject Matter Experts (SMEs), and E&T specialists. The success of the WG relies upon the discretion, experience, and expertise of the assembled members and their respective abilities to make reasoned judgments throughout the Analysis Phase. If the problem or performance gap is not clearly understood, the likelihood of designing an effective E&IT solution is diminished. Having the right people involved in the WG is essential to providing the required guidance to design an E&IT solution during the following phases of the NATO SAT.

The following steps are undertaken during the Analysis Phase:

Step 1: Establish a Training Needs Analysis (TNA) WG

Step 2: Analyze tasks

Step 3: Write performance objectives

Step 4: Refine target audience

Step 5: Formulate guidance

Step 6: Document the results

3.3.1 Analyze tasks

The task analysis for the target audience identifies all tasks, sub-tasks, and task elements carried out correctly and efficiently. With current performance problems, it identifies the gaps between current and intended performance, and it identifies other factors that might affect performance (e.g., incompatibility of technologies, tools and procedures).

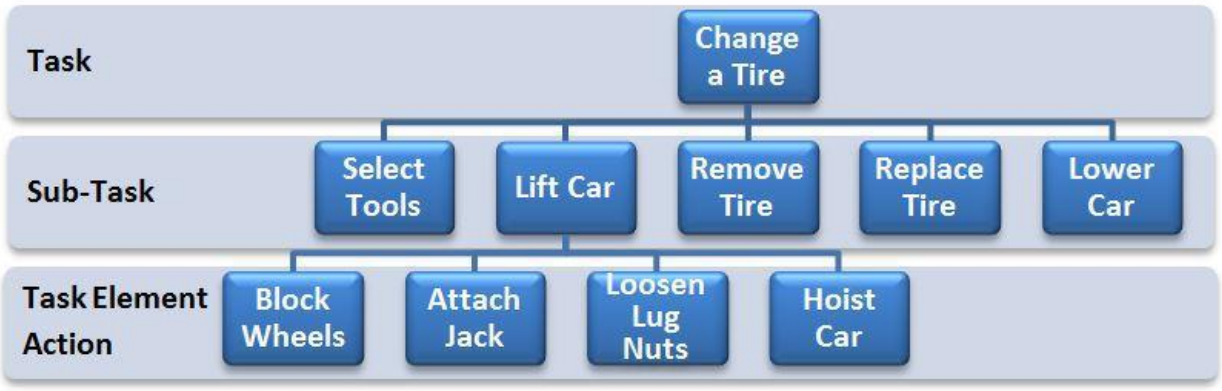


Figure 3-4. Simplified task analysis

Example: With new equipment, the task analysis might lead to the following top-level items: Unload the equipment from ships or trucks, install the equipment, start the equipment, safely operate the equipment, perform the typical activities A, B … P, perform standard maintenance activities Q … W, know when and where to get support for non-standard maintenance and repairs. Each of these items needs to be broken down into more detail. (e.g., Unloading equipment by crane or forklift might include tasks such as knowing the weight, correctly hooking up, and knowing where to support the equipment.)

Note: In the case of performance problems, a broad look at all causes is essential, as some causes may require more than another training course! If, for example, certain equipment shows unexpectedly high downtimes, the reason is not always incorrect operation or maintenance. It could be that the equipment was never meant to be used in a given environment at the given intensity. In other cases, such as not observing safety rules, the reason does not need to be lack of training. Perhaps there were just some signs missing on the equipment to remind operators of what they had learned long before.

3.3.2 Write Performance Objectives (POs)

POs (also called Behavioural Objectives or Learning Objectives in some national systems) specify, in precise terms, what an individual must be able to do in terms of job performance. A well-crafted Performance Objective includes clear performance statements, the conditions under which the performance is to be carried out, and a standard that defines the proficiency level which individuals are expected to achieve. Not all tasks, sub-tasks, and task elements identified during the previous step will necessarily appear in the POs, but they can help formulate the conditions and standards statements. The elements of a PO are as follows:

a. **Performance Statement.** A concise statement representing a logical and complete part of the job function that is observable and measurable. The performance statement forms the first element of the PO. Performance statements are derived from the task statements identified during task analysis. A PO performance statement often represents a group of related tasks and activities. For example, "write a memorandum," "write a military letter," and "document minutes of a meeting" are all tasks that can be combined as "prepare military correspondence." Tasks are grouped or combined based on a) similarity and b) complexity of the skills required to perform each task. A hierarchy of objectives can also be used. Higher-level objectives are called "terminal objectives," and the objectives that enable accomplishment of the terminal objective are called "enabling objectives."

b. **Conditions.** Conditions provide context and describe the situation under which the performance must be completed. Conditions affect how the job or function is done. These are based on the actual workplace or other presumed area of operation. This answers the "when, where, and with what" of the tasks being performed.

c. **Standards.** Standards describe how – and how well – the performance must be completed. The greater the specificity provided, the more valuable the contribution to the development of E&IT solutions. Clear, detailed, and specific standard statements provide the scope and focus for E&IT; they also facilitate accurate assessment. In all instances, the proficiency level required is based on actual job performance requirements. Standards generally specify a product, a process, or a combination of the two; and standards include measures of completeness, soundness of judgment, accuracy, and/or speed.

3.3.3 Refine the target audience

The learners in a particular training project often are not required to master the same exact tasks within the context of that project. For example, the participants in a training for new equipment may include both primary users of the equipment and maintenance personnel. They would all share some training needs, but there also would be some needs unique to each group. Primary users, for instance, would not be expected to master all skills to maintain the equipment, and maintenance workers would not be expected to operate the equipment in combat conditions. Thus, the different groups within a training project's audience must be identified and characterized early to effectively analyze their relevant tasks; and such cases will require a modular training solution, with modules addressing particular training gaps.

For any training project, it is equally important to know the characteristics of the target audience. These include current job experience, prior background, education, and training and experience with computers and ADL. A good understanding of the target audience helps avoid typical mistakes such as using the wrong level and style of language, or trying to build on knowledge and skills that the participants do not

possess. Whenever style and content do not align with the needs of the target audience, the content will not be effective.

3.3.4 Formulate guidance

With a clear picture of what an E&IT solution is expected to achieve and the intended audience, it is then possible to provide additional guidance for the Design Phase activities. During this step, the WG will review training strategy options and provide a preliminary estimate of how the E&IT requirement will likely be met.

For most situations, the learning environment falls into one of three delivery options:

a. **Residential Delivery:** This is mainly instructor-led training and education. The students are brought to a centralized location.

b. **Distributed Delivery:** The course is taken to the students. Distributed delivery is usually accomplished by the following means:

   i. **E-Learning/Advanced Distributed Learning (ADL**). These E&IT solutions can use an array of communications and collaboration tools as well as virtual/online environments. They may be self-directed (individual) programmed instructional packages, or they may utilize real-time instructor collaboration and support.

   ii. **Mobile Education and Training Teams (METT**). This E&IT solution usually involves delivering courses in the workplace or at specific locations.

c. **Blended Learning:** A combination of residential and distributed instruction options. It has the potential to reach large numbers of students anytime and anywhere while still leveraging the benefits of residential delivery, making it a particularly attractive approach.

3.3.5 Document the results

This step is used to capture the results of the Analysis Phase. A record of proceedings (sometimes called a **record of decisions**) is recommended to document the WG's decisions, assumptions, and methodologies. The record of decisions is an important document for e-Learning designers and developers because it provides insight into the intent of the E&IT solution and what outcomes need to be achieved. A well-rounded analysis will provide the following:

a. **Requirements for a course.** The rationale for a specific E&IT solution, with the background and history serving as the basis for developing the course.

b. **Aim.** The overall reason(s) for the E&IT.

c. **Performance Objectives.** The details of the outcomes to be addressed through an E&IT solution. Each PO includes a performance statement and the conditions and standard to be achieved. POs also specify the proficiency level, and they may include additional details to support the design of E&IT solutions.

3.4 Summary

The Analysis Phase concludes with a clear definition of the E&IT requirements and provides guidance for designing E&IT solutions. If the Analysis Phase is properly conducted, e-Learning designers and developers will be presented with a solid rationale and requirements for the remaining SAT phases. They then will have to decide which of the four development options best fits their circumstances: developing the content in-house; reusing or repurposing content that is available to be shared by other organizations (information available from national NATO Training Group representatives); buying off-the-shelf commercial content; or contracting with a vendor for custom development. The topics discussed in this chapter apply to whichever option is selected.

4 Design

4.1 Scope

This chapter focuses on designing a course or training that includes ADL content. It highlights methods and media selection, applying pedagogy, and appropriate instructional designs. The adoption of technology adds a critical element to consider when designing ADL content.

4.2 Pedagogy

4.2.1 Introduction: Generalities about pedagogy/andragogy

Although it is possible for a single person to be responsible for creating a course, ADL course design usually requires teamwork in which pedagogy must be considered from the beginning of the process.

What does the term mean?

- Pedagogy is the art of teaching. It refers to strategies, methods, and styles of instruction, usually in the context of teaching children. In general, pedagogy is more focused on teachers presenting knowledge for students to acquire.

Before considering content design, the pedagogical team – in close coordination with instructors/teachers – must choose the appropriate combination of face-to-face education and ADL. Various types of training methods offer differing balances between the two, as well as the dedicated coaching. The following are among the possible training methods:

- **Enriched face-to-face learning:** The students are physically present in a training center with the teacher but have access to additional ADL content to reinforce what they have studied.
- **Blended learning:** Traditional face-to-face classroom methods are combined with ADL courses articulated in a complementary way. The ADL can be presented prior to, during, and/or following the face-to-face instruction. For the ADL courses, the student may benefit from coaching, ideally by the face-to-face course instructors. For certification courses, blended learning is an effective means of providing practical application exercises.
- **Remote face-to-face learning:** Rather than being physically present in a training room, the students are connected to the teacher and peers via live video, chat sessions, help desks, and/or virtual classrooms.
- **Distance learning:** The students participate in a distance educational program in a virtual learning environment. Though not physically present in a training room, the students also receive coaching related to the material.
- **Self-learning:** Self-directed learning in which the content is placed online for the students to access but without any additional assistance.

The following chart illustrates these concepts in relation to four parameters:

- **Co-located versus Remote** (whether students are all physically present in the same place, or in different locations)
- **Asynchronous versus Synchronous** (whether students individually choose when to perform learning activities, or perform learning activities at a designated time)

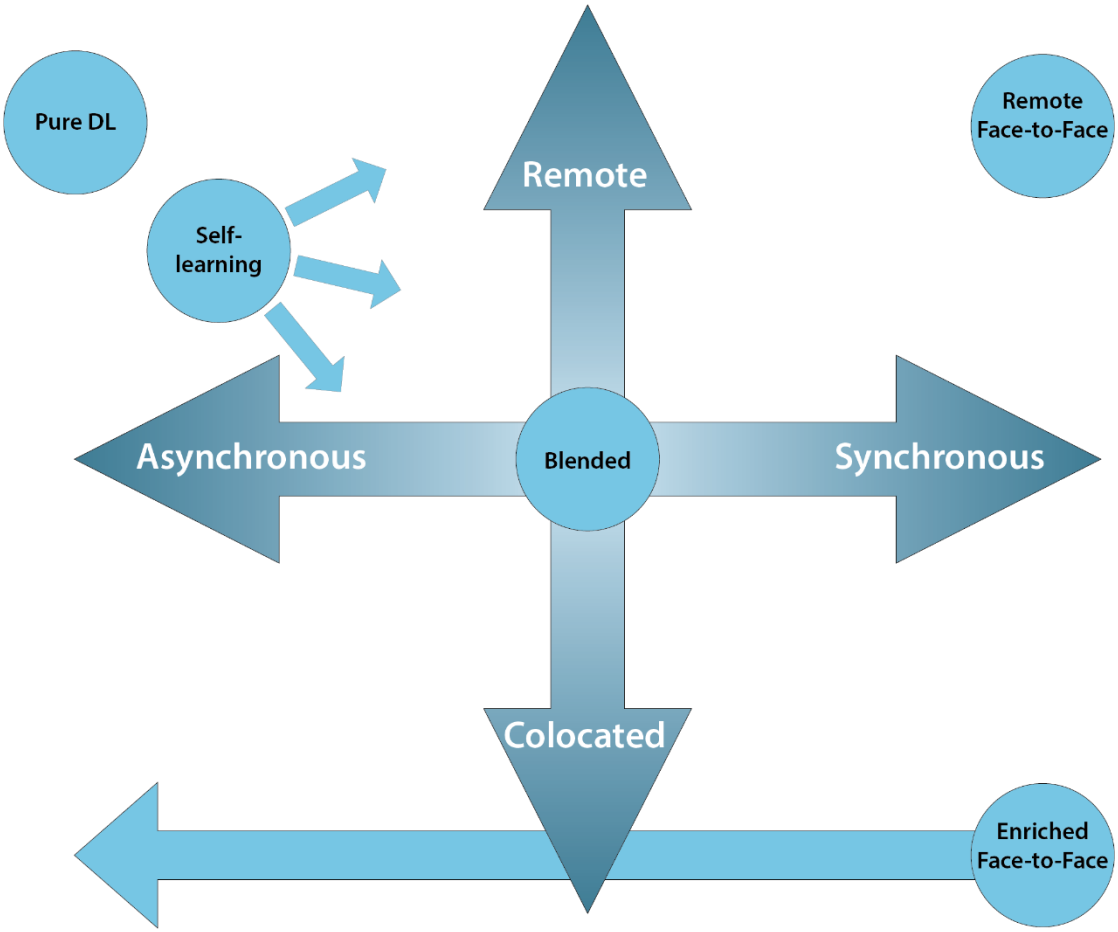


Figure 4-1. Remote vs. Co-located & Asynchronous vs. Synchronous

Before developing training content, it is essential to decide what type of training method to apply in order to implement the appropriate learning structure.

Producing effective ADL instruction requires an understanding of the processes by which students learn and interact with technology. The basic principles of pedagogy used for conventional courses also apply to ADL courses, but from the pedagogical point of view, the development of ADL courses must take into account the following considerations:

- The learning process happens at a distance and regularly without the physical presence of the teacher. The ADL courses and their technical environment (Learning Management System) must include all the necessary self-educational learning material needed for effective understanding of the content in order to achieve the learning objectives (LOs).
- The interactive communication between the different participants in the learning process will also happen virtually and without physical contact. The instructor should periodically check the students' comprehension and provide feedback.
- If the ADL course is web-based, the interaction with technology can be an obstacle for both the learners and the teachers.

The target group for developing military ADL courses is the adult learner. Therefore, six principles have to be taken into consideration

- they know the reason for learning or doing something;
- learning is experiential (including error);
- they fully have control over their learning and are responsible for their decisions on education (timing, planning, evaluation, etc.);
- the subject matter has immediate relevance to their work and/or personal lives;
- the learning is problem-based rather than content-oriented; and
- the process is positive and encouraging. Adults respond better to internal versus external motivators.

Adult learning with technology involves a cycle of **conceptualization** (students given information); **construction** (students perform tasks); and **dialogue** (students given feedback). ADL modules must contain distinct or combined parts that let the students perform these three actions.

- At the **conceptualization** stage, students are exposed to other people's ideas or concepts. For example, reading lecture notes or watching images or videos online.
- At the **construction** stage, students apply these new concepts in the performance of meaningful tasks. For example, performing a task such as answering a quiz or writing a journal online.
- At the **dialogue** stage, students receive feedback on their performance during the course. Without feedback, students cannot self-assess their learning progress. Feedback can be communicated in several ways, including in face-to-face discussions, online discussions, videoconferencing, and entirely online and automatic feedback.

Like with other conventional learning methods, the following guidelines are also applicable for ADL courses. The more iconic and interactive the ADL products, the higher the level of individual retention will reflect the following figure:

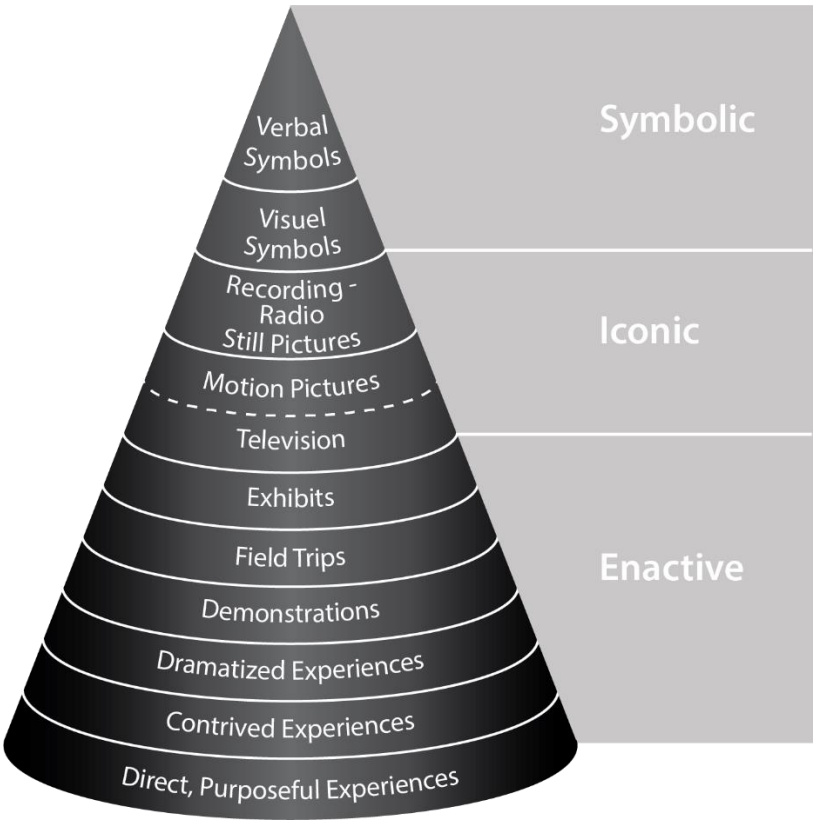


Figure 4-2. "1969 Audiovisual Methods in Teaching," 3rd Edition

Successful learning pedagogy requires an understanding of how students learn, memorize and reflect. Figure 4-2 depicts a notional pyramid of how learners best retain information. ADL modules ideally combine a range of presentation and active teaching methods to optimize learning and retention.

The development team must have the capacity to design, implement, and assess educational activities that meet the needs of all students. ADL development must incorporate learning pedagogy/andragogy to include a deeper study into the incorporation of instructional strategies that consider real-time personalized learning content-to-learner adaptability.

In order to achieve the LOs, the development team has at its disposal a wide range of tools (synchronous and asynchronous) that are not necessarily designed for learning but are perfectly usable in a training/leaning program. It also is essential that the development team understands and masters the specific pedagogical added-values of all the technical resources (chat, forum, wiki, blog, vlog, email, simulation activities, virtual classroom, video-conference, survey, podcasting, whiteboard, etc.) in order to integrate them correctly in the learning process. In this regard, the development team must weigh the technical maturity of the target group of learners.

4.2.2 Actions to be done before starting ADL development

4.2.2.1 Define the Enabling/Learning Objectives (ELOs)

ELOs identify a segment of instruction that constitutes a major step toward achieving the Performance Objective (PO). ELOs define what the individual will learn, and a well-written ELO provides the basis for student assessment. ELOs also guide the sequencing of instruction and other decisions concerning an instructional strategy. The knowledge, skills, and attitude (KSA) elements, which support tasks, are categorized into specific learning domains and structured to reflect different levels of learning required during a course.

To make ELOs precise, the following pattern has proven effective in all areas of training and education:

- **Conditions.** Description of the conditions under which a performance is to be demonstrated.
- **Performance.** Precise, operationalized description of the performance to be demonstrated.
- **Standard.** Description of the values and indicators required for mastering the objective.

The key element of the ELO is *performance*, which is usually stated as an activity with a verb. The conditions and standards contain additional information to correctly teach or train and reliably test mastery of the ELO.

Example 1 (higher-level objective):

- **Conditions:** Given any indicators of the installation of an Improvised Explosive Device (IED) (the range representing the most common threats in current operational theaters).
- **Performance:** React to a given IED threat in line with NATO standard procedure.
- **Standard:** First measures must be 100% correct, according to regulations XY.

The ELO itself does not always describe exactly how it will be covered with an ADL module. In the above example, “react” in the real world may mean to “move away” from a threat. With the ADL module this may translate into “choosing” a text-option or “move away” from various other alternatives.

There are usually several levels of ELOs. Top-level learning objectives describe an overall performance in a more general way. To ensure precision, higher-level learning objectives need to be broken down into sub-objectives, and further down to those ELOs that represent entry-level skills. This is what is often referred to in instructional design as the learning hierarchy. This hierarchy of LOs will correspond with the internal structure of the course and its subdivision into chapters and modules. The above LO might be broken down further:

- Identifying signs of IED installations in the right places.
- Identifying the typical indicators for IED installations.
- Reacting correctly to an identified IED threat.

Example 2 (sub-objective):

- **Conditions:** Given any indicators of the installation of an IED (the range representing the ten most common threats in current operational theaters), as well as normal electrical/mechanical installations, and without looking up information or referring to notes.

- **Performance:** Identify indicators of the installation of an IED.
- **Standard:** Typical and reliable IED indicators: 90%. Possible (but unreliable) IED indicators: 80%.

The conditions stated in an ELO may significantly affect the amount of effort put into training it. In the above example, the conditions indicate that the module needs to cover the ten most common threats and not just one or two. In addition, normal electrical/mechanical installations also are to be treated as content. Further, the conditions state that no additional reference information may be used, which calls for "learning by heart" (i.e., instinct or gut feeling) involving regular rehearsals.

The standard to fulfill a specific ELO is of great importance when it comes to self-assessment and/or testing. In the above example, learners are expected to identify typical and reliable indicators of IEDs in 90% of cases, the percentage for possible but unreliable indicators being a bit lower. To correctly test the above objective, a test would in fact require numerous items (e.g., 10 examples of reliable indicators of which 9 must be identified, and 10 examples of possible indicators of which 8 must be identified, plus multiple instances showing no threat at all).

4.2.2.2 Educational assessment items

The main goal of an educational or learner assessment is to measure how, at the end of the learning module or at the end of the course, the learner masters the desired performance (i.e., knowledge, skills, attitudes, and beliefs) set by the ELOs. It is thus crucial that the assessments are thought out, planned, and designed in direct alignment with the hierarchy of ELOs. Each ELO and each learning sub-objective will be covered by at least one or multiple assessment items.

Educational assessment is often divided into formative assessment and summative assessment.

Formative assessment or *diagnostic testing* is a range of formal and informal assessment procedures employed throughout the learning process, principally to improve the students' attainment of the KSAs outlined in the ELO. It typically involves qualitative feedback rather than quantitative feedback (scores).

Formative assessment items are learner-oriented and serve four principal purposes in an ADL course:

1. Provide feedback on course participants' level of objective mastery.
2. Direct attention/focus on core aspects of course.
3. Motivate course participants' interaction with course material.
4. Promote instructors' accountability for student learning.

Summative assessment is an evaluation of the student's learning by comparing it with some standard or benchmark. The summative assessment items are exclusively learning-oriented, and they are generally carried out at the end of a learning module and at the end of the course. They exclusively serve to measure the achievement of the competencies specified in the ELOs. Summative assessment items are evaluative and are typically used to assign the student's course grade.

A learning module (or a set of learning modules) usually finishes with a final summative test that serves to prove mastery for the records. For ADL courses, such tests are usually taken online in a proctored environment, to fulfill the legal requirements of a test. These requirements may become important if, for instance, an accident that occurs after training is attributed to lack of training.

4.2.2.3 Kirkpatrick-Phillips Training Evaluation Model

In order to be able to improve all aspects of the course (content, technical environment, interactivity, pedagogical aspects, coaching, etc.), it is absolutely necessary to include evaluations. The key purpose is to include feedback for future revisions to improve training.

The following levels of the Kirkpatrick-Phillips Training evaluation model have proven helpful:

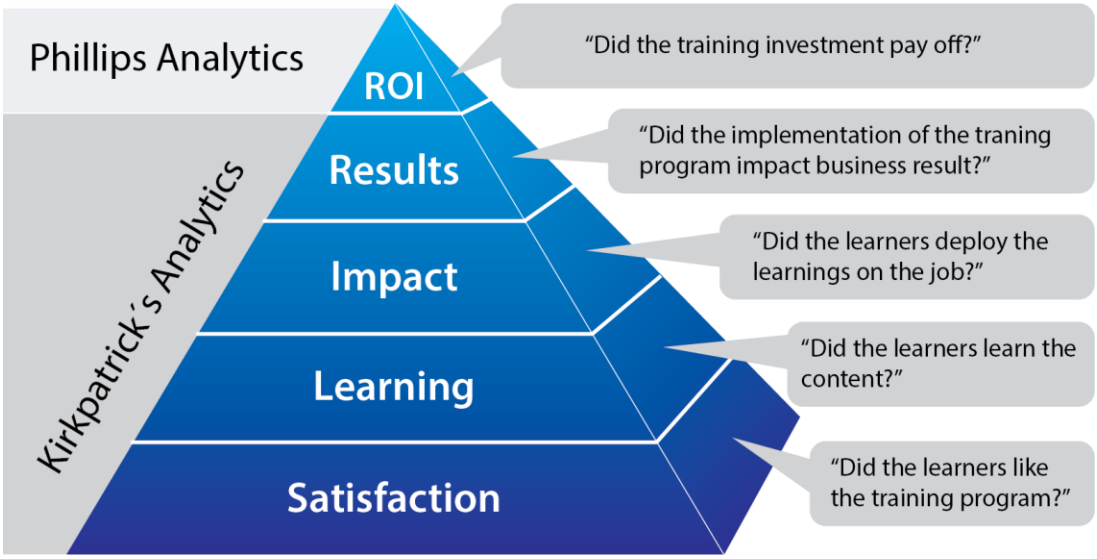


Figure 4-3. The Kirkpatrick-Phillips training evaluation model

For this chapter, we will focus on the initial three tiers (Satisfaction, Learning, and Impact) because the top two tiers are more closely associated with evaluation (the "E" in ADDIE) that is discussed in Chapter 8.

1. **Satisfaction**: The first level captures immediate feedback on the course by the trainees. This type of evaluation is often known to many as "smile-sheets" distributed in classrooms. With ADL, this first reaction can be evaluated using an online survey. It is important that this first feedback is provided immediately after taking the ADL course. With Learning Management Systems (LMSs), reminders may be automated. Access to the next course level can be made dependent upon completing a survey.
2. **Learning**: This second level evaluates whether learners have mastered the content. With ADL this usually happens in the form of a final, online test. Such assessments may take place at the end of the course or later, to evaluate long-term retention of what was learned.
3. **Impact**: This third level evaluates the impact of the training on the trainee's behavior. This level too can be accessed using online surveys that address trainees and/or supervisors sometime after the training is complete. The goal of this survey is to find out the impact that the training had on the performance of the trainees.

4.2.2.4 The storyboard from the pedagogical/andragogical point of view

Like the blueprint for a house, ADL design should derive from a carefully crafted plan. This plan is called

a *storyboard*.

A storyboard can be an outline or a script with actors, dialog, and directions. The dialogue can be either on-screen, spoken, or both. The actors are not people, but rather on-screen elements like text boxes, images, videos, and things the learner clicks. The following is an example of a simple storyboard:

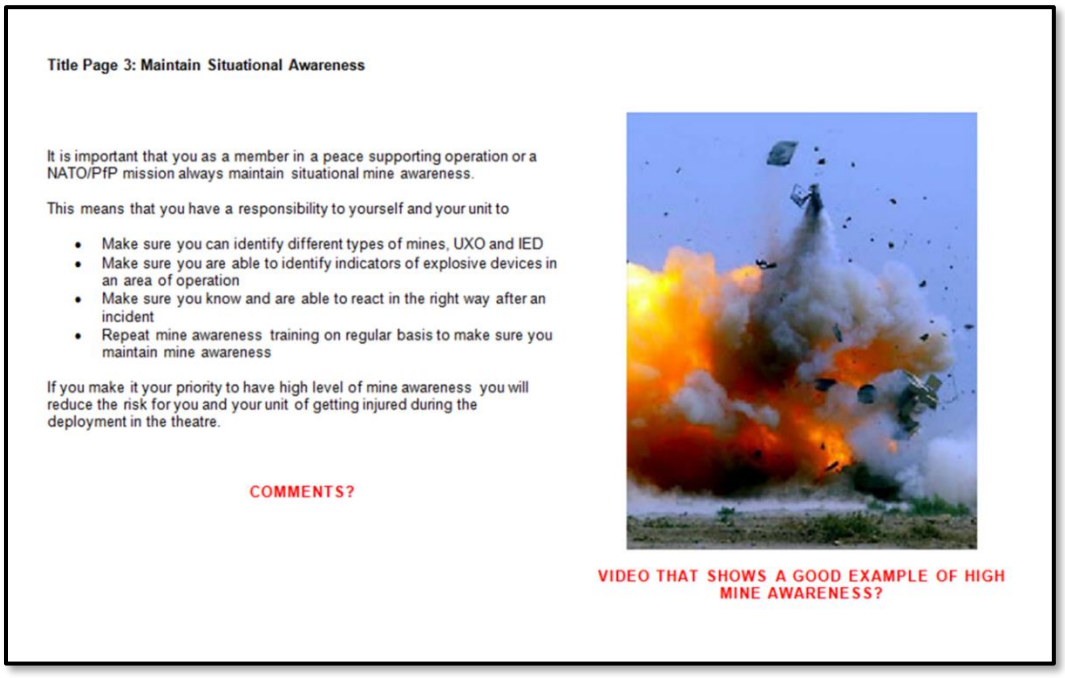


Figure 4-4. Sample storyboard

The storyboard's primary value is that it forces the developer to have a reason and a consistent approach to everything he or she does. The storyboard is the plan for sequencing and splitting the content, applying a consistent style, establishing pedagogical rules, designing meaningful activities, providing feedback or instructions to the learner, etc.

From the pedagogical/andragogical point of view, the storyboard consists of the description of sequential steps that the student must go through to successfully complete the learning activity and achieve the assigned LOs. The following should be taken into consideration while designing the scenario of an ADL course:

- Stay focused on the topic and provide a consistent thematic presentation of the learning course.
- Deliver information in short sequences that allow the student to set his or her own pace to absorb the material.
- Do not provide too many alternatives. A complicated tree-like course structure is not as good as a linear-type course. Branching may be an option to provide several examples to a specific topic or to explore a topic from various viewpoints. However, when the program contains branching options, it must make sure the learner is forced to explore all branches before proceeding to the next topic.
- Clearly label optional material. If optional material (examples or complementary information) is included in the module, it should be clearly labeled as such to ensure the learner knows that

completion of the module does not depend on having studied the optional material. Additionally, material designated as "optional" must not be included as testable content within the design of the assessment instruments.

- Make the pieces of the learning material reasonably sized. Break down the learning material into small and logical instructional sequences. Such sequences (made up of one or several screens) should not follow each other automatically; instead, they should be started by the user with the buttons "next," "previous," or "repeat." This way, the user may repeat a small sequence only if something was not understood.
- Build a clear hierarchy structure. If the learning material is extensive, break it down into coherent thematic modules with clear and consistent story lines and content. It is not recommended to group more than one learning subject into a module. It is better to use more modules in the course than overload the modules with different subjects.
- Present only one topic per slide. Most likely, the student will remember none of the concurrent topics if a slide is overloaded with several related items. However, this does not mean that the entire learning material within a larger topic should be placed on only one slide; in most cases that would be difficult and messy.

4.2.3 Pedagogical educational tips

This section provides a series of pedagogical attention points to consider when designing the content outline and storyboard. It also gives useful tips on how to achieve an optimal design of a course.

4.2.3.1 Know your audience

The primary educational prerequisite for proficient instructional design is to "know your target audience." That is, know their skills, needs, and motivations.

4.2.3.2 Inform your audience about the course

The first section of a course should be an introduction that provides information about the course, such as general prerequisites for the course, LOs, overview of the course (structure, organization, timing, type and organization of tests), and reference to external material (books, websites, etc.). The information should also state how much time is needed to go through the material.

Important: Well-developed ADL modules usually have a menu that is relatively self-explanatory. Avoid extensive descriptions of the content and structure. If a course design requires a lot of explanation, then it is probably a poorly designed course.

4.2.3.3 Didactical reduction

Didactics is the science of teaching. Didactical reduction is the process in which content/text is reduced in its complexity in order to reach optimal comprehension for the target audience. Didactical reduction is a core tenet of effective instructional design/development. Didactical reduction is achieved by

- removing all non-essential information;
- simplifying the terminology, wherever possible;
- transforming differentiated statements into general statements;
- using pictures and graphics to illustrate complex topics;
- using simple examples to explain difficult theories; and

- KISS (Keep it short and simple).

4.2.3.4 Small learning units

A lesson (learning module) should cover a minimum of 15 minutes and no more than 30 minutes of learning. If the module is longer, it should be divided into two or more lessons/modules. This is often referred to as “chunking.”

4.2.3.5 Short text chunks

Avoid pages that are densely packed with text. Break complex text into segments that are separated by white space and headings. Good practices are using headings, subheadings, paragraphs, lists, and tables to structure the text and disperse long texts over several pages. The following example shows use of white space, short headings, and a callout to structure text.

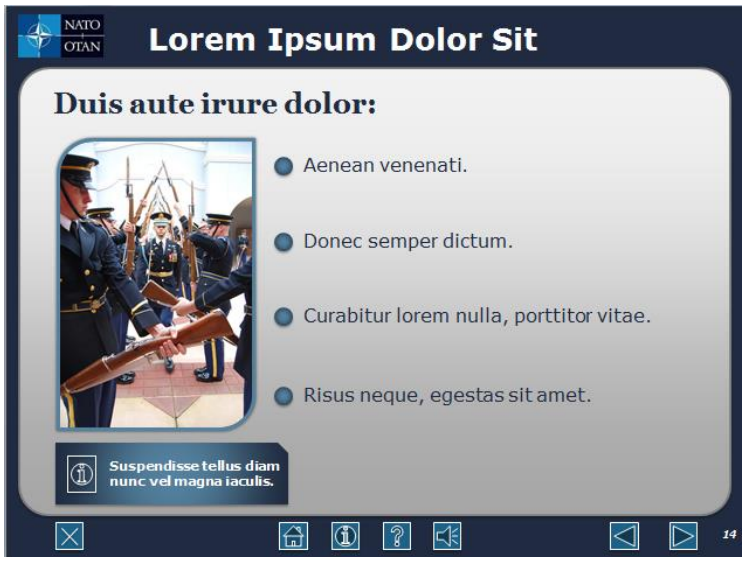


Figure 4-5. Sample use of white space

4.2.3.6 A picture is worth a thousand words

Use media such as pictures, graphics, video, and animation to illustrate, clarify, visualize, and simplify complex connections and information. In the following example, pictures are used instead of text to illustrate and inform the student.

Figure 4-6. Sample use of pictures to tell a story

4.2.3.7 Get your students motivated: The ARCS model

The ARCS model, developed by John M. Keller, is a problem-solving approach to designing the motivational aspects of courses (not only ADL courses) to stimulate and sustain students' motivation to learn. The ARCS model[3] is composed of four factors:

Attention

The first and single most important aspect of the ARCS model is gaining and keeping the learner's attention. Strategies for attention include sensory stimuli, inquiry arousal (thought-provoking questions), and variability (variance in exercises and use of media).

Relevance

Attention and motivation will not be maintained unless the learner believes the training is relevant. The training program should answer the critical question, "What's in it for me?" Clearly state the course's benefits. This applies not only to the whole program but also to specific content. Example: "Correctly charging the radio battery is important. With this particular radio, a low battery will cause the radio to switch off with no warning. It will need at least ten minutes of charging before it can be switched on again!"

Confidence

The confidence aspect of the ARCS model is required so that students put effort into the program. If they think they are incapable of achieving the objectives or that it will take too much time or effort, their motivation will decrease. In technology-based training programs, students should be given estimates of the time needed to complete lessons and/or a measure of their progress throughout the program.

Satisfaction

Finally, learners must obtain some form of satisfaction or reward from the learning experience. This can be in the form of entertainment or a sense of achievement. A self-assessment game, for example, might end with an animation sequence acknowledging the player's high score. A passing grade on a post-test might be rewarded with a completion certificate. Other forms of external rewards would include praise from a supervisor, a raise, or a promotion. Ultimately, the

best way for learners to achieve satisfaction is for them to discover that their new skills can be immediately useful and beneficial in their jobs.

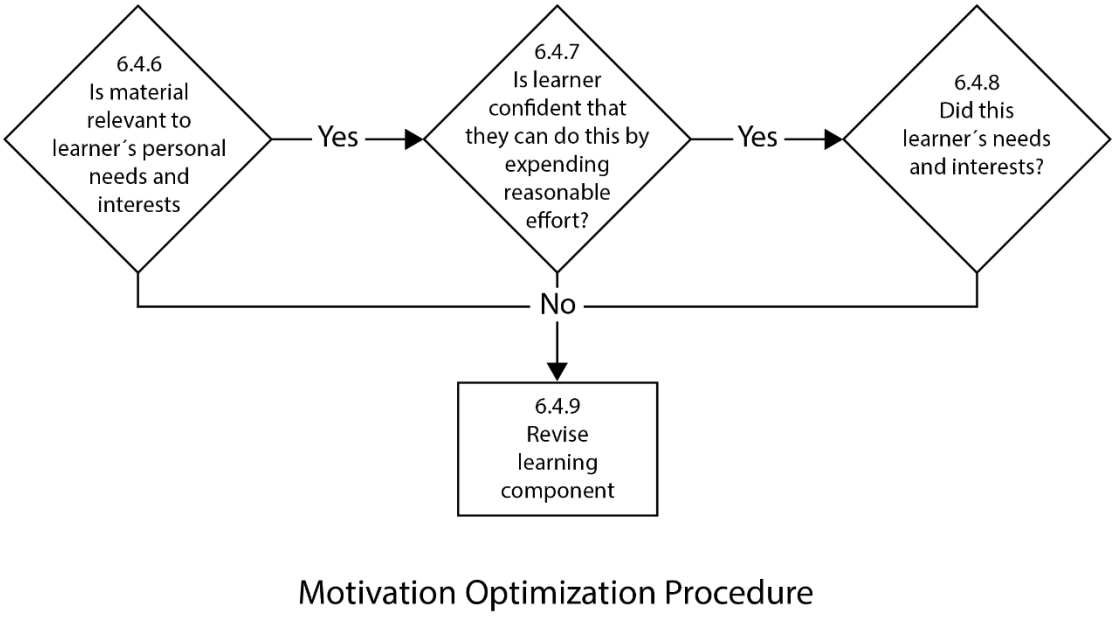


Figure 4-7. Motivation model

4.2.3.8 Innovation and creativity

During the development of the ADL course, the project team must constantly show creativity and innovation (think outside the box) not only on the choice of the technical solution to be implemented but also on the scenario and content level. The aim is not to artificially and unnecessarily make the course more complex, but to develop an engaging one that will offer learners varied and attractive content, approaches, and interfaces.

4.2.3.9 Activity and interactivity

The ADL course must motivate learners to become (and remain) active by stimulating the interactivity between

- the learner and the content.
- the learner and the teacher.
- the learners themselves.

4.2.3.10 Learning and positive emotions

The design team must ensure that the course content regularly creates positive feelings (joy, surprise, amazement, etc.). Feelings often dictate our daily behaviors, choices, and perceptions. Positive feelings make communication more effective, and they confer high-level impact to delivered messages. Positive emotions play a key function in the learning process by improving

- the understanding and retention of the content; and
- the motivation, attention, and commitment of the learner.

The use of technology is not the best way to create positive feelings and is, for a non-specialist, often a source of frustration. In the conception of the scenario, content, and user interface, the design team must be aware of the negative effect of potential negative feelings (frustration, monotony, annoyance), and must try to avoid them.

4.2.3.11 Storytelling

One of the best ways to learn is through storytelling. This principle is also perfectly applicable for e-Learning. Adult learners must see the relevance of something in order to feel persuaded to learn about it. Explaining concepts in the context of a story that learners can relate to is crucial to the learning process. By helping learners integrate knowledge into their mental models in meaningful ways, the realistic context of a story makes information easier to remember. Cleverly crafted stories also stimulate an emotional response to training content, such as a desire to help, curiosity about how something works, or a drive to achieve. Thus, the story helps persuade learners to engage in the training, and ultimately perform the desired behaviors.

4.2.3.12 Tracking of the activity of the learners

To evaluate the content's adequacy to meet the learners' needs, it is helpful to know the amount of time they have spent on the different LOs. The LMS captures the access data, tracks each student's learning activity, and stores the initial and final timestamp of each LO accessed. Using LMS parameters and filters, the results can be viewed and analyzed by the instructor. For example, the instructor can know what specific material was used most often by students, what kind of media they prefer, what time and day of the week students prefer, and even if the scores and grades reflect the amount of time the students accessed the content. Using the data captured by the LMS, the instructor will be able to reflect on a learner's behavior and performance, and then make some inferences about the content quality. If you are tracking learning events outside of a browser that has a connection to an LMS, you may want to consider using the ADL Experience API (xAPI) specification. See chapter 9 dfor more details.

4.2.3.13 Distance learning and coaching

While taking an ADL course, the learner can have the sensation of being alone with the content, the computer, and the technology. To counter this isolation, and to ensure the motivation and the commitment of the learner, a personalized coach may be considered. The aim of this coaching is to

- guide, help and stimulate the learner; and
- follow and help manage the learner's progression through the course.

In this context, the traditional role of the teacher evolves to the role of guide, facilitator, mentor and/or coach. The instructional team may be able to provide coaching opportunities if resources are available.

The workload generated by this coaching is one of the major stakes of managing ADL. It is very important to choose the adequate coaching method (reactive or proactive) and the optimal combination of communication and collaboration tools. This choice will be based on the LOs, the profile and the technical maturity of the learners, the profile and the technical maturity of the teachers, the number of learners, the duration of the course, and the limitations of the learning environment (especially the availability of material and human resources).

4.3 Instructional Design

4.3.1 Overview

This section provides guidance on the correct application of education and training strategies related to the instructional systems design (ISD) processes to be followed when developing ADL courses. The ISD processes are broadly similar to those used for the design of traditional classroom-based learning. Most importantly, the ISD processes for ADL should be based on the sound pedagogical practices described in the previous chapter. This information will benefit both policy makers and ISDs, and it will assist in producing a credible and interactive ADL course.

The ISD process consists of five stages:

1. Communication of objectives
2. Task contents
3. Engaging material
4. Interface design
5. Layout

4.3.1.1 Communication of objectives

This section describes the elements of effective ISD and how to identify engaging materials. Firstly, when thinking about the project in the design phase (i.e., developing the course storyboard), consider the four As of ISD:

1) Attraction

- You have approximately 0.1 second to attract a potential learner; therefore, you must create an attractive design to capture the attention of the learner to motivate him or her to continue using your ADL course.
- The course should be easy to use and flow in a cohesive manner.
- Three five-minute modules with a single learning point may be more effective than one 15-minute module that covers three similar points.

2) Attention

- Each module should focus on a single learning point. Consideration should be given to understanding the processes rather than just simple knowledge transfer.
- The information within the course should be concise and accurate, and it should be exactly what the user requires.
- Include hyperlinks to additional information such as books, Internet sites, and journals that assist in directing information and reinforcing theory.

3) Availability

- The Internet provides easy access to courses and information that change rapidly. What is relevant today may not be tomorrow. Focus on short-term memory rather than long-term memory by delivering information in a way that can be easily and instantaneously transferred by the user to fulfill the needs of the current task. Just-in-time and workflow models help satisfy these needs.

- Different versions of courses should be easily identified outside of the learning environment (i.e., on the LMS).
- The content should always be easy to find: not just the module in the system or course in the LMS, but also the data within the module.

4) Application

- The single most important factor is the motivation of the learner to complete the course. Excite the users during the intervention so they will want to use what the module contains. Each module should encourage learners to go and use the information they have gained, or process what they have learned, immediately.
- Provide assessment within the course at the right time and as a separate intervention. This is best included when the user has had time to reflect, explore the theory, or actually use what they have learned in a task on which they are working. Designers can assist the learners by providing checklists or job aids that they can follow to complete a task.
- Developers need to clarify concepts and transform abstract information into material that is relevant and applicable. Using questions to build on learners' experiences, and leading them toward the learning point, is a means to increase relevance.

4.3.1.2 Task contents

If the task contents within a course do not motivate the learners to engage, they will not see any relevance for doing the training. It is best to present the learning material in various ways. (e.g., Using text descriptions, diagrams, still images, rich media, interactive graphical media, 3D models, diagrams with pop-up explanations, etc.) Having a variety of relevant media for the students is essential. The learners also need to experiment with the material to ensure they fully understand the concepts. This can be done through test questions, case studies, simulations, games and other tasks. Tutorials are required to provide guidance in response to the students' practical work (e.g., automated feedback, checklists, or means by which learners can check their own work.)

4.3.1.3 Engaging materials

Consider why film and TV can be engaging, how good instructors can make even the most mundane subjects interesting, and why you click on certain websites and avoid others. Then think about those ADL programs that you have enjoyed and consider what made the program enjoyable. What did these programs include to hold and maintain your attention? Did they use audio, rich media, etc.?

Potential engaging activities to include in an ADL design:

- ✓ Check Questions
- ✓ Structured Presentations
- ✓ Tutor Reviews
- ✓ Games
- ✓ Discussions
- ✓ Peer Review
- ✓ Self-Reflection
- ✓ Assignments
- ✓ Simulations
- ✓ Demos

- ✓ Questionnaire
- ✓ Information Resources
- ✓ Case Study
- ✓ Peer Review

It is important to note that while sound and motion can attract attention and help engage the learners, evidence indicates that relevant material and interactivity are key to reinforcing and maintaining engagement. It is best to use various media and meaningful interactivity when the learning content demands it (e.g., to explain things that cannot be adequately conveyed using text and graphics). Concentration of meaningful interactivity is one of the reasons why self-study materials can be so efficient in reducing learning times; it challenges the learners and heightens their attention levels.

4.3.1.4 Interface design

Some basic guidelines should be followed to ensure courseware does not become distracting to the user. If the interface design is bad, learners can quickly lose interest and motivation. Amending the layout, color scheme, text, graphics, and audio could significantly increase the likelihood of someone reading and remembering the well thought-out content.

In general, content should account for about 70% of the ADL screen, leaving about 30% for the total interface elements, as shown in this example:

Figure 4-8. Sample interface design

4.3.1.5 Layout (Primary Optical Area)

A moving object on a screen will always become a master anchor point for the eye. If the moving object is at the bottom of the page, it becomes difficult for readers to move their eyes back up to the top of the page. Therefore, the best practice is to not have any moving objects on the screen once the text is being displayed. A video may look good and display the developer's creativity, but it could be a distraction for the student.

In the following example, the red highlight moves in a clockwise direction to show the area of emphasis as the narration plays. There is no text to distract the student (except for object labels).

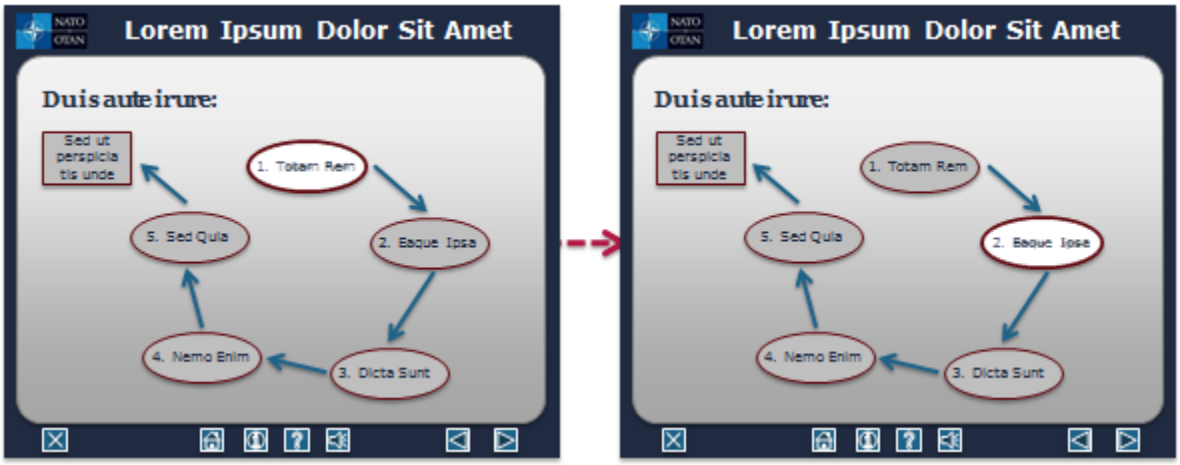


Figure 4-9. Sample of proper layout concept

The Primary Optical Area (POA) is the point where the eye starts scanning. The POA should be where the information begins, so the eye does not go back after starting at the POA. Moving objects or engaging images often become the Master Anchor and override the POA; therefore, pay close attention when animation or pictures are introduced and played.

4.3.1.6 Text layout

It is important to choose the correct font type and size and to remain consistent throughout. Verdana is the most popular font for screen reading, followed by Arial. Both are sans serif fonts. Body text should always be in sans serif, while headings should use a font of high contrast to a serif font.

When using text for describing events (not headings), it is best to use a minimum of 12-point font with 14-point spacing; this is what our brains are used to reading. Double line spacing can become confusing. And as a rule of thumb, only four sentences in a block can be read before the eye becomes tired. Use text bullets to help separate blocks.

4.3.1.7 Color schemes

The organization which will use the ADL may express a desired color scheme, but great care and attention should be placed on this design element to consider the needs of those personnel who have specific learning difficulties. Eye strain and clarity of words can all be affected by the choice of color schemes. Some organizations allow the end-user to change the screen background color for themselves. This is easy to do and something you may want to consider.

- Similar colors can contrast well, but background patterns can make it difficult to read the text. Good practice includes either yellow on blue, or pastel colored backgrounds with black text. Although gradients can aid drawing the eye down the page, avoid introducing a Moiré Effect whereby the image will blur and reduce clarity.

- Do not use too many different colors, particularly for text. Aim for no more than four colors. Once a set of colors has been chosen, stay consistent throughout. (Note: Colorblind individuals may not be able to distinguish between certain colors. Make sure that colors are not the only method used to convey important information.)

  Colors have associations: RED = STOP and WRONG, GREEN = GO and CORRECT, YELLOW = LOOK HERE.

  Remember, wrong color = wrong message. Associations can build up in a program (e.g., one color text for correct feedback and another for incorrect). It is also important to note that color schemes are merely one part of the design considerations. (i.e., Do not rely on color schemes to try to create engagement). Often, a change in font, using words like "STOP" or "CAUTION," or using engaging graphics can be just as (or even more) effective than the color scheme.

- A house style metaphor can be the easiest way to remain consistent throughout. By establishing the house style at the inception of the design phase, developers can ensure the correct color scheme, logo, text style, and layout are set for the entire the learning content.

4.3.1.8 Text Emphasis

There are various ways to emphasize text. Developers may decide to enlarge the text deemed important, **bold** the text, or use a different **color**. It is important that any text superimposed on a graphic is readable. The use of a semi-transparent bar (shown below) is one means to maximize legibility.

Figure 4-10. Use of a semi-transparent bar to maximize legibility

4.3.1.9 Text and Graphics

The use of text with graphics is an effective way of reinforcing information for the students. By putting text either close to the graphic, or better still, as part of the graphic to which it refers, students are nearly assured not just to look at the picture.

4.3.1.10 Narration

Words presented by audio are better than on-screen text, especially when they are describing an on-screen graphic, because the input is being spread over two channels. However, some people don't like reading the text while listening to the audio. Therefore, the ability to turn off text or audio should always be provided as an option. Probably the best way to use audio and text is to introduce key bullets of text at the appropriate points in the audio narrative. This will help to reinforce the learning points without overloading the learner.

There are two mistakes that negatively affect acceptance and comprehension of content and must be avoided:

1. Narration of a long text that is displayed in parallel on the screen. Learners can and want to read text themselves. Displaying parts of the narrated text at the appropriate moment is more effective. They may be single words or short statements.
2. Having narration and screen text that differ in words or word order. Having people read any text while a different text is narrated negatively affects comprehension and retention. Whatever is narrated must be identical to the screen text, even with short statements or simple key words. At the same time, avoid reading all content displayed word-for-word.

4.3.1.11 Evidence based practices

When designing e-Learning courses, it is important to incorporate both best practices from industry and evidence-based practice from designed research experiments. The following principles for e-Learning are the result of research presented by Dr. Richard Mayer and Dr. Ruth Clark[4]:

1. **Multimedia Principle:** Student retention is improved through words and graphics rather than through words alone.
2. **Contiguity Principle:** Students learn better when corresponding words and pictures are presented near each other rather than far from each other on the page or screen.
3. **Modality Principle:** Students learn better from animation and narration than from animation and on-screen text.
4. **Redundancy Principle:** Students learn better when graphics are explained with words in audio or text, but not both.
5. **Coherence Principle:** Students learn better when extraneous words, pictures, and sounds are excluded rather than included.
6. **Personalization Principle:** Students learn better when a conversational style of writing is used rather than a formal style.
7. **Segmenting Principle:** Students learn better when information is structured in bite size chunks.

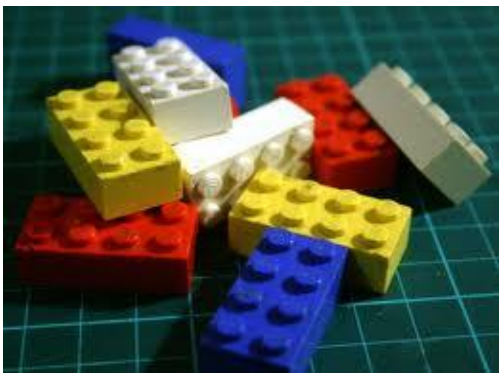
Using the above evidence-based practices when designing e-Learning programs and storyboards will lead to better student retention and understanding.

4.4 Summary

Below are some summary points to remember when designing courseware:

1. Keep it simple – text, sound, motion and color may be used to support the instruction. However, if an element does not support the information being relayed, then remove it.
2. Provide a harmonious and consistent variety of text, sound, motion and color that holds the attention of the learner throughout the entire course.
3. If using simulations or problem-solving interactions, replicate the real-work environment as much as possible.
4. Graphics and pictures should support instruction and reinforce a message, not just provide superfluous fillers.
5. Exam elements should accurately question the learning objectives and key learning points to be achieved.

5 Development



5.1 Scope

This chapter will cover tips and considerations for developing ADL. It addresses topics such as standardization and development methodology.

5.2 Introduction

There are many ways to produce electronic content. However, requirements influence the way a piece of electronic content is designed. Some of these requirements include:

- Tracking learner progress
- Storing learner data
- Adapting content to learner's previous achievements (i.e., learner profile)
- Viewing content on hand-held mobile devices
- Engaging in a virtual environment or simulation
- Communicating with others

5.3 Standardization

Content can be produced in a way that increases interoperability by using standards. This section provides guidance on technical standards and specifications which help ensure interoperability, reusability, and portability of content. They apply both for production of traditional e-Learning and for new areas such as mobile learning elements.

5.3.1 Sharable Content Object Reference Model (SCORM®)

SCORM is a set of technical standards for e-Learning software products. **SCORM® tells programmers how to write their code so that it can function well with other e-Learning software**. It is the de facto industry standard for e-Learning interoperability. Specifically, SCORM® governs how online learning content and Learning Management Systems (LMSs) communicate with each other. SCORM® does not speak to instructional design or any other pedagogical concerns; it is purely a technical standard.
Be aware content stored on one LMS cannot be accessed by another LMS. The user would need an account on each LMS. SCORM does not address the transfer of data between LMSs.

NATO STANAG 2591 "Advanced Distributed Learning" (8 May 2013) states: Participating nations agree to adopt SCORM® 2004 3rd Edition as the standard for the purpose of conformance of the following:

- Learning Management Systems (LMSs)
- Content Packages
- Sharable Content Objects (SCOs)

SCORM® integrates a set of related technical standards, specifications, and guidelines designed to meet functional requirements for accessible, interoperable, durable, and reusable content and systems. SCORM® content can be delivered to learners via any SCORM®-compliant LMS using the same version

of SCORM®. A brief explanation and example for each of the four functional requirements (also referred to as the "ilities") are presented here:

Accessibility. The ability to locate and access instructional components from multiple locations and deliver them to other locations.

> *Example*: A SCORM® course can be moved from one SCORM®-conformant system to another SCORM®-conformant system without complex reconfiguration/installation.

Interoperability. The ability to take instructional components developed in one system and use them in another system.

> *Example*: Content packaged for delivery in one SCORM®-compliant LMS can be loaded into another SCORM®-conformant LMS for delivery to learners.

Durability. The ability to withstand technology evolution and/or changes without costly redesign, reconfiguration or recoding.

> *Example*: Upgrading to a new version of an LMS will have no effect on the delivery of content to learners.

Reusability. The flexibility to incorporate instructional components in multiple applications and contexts.

> *Example*: E-Learning content designed for one organization can be redeployed, repurposed, or referenced by other organizations that have similar learning needs.

5.3.1.1 SCORM® Conformance

Conformance is about functional requirement. SCORM® is a set of functional requirements; therefore, if a product adheres to these requirements, it is conformant. The SCORM® Test Suite contains the software, procedures, and supporting documents to verify SCORM® conformance of LMSs, content packages, and Sharable Content Objects (SCOs). It provides a detailed log of each test outcome.

A SCORM® product tested and validated successfully in the SCORM® Test Suite is considered "conformant." Conformance is the result of an error-free, repeatable test that proves content or systems meet the minimum requirements defined in SCORM®.

5.3.2 Implementing SCORM®

5.3.2.1 Determining whether SCORM® should be used

If an organization is developing learning content for the web, the organization may think that it must use SCORM®. That is not necessarily true. The two major benefits of SCORM® are enabling interoperability and the reusability of tracked data across learning objects. A developer may not have to use SCORM® if

- the content is meant to live and die within a single system.
- there is no requirement for tracking course results and progress.
- the intended audience does not access content through an LMS.
- the content has a short life span (e.g., only developed for a single purpose and for a specific amount of time).

- the organization already has custom tracking code, and the content being created would not leave the system.

The biggest factor in determining whether SCORM® should be used is the end-deployment environment. If an organization has a SCORM®-conformant LMS and normally develops SCORM® content, it makes sense to do so.

Determining how much SCORM®
If SCORM® is a necessity for your content or organization, the next step is figuring out how much SCORM® should be used. The first step is to determine the version of SCORM needed: either SCORM® 1.2 or SCORM® 2004 3rd Edition. SCORM® 2004 3rd Edition and SCORM® 2004 4th Edition are very similar, but the 2004 3rd Edition is recommended for use as the support within LMSs and authoring tools is higher. Consult with the requirements or LMS provider before proceeding with development.

SCORM® 1.2 is the earliest stable version of SCORM® that is still supported today. It is the most widely adopted version of SCORM®. SCORM® 1.2 has no concept of content sequencing. This means that most SCORM® 1.2 content is either free-choice and allows users to take whatever content they want at any time, or the content handles all sequencing and navigation internally. As a result, entire courses typically end up as a singleSsharable Content Object (SCO). This hurts reusability and the ability to track user activity at the instructional level a SCO would normally implement (typically a lesson)Normally, each SCO reports a score, completion data, and success data. If there is only one SCO, granularity is lost if this information is not tracked elsewhere). The biggest shortcoming of SCORM® 1.2, however, is the idea of mandatory and optional data model elements for the LMS. If an organization or content is relying on an unfamiliar SCORM® 1.2 LMS, developers should verify that it implements all SCORM® 1.2 Data Model Elements, not just the mandatory ones. **An LMS can be SCORM® 1.2 conformant and not support these elements.** Another important caveat of SCORM® 1.2 is that a learning object is either "completed," "passed," or "failed" but never more than one of these.

5.3.2.2 Are you designing for reuse?
SCORM® is typically used to enable reusable content. This could mean reuse within a course, within a curriculum, within an organization, or across organizations.

The term "reuse" is straightforward, but it requires some explanation when developing for reuse across organizations. For example, your organization is tasked to develop content on First Aid. Before beginning development, you should search for content that can be reused. Here are three options that may help your organization save development costs:

1. **Reuse.** You may be able to discover First Aid content that meets your needs and is freely available. Your organization can simply download the content to your LMS and provide access to it.
2. **Repurpose.** You may discover First Aid content that is good but does not precisely meet your needs, though the content is freely available and accessible. You may be able to download the content and "repurpose" it by deleting or adding information that makes the content pertinent to your organizational needs.

3. **Reference.** You may discover that another organization already hosts content that fully meets your needs, and that the LMS hosting the content is fully compatible with your LMS (or that you do not need to track student data). You can then "reference" the content, and the people in your organization can meet their training requirements by accessing the content hosted on the other LMS.

There are rules when designing for reuse, such as making files similarly accessible, making the content itself context-free, and implementing SCORM® calls and packaging. If the content is meant to live in a single course and never leave that course, it may not be worth the time investment to make the content reusable, and not making it reusable would be perfectly acceptable. It is still possible to create that content as SCORM® content but leave out some areas of reusability.

Designing for reuse involves a different mindset throughout the content creation process. Reusability is a sliding scale, not merely a box to be checked. Implementing the most basic SCORM® requirements enables interoperability, which is a form of reusability itself. However, much work is involved in making content fully reusable, from file structures (flat is best), to file naming conventions (for example, avoid calling things "Lesson 2"), to the removal of context within content (again, "Lesson 2" or references to other SCOs). Metadata can also be used to make content more "findable" in repositories, but this is not a requirement of SCORM®.

Finally, "sizing" or "chunking" can help ensure content can be easily reused or repurposed. As mentioned above, an entire course that is wrapped as a single SCO greatly limits the likelihood of reuse. Although SCORM® doesn't define or mandate SCO size, developers should consider chunking the content into reusable pieces. To further enhance reuse, provide the source material down to the asset level. Going back to the example of developing a First Aid course, a good example of chunking would be to develop SCOs such as "Stop the Bleeding," "How to Help a Choking Victim," and "Cardio Pulmonary Resuscitation (CPR)." These chunks are much more reusable than wrapping all these (and other) sections into a single SCO titled "Basic First Aid."

5.3.2.3 Impact on design

Although it is claimed that SCORM® does not change how content is designed, the assertion is only half-true. SCORM® implemented to the simplest degree indeed does not affect design; but, if SCORM® is done well, it will cause some implementation changes from how a course is typically made. In addition to the reuse considerations noted above, developers should be aware of the following:

Understanding LMS controls and content controls

A common discrepancy when launching SCORM® content in an LMS – and particularly across LMSs – is how the controls work. Some LMSs expect SCORM® controls to be within the content, while others expect to maintain their own controls and launch the content in a frame. Given the likelihood that a SCO has more than one page or frame, developers easily can end up with one set of controls for paging and a different set of controls for navigating between SCOs. While designing for reuse is important, designing for the target LMS should not be overlooked at the cost of reusability.

Sequencing

While SCORM® sequencing enables more than 99% of behaviors for which an instructional system designer (ISD) would look, there are still a couple of odd cases that cannot be accomplished with SCORM®. The ISD's concern, however, should be with the 99%. An ISD can likely describe a fully

viable sequencing strategy that is implementable within SCORM® 2004, but a SCORM® programmer may not be able to reproduce it easily, even though it is possible. This arises because SCORM® implements "simple sequencing," but all scenarios are not simple.

5.3.2.4 Technical and instructional implementation details

Both ISDs and learning content creators can refer to individualized guides on SCORM® Best Practices. These guides are available for free from https://www.adlnet.gov/research/SCORM.

SCORM® Users Guide for Instructional Designers
https://adlnet.gov/assets/uploads/SCORM_Users_Guide_for_ISDs.pdf
SCORM® Users Guide for Programmers
https://adlnet.gov/assets/uploads/SCORM_Users_Guide_for_Programmers.pdf

6 Development of ADL – Methodology

This chapter focuses on the best procedure to develop ADL products. While the focus is on web-based training products, some of the key principles equally apply to any other instructional product.

6.1 Introduction

Producing ADL of any kind is a major project, involving several roles and responsibilities. This chapter provides step-by-step guidance on how to set up a production team and how to efficiently produce learning content that is in line with the training requirements.

6.2 Staffing for a project

6.2.1 Typical Roles

The setup of a project team differs widely between organizations and specific projects. How a team is set up depends heavily on the skills of its individuals. The minimum roles involved typically include the following:

- **Customer.** Asks for the project to be completed.
- **Subject Matter Expert (SME).** Provides background and content expertise.
- **Project Manager (PM).** Oversees the planning and progress of the project.
- **Instructional Systems Designer (ISD).** Responsible for the instructional design of the content according to established procedures.
- **Multimedia Developer (MD).** Responsible for creating all media according to the ISD's inputs.
- **Courseware Developer (CD).** Responsible for bringing together all elements in an authoring tool such as, Articulate, Lectora, Camtasia, Captivate among others.
- **Learning Management System (LMS) Administrator.** Responsible for uploading courses to an LMS and making it accessible to students.

In smaller production units, and depending upon the tools used for development, some of the roles may be combined in one person.

6.2.1.1 Special role of the customer

The customer is the person or organization for whom a project is being produced. His or her inputs play a vital role in the design and completion of a successful project. This especially applies to any special expectations regarding the outcome.

6.3 Key role of the subject matter expert

The SME is the key person to provide all inputs required to produce content that is in line with and focused on the real-world tasks to be mastered according to established rules and operating procedures, and oriented towards what the learners will be expected to perform under real-life conditions.

6.3.1.1 How to identify a good SME

In order to best support any training project, an SME should be

- available to the project team for early, often extensive, project meetings and follow-up enquiries by e-mail or via other channels;
- available and ready to review major project steps from concepts to storyboard and final products;
- able to focus on the essentials according to a project, regardless of his or her vast knowledge and experience;
- able to identify the knowledge/skills for the successful completion of a performance goal;
- able to communicate effectively with ISDs and other project personnel, who likely have less knowledge in the SME's field of expertise; and
- committed to the scope of the project.

Choosing/tasking the best-suited SME is essential to successfully and efficiently completing any training project. Besides the attributes listed above, a good SME also combines solid knowledge of the content to be taught and experience with applying the knowledge in real-life situations.

Sometimes the best approach may be to have two SMEs: One covering the subject matter, and one covering the required real-life experience.

6.3.1.2 What most SMEs are not

Many SMEs are not trained and experienced writers or ISDs. Do not try to force such work upon them unless they are comfortable doing it. Inform the SMEs that they are not expected to produce ready-to-use text. This task belongs to the ISD.

6.3.1.3 How to get the most out of SMEs

SMEs fulfill project-related tasks as well as other duties. The following approaches can help establish successful long-term collaboration:

- Get the SME officially tasked to support the project, including assignment of work time.
- Clearly inform the SME about the target audience and the real-life performance to be supported by the training; also tell him or her what does *not* belong to the scope of the project.
- Inform the SME about the overall project plan and milestones as well as the timing of his/her critical contributions.
- Provide the SME with a summary of whatever analysis and concept work has already been carried out and signed off.
- Limit the workload on the SME by encouraging pragmatic approaches to provide inputs. Possible work methods include:
    - Have the SME mark up any existing material with comments, suggested deletions, updates, or additions.
    - Invite the SME for an interview and have him or her explain processes with pictures (or other media) while videotaping everything.
    - Provide the SME with a detailed questionnaire asking for specific answers and draft-inputs (e.g., single PowerPoint slides, commented manual pages, handwritten notes, etc.).
    - Do as much of the writing as possible, with the SME only having to review critical work steps and the final product.

- Finally, do not forget to officially thank the SME for his or her contribution and invite the SME to any project wrap-up activities.

6.4 Typical project phases and milestones

6.4.1 Basic principles for a successful project

The secret to successfully running any project is having step-by-step procedures which involve all stakeholders at the right time, and carefully making decisions before attempting any work. This will greatly reduce costly and time-consuming rework due to incorrect assumptions.

6.4.1.1 Basic rule about critical steps

Have the output of all critical intermediate steps signed-off before starting any work.

6.4.1.2 Overview of the work phases

There are many ways to produce content, from experimental prototyping to production according to strict workflows. The following approach covers the latter. It assumes that a careful analysis of the training problem has been completed which resulted in an array of well-defined learning objectives for one or more web-based training modules:

- Start: Kick-off meeting
- Phase 1: Develop the basic concept and structure
- Phase 2: Develop the design and content outline
- Phase 3: Develop storyboards
- Phase 4: Produce media elements
- Phase 5: Conduct the programming
- Phase 6: Test the course on the target LMS
- End: Conduct an After Action Review/Final meeting

6.4.2 Start - Kick-off meeting

The kick-off meeting is key to a smooth start and continuation of a project. It typically includes the following elements:

- Introduction to the project (background, goals, key analysis results)
- Introduction of all project partners
- Definition of all roles, covering what is and what is not expected from each person
- Presentation/fine-tuning of the project plan and milestones with all partner schedules
- Identification and open discussion of any critical issues that may help ensure the success of the project
- Definition of the next steps

NOTE: It is important that before the kick-off meeting is concluded all participants are in agreement on the plan and on all key decisions taken. All participants also should receive copies of the meeting minutes.

6.4.3 Phase 1 – Basic concept and structure

If it has not already been outlined in the advance work, start by clearly defining a basic concept and an idea about the structure of the content to be developed. This preliminary phase gives everyone a chance to discuss a range of approaches and identify the most promising one before investing time and money in more detailed work.

The result of this early phase typically may include the following:

- The **key building blocks** of the final product
  - Example: One web-based Introductory Module with self-assessment questions, one online-test, an online glossary, a version of the glossary for smartphones, new online Frequently Asked Questions (FAQs) on a selected website, etc.
- **Raw description of the structure**
  - Example: Main Chapters only of the web-based training modules, Sections of the FAQs
- Basic assumptions regarding **the size of the project**
  - Example: Web-based training module of 60 minutes or 80 slides including 20 questions, random final test with 10 out of 20 questions, glossary with about 200 terms, FAQs with about 50 questions in total
- **Raw design approach**
  - Example: SCORM® learning module with menu on the left, standard layout and sub-navigation as used for other projects with adapted design to meet the content. The design at this early stage may be a simple sketch on paper. There is no need to invest in hours of fine design at this point

6.4.4 Phase 2 – Design and content outline

This phase provides a solid basis for writing the storyboard. Because the storyboard describes what is to happen on each screen, it depends on some key decisions regarding layout and navigation. If these decisions are not made early, the storyboard likely will not suit the interaction options. In addition, this phase ensures that the storyboard writer has a solid, approved plan to guide his or her work. This phase usually results in the following:

6.4.4.1 Design

- **Basic design for each screen** and **screen variant** according to the specs and the screen size of the delivery platforms
  - Example: Image with reference list, video with key words, assessment-item, animation, etc.
- **Sizes to be considered when producing media**
  - Example: Size of videos, maximum allowable text, standard images and zoomed images, font sizes for titles, body text, symbols for bullet lists, icons for content classification, etc.

6.4.4.2 Content Outline

The content outline is a **first draft**, describing the contents and illustrations in keywords only.

Example: Introduction consisting of an attractive animated splash page followed by general information about the module. Users may proceed directly to the menu. Learning time: 1 minute, overall.

A **table format** – with a row for each content element and the **allotted time expected for each content element** – is an easy and clear way to depict the outline. Include pauses and time for reflection. The table greatly supports control of the agreed-upon learning time.

Another row may contain hints on media that are either available or need to be produced. This way, research and production of some of the media can start early, without waiting for the complete storyboard.

6.4.4.3 Test and self-assessment items

Writing the assessment items and having them signed off before starting the storyboard helps enhance the **alignment of the final content to the learning objectives.**

Even with greatest care, some learning objectives may be interpreted differently by different people. Classic instructional design processes recommend writing all test items before starting with the storyboard because the **self-assessment items help clarify any deviations early.**

It is essential that work not proceed to the next phase until all the above items are signed off by the SMEs and other crucial project team members.

6.4.5 Phase 3 – Storyboard

The storyboard is the final, detailed plan for building an ADL course. It contains a thorough description of all content elements (screen text, narration, images, highlighting elements, text labels, etc.), including the correct synchronization of all appearing, disappearing or moving elements with sound/narration and all hints regarding navigation.

There are many ways to write a storyboard. One option is to write it in table form; another option is to use a database approach that allows easy export of narration text or other elements for production purposes.

A good storyboard takes into account all earlier decisions and relies on the range of interactions and visualizations defined in the basic concept.

Learners need to be able to process the content. Thus, too many things should not happen on the screen at the same time. For example, if you present a complex diagram,

- build it up component-by-component;
- have the sequence or the narration pause briefly, before showing the next element; and
- do not present the complete narration as screen text in parallel; instead, only display keywords or phrases synchronous to the narration.

6.4.6 Phase 4 – Production of media elements

The production of media elements provides all the material according to the storyboard and the defined design specs. In the course of producing these elements, distinguish source materials and production output.

IMPORTANT NOTE: When using third-party materials (graphics, photos, images, videos, etc.), make sure not to violate any copyright laws and stay away from any legally restricted media. Whatever media is used, organizations should consider intellectual property rights and legal issues pertaining to reuse/re-purpose rights.

The following hints illustrate some of the key factors to be observed in media production.

6.4.6.1 Images

- With today's digital cameras, it is easy to quickly create image material.
- Never enlarge images that are too small for their intended purpose.
- Always use layers when working with images containing text. Layering greatly simplifies any corrections and allows for fast translation, if required.

6.4.6.2 Videos

- Make sure to use the correct output size and file format. If in doubt, do some test pages in the final export format and run them on the typical platforms and browsers before continuing with the work.
- Render videos in the final output size, as defined in the design concept.
- Resizing videos "on the fly" may result in bad quality or performance problems.

6.4.6.3 Sound

- Playing sound and video uses system resources on the learner's platform.
- Make sure that the quality of sound (and video) does not surpass the limits of the typical learner's delivery platform.

6.4.7 Phase 5 - Programming

The programming phase includes the following elements:

- Integration of all media elements into screens/sequences according to the storyboard
- Definition of all timed effects
- Programming of all standard and special navigation elements
- The set-up of all communications between the content and an LMS or other components

Depending on the production software used, this phase may or may not require higher-level programmers. Whatever programmer is working on the task, he or she must stick to the storyboard.

Tip: Involving the programmer early in the project can help ensure that ADL plan is realized without unexpected costs and unpleasant delays.

6.4.8 Phase 6 – Testing

The planned product will be the result of the programming, if all the phases were followed, including all sign-offs of important intermediate steps. Nonetheless, even with the most capable production team, flaws or errors in the program can and almost certainly will remain undetected without thorough testing.

Thorough testing of web-based learning includes its deployment on the development team's own LMS, and eventually some other LMSs, with a range of testers going through the content with all expected browsers.

The range of testers should support the following final tests:

- Technical quality (Instructional Designer, all users)
- Subject matter (SMEs, experienced professionals)
- Instructional design quality (all testers)
- Crash-test (experienced users, checking the program's robustness in case of unplanned/uncommon interactions). Example: Clicking "next" or another menu item before the narration has stopped: Will the sound stop or still run while new content is displayed?

The test should also include proofreading the course. The proofreading should not only check spelling and grammar but also ensure that the content is understandable for the target audience.

When all these tests have been conducted and no intolerable flaws have been detected, the program can be officially deployed for use in training.

Important: Have all tests documented and the SME's written sign-off filed.

6.4.9 End: After Action Review and final meeting

The end of any project is a great opportunity for everybody involved to learn and see the fruits of their labor. Make sure to plan an event at which the development group may look back on the project as a team, identify potential improvements for the next project, and identify points that worked well (i.e., sustains).

6.5 Rapid content production

Rapid Content Production refers to tools and processes to produce ADL content on a short timetable. The reduced production time is typically met by using special tools which support a limited range of predefined design and interaction features, thus requiring only minimal training. Rapid content can thus be produced by anyone – even those without programming skills. However, even with rapid content production, the basics of instructional design and ADL development, along with some expertise in designing attractive screens, are a must for developing effective content.

Most of the rapid content production tools on the market support the creation of ADL modules based on PowerPoint content, which is usually widely available from traditional instructor-based training. As PowerPoint is widely known, content can be easily created or adapted without the use of complex graphic design and image editing tools. And even for recording and editing sound and narration, most of the required tools are embedded in easy-to-use format.

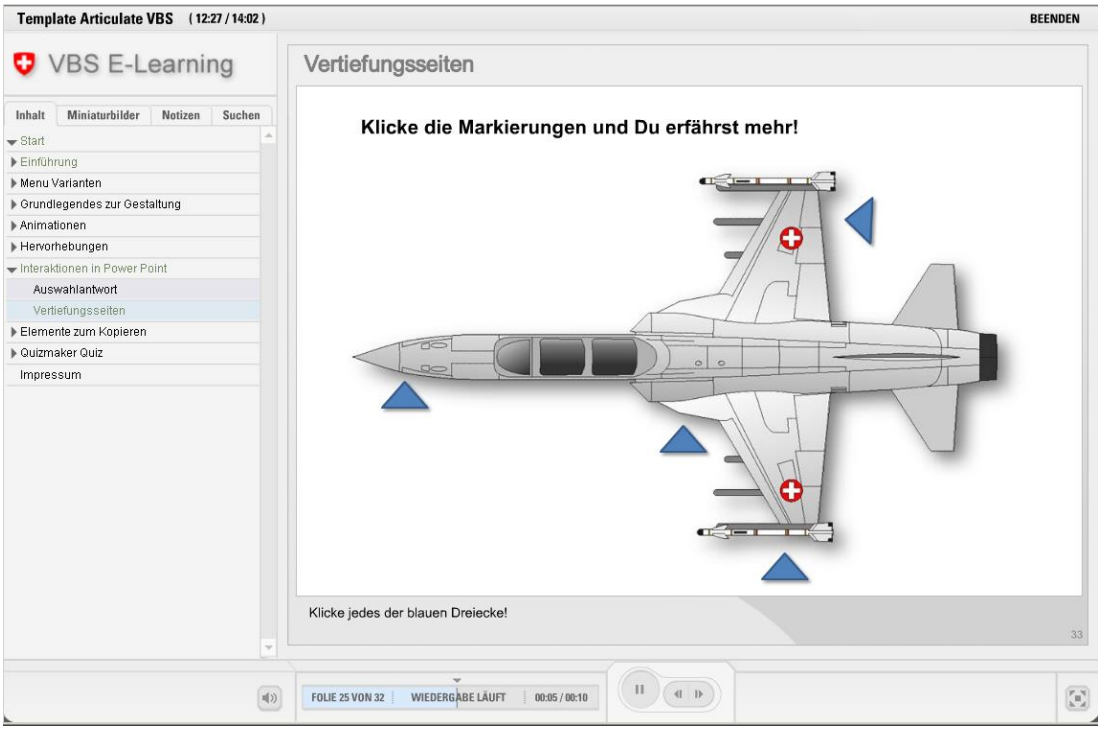


Figure 6-1. Example of PowerPoint-based Rapid e-Learning (Articulate Presenter, Layout of the Swiss DoD)

Please consider the following factors when trying to establish rapid ADL production.

Pure import of existing PowerPoint material – with added narration and animation and sound effects – will not result in success. For the best results, the original PowerPoint content should be adjusted to get away from the classic "presentation-look." This typically means

- removing the "standard" slide backgrounds and other usual PowerPoint design elements;
- reducing screen text to keywords and having the full statements narrated;
- making use of narrated graphics, diagrams, and images, with highlights and text labels added; and
- adding, wherever possible, interactive functionality such as hotspots on images to get more information, and question items using the tool's built-in authoring features.

Good Rapid ADL tools will support wide use of PowerPoint hyperlinks and animations.

When establishing Rapid ADL, make sure to first organize sound design templates and some binding guidelines for production. Another option is to offer productive workshops, where rapid content is produced with some coaching by experienced professionals.

The development of Rapid ADL content tools is very dynamic; therefore, this handbook does not provide a list of tools. Current tools are easily found via the Internet.

7 Implementation

In any description of the Analysis, Design, Development, Implementation & Evaluation (ADDIE) ADL development method, the *Implementation* step is critical. Note that a wide variety of possible scenarios for implementation may be available. This differences stems from case-specific and non-pedagogical policies that must be considered. Here, implementation means that the ADL course module is about to be deployed (i.e., made available from the LMS) for its intended audience.

Implementing a designed and developed course module includes two steps:

1. Deploy it (make the course module available)
2. Run it (have a learner go through the contents of the course module)

Prerequisites for the first step can be outlined by organizational policies, the learning infrastructure, and the availability of expertise. The second step is defined by the designers and developers of the content. Because the steps may influence each other, it is wise to carefully compare the desired outcomes with the constraints of each of the two scenarios outlined in the next section.

7.1 Deployment

Deployment of a course module means that it is being made available – with the aid of a system – to someone (i.e., the learners), by someone (i.e., the administrator).

Technical aspects are concerned with bandwidth (e.g., high definition or HD), the required client (e.g., Internet browser), format (e.g., SCORM®), required plug-ins (e.g., Flash module), and security requirements (e.g. classification demanding the course to be installed on a secure network).

There may be two scenarios for deployment:

- In the simplest deployment scenario, a course module is made available to anyone who has access to the system on which it runs. There may be some administration involved, but that may well be limited to automatic logging or time-stamping. This would suggest that the course module itself may either be voluntary, or that it might be an optional part of the formal learning program, while the initiative to run the course module is (technically) left up to the learner.
- A more complex scenario could involve the following:
    - Planning and scheduling the course for a more specific audience at a specific timeslot
    - Active communication
    - More detailed administration

Because the course is now scheduled, it will probably also be monitored more accurately, requiring the registration of a specific result rather than a check-the-box exercise. These more complex scenarios will have more added value when administratively linked to a capable student/personnel administration management system (e.g., a human resource system).

In this way, the course can be used directly as part of a regular training program, a procedure to fill a vacancy, or as qualification for a task/job without the requirement of detailed administration.

7.2 Running a course

Running a course is all about a learner going through the course contents, with or without (i.e., a remote user) the aid of a teacher/coach.

In the simplest scenario, the user opens the course and moves through the contents by tree, or "previous/next" navigation, until the last part of the course has been opened, or when the learner decides that he or she has seen enough.

In a more complex scenario, the course invites the learner to do more than just see it. There may be exercises, tests, assignments (possibly involving student-student or student-teacher collaboration), simulations and other interactions as part of the course. Ultimately, the more a learner gets involved, the better he or she will remember (see Figure 3-4 in Section 3.2.1 of this Handbook); but the more complex the situation gets, the more things which can and will go wrong (i.e., "Murphy's Law").

Between the simplest and most complex scenarios lies a world of possibilities (challenges, if you like) that require a clear understanding of consequences and requirements. Whatever method of implementation is chosen, it may have repercussions on the method of development, and vice versa.

7.3 A model for implementation

Any implementation can be described by a model that highlights four key elements:

- Procedures
- Information (required/conveyed)
- Tools
- Roles (people involved)

Procedures tell us what needs to be done as logically connected activities. Of course, the implementation procedures are always part of a larger chain (ADDIE). A common way of stating a procedure is by using a verb and a noun (i.e., "Do this").

Information tells us what goes in or comes out of an activity. It is mostly described as units of information (e.g., ADL module, an evaluation report, or a log file). Information resulting from a procedure is almost always input into another activity. A common guideline is to use a neutral noun to describe the purpose of the information.

Tools describe network systems that are involved, infrastructure databases, interfaces, or any other "technical" support the process requires. Preferably, the tools mentioned are (or can be) part of an interconnected infrastructure.

People involved tell us what roles are recognized in the process with respect to the different procedures and – when appropriate – with a connection to the tools (e.g., authorization diagram).

A beautiful part of drawing up architectural models with the aid of the above-mentioned elements is that no matter how much effort is expended, and although they *never* describe the actual truth, they still look very acceptable. Foremost, they allow for communication on the topic and offer a basis for further detailing. The real challenge is to know what level of granularity to apply to the models. A lot of detail

enhances the accuracy, but it can detract from the simple one-page message the developer is trying to convey.

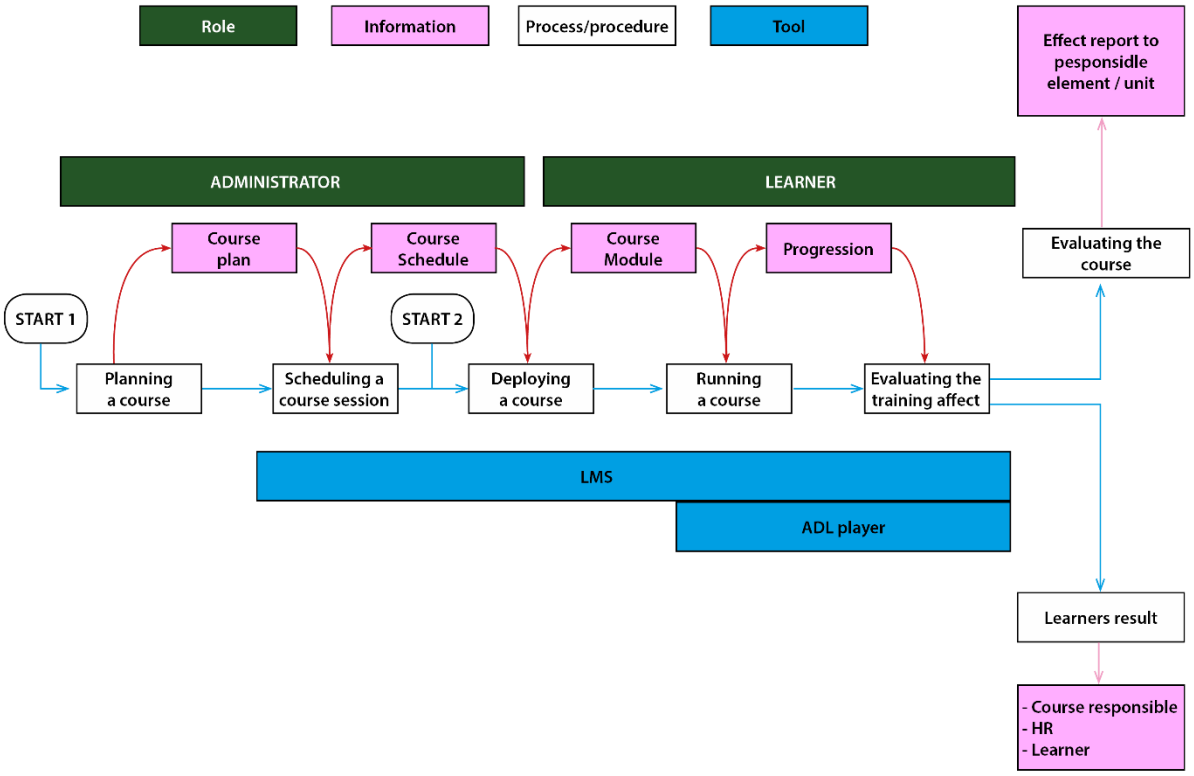


Figure 7-1 Model of the implementation of courses (sample)

Figure 6-1 shows a sample of a model which can be used for implementing or as an idea to build a model.

7.3.1 The information

Basically, there are three groups of information:

- Learner information
  - Personal data (name, ID, email, etc.)
  - Qualifications
- Course module information
  - Module details (description, prerequisites, content, etc.)
  - Session information
  - Planning/schedule
- Progression of competence development
  - Result/score, percentage of completion, time used, acquired qualification(s), certificate(s), etc.

- Administrative details (logging, timestamp, etc.)

7.3.2 The roles

7.3.2.1 Administrator

In the most basic scenario, an administrator is only required to make course modules available. The administrator will then stand by until a system failure arises. In more complex scenarios, the administrator will have ongoing tasks regarding security, deployment, access, and support.

7.3.2.2 Learner

The learner is the most important end-user of any course module, which is the only truly mandatory role.

7.3.2.3 Coach/Instructor

Additional roles, such as a coach or an instructor, are possible. Their involvement is related to the purpose of the course. (e.g., Is it self-paced or instructor led? Does it require social interaction? etc.)

7.4 Summary

Implementation is part of the ADDIE process and refers to an ADL course module that is ready to be deployed (i.e., made available from the LMS) for its intended audience. Implementing an ADL course module includes two steps: Deploying the course/module and running the course/module. Prerequisites for deployment are outlined by organizational policies, the learning infrastructure, and the availability of expertise. Running the course module is defined by the ISDs and content developers. There are numerous scenarios for implementing a course; so, it is important to seek a balance between what your organization's training requirements are and its long-term capabilities. Proper implementation requires well-prepared systems (whether dedicated or integrated off-the-shelf toolsets), well-prepared experts (whether administrator and learner or designers, instructional/interaction), developers (pedagogical/technical), subject matter experts, instructors, and corresponding development methods/policies.

8 Process Evaluation

8.1 General information about evaluation

To ensure quality, and provide information for improvement and future development, it is necessary to focus on the process of evaluation. As a crucial stage in the ADDIE process, and to enhance quality, evaluation involves learning effectiveness, student satisfaction, and cost effectiveness.

The Kirkpatrick-Phillip straining evaluation model, presented earlier in Chapter 3 (Design), is also included here to help clarify the difference between learner assessments (associated with learning outcomes), and the evaluation of the course's effectiveness. Learning evaluations focus on whether the learner retains what he or she is supposed to learn. The "E" in ADDIE focuses more on the evaluation of the course effectiveness. (e.g., Does the course accomplish what it is designed to achieve?) The key purposes of evaluation are to improve the training and to include feedback in future revisions.

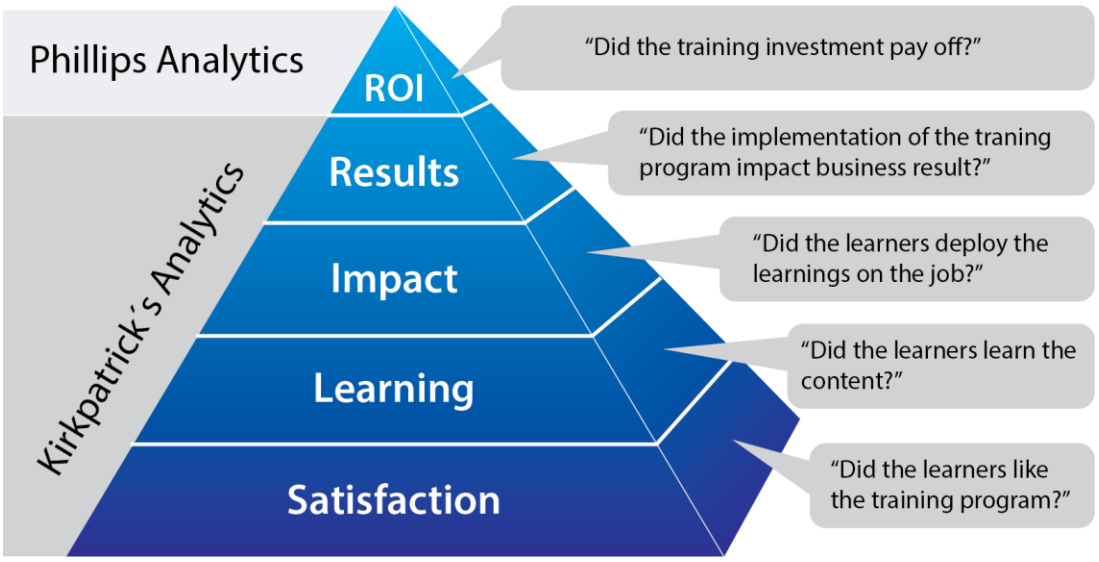


Figure 8-1. The Kirkpatrick-Phillips training evaluation model

Though it is not clearly delineated, learner evaluations generally focus on the bottom three tiers of the Kirkpatrick-Phillips model (Satisfaction, Learning, and Impact) – as discussed in Chapter 4 – while evaluation focuses more on Results and the Return on Investment (ROI) of the course. Here are the definitions for the top two tiers (Levels 4 and 5) of the Kirkpatrick-Phillips model:

Results: This level evaluates whether the training has led to tangible results. For instance, a safety-related course might seek to find out whether the number of accidents actually has decreased.

ROI: The Return on Investment evaluation is a complex undertaking which should be considered as part of a development project. While ROI typically measures the monetary effectiveness of the training, it can also be considered as an extension of the results.

8.1.1 Purposes of evaluations

Evaluation involves systematic and careful data collection and analysis in order to answer a specific research question[5]. The "research question" most often asked in this phase of the ADDIE process is: How effective was the training? Regarding this question, it is possible to enumerate three main **purposes of evaluations**[6]:

1. To make judgments (judgment-oriented) aimed at determining the worth, value, or success of a program
2. To make improvements (improvement-oriented) connected with improving a given program while it is being implemented
3. To generate knowledge (knowledge-oriented) that helps build theory and sometimes informs the policy-making processes.

8.1.2 Evaluators

Evaluation may be conducted by internal or external evaluators. The key is that the evaluator possesses intimate knowledge of the intentions and desired outcomes of the training. Often, evaluations center on asking a former student who has completed the designated training to conduct a post-evaluation. The intent would be to learn from the student how he or she *now* feels about the effectiveness of the training (i.e., once he or she is on the job and has had the opportunity to apply the training in the workplace). Another method is to ask the former student's supervisor whether he or she feels the training was worthwhile. (i.e., Did the student gain noticeable improvement in his or her performance after completing the training?)

8.1.3 Evaluation characteristics and criteria

Evaluation must fulfill the following conditions: independency, reliability, objectivity, and impartiality. It should also be systematic and based on specified methodology.

Additionally, the evaluation should focus on criteria which include:

- **Relevance.** Whether the teaching objectives addressed to identified problems
- **Efficiency.** Input and output ratio (efforts and effects)
- **Effectiveness.** Whether the objectives have been achieved in an acceptable time
- **Impact.** To what extent the benefits learners obtain will affect others
- **Sustainability of the effects.** Whether the project's effects remain without further resource expenditures

8.1.4 Confidentiality

A crucial element of any type of evaluation is the maintenance of respondents' confidentiality. If possible, the questionnaire should be anonymous. It is especially important in online evaluations when respondents may not be willing to answer the questions. Furthermore, respondents should be told why the information is being collected and how the results will be beneficial in improving the course. They should be asked to reply honestly: even if their feedback is negative, this is just as useful as positive feedback. It is also recommended to present the results of evaluation in the respondent's domestic language.

The survey should begin with an introduction in which the organizer of the survey indicates the purpose of the survey and the conditions of participation (i.e., time, anonymity). The instructions for the survey should be clear and brief, and it should be written in the natural language of the respondent. The tool should display progress (e.g., Question 1/10, 2/10).

8.2 Types of evaluation

8.2.1 Surveys and polls

The survey is one of the most effective methods of data gathering (post-evaluation) on ADL courses/programs. This is because some LMSs contain tools for preparing questionnaires with varied types of questions. The following are types of possible questions to construct in LMSs:

1. **Matrix questions.** Identical response categories are assigned to multiple questions.
2. **Close-ended questions.** The set of responses is set, and most scales are close-ended. Examples of close-ended questions are yes/no, multiple choice, and scaled questions.
3. **Contingency questions.** The question is answered only if the respondent gives a particular response to a previous question.
4. **Open-ended questions.** No options or predefined categories are suggested. Open-ended questions can generate large amounts of data that can take a long time to process and analyze. (Hence, piloting and deliberate question preparations must be taken into consideration.) The following are some example types of open-ended questions:
    a. **Completely unstructured.** For example, "What is your opinion of the course?"
    b. **Word association.** Words are presented, and the respondent mentions the first word that comes to mind.
    c. **Sentence completion**, story completion, or picture completion.

8.2.2 Online questionnaires

The main advantage of using online questionnaires is that the responses can be quickly gathered in a standardized way; therefore, questionnaires are more objective, certainly more so than interviews. On the other hand, as they are standardized, there are no possibilities to explain any points in the questions that participants might misinterpret.

8.2.3 Interviews

While interviews may seem to be the most effective means of collecting information about the effectiveness of a particular training, they are more difficult to develop, and they normally are more costly to conduct than surveys, polls, and/or online questionnaires. Also, there may not be an opportunity to interview all course or training participants.

8.3 Summary

Evaluation is a crucial stage of the ADDIE process for enhancing quality. Evaluation involves learning effectiveness, access, student satisfaction, and cost effectiveness. Evaluation can be defined as purposeful gathering, analysis, and discussion of evidence from relevant sources about the quality, effectiveness, and impact of provision, development, and policy. Although there are several methods for conducting evaluations, it is critical that each method protects the respondent's confidentiality.

9 Examples of Emerging Technologies for Training and Education

9.1 Scope

As we move toward a more learner-centric environment, individuals need new learning options. In many cases, learners want to manage their own learning environments and share, organize, collaborate on, and access all kinds of resources (such as video, audio, images). In essence, they want overall informal learning. Informal learning is increasingly being supported by technologies such as social media. Conventional classroom and ADL systems do not support the virtual environment; it is available via mobile devices.

This chapter gives an overview of new learning technologies and methods to be considered when developing courses and training. Social networks (Facebook, Twitter, etc.), virtual worlds (e.g., Virtual Battle Space (VBS)), Virtual Reality (VR), mobile platforms, serious games, gamification and augmented reality are no longer considered emerging technologies; but the ways to use them for instruction and/or to augment more traditional learning are rapidly developing. This chapter will highlight considerations in implementing these technologies. The authors of this Handbook intentionally did not try to include a list of specific emerging technologies because the material would quickly become outdated. Instead, we have provided some overarching concepts about the future learning environment to consider when designing ADL:

- The future classroom will be increasingly aided by "informal learning" from outside the classroom. Social media will provide peer-to-peer and mentor-to-student capabilities that are critical to personalized instruction.
- The future may rely more on "training" than "education." Instead of spending a lot of time educating students for a particular skill, they will be taught only basic skills and allowed to hone their skills on the job, saving teaching time and resources.
- Technology may (at times) not be available. Also, we can't assume that everyone possesses technical skills, but we may be able to assume that there are varying levels of expertise. We need to ensure that students can function well without technology. How do we help avoid "regression" when technology is not available?
- We need to offer "content" in a variety of mediums. Although there is much debate about "learning styles," it is probably safe to assume that offering a variety of mediums gives learners choices in how, where, and when they learn.
- Some aspects of military training will remain the same because some skills must be taught face-to-face (e.g., teamwork, military culture, marksmanship).
- Reading levels are a "common denominator." We will continue to develop instruction and teach at the appropriate level of comprehension.
- We need to teach toward "adaptability" or "cognitive agility." This skill will be an overarching one that will be used throughout a learner's career.
- Instructors are multifaceted. (e.g., They often provide IT support, facilitate the classroom, teach the class, and manage the courseware.) We need to teach these skills to instructors and help them be better prepared for the future "classroom."

Considering just the past few years, we can easily recognize how rapidly technology is changing. New learning technologies provide different tools to educational organizations and individuals. The following sub-chapters contain essential information about emerging technologies which are being used in learning.

9.2 Collaboration tools

Collaborative tools can be used by students to learn together, regardless of location and distance. However, it is important to bear in mind that collaborative tools are truly effective only when used by groups of more than two people. Otherwise, it is more advisable to use e-mail or other forms of communication.

These tools enable users to create content together, collaborate with each other, work, reflect, and learn together. Social tools force the individual user to be aware of his or her environment, and to be responsible about their presence on the network. They become visible to different groups of people based on their activities and interests. The users must be informed about the following issues:

- **Presence.** Who is online? Where are my teachers, instructors, classmates and/or colleagues?
- **Identity.** Who am I? How do I present myself to in the virtual world? Who can see my profile and my content, and how can they access it?
- **Reputation.** What is my value to the community based on ratings given by other community members?
- **Relations.** What is my social network?
- **Conversation.** Who are the people I talk to, and what do we talk about?
- **Activities.** What is going on right now?
- **Groups.** With whom do I share individual interests and activities?
- **Sharing.** What common content, information, and knowledge do I exchange with others?

Social tools can be divided in two general groups: tools focused on content, and tools focused on communication.

9.2.1 Social tools focused on content

Content-focused social network tools can be used for ADL purposes. Learning content, student media, and problem solutions can be shared with the group. The discussion between participants can be notes (annotations) that represent additional learning material, which help improve understanding and description of the content. Content-focused social network tools have two main purposes:

- To provide possibilities for file sharing (text documents, videos, images and other media files) among the participants (social group members). Shared documents can be described and commented upon.
- To support collaborative work on shared content.

File sharing tools allow for content sharing and/or publishing. They emphasize technical character because content must be transformed from its original form to a web-readable format. An author (publisher) can describe the content (by metadata), and then search engines can index shared content, making the information easy to find and reuse by other people.

Figure 9-1. Sharing content tool

Users can add their comments about the specific content, and the content becomes the center of gravity around which users can add additional information. Users can discuss issues and share ideas through commenting tools. Administering comments or notes (accepting or rejecting) is necessary.

Collaborative (team) work on the same content represents another approach for using content-focused social tools in ADL. Such tools have proven very effective in supporting problem-solving and decision-making processes. In addition, it can support work on other collaborative projects. Using this process, participants can edit the content simultaneously.

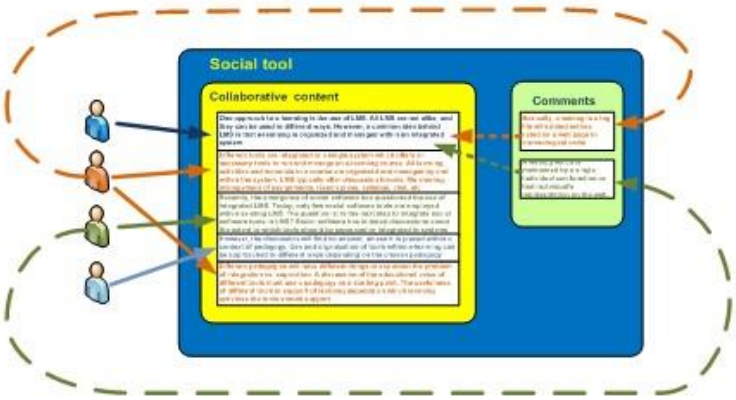


Figure 9-2. Collaborative (team) work on the same content

In addition to document editing, users can add comments to the content. Hence, the content creators also play the role of advisor, with collaborative content reviewed during the process of creation.

9.2.2 Social tools focused on communication

The main purpose of social tools focused on communication is to provide synchronous (instant messaging, VoIP, video conferencing) and asynchronous communication (discussion forums, blogs) between participants (students, teachers, instructors, subject matter experts).

Synchronous communication tools enable real-time communication between participants and their collaborators. They enable the users to be in different places and communicate with each other regardless of distance, although distance can sometimes be a limiting factor for this kind of communication (i.e., if

participants are located in different time zones). Another constraint is the link bandwidth, especially for rich media tools such as video and audio conferencing.

Instant messaging is the most common synchronous tool used in e-Learning systems. It includes interactive exchange of short messages between participants. This is particularly useful in the situation of limited data throughput, and in situations where a correspondent needs help or information. Instant messaging tools are embedded in the ADL systems as widgets, and the student can see notification of arriving messages immediately after they are sent. Messaging usually occurs between two users (i.e., teacher and student, or two students). Instant messaging is useful when exchanging short messages.

VoIP (Voice over Internet Protocol (IP)) tools provide users with audio communication. This tool replaces traditional telephone communication – because telephone lines and devices are not needed – with a digitalized voice through Internet connection. VoIP tools are usually stand-alone client tools connected to the VoIP web service provider (e.g. Skype, Vonage, and Ooma). VoIP communication is designed for one-on-one communication; it is difficult for participants to recognize the voices of different people on VoIP multicasting, for instance. Still, a conference call can be made if a participant wants to send the same information to more than one user, such as a teacher providing some audio lessons in this manner. VoIP's direct voice communication is more efficient than instant messaging for content more than just a short exchange. Typing is avoided, and there is no need for correcting typing errors.

Video conferencing tools provide users with video communication. Video communication is useful for giving online lessons and organizing online workshops. The impression of the physical presence of participants makes the emotional aspect of learning more expressed than in other synchronous techniques. There are two types of video conferencing tools: direct communication between participants, and communication with the provider's mediation.

Video conference tools have proved their value and expanded during the Covid-19 pandemic where it made it possible to continue lectures online.The first type of video conferencing is via stand-alone client applications connected to a video conferencing provider, such as Adobe Connect, or Team Viewer. Basic web equipment (camera, headphones, and microphone) is required with software implemented as a light client application. Multimedia streaming is performed over an HTTP-based Internet network. Due to HTTP over-heading, network, and server occupancy, the quality of video might be change during the connection, and the quality of service is not guaranteed. On the other hand, low cost is the main advantage of this approach.

The second type of video conferencing utilizes tools without a provider's mediation, such as a Polycom system. Every video conferencing site (i.e., equipped space in which participants can communicate using video) must have its own video conferencing equipment – video streaming server, camera, and microphone at a minimum – and a fixed IP address. The overall system then acts as a network of peer entities. The communication rate and signal quality are usually better than with stand-alone applications by avoiding of HTTP over-heading (the use of internal data formats).

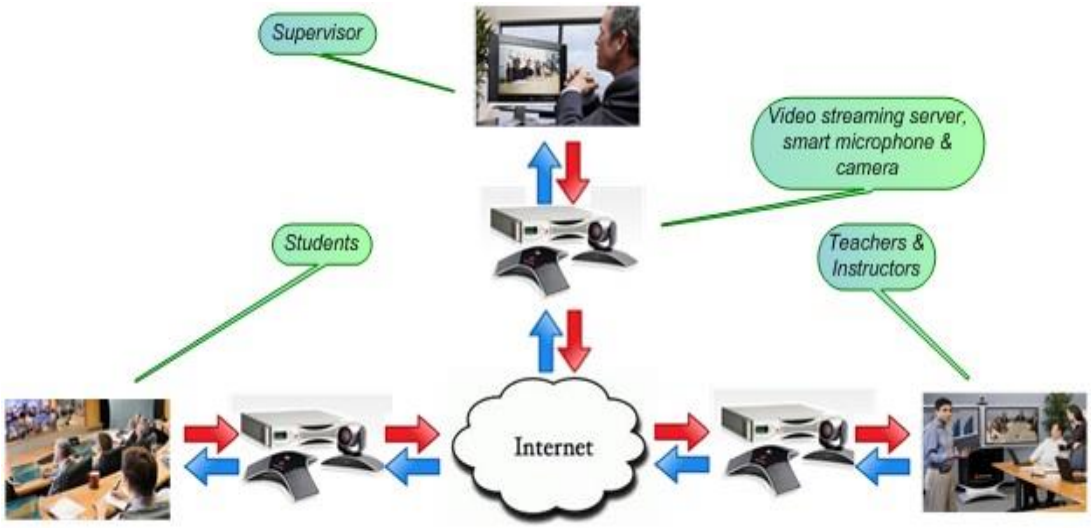


Figure 9-3. Video conferencing without provider's mediation

The second solution is significantly more expensive than using existing web services, but it provides higher security and signal quality. There is no limit to the number of participants. Advanced equipment such as smart microphones and cameras can locate the voice source and automatically zoom in on the speaker. The camera can be preprogrammed for different zoom and positions, and the speaker can control it using a remote control. It is especially useful for teachers to make video transitions between them, the whiteboard, a screen with presentation slides, and other equipment.

Asynchronous communication tools are very useful when the users cannot participate in communicating at the same time. The most common asynchronous communication tools are e-mail, forums, and blogs. These tools are embedded in almost all e-Learning systems. They are designed for interchanging text format messages; they are, therefore, less dependent on link bandwidth.

E-mail represents the most common asynchronous communication tool.

On *discussion forums* (discussion boards), participants communicate by posting messages to a bulletin board system. Messages connected to the same topic are called posts, and they are chronologically chained by the system. They form message threads. This series of message exchanges can occur over minutes, hours, or even months. Discussion boards are common social communication tools, and they are often used in online education. They can be used in formal learning environments to discuss issues and to share ideas among the participants. An instructor usually gives a task (e.g., a discussion topic) to the group of students. Then, he or she tracks the posts and helps the students during the activity. In formal learning environments, the topics are usually time-limited, and teachers can evaluate the contribution of each participant.

Blogging tools enable users to create their own web pages (blog homepage), add different content (blog entries), and to share with others. Sharing allows other people to post their comments. Because of these characteristics, blogs are more suitable for informal learning environments. Users manage their own blogs and can respond to comments, remove unsuitable posts, and create new entries. Communication may occur between those commenting on the blog post, or between the blog creator and the readers. Blog tools

can also be embedded as a tool in an LMS. They can be used in a course, and they fit well with a course's open nature. Blogs can be helpful for sharing and/or collecting information and ideas from others, and they provide a venue to express opinions and attitudes.

Wiki is a Hawaiian word which means fast and it is used about searchable pages on which visitors can, quick and simple, edit the content. The changes are published immediately, without being reviewed by anyone else, and as such, a wiki stands out as more dynamic that other forms of website. The most well-known wiki is Wikipedia, the world's largest encyclopaedia, which has over 17 million articles in more than 270 languages. Anyone can write an article for Wikipedia, and the idea is that any errors that occur will be subsequently corrected by other visitors.

Wiki is a collaborative tool which supports connectivity and development of shared knowledge. It encourages the participants to contribute in creating knowledge, instead of just processing a learning material that someone else has produced. In a wiki you can create an environment in which information continuously flows and knowledge is developed and owned by the participants jointly.
Wikis can be used for both formal and informal education. All users who have registered for a specific wiki can write, change and delete text in it. The content in a wiki grows and changes accordingly, providing, for example, teachers with an effective opportunity to follow students' learning processes. By observing who has contributed with different sections of text, and when this has taken place, teachers gain overview of how the students are working when they collectively create a text or solve a problem.
There are also benefits to using wikis in the context of informal learning in the workplace. For example, they can be used by a platoon or a unit where soldiers as a group need to prepare themselves for a work task or acquire knowledge about a certain subject.
There are several pedagogical benefits of using wikis. They often create a sense of solidarity in the group and can be used for everything from brainstorming to more complex problem-solving. The focus in wikis lies on the collective development of knowledge. Here, the insights and reflections of the group that take centre stage, not what some commander or teacher has decided that the employees or students should learn.
Certain critics have pointed out that the opportunity to edit wikis – that anyone can write and change information– may lead to the content being of low quality and not trustworthy. However, several researchers have pointed out that wikis, for this reason specifically, have an exceptional pedagogical potential; they force the participants to evaluate the content and thus give them the possibility to improve their critically thinking skills.
There are many ways to use wikis, and the flexibility of this tool may, sometimes, become a problem. When setting up a wiki for learning activities, it is thus important to clarify how it is intended to be used. Why not write some short guidelines that clearly explain what is expected of the other participants? At the same time, there is always a risk of being far too specific. This can place restraints on the creativity of the participants, and the result will then be that the collective effort comes to a standstill.

9.3 Artificial Intelligence

Artificial intelligence (AI) involves the use of statistical and computational techniques to train machines to mimic human learning and problem-solving abilities. In the training and education domain, AI has already been applied to endeavors such as military simulation, content recommendation, and intelligent tutoring systems. It is also an indispensable tool for the analysis and interpretation of large data sets.

Educators, administrators, and instructional designers are recognizing that learning is no longer confined to a particular location or time of day. The emerging technologies discussed throughout this chapter are

assuming larger roles in students' lifelong learning journeys, but without traditional methods of assessment and feedback, many of these technologies require AI to maximize their pedagogical value. For example, massive open online courses (MOOCs) often employ machine learning to predict when a student is likely to drop out. This allows instructors to intervene early and help get the learner back on the right track.

As research advances and computational power grows, AI is becoming more prevalent across the industry, so it is critical to understand its applications, strengths, and limitations. This section examines the current state of AI in training and education and explores the exciting frontiers of contemporary research to help organizations prepare for the road ahead.

9.4 Virtual classrooms/learning space

The advantage of virtual classrooms is that a visual connection between two or more people can take place easily and quickly, all around the world. It is based in a video conference tool with extended management options. It is versatile, working for eTeaching (conference or Massive Open Online Course (MOOC)), eTraining (one teacher and fewer than 10 students), or eCollaboration (three to four people). These types of learning tools are used in accordance with the existing teaching mode, and virtual classrooms are designed according to pedagogical concepts.

Teachers and participants use various didactical tools in a normal session: pen-and-paper, e-presentation (e.g., PowerPoint, Adobe), and references, etc. All of these possibilities are retained in the eSessions.

The advantage of a virtual classroom is that the participants stay at home or at the office; travel to the training center is not necessary.

9.4.1 Online synchronous learning

There are different ways of collaborating online. The following models can be used:

Lecture

As in a typical university lecture, the teacher presents a theme and the students who are interested can take part in the lecture. The interaction is limited because the students can only ask questions through chat. Server capacity is the only limitation on the number of students who can participate in the lecture.

Tutorial

The tutorial is designed as a small class with a teacher and normally up to 20 students. The students can participate through questions, exercises, etc., but the conversation will normally be limited to between the teacher and one student at a time.

Knowledge sharing

Knowledge sharing takes place in a discussion group typically made out of three to five people. There is only a facilitator for administrative purposes. Every participant can see, speak, hear, and act. Normally,

the participants use a virtual whiteboard. Knowledge sharing can be used in connection with a tutorial if the system being utilized can accommodate break-out rooms.

With both the lecture and knowledge sharing options, the sessions can be recorded for later use.

When conducting a lecture, it is a good idea to have both a host and an instructor. The host is the manager of the event and assumes all the administrative tasks: invitations, virtual room reservation, session configuration, etc.

9.4.2 MOOCs

A **massive open online course** (**MOOC**) is a course aimed at large-scale interactive participation and open access via the web. In addition to traditional course materials such as video, readings, and problem sets, MOOCs provide interactive user forums that help build a community for the students, professors, and teaching assistants (TAs). MOOCs are a recent development in distance education.

Although early MOOCs often emphasized open access features – such as open licensing of content, open structure and learning goals, and connectivity to promote the reuse and remixing of resources – some notable, newer MOOCs use closed licenses for their course materials while maintaining free access for students.

Many MOOCs use a video lecture style of pedagogy, repeating the old form of teaching using new technology.

Because of the massive scale of learners, and the likelihood of a high student-to-teacher ratio, MOOCs require instructional design that facilitates large-scale feedback and interaction. There are two basic approaches:

- Crowd-sourced interaction and feedback by leveraging the MOOC network (e.g. for peer-review, group collaboration)
- Automated feedback through objective, online assessments (e.g., quizzes and exams)

Connected MOOCs rely on the former approach; broadcast MOOCs, such as those offered by Coursera or Udacity, rely more on the latter.

Because a MOOC provides a way of connecting distributed instructors and learners across a common topic or field of discourse, some instructional design approaches to MOOCs attempt to maximize the opportunity of connected learners who may or may not know each other through their network. This may include emphasizing collaborative development of the MOOC itself, or of learning paths for individual participants.

The evolution of MOOCs has been accompanied by innovation in instructional materials. An emerging trend in MOOCs is the use of nontraditional textbooks such as graphic novels to improve students' knowledge retention. Others view the possibility of videos and other material produced by a MOOC as

becoming the modern form of the textbook. "MOOC is the new textbook," according to David Finegold[7] of Rutgers University.

Producing and delivering MOOCs is a technological challenge. Unlike traditional courses, MOOCs require videographers, instructional designers, IT specialists, and platform specialists.

9.4.3 Related educational practices and courses

There are few standard practices or definitions in the field of MOOCs. Several organizations – such as the Khan Academy, Peer-to-Peer University (P2PU), Udemy, and Course Hero – are seen as being similar to MOOCs. However, they differ in that they work outside the university system, or they mainly provide individual lessons which students may take at their own pace, rather than having a large number of students working on the same course schedule. Udemy allows teachers to sell online courses, with the course creators keeping 70% to 85% of the profits and all of the intellectual property rights. Udacity differs from Coursera and edX in that it does not have a calendar-based schedule (asynchronous); students may start a course at any time. While some MOOCs, such as Coursera, present lectures online – echoing traditional classrooms – others, such as Udacity, offer interactive lessons with activities, quizzes, and exercises interspersed between short videos and talks.

9.5 Mobile Learning

9.5.1 Overview

This section covers the basics of mobile learning (or m-Learning) as well as the production of content for, and use of, handheld computing devices to provide access to learning content and information resources. A specific definition of m-Learning can be limiting to some organizations. Many of the existing definitions of m-Learning are either too learner-focused or too device-focused. A universally-accepted definition seems improbable. Both the learner and the devices of today, as well as the future, should be considered in order to provide a more flexible view of mobile learning. A generic definition of mobile learning for the purposes of this Handbook describes m-Learning as:

> "*Leveraging ubiquitous mobile technology for the adoption or augmentation of knowledge, behaviors, or skills through education, training, or performance support while the mobility of the learner may be independent of time, location, and space."* The Advanced Distributed Learning (ADL) Initiative's Mobile Learning Decision Path report (p. 5). http://www.adlnet.gov/public/uploads/MLDP-Report.pdf[8]

This description is intentionally generalized to allow for a growing number of m-Learning scenarios as well as future capabilities of new technology and device types. As an illustration of this, consider Table 8-1 as possible future m-Learning capabilities/augmentations:

M-Learning should be viewed as a way to support the learner through the use of ubiquitous technology that provides access to learning content and information anytime, anywhere. Unlike other learning technologies, m-Learning is unique in that it can accommodate both formal and informal learning in collaborative or individual learning modes. M-Learning certainly is not just "ADL light."

Training Modules Just-in-Time Learning Microlearning Reach-back/Review Forms and Checklists Coaching/Mentoring Conferencing Feedback Social Networking Video/Audio Recordings Podcasts Glossary	Performance Support or Job Aids On-the-Job Support Alerts/Reminders Games and Simulations E-books/Text Books Procedures Collaboration Location-Specific Content Tests/Quizzes/Evaluations Field Guides Presentations/Papers	User-Generated Content Note Taking Translation Photos/Videos Spaced Learning Audio Capture Surveys or Polls Reporting Augmented Reality Contextualized Learning Manuals or Reference Guides

Table 9-4: Innovation considerations for m-Learning (list is not all-inclusive)

Mobile should be an integral part of learning and information infrastructure/architecture. It should not be viewed as a replacement for other learning options, but as a supplement or reinforcement for learning and performance support. Think about users' experience and their learning opportunities before making design decisions.

Instructional designers on an m-Learning project team will no doubt have cherished, tried-and-true instructional design principles, process strategies, and pedagogical models which they have learned from their involvement in traditional e-Learning projects. Some of these may need to be unlearned for m-Learning. Of special importance are the considerations and decision nodes in the analysis process that could lead development teams to choose m-Learning as the optimal solution. A developer does not want to end up with m-Learning as a solution to a problem for which it is not appropriate.

Above all, developers who want to start down the path of m-Learning should be ready and willing to accept the range of m-Learning solutions (i.e., performance augmentation and informal/social learning) in their repertoire of training strategies. As stated above, the instructional design process model must include routes to these strategies and outcomes.

9.5.2 Design considerations

Too often, we start with the device rather than the learning or the support requirements. The learning outcome should always be the focus. Familiarity with the capabilities of handheld devices may open new doors, or they may require taking a step back.

When thinking about mobile device categories, it is important to remember that the mobile device is more than just a phone. Basic mobile phones are limited for m-Learning. Mobile device categories will continue to evolve both from a function and feature perspective, and from vendor marketing messages. The main concern for m-Learning developers is what devices and/or features need to be supported for intended learners.

9.5.2.1 Features

Devices are equipped with various features that could be used to enhance learning. The important question is which features do the developer's target group of learners have?

Figure 9-5. Smartphones are capable!

9.5.2.2 Tablets

Most people who have a tablet do not carry it at all times, but the use of tablets is growing rapidly in education and training. Other than differences in screen size, the development of learning content for tablets varies little from that for mobile phones. Electronic publication (EPUB) formats are growing in popularity for creating digital texts for viewing on tablets and other devices.

9.5.2.3 Connectivity and bandwidth

For most users, bandwidth is becoming less and less of an issue with the availability of 4G and 5G networks. However, connectivity will always be an important consideration for mobile development strategies. Issues to consider when addressing device connectivity and bandwidth include the following:

Image Compression. Files must be optimized for quicker load times.

HTML5 provides a means for persistent local storage of data (for times of little or no connectivity) similar to the cookies concept, but not auto-transmitted back to the server. The data remains local as keyed name/value pairs to be stored within the browser.

9.5.2.4 Caveat

All mobile devices are not created equal. Consider the following issues when deciding on a mobile development and design strategy:

- Poor/inconsistent support for pop-up windows and framesets
- Limited video support (varying formats supported)
- No support for Flash player. Flash has been terminated in 2020. It is strongly reconmented to convertet all old courses if they are running Flash.

9.5.3 Native apps

A native app is an application specifically designed to run on a device's operating system and machine firmware. It typically needs to be programmed in a unique or proprietary language and development environment for each platform or operating system. The terms "platform" and "operating system" are often used interchangeably in the mobile industry. A native app is much more than the look and feel; many things matter, including the way that data are stored on the mobile device. In a native app, most of the application is stored locally on the device, but the user data may be stored on the device, in the cloud (remotely), or both.

9.5.3.1 Native app development

Developing for each native platform requires a specialized development approach, often coupled with an integrated development environment (IDE) or a software development kit (SDK).

9.5.3.2 Native app stores

Each mobile device today usually provides direct access to a specific platform app store, but not all app stores are accessible on each platform because they are proprietary and unique to each device's operating system. Each app store has a unique process, file formats, and specific requirements for distribution to its app store. The process of distributing an app to these different app stores for each platform can be time-consuming, and it should be considered in a developer's overall distribution strategy.

9.5.4 Mobile apps

It is also possible to develop mobile apps using HTML5 and web technologies, such as JavaScript and CSS, and deliver them to the end-user using the mobile browser. These are known as "Web Apps." This term can be confusing because even native apps are dependent upon leveraging the web to deliver content.

As mentioned earlier, two important things to consider in mobile development strategy are distribution and access. Each mobile device will provide a dedicated app store for a specific device platform. While not every mobile device will be able to run an Android-based app on it, every mobile device does have a web browser. Compared to native applications, mobile web apps are usually easier to develop and maintain. They do not require any third-party validation or fee to be online, and they are fully available to everyone. The lines are beginning to blur between native apps and mobile web apps. The primary difference today is that native apps are installed locally on a mobile device and only accessible via a proprietary app store, whereas mobile web apps can be accessed in any mobile web browser and may or may not be listed in a particular web app store.

As standards continue to mature, much of the mobile development world anticipates that there will someday be very few advantages to native app IDEs and SDKs. It is expected that developing with web standards will provide the same types of capabilities that were only previously possible when developing natively. The status of the formal standards for web applications on mobile devices can be found at the World Wide Web Consortium (W3C) (http://www.w3.org/2013/09/mobile-web-app-state). All the native app stores also have mobile web apps available to install. In addition, there are an increasing number of independent app stores.

9.5.5 The hybrid approach

While the mobile device development community argues about which is the better approach (native or web app), the truth is that native apps vs. web apps is not really a debate. There is no winner, and there is no loser. The choice of which type to develop is an engineering and design decision that should be based on a solid set of requirements. While developing a mobile web app is easier and more cost effective, developers must also consider the end-user's view and meet their expectations for access. End-users expect ease of use and the discovery of an app to meet their needs. Why not support both mobile web app and native app deliverables?

Facebook, Google, and many other companies are supporting both types. However, these large companies can afford to have big development teams to support both. One alternative for any company or organization on a smaller budget is to consider the *hybrid approach* to support both the mobile web and native apps. The hybrid approach provides the best of both worlds. Hybrid apps can be developed using HTML5, CSS, and JavaScript, and they support multiple platforms by packaging content as a native app to be installed directly on the device.

9.5.5.1 Mobile development using frameworks

There are several free open-source frameworks which can be used to develop hybrid mobile apps using HTML 5, JavaScript, and CSS. Mobile apps developed using some of these frameworks can be written once and then deployed to many platforms as both a native app and/or a mobile web app. Some of these frameworks are more mature than others. Developers should try out several and see which best meets their requirements.

9.5.5.2 App store distribution processes for developers

Whether a developer decides to design a mobile app using SDKs or HTML5 frameworks, once the app is finished, the developer will be ready to distribute it to each of the app stores and follow several different processes. Most of the app stores require an app to be tested and signed with digitally encrypted certificate keys in advance. In addition, developers will have to generate app icons and screen captures and other metadata for their app. The app stores all have different requirements for the resolution of these icons and screen captures as mobile devices support various levels of resolution; so, this can be somewhat challenging to support if the developer is not prepared in advance.

9.5.6 Mobile development resources

Developing for mobile devices is not an easy task. While there are advantages to developing native apps over mobile web apps, the hybrid approach has the greatest potential for the long-term. In terms of lifecycle maintenance of app content, it might make sense to consider this approach unless a developer is only targeting one platform. Targeting multiple platforms will ensure an app is accessible to as many end-users as possible. Targeting both platforms and browsers will increase the ubiquity of a mobile app. A developer's approach and distribution strategy are key parts of app development. They could easily account for 50% (or more) of the time it takes to complete an app project. If these two critical aspects are not considered, a project could suffer from missed deadlines and scope creep.

9.6 Simulations and serious games

Live training has high value, but it is costly and time-consuming in terms of resources. Resources are too limited to perform as much live training as would be required for the wide variety of training scenarios mentioned in the preceding paragraphs. In addition, performing complex tasks requires a high level of skills and knowledge which should be gained through practicing and repetition. In most cases, live training opportunities for units or individuals do not allow repeating parts of an exercise, of situations, or fully training every unit or individual to the high level of skill that is required for today's missions. Therefore, despite the resources expended on live training, many educational goals are not fully met[9].

Serious games can complement live training events in many ways. First, research indicates that computer simulations can improve students' spatial learning and perceptual skills[10], and simulations can enhance the quality of the learning process, mainly based on textual and verbal interaction. Simulation-based training can be performed in virtual environments that replicate actual scenarios, which keeps learners highly engaged. Interactivity and competition can motivate learners to use all their skills and knowledge in dealing with the concrete tasks and practicing problem-solving skills. Furthermore, teachers, instructors, and trainers have full control of a computer simulation, and they can react to certain situations (e.g. bringing in a dilemma as a quick reaction). They can start, stop, examine, or restart a simulation at any time, unlike in a real situation[11]. With these capabilities, complex or dangerous skills can be rehearsed multiple times without endangering military members while simultaneously increasing the effectiveness of training opportunities. These are just some of the reasons that simulations are recognized in military environments as a way in which complex training and education can be performed in an effective (enriched quality) and efficient (cost reducing) manner.

Lastly, modern simulation-based training is designed in a way which reflects the technology with which the new generation of soldiers have grown up and know "from home." Therefore, much less training is needed for soldiers to become familiar with the training environment.

9.6.1 Simulations

Many different types of simulations are used all over the world to support training. This domain is also called Modelling & Simulation (M&S) as a whole, and it covers more than just training. Many simulations are also used for experimentation to support daily business and to provide the necessary data to improve the decision-making process for leaders.

Figure 9-6. High-end simulation for training air-to-air refuelling

Modelling and Simulation is used for the following:

- Research and analysis for new concepts, to support policy formulation
- Force planning
- Operations planning and support for deployed forces
- Support in military decision-making for military capability and acquisition
- Support in mission planning and pre-deployment training
- Individual, collective (to the largest units), Joint and Combined training

A definition of the simulation from *A Dictionary of Computing*:

> *A Simulation is an imitation of the behaviour of some existing or intended system, or some aspect of that behaviour.*

Simulations give the trainee complete insight into a complex process. The added value comes from the data that is collected, which can be used for the after action review (AAR) at the end of a training sequence. The other benefit is that the training will be more effective than it would be absent the support of simulation.

Generally, we differentiate between four levels of models, from the most accurate and scientifically-based to the highest aggregation level used for large scale simulations for Commander and Staff training. The four levels are as follows:

- Engineering
- Engagement
- Mission/Battle
- Theatre/Campaign

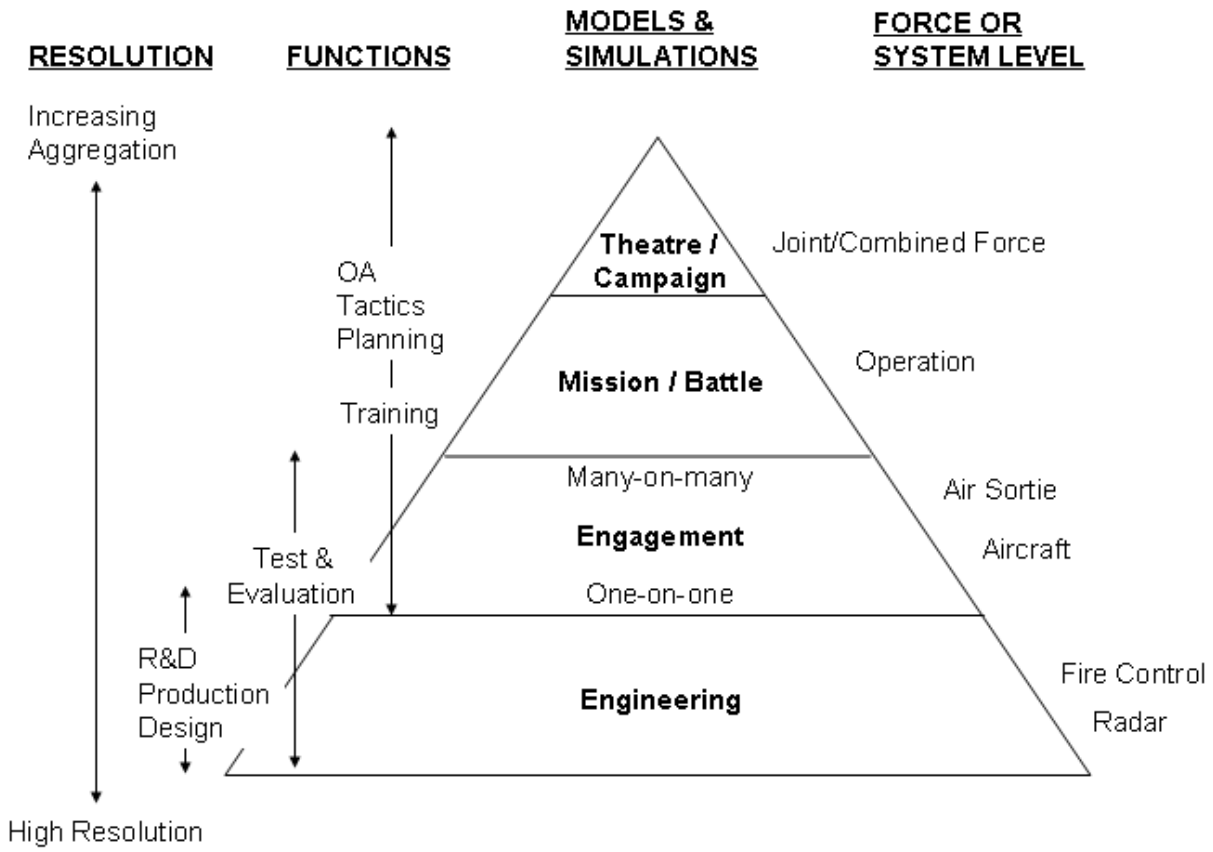


Figure 9-7. The models and simulations hierarchy from the US DoD.

Every level of simulation has advantages and disadvantages, and each is focused on specific use. For example, a model for experimentation will not meet the needs of a training simulation at brigade-level or higher. Thus, for each task (training/experimentation) the correct models must be selected according to the goals to be achieved with that simulation.

The next level is to answer the question of which type of simulation will fit the purpose of that particular task. A model alone will not do the job.

Simulations are basically the interaction between different models in a specific environment. Because of the wide variety of tools available on the market, the subject is divided into three groups:

- **Live simulation.** Real people, in a real environment, operating real equipment but with simulated effects.
- **Virtual simulation.** Real people, operating simulated equipment in a simulated environment, generating simulated effects.
- **Constructive simulation.** Real people conditioning simulated people or entities, operating simulated equipment in a simulated environment and generating simulated effects.

Today more than ever, these three categories are brought together to offer a training environment as close as possible to the reality of the modern battlefield. Armed forces are using these simulation tools for training, but the rapidly evolving game market is used more to acquire low-cost simulations based on game technology to train the lower echelon (e.g. Virtual Battle Space (VBS)). This trend started in the late 1990s, and it is generally favored in the simulation environment for training. For example, serious games are often complementary to the large-scale simulations built by the defense industry.

The evolution of simulation models – as a consequence of improvements in processors, video cards, memory, networks, etc. – has resulted in high-fidelity models which can be used today on a generic laptop or desktop PC. Furthermore, this has allowed simulations to be integrated into many tools that are used every day.

The possibility of distributing a simulation over a network is not new, but building simulations as web applications opens new possibilities for learning and training. An example is the evolution of a game called "World of Tank," which is based on web app technologies. With minimal software on your computer, you can participate in game-play over a vast network of individuals from all over the world. The simulation is not done on your computer, but in central servers with access from anywhere in the world. Furthermore, with modern technology all this can now be done on tablets and in the field with a mobile connection.

For ADL, this represents an opportunity to move from static content to a world of dynamic lessons, in which the student can interact in new ways. Rather than a static display for tactical training, the new type of lessons – based on a constructive or a virtual simulation – can put the trainee in a synthetic environment where he or she can discover tactical principles by him- or herself: arranging the platoons, issuing the orders, and then watching to see whether his or her tactics succeed in that small battle. After analyzing the results, the trainee can rearrange or modify tactics and make a new run. It empowers the player to understand the step-by-step principles of a successful tank attack. Ultimately, even a complete operation can be planned and played in the real environment before going into action.

Today's digital native trainees are very familiar with this kind of environment, and they often learn more efficiently through it than with traditional classroom training. A few studies that have analyzed the learning habits of different generations from the 1950s to the 2000s. The differences are impressive, and if the lessons target the wrong student generation, the efficiency of the learning can decrease by as much as 20%. Although generalizing is limited, an ADL lesson for senior military members may have to be designed in a different way than for a younger audience.

The field of applications for ADL is large, and to achieve the training goals, the simulation experts and ADL experts should work together from the very beginning. The key here is to be able to produce high quality military training for each particular suite of lessons. If this is not met, the results may not meet the training requirement. At a time where cost efficiency is the central pillar of any project, it is critical that training is developed in an effective and cost-efficient manner.

9.6.2 Serious games

Today, the role of serious games and virtual technologies is expanding training opportunities for the military. Serious games represent a mental contest, played on the computer (or mobile device) in accordance with gaming rules which use entertainment for educational purposes and training[12]. Different from most commercial games that are primarily designed for entertainment, serious games have additional pedagogical functionality which provides game scenarios based on learning objectives (Figure 8-8). In this way, pedagogy is used for adding instruction into the gaming.

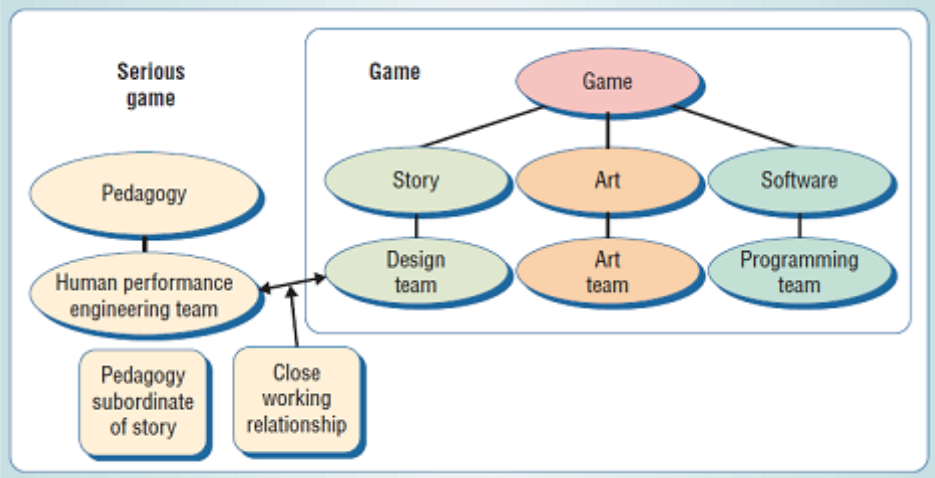


Figure 9-8. Relation between games generally and serious games (Zyda, 2005)

The term “serious games” Is defined as a game designed for the priomarily purpose other than entertainment

The mission of modern militaries has changed significantly over the past couple of decades. Besides the traditional military tasks, they are increasingly involved in assisting people in the wake of natural and man-made disasters (e.g., floods, earthquakes, fires, traffic, nuclear and chemical accidents). Moreover, in terms of international cooperation, military personnel need additional skills regarding multi-cultural sensitivities and language. These tasks have a complex nature due to differences regarding units, organizations, social groups, governmental and non-governmental institutions, emergency services, rescue teams, voluntary groups, and local communities.

Serious games with well-defined learning goals and objectives – which have appropriate pedagogy implemented in the system – are recognized as an alternative solution for many different aspects of military education and training.

Owing to strong influence on the users’ motivations, serious games are applied in many domains such as healthcare, defense, and education (Figure 8-9). They are also related to military training and simulation. Two main directions for their application for military training include mission rehearsal and combat modeling and analysis. The first is used in the mission preparation phase. The second is used in military doctrine research and development.

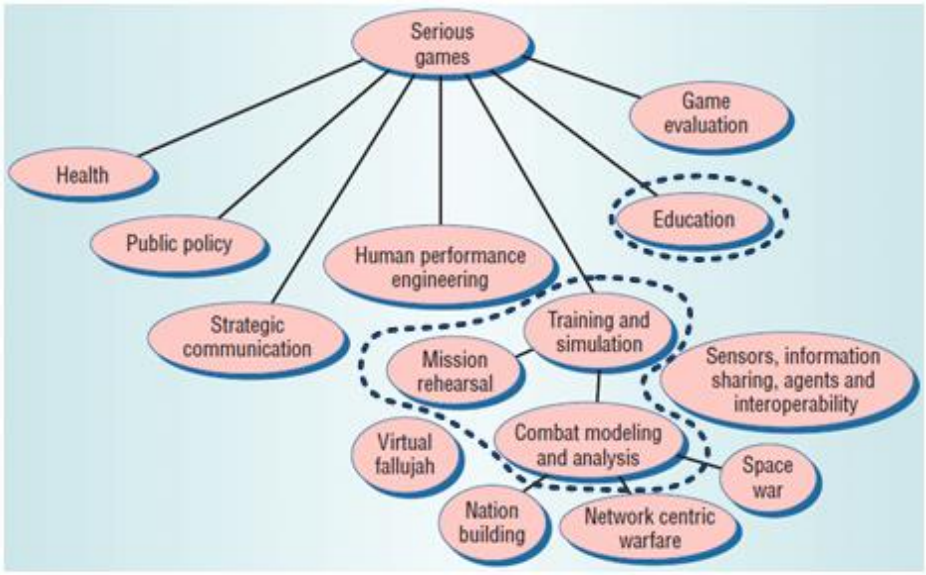


Figure 9-9. Serious games as a general concept (Zyda, 2005)

Mission rehearsal requires high-quality serious game software, which means that high fidelity of terrain, objects, personnel, equipment, and behavior are needed for preparing individual and/or units for combat tasks. Different variants of unit engagement are used in the scenario: the main course of action (defined in accordance with the mission tasks), and alternative courses which are used for providing uncertainty of the scenario. Alternative courses are also important because they represent the prediction mechanism for implementing the possible directions of situation development.

Based on the diagram above, computer simulations represent the extension of serious games. From this perspective, simulations share many common characteristics with serious games. Authors more focused on a technology approach highlight the common way in which serious games and simulations are built and structured. They recognize serious games and simulations as two sub-domains under the training domain[13]. Others highlight different characteristics based on differences between gaming and training preferences (e.g., Roman and Brown, 2008). The engagement represents the main goal of the games. While the engagement still exists in simulations, it represents just one of the motivational factors of the learning and training process.

9.7 Gamification

9.7.1 Definition

Gamification is the application of game-design elements and game principles in non-game contexts. Gamification commonly employs game design elements to improve user engagement, organizational productivity, flow, learning, crowd sourcing, employee recruitment and evaluation, ease of use, usefulness of systems, physical exercise, traffic violations, voter apathy, and more. A collection of research on gamification shows that a majority of studies on gamification find it has positive effects on

individuals. However, individual and contextual differences exist. Gamification can also improve an individual's ability to comprehend digital content and understand a certain area of study such as music.

9.8 Experience API (xAPI) Standard

xAPI is a data and interface standard that lets software applications capture and share (big) data on human performance, along with associated context information (i.e., "experience" data). Combined with learning analytics, xAPI promises to revolutionize the way education and training are conducted, managed, and measured. xAPI can be incorporated into nearly any (new or existing) learning technology, and it is agnostic about the type of learning content being delivered. xAPI is open-source and licensed under Apache License, Version 2.0.

"xAPI" stands for Experience Application Programming Interface. The 'x' stands for experience, because xAPI enables detailed recording and transfer of "learning experience" data, whether those data come from an e-learning experience, a simulation-based training experience, a tablet-based educational experience, or even an operational (on-the-job) experience.

In software, an Application Programming Interface (API) allows two or more applications to exchange data with (or "talk to") one another. In the context of education and training technologies, APIs can be used to share data about learners and learning activities. Hence, xAPI is a particular standard designed to enable the interoperable exchange of data about learners' behaviors and performance. In other words, it encodes someone's performance using a standard format, and it follows standardized transportation rules to move those data to a data store or between applications.

xAPI can be implemented in any digital environment, including mobile learning, simulations, virtual worlds, serious games, real-world activities, mobile and wearable devices, experiential learning, and more. It can be used to track and store data on any imaginable activity, such as:

- Reading an article or interacting with an eBook
- Watching a training video, stopping and starting it
- Training progress data from a simulation
- Performance in a mobile app
- Chatting with a mentor
- Physiological measures, such as heart-rate data
- Micro-interactions with e-learning content
- Team performance in a multi-player serious game
- Quiz scores and answer history by question
- Real-world performance in an operational context

9.9 cmi5

cmi5 is an xAPI profile that provides a set of rules for how online courses are imported, launched, and tracked using a Learning Management System (LMS) and xAPI, which is a key piece missing from the xAPI data standard. cmi5 uses a simplified tracking model specifying only the most essential elements for interoperability across most learning in stances, including score, status, and time. While cmi5 only

explicitly defines the neces sities, it's capable of recording and reporting on much more. To think of cmi5 another way using an analogy:

> "Imagine that xAPI is like the electrical service in your home, and cmi5 is like a wall socket. The wall socket is a simple "plug and play" standard for using electricity with consumer appliances (a very common "use case"). The additional rules imposed by the wall socket for connecting to the electric wiring make it much easier to use. You don't have to have special knowledge or hire an electrician – you just plug it in and it works (as long as the appliance and the wall socket follow those 'extra rules')."

Bill McDonald, cmi5 Working Group Leader 4

The cmi5 specification was designed to bridge the divide between SCORM and xAPI by reproducing the functionality of SCORM while leveraging the technology benefits that xAPI supplies. The purpose was to replace SCORM as the de facto format for online courses and traditional computer-based training.

9.10 Summary

Instructional Training and Education Developments (IT&ED) is looking at contemporary technologies for their use in military training and educational process in the new way. Learning resources should be accessible everywhere, whenever they are needed, and offered in different formats regarding the conditions and locations that the learner requires.

Although the delivery of ADL can be achieved by using external memory units – such USB sticks, CDs or DVDs, and off-line learning – these methods often preclude communication with the teacher or trainer. The advantages of social tools, mobile applications, virtual worlds, serious games, and simulations as described in this Handbook can be used for advanced learning purposes. Blended approaches – in which high-skilled teachers and trainers implement appropriate pedagogy and didactics in the learning/training scenarios – combined with some of these advanced tools can help provide high motivation and engagement of the learners, and produce excellent results.

Annexes:

a. Contributors to the NATO ADL Handbook
b. Acronyms
c. Ressources and References
d. Advanced Distributed Learning in Exercises

Annex a: Contributors to the NATO ADL Handbook

The NATO Trasining Group Individually Training & Education Development want to specifically thank the following people for their efforts during the production and development to bring this handbook to fruition.

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Annex b: Acronyms

ADDIE	Analysis, Design, Development, Implementation & Evaluation
ADL	Advanced Distributed Learning
CMS	Content Management System
E&IT	Education and Individual Training
ELO	Enabling/Learning Objective
HD	High Definition
HRM	Human Resources Management
ISD	Instructional Systems Designer
ISD	Instructional Systems Development
LMS	Learning Management System
LO	Learning Object
MOOC	Massive Open Online Course
PO	Performance Object
SCO	Sharable Content Object
SCORM	Sharable Content Object Reference Model
SME	Subject Matter Expert
TNA	Training Need Analysis
TRA	Training Requirements Analysis
VBS 3	Virtual Battlespace 3
VoIP	Voice over Internet Protocol
xAPI	Experience API

Annex c: Resources and References

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SCORM Resources (Chapter 4, Development)

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SCORM Users Guide for Instructional Designers
http://www.adlnet.gov/public/uploads/SCORM_Users_Guide_for_ISDs.pdf

SCORM Users Guide for Programmers
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ADVANCED DISTRIBUTED LEARNING IN EXERCISES

Annex to NATO ADL Handbook

Version 2022 May

Table of Contents

1 Executive Summary

Training is vital to mission success, yet it is difficult to quantify the impact of any particular training event or exercise. Advanced Distributed Learning (ADL) enables exercise planners to provide cost-effective, easily accessible, highly learnable courses and materials that can be tailored to address specific knowledge gaps, training objectives, and exercise scenarios. Equally important, ADL return-on-investment (ROI) analysis empowers training commanders and exercise management to maximise and justify the expenditure of limited resources.

ADL makes the work of exercise planners and managers easier, more efficient, and more effective. This Annex provides a practical, validated set of guidelines that both the military exercise community and the ADL community can relate to and act upon. It presents methods and best practices for developing and integrating ADL into all types and levels of training exercises, experimentation, mission rehearsals, and war gaming.

The most obvious advantage of using ADL is for Training Audience (TA) pre-exercise preparation. Far too often, valuable time at an event is spent instructing the TA on information they should learn before arrival. ADL courses and microlearning modules provide the pre-training solution for this problem. Moreover, members of the Exercise Planning Group (EPG) and Core Planning Team (CPT) require training and preparation at the outset of the exercise planning process, and Observer Trainer Mentors (OTM) need instruction to assure uniform standards for TA performance scores. ADL is well-suited to each of these important tasks.

Beyond early learning, ADL can play an important part in exercise event execution, shifting from an educational to a supportive function. The ADL dashboard can give management real-time visualisations of training progress and data analysis, and the ADL platform can supply learning at the point of need during the exercise execution, with templates, checklists, and standard operating procedures for activities such as conducting a briefing or interacting with the media.

ADL's value and utility continue in the post-event evaluation process. ADL resources can help inform Post-Exercise Discussions (PXD), provide data and analysis for documents such as the First Impressions Report (FIR) and Final Exercise Report (FER), and aid the development of lessons learned and recommendations. And in the necessary financial review, the ADL ROI Dashboard can quantify and illustrate the training gains made in the exercise.

This Annex concludes with case studies of VIKING 18 and two other exercises, detailing the successes, shortcomings, and lessons learned from the integration of ADL into these training events:

- Integrate ADL into all exercise phases (e.g., pre-training, execution, evaluation, post-exercise discussions).
- Tailor key learning content to the exercise and align it with the training objectives and exercise themes.
- Support anywhere/anytime ADL access for just-in-time learning.
- Emphasise content quality over content quantity.

2 Introduction

2.1 General

This Annex provides pragmatic guidance on introducing, developing, and integrating Advanced Distributed Learning (ADL) into all types and levels of training exercises and similar events, such as test experimentation, mission rehearsal, and war gaming.

Relevant actors around the world face comparable training and education challenges to building readiness capacity. Operations are increasingly multinational and multi-domain; supporting systems are ever more complex; and most organisations are suffering from a performance gap. Military and civilian personnel facing unpredictable, complicated, and evolving security environments require an expanding range of competencies at higher levels of proficiency. The quick acquisition of knowledge and skills is essential to confronting novel multi-domain challenges. In many NATO and national exercises, augmentees are introduced to the exercise at the last minute, requiring them to "get up to speed" in hours or days. The introduction of distributed learning can assist in preparing the Training Audience (TA) and the Exercise Control (EXCON) staff.

However, resource-constrained systems must meet these training and education needs without significantly raising expenditures. Operational integration of ADL assets into multinational exercises is one step toward achieving this goal. ADL enables exercise planners to provide cost-effective, easily accessible, highly learnable courses and materials that can be tailored to address particular knowledge gaps, training objectives, and exercise scenarios. As the number and scope of distributed computer assisted exercises (CAX) increase, and educational systems go online, the ability to deliver ADL training and education becomes a critical capability.

Figure 2-1. VIKING Exercise Control, Joint Exercise Centre.
Photo by: Swedish Command and Control Regiment

VIKING – a regularly scheduled, multinational, civil-military CAX – is one of several similar events that aspire to full operational integration of ADL as an essential part of exercise training and preparation, and ADL has been a supportive learning concept in the VIKING events since 2003. This includes utilising Experience Application Programming Interface (xAPI), an eLearning software specification that allows learning content and learning systems to speak to each other in a manner that records and tracks all types of learning activities. The VIKING 2018 exercise expanded the scope and scale of ADL resources to include assets of both pre-training and operational value. The event also highlighted analytics on a common dashboard with data from both the learning management system (LMS) and the command-and-control (C2) system. This enabled the comparison of pre-training data with exercise execution data, including data from the designated evaluation team and exit interviews with participants.

2.2 Purpose

The purpose of this Annex is to enhance military training and education by synthesising the best practices of integrating ADL capabilities into joint and coalition training exercises. This use of ADL resources can yield concrete benefits: quantified measurement of training effectiveness; improved learning outcomes; increased learning efficiency by easing access to instructional materials and making them more convenient to use; and expanded readiness reporting through learning analytics and their associated visualisations.

2.3 Scope

This Annex is intended to serve as a practical, usable set of guidelines that both the ADL and exercise communities can relate to and act upon. It covers event planning, execution, and evaluation; and it offers insights and topics for consideration when implementing and maturing ADL in support of a training exercise.

2.4 Initial Steps

No "one-size-fits-all" process exists for integrating and maturing ADL in training exercises. There are too many different types of exercises, too-varied exercise and training objectives and learning content, and too wide a range of particular constraints. Developing an exercise's ADL components also depends upon the level of the organisers' existing eLearning material: Will they create new courses from scratch? Update previously used ADL courses? Convert established classroom courseware into ADL? Likely, it will be some combination of the three. (And the latter two cases would provide some already well-defined learning objectives, media, quizzes, etc.)

In all circumstances, the initial step to creating an ADL solution for an exercise should be conducting an analysis of the gap between the desired state of performance and the current state of performance. When leaders discover a performance gap, the automatic recommendation often is to improve the training. However, a best practice is to verify first that the root cause (or causes) of the performance gap actually can be addressed through education and training. Mature organisations assess the

source of the performance discrepancy and generate a list of possible causes that have resulted in, or may yet lead to, the performance shortfall.

When enhanced or wider-scope training is identified as the means to close a performance gap, this Annex – with its best practices and recommendations – can help organisers recognize key concerns to guide this effort and the subsequent planning and execution. To maximise the value of incorporating ADL into exercises, it must be considered in each of the exercise life cycle's main stages: strategic guidance, design, preparation, execution, evaluation, and analysis.

Cross-cutting themes that we address in this Annex include:

- *Early engagement and training for planners and management*
- *Learning to support information, introduction, and instructions*
- *Hosted learning platform*
- *Standards and technical requirements*
- *Content responsibility – Subject Matter Experts*
- *Content and information ownership*
- *Academia and curriculum*
- *Pre-training (some mandatory) for TA and EXCON*
- *Repository (even during execution)*
- *Microlearning (even during execution)*
- *Capturing performance data*
- *Assessment*
- *Analytics*
- *Evaluation (support to the Exercise Evaluation and Final Exercise Report)*
- *Dashboard (summarising and visualising results)*
- *Continuity, reuse, and content sharing (after and between exercises)*

2.5 Return on Investment

Experimental research demonstrates that integrating ADL content and automated learning analytics into military exercise technologies improves learning outcomes and operations effectiveness while advancing business intelligence for readiness reporting.

- Aim & Purpose: *Build readiness; enhance efficiency and effectiveness*
- Objectives: *Improved learning, training, and exercises*
- Performance Gaps: *Identified and assessed by leadership*
- Requirements: *Operational (Task List) and technical capabilities*

2.6 Research and Development

The modernisation of learning remains a concept in development, and operational integration of ADL into exercises offers near-real environments both to conduct essential R&D of solutions our war fighters depend upon and to provide learning at the point of need. Using ADL in exercises offers a variety of benefits, including:

- Enhanced demand signal by feedback from uniformed soldiers

- Innovative solutions validated in an operational context
- Increased visibility to help win new stakeholders
- Improved capture of lessons identified

2.7 Use Case Studies

Case studies of ADL use in these exercises are presented in Chapter 4:

- VIKING CPX/CAX
- NATO Standards Ukraine
- Bold Quest Interoperability experiment

Figure 2-2. Computer Assisted Simulation Control, VIKING Exercise Centre.
Photo by: Swedish Command and Control Regiment

2.8 References

- **NATO Bi-SC 75-7 E&ITD** (Education & Individual Training Directive) The latest version is available through NATO Transnet: https://www.act.nato.int/images/stories/structure/jft/ptecs/etd-075-007.pdf
- **NATO Bi-SC 75-3 CT&ED (Collective Training & Exercise Directive)** The latest version is available through NATO Transnet: https://www.act.nato.int/images/stories/structure/jft/ptecs/cted-075-003.pdf
- **NATO AMSP-05 (Allied Modelling & Simulation Publication),** Handbook (Best Practice) for Computer Assisted Exercises (CAX).
- **Guidelines to Methods in Computer Assisted Exercises** (CAX), Partnership Simulation Network and VIKING 22.
- **Computer Assisted Exercises and Training, A Reference Guide,** Prof. Erdal Cayirci and Dr. Dusan Marincic.

- **The NATO Advanced Distributed Learning Handbook,** NATO Training Group Task Group for Individual Training & Education Developments (IT & ED).
- **VIKING 18 FIR, First Impression Report,** Swedish Armed Forces.
- **I/ITSEC 2018 Paper 18152, Integrating Advanced Distributed Learning into Multinational Exercises,** Mj Niclas Ljung, Mj Tohmas Ax, Dr. Aaron Presnall, Dr. Sae Schatz.
- **I/ITSEC 2018 Paper 18196, Learning Analytics with xAPI in a Multinational Military Exercise,** Ms. Vesna Radivojević, Dr. Aaron Presnall
- **ADL Initiative MADLx Protocol Report (DI-MISC-807ip11A) NATO Standards Exercise Ukraine,** Ms. Biljana Presnall
- **I/ITSEC 2021 Paper 21222, Enhancing Military Exercise Team Performance with Diversified xAPI Instrumented eLearning**, MG Serhii Salkutsan, Col Andrii Golovanov, Col Andrii Shyhyda, Lt Col Maksym Tyshchenko, and Ms. Biljana Presnall

2.9 Contributors

This Annex is a compilation of initiated nations working together under the umbrella of the NATO Training Group (NTG) Individual Training & Education Development (IT&ED). We want to specifically thank the following people for their efforts in drafting this Annex.

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3 Exercise Framework

3.1 Planning and Execution Process

The exercise planning and execution process follows six steps: strategic guidance, design, prepare, execute, evaluate, and analyse. ADL uses a similar framework of production, which is called ADDIE: analysis, design, development, implementation, and evaluation. The two processes are complementary, as illustrated in Figure 3-1.

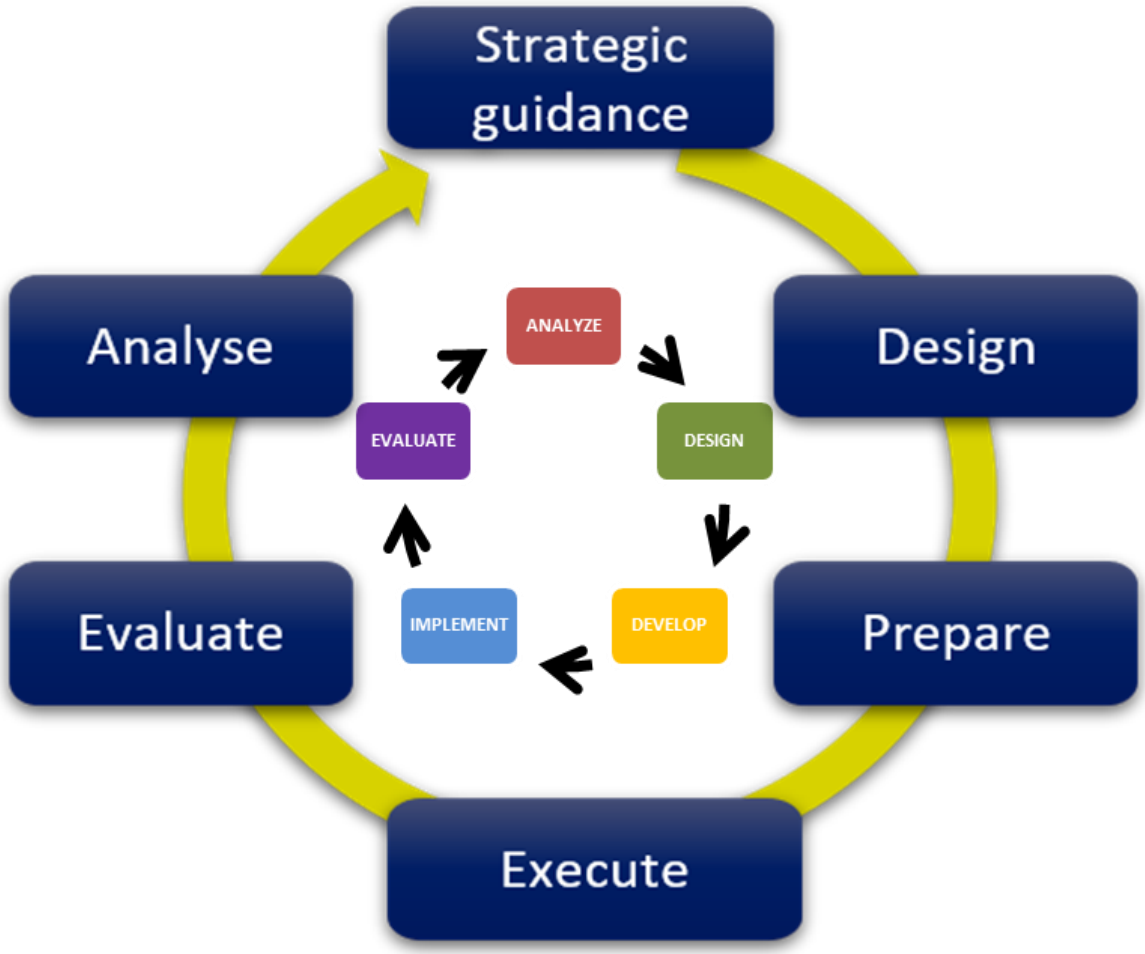

Figure 3-1. Exercise and ADDIE processes.

The six-step exercise planning and execution process is based on twenty years' experience and was developed from NATO directive Bi-SC CT-ED 75-3 for use in major multinational distributed exercises. It is detailed in *Guidelines to Methods in CAX* (Swedish Armed Forces – VIKING edition). The ADDIE process for developing eLearning content is detailed in the *NATO Advanced Distributed Learning Handbook* (2019), and the eLearning course "Kickstart to ADL" (NORDEFCO) provides interactive instruction on how to create ADL material.

3.2 Exercise Planning Cycle and Products

Each of the six steps in the planning and execution cycle is driven by particular considerations, which in turn inform the subsequent step, as illustrated in Figure 3-2. Subsections 3.4 to 3.10 in this Annex will explain in detail how ADL can support each phase of the process.

Figure 3-2. Planning and execution cycle considerations.

3.3 Timeline for ADL in Exercises

To maximise its value, ADL must be a central part of the exercise process from beginning to end. Figure 3-3 illustrates the ideal timeline for the ADL deployment phases. It includes some of the most important applications of ADL resources for each step, including two critical elements of effective ADL support for the exercise: early access and delivery of the ADL platform and courses. This ADL timeline is intended to be aligned with that of the exercise planning, execution, and evaluation process, and the two always should be coordinated as the process actually unfolds.[1]

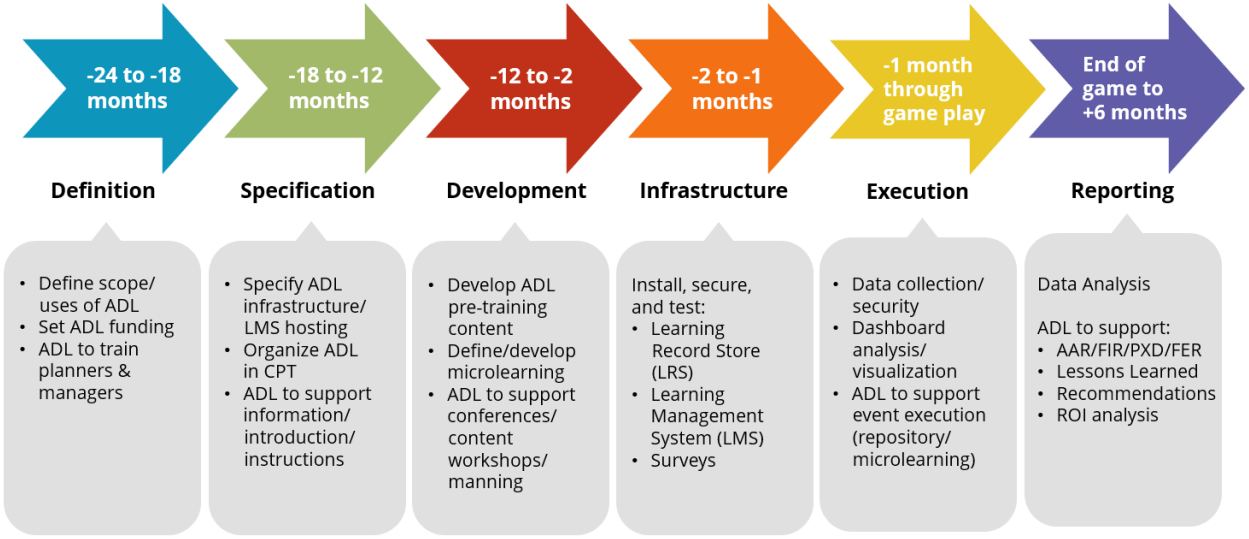

Figure 3-3. ADL production and execution timeline.

[1] In Figure 3-3, Reporting phase: AAR=After Action Review; FIR=First Impressions Report; PXD=Post-Exercise Discussions; FER=Final Exercise Report.

ADL in Exercises: Step by Step

The diagram in Figure 3-4 shows the relationship between the six steps in the exercise process and the corresponding uses of ADL assets for each step. The lists of ADL resources are not exhaustive, but they illustrate the specific ways that ADL can aid and support each step of the exercise process. ADL makes the work of exercise planners and managers easier, more efficient, and more effective.

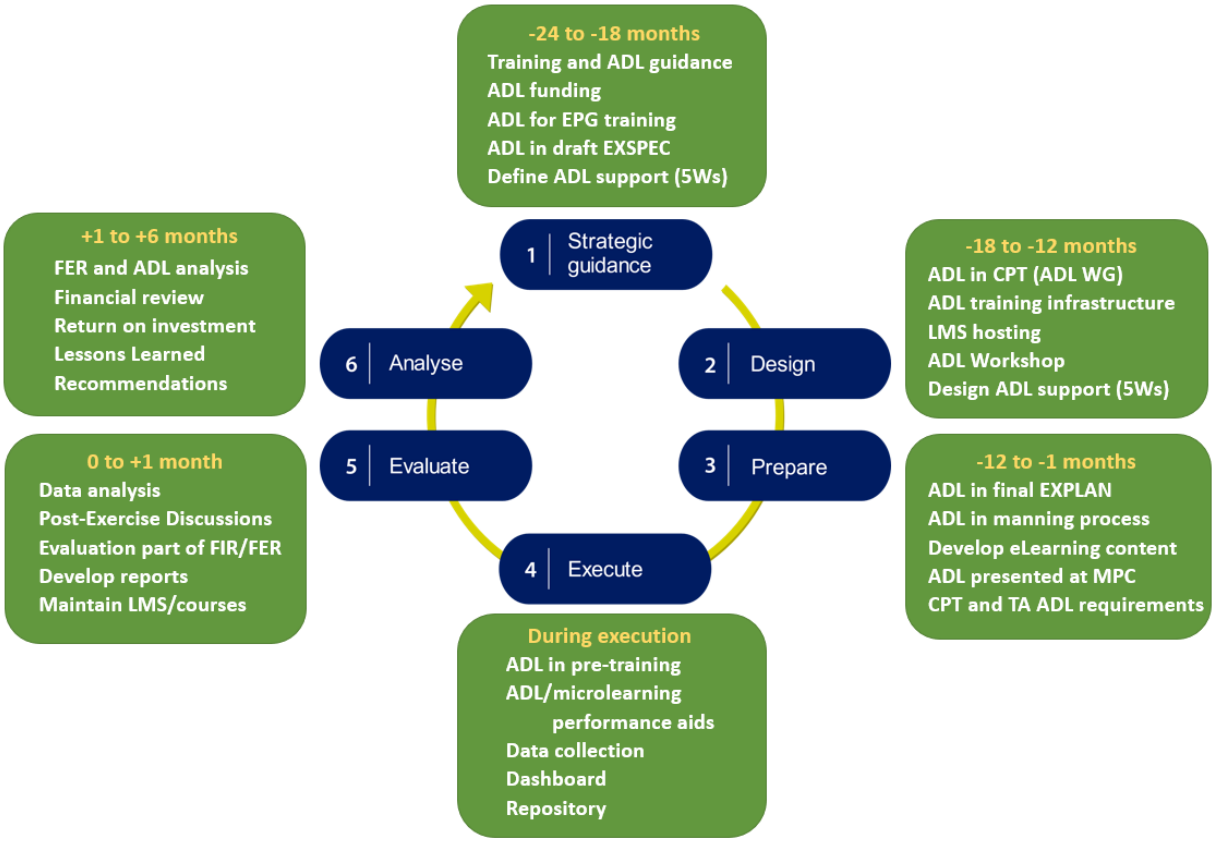

Figure 3-4. Specific ADL assets for each step of the exercise process.

One resource to familiarise exercise planners with the process of successful ADL integration is the eLearning course "CAX Method with ADL" (MADLx Project). The course can be accessed at this site: https://nordicadl.com/course-catalog.

3.4 Step One: Strategic Guidance

Scope

Strategic Guidance is the initial step in the exercise process, from 24 to 18 months before execution of the exercise event. The aim for ADL is to establish it as a central element of the entire exercise process. The Officer Scheduling the Exercise (OSE) staffs the Exercise Planning Group (EPG), which comprises the OSE staff, invited partners, and representatives of the Training Audience (TA), participating organisations, and the exercise centres.

The OSE tasks the EPG with various activities and responsibilities to support the early exercise process. The EPG prepares the first draft of the Exercise Specification (EXSPEC), and it plans and conducts the Exercise Specification Conference (ESC) to revise and finalise the EXSPEC draft.

Establishing ADL integration into the overall exercise guidelines and mandates begins with raising the awareness of the OSE, OSE staff, and EPG. One practical way to demonstrate the value of ADL is using it for training the EPG members when the group is first staffed. In the Strategic Guidance step, it is crucial that the ADL training ambitions and guidance are included in the EXSPEC outline and placed on the ESC agenda. The OSE should appoint ADL representatives to the EPG, and the EPG should create an ADL Working Group (WG) within the Core Planning Team (CPT). ADL resources, support, and funding should be addressed according to the "Five Ws and How" (Who, What, Where, When, Why, and How) and be the baseline for the exercise design.

Best Practice

- Establish early management attention to ADL, leveraging success case studies.
- Have management provide clear guidance on ADL use, stated in EXSPEC.
- Do not wait for requirements from management; take the initiative and adjust along the way.
- Base ADL effort and road map on lessons identified in prior exercises and previous experience.
- Be open and strive for ADL concept development.
- Ensure that ADL representatives are part of the Exercise Evaluation (EXEVAL) team to provide recommendations for future ADL in exercises.

3.5 Step Two: Design

Scope

Design is the second step in the exercise process, from 18 to 12 months before execution of the exercise event. The aims for ADL are to design the ADL concept and infrastructure and set the main requirements for exercise event pre-training, complying with the overall planning design and timeline. In this second step, the EPG designs the exercise concept (method and technique) based on the OSE's strategic directions and guidance. The EPG's exercise concept is established in the EXSPEC. Also in this step, the CPT is activated under the control of the Officer Conducting the Exercise Officer Primary Responsible (OCE OPR).

ADL resources should be used in the training of the planners, including the CPT members. ADL should be formally represented on the CPT, as noted above, preferably as one of the members responsible for training and education planning. The design of ADL support and infrastructure should be structured and clearly defined in a plan (remember the "Five Ws and How") that is included in the EXSPEC Training Annex.

Some ADL and microlearning courses should be mandatory for all exercise participants, but the number of required courses must be limited if participants realistically are expected to complete them. Learning content aimed directly at meeting the exercise, training, and learning objectives should be mandatory, while other useful materials should be presented as recommended or supplementary. One course that should be mandatory is an overview of the exercise scenario. All participants, especially the TA, should be required to complete it to prepare for STARTEX. Some courses addressing exercise-specific information should be mandatory only for particular groups of participants. For example, the EXCON staff, but not the TA, should be required to complete courses on EXCON organisation/functions and implementing/conducting exercise procedures and methods. Similarly, Observer Trainer Mentors should be required to complete a "how to" course on their duties.

Best Practice

- Include the deadline to decide ADL course/content production early in the draft exercise timeline.
- Identify where ADL should be situated in the Exercise Management Organisation.
- Conduct a Training and ADL Workshop early in the process (to develop the "Five Ws and How" and set the plan and standards for ADL in the exercise process).
- Involve necessary actors in an ADL WG (preferably formed at the ADL Workshop).

- Define the Learning Management System (LMS)/Learning Record Store (LRS) hosting agency/agencies early (to set the standards and make ADL available for planner training/aid).
- Define how data will be extracted from exercise management and exercise support systems for analysis.
- Use microlearning for wider reach than the partly restricted exercise platform.
- Identify the availability and owner(s) of the information used in ADL/microlearning resources.
- Monitor and advocate for ADL and training involvement in drafting the EXSPEC.
- Consider early action items in network security, personal integrity, information security, accounts, etc.

3.6 Step Three: Prepare

Scope

Prepare is the third step in the exercise process, from 12 months to one month before execution of the exercise event. The ADL aims are to set the ADL plan, produce the course materials, establish the infrastructure configuration, and make the ADL platform available for participants – including planners – well ahead of event execution. Overall in this step, the planning begun in the Design phase broadens, deepens, and intensifies. When the Prepare step ends, all pre-event components and products are fully developed and ready for execution, including deliverables such as the exercise planning directives and Standing Operating Procedure (SOP).

The results of this step are delivered primarily through the Exercise Plan (EXPLAN), which builds and expands upon the EXSPEC. The EXPLAN is completed by the CPT, and it guides the work of all subgroups and organisations responsible for planning, executing, and evaluating the exercise. The EXPLAN is organised in four main parts (followed by annexes and sub-annexes):

- Part I: Exercise Concept
- Part II: Exercise Planning and Development
- Part III: Exercise Implementation
- Part IV: Exercise Evaluation

The general details and guidelines of ADL and training should be integrated into all four parts of the EXPLAN, with specific instructions and information in the annexes. The CPT Training OPR and the ADL WG should present the ADL and training concept at the planning conferences. Ideally, the ADL platform is launched and demonstrated at the Main Planning Conference (MPC), and it is operational and available thereafter to all participants (including the planners). In addition, the ADL WG should support and prepare the exercise leadership to emphasise the importance of ADL pre-training, preferably during the leadership closing remarks at the MPC.

Best Practice

- Bring ADL competence into the manning process as early as possible for an active planning presence, linking directly with the staff assigned as training officers.
- Do not expect exercise planners to have experience with ADL in exercises.
- Provide planners with early advice and monitor and give support throughout the planning process.
- Put strong professional effort into ADL's addition in the EXPLAN; it establishes the pre-training norms and is the main mechanism for outreach, especially to distributed sites.
- Be sure that the EXPLAN includes analytics standards (xAPI).
- Encourage partners and the ADL community to contribute early to the ADL concept.
- Encourage distributed site nations to provide specific ADL products addressing their

particular pre-training needs.

- Ensure ADL experts are part of the Exercise Evaluation (EXEVAL) team throughout the process.
- Use microlearning for brief, focused training modules.

3.7 Step Four: Execute

Scope

Execute is the fourth step in the exercise process, from one month before STARTEX through the end of the event. The ADL aims are to provide courses for job training and Work-Up Staff Training (WUST) in the few days prior to STARTEX, resources for use during the exercise event, and analytics before, during, and after the exercise event. ADL and microlearning are of equally high value during the exercise event execution as during pre-event training.

Overall, this step comprises three main activities: adapted job training prior to the game start, implementation of the scenario-driven game from start to stop, and the initial evaluation primarily to determine whether the training objectives have been fulfilled.

Job training follows the guidelines presented in the EXPLAN, and the use of ADL in this training is crucial. ADL both improves the quality of learning and reduces the expenditure of training time and resources. A participant's exercise assignment determines the type and topics of the pre-training they need. Job training generally takes one of three forms, all of which can be conducted or supported with ADL.

- **Academic seminars/formal education.** The purpose is to prepare commanders and key personnel in trained units to meet the challenges of specific operations exercises by giving them the opportunity to study and analyse strategic and operational conditions.
- **Method Training.** Specific training on the gaming method, exercise management, and exercise support system.
- **Operator Training.** Simulation systems and other systems training for operators, such as SitaWare HQ, Sword, OneSAF, VBS, ITC, and Actor.

These forms of job training apply when standing units/staffs/headquarters are to be trained, and they are expected to conduct the training with their own resources. Exercise-related training is planned and implemented according to the Exercise Director (EXDIR) and the CPT. The WUST is based on exercise-related information and the exercise scenario, focusing on practical development of participant abilities. It includes information and management systems training. In other exercise types, where the goal is to train individuals, the CPT is responsible for planning and executing customised training for those individuals.

In addition to pre-event training, ADL offers a variety of other benefits during the execution phase, when it can shift from an educational to a supportive role. During exercise, the ADL platform can provide participants with learning content as performance aids. It can generate checklists, SOPs, templates, or other reference material for immediate use, such as conducting a briefing or interacting with the media. The LMS also can serve as a general document repository, making different information readily available for the creation of reports, presentations, and spreadsheets utilising the platform's built-in functionality.

The final activity in this step, after game play has concluded, is to create the First Impression Report (FIR). It documents the main initial results and analytics of the exercise event. During event execution, the OTMs create a collection of observations detailing TA capabilities and training objective fulfilment. This observation data is used to produce activity/function and/or unit reports that are given to the TA as appendices to the FIR. The FIR, staff reports, and Staff Instructors' activity reports are presented to the participants before their departure from the exercise.

Best Practice

- Establish a plan for efficient data collection.
- Make ADL management modules available as courses and hands-on training.
- Provide ADL and microlearning solutions to support the exercise event during game play.
- Provide internet access as close to the participants' working areas as possible.
- Consider setting up an ADL lab with internet workstations and ADL support.
- Use ADL information as a repository for identifying knowledge gaps.
- Use a dashboard to give management visualisations of data analysis, ideally with the results available on-demand.
- Make relevant exercise documentation and checklists available to the TA on the LMS and mobile solutions.

3.8 Step Five: Evaluate

Scope

Evaluate is the fifth step in the exercise process, from execution to one month after the event. The ADL aim is to integrate the ADL dashboard, analytics, and survey capabilities into the evaluation process. In general, the purpose of this step is to evaluate how and whether the planning, implementation, and execution phases led to fulfilment of the exercise aim, exercise objectives, and training objectives. The evaluation process is based on the collection of information and data for analytics that has occurred throughout the entire exercise cycle.

The Final Exercise Report (FER) and other functional reports are the primary vehicles for delivering the results and the main outcome of this step. The FER assesses whether the exercise achieved its stated aims and objectives, including how the design and implementation of the exercise supported TA performance, and it incorporates participant evaluations of the exercise. The FER draws conclusions, makes recommendations, and identifies lessons for future activities (action proposals). The Director of EXEVAL is responsible for completing this step and delivering the FER to the OCE, with the OTMs and EXEVAL following a detailed SOP to support their operations.

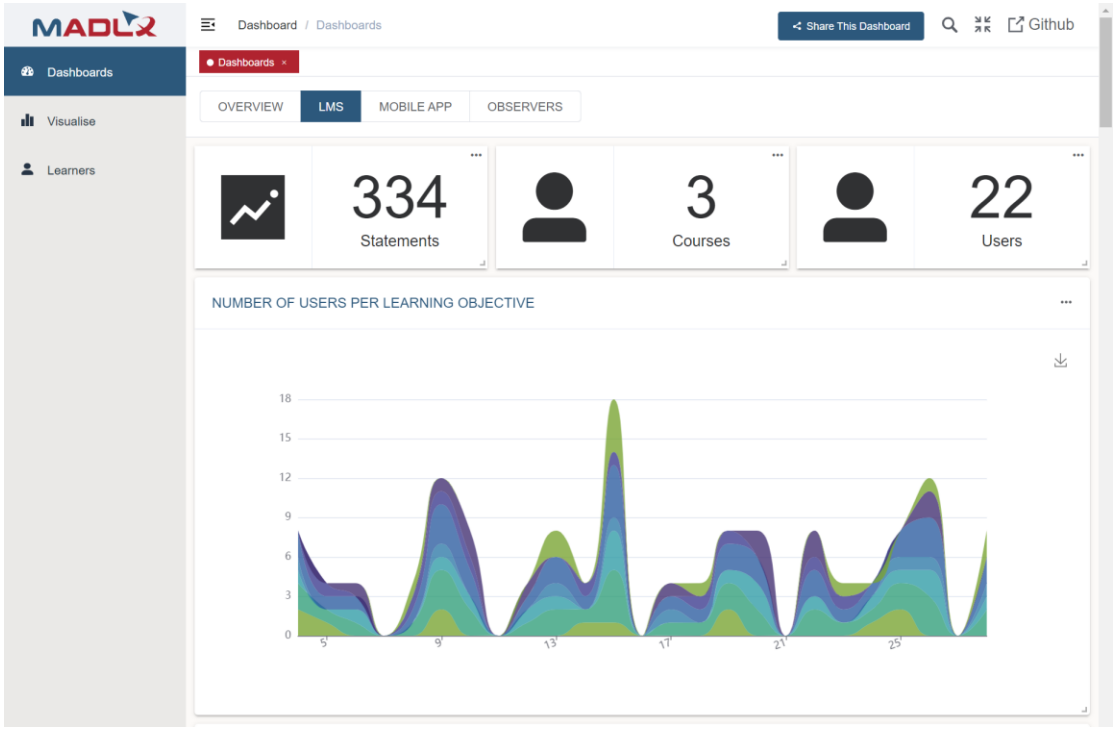

Figure 3-5. Analytics dashboard presenting xAPI outcomes.

Best Practice

- Ensure ADL representation in the Post-Exercise Discussions (PXD).
- Ensure ADL and training lessons identified are included in the FER.
- Establish a Training and ADL Annex to the FER.
- Use ADL to help develop reports.
- Maintain post-exercise event hosting of LMS and ADL courses.

3.9 Step Six: Analyse

Scope

Analyse is the final step in the exercise process, from one month to six months after execution of the exercise event. The ADL aims are to analyse the exercise learning data; support analysis of the FER; and provide analytics to support the exercise financial review, lessons identified and lessons learned, and recommendations for future exercises. Overall, this step contributes to the strategic development and enhancement of future training and exercise design by identifying successes, challenges, best practices, limitations, problems, and areas for improvement.

To this end, it is important that all functions involved in the CPT document their experiences and identify lessons learned. This information, along with the exercise reports and participant evaluations, helps future planners and managers both reduce the repetition of mistakes and learn positive lessons from good and productive examples.

The analysis step is conducted by headquarters planners, exercise planners, and staff from the hosting platform (e.g., a Joint Training Centre). The OSE staff is responsible for coordinating this foundation for future training operations, and they should conduct a workshop within one month after the exercise ends to initiate this step. Full engagement in the exercise does not end until staff follow up on all measures, reports, and data to confirm that the intent and guidance of evaluation and analysis have been effectively communicated. Ideally, recommendations should describe how a change should be implemented and by whom, with the exercise's conclusions and recommendations addressed through either direct adaptation or controlled implementation (institutionalisation). Both will lead to changes in technology, methodology, organisation, and/or personnel.

Best Practice

- Use CPT experience documentation to help inform analysis.
- Define how data will be extracted from exercise management and support systems for analysis.
- Clarify the potential consequences related to GDPR (if any) and how to address them.
- Define which ADL material is needed for the analysis.
- Define who will support the development of ADL content and ensure ADL quality control.
- Define how other relevant external ADL material can be used.
- Define how ADL analytics can be integrated into the EXEVAL function.

3.10 Checklist

STEP	**1. STRATEGIC GUIDANCE (-24 to -18 months)**	**ADL/EDUCATION/TRAINING**
Activity	● Organise EPG ● Draft Exercise Guidance/Terms of Reference (EG/TOR)	● Training and ADL guidance ● ADL funding
Product	● Strategic decision ● Exercise EG/TOR ● Exercise Objectives	EXSPEC ● ADL in EPG ● ADL support to make STARTEX available ● ADL support to EXEVAL (data + analysis) ● ADL support in language training to remote sites ● Plans for ADL experimentation, demonstration, and concept development ● Key themes that ADL should support
Responsible	Officer Scheduling the Exercise (OSE), Exercise Planning Group (EPG)	EPG
STEP	**2. DESIGN (-18 to -12 months)**	**ADL/EDUCATION/TRAINING**
Activity	● Design Workshops (Ops, Tech) ● BiL Concept Development Conference ● Exercise Specification Conference (ESC)	● ADL tech infrastructure (internet/internal systems) ● ADL LMS hosting ● ADL organisation ● Design workshop Concept of Training ● ADL support to make the scenario available ● ADL support to disseminate exercise documentation
Product	● Officer Conducting the Exercise (OCE) Planning Guidance ● Exercise Specification (EXSPEC) ● Main Training Objectives	● ADL must be a function or position in the CPT (e.g., ADL WG) ● ADL-related interdependencies in timing/planning schedule ● ADL on what is a CPX/CAX ● ADL on planning process
Responsible	EPG, OCE Officer with Primary Responsibility (OPR)/Core Planning Team (CPT)	CPT
STEP	**3. PREPARE (-12 months to -1 month)**	**ADL/EDUCATION/TRAINING**
Activity	● Initial Planning Conference (IPC) ● Workshops (Tech, IM, OPS, MEL/MIL) ● Main Planning Conference (MPC) ● Final Coordination Conference (FCC)	● ADL requirements concerning the manning process ● ADL to support evaluation, analysis, and reports
Product	● Exercise Plan (EXPLAN) ● Scenario Modules ● Main Events List/Main Incidents List (MEL/MIL)	● Present pre-training/training/ADL concept at MPC ● ADL clear part of final EXPLAN ● Develop eLearning content
Responsible	OCE OPR/CPT	OCE OPR/CPT

STEP	4. EXECUTE (-1 month through event)	ADL/EDUCATION/TRAINING
Activity	● Pre-Training ● CPX/CAX execution performance aids ● Follow-up Training Objectives ● After Action Review ● ENDEX Review	● Clarify ADL support in job training section ○ Blended Learning ○ Microlearning ○ Documentation ○ AR/VR/XR possibilities ○ Data collection ○ Dashboard(s)
Product	● Observer Trainer Mentors (OTM) report ● Commanders reports ● First Impression Report (FIR)	● ADL support for data/analysis and reporting
Responsible	Exercise Director (EXDIR), Exercise Control (EXCON)	EXDIR, EXCON
STEP	**5. EVALUATE (0 to +1 month)**	**ADL/EDUCATION/TRAINING**
Activity	● Post-Exercise Discussions (PXD)	● ADL evaluation ● xAPI data and analysis
Product	● Final Exercise Report (FER)	● ADL separate headline
Responsible	Exercise Evaluation (EXEVAL)	EXEVAL
STEP	**6. ANALYSE (+1 to +6 months)**	**ADL/EDUCATION/TRAINING**
Activity	● Economy review ● FER analysis	● xAPI data and analysis ● ADL ROI
Product	● Lessons Learned ● Recommendations	● ADL LL and recommendations
Responsible	OSE	OSE

4 Case Studies: ADL Use in Exercises

4.1 VIKING 18

Background

VIKING is the world's largest multinational civil-military training exercise. This unique concept was initiated by the U.S. and Sweden in 1999. A total of nine VIKING events have been conducted, successfully bringing together more than 25,000 participants and more than 100 nations and organisations over this time.

The aim of the event is to train and educate participants – civilian, military and police – to operate together for multidimensional crisis responses and peace operations. The VIKING 18 exercise, conducted 16-26 April 2018 with 2,500 participants, was created for individual and team training and learning at the tactical and operational levels. The staffs consisted of several simulated HQs at different locations in Sweden and other countries.

Figure 4-1. Response Cell Air workplace in Uppsala
Photo: blogg.forsvarsmakten.se/viking/

ADL Content

The VIKING 18 Core Planning Team (CPT) formed a multinational ADL Working Group (WG) to manage eLearning integration, provide existing national/NATO ADL assets, and to produce a limited quantity of new, exercise-specific ADL content. VIKING 18 also had a designated ADL evaluator within the Exercise Evaluation (EXEVAL) team, who was tasked specifically with observing how the ADL effort influenced exercise performance and outcomes.

Six nations contributed a total of 29 eLearning courses to the exercise: 27 legacy courses that met different VIKING 18 themes and learning objectives, and two purpose-built courses. The only mandatory course (*Introduction to VIKING*) was developed especially for VIKING 18 and provided an overview of the exercise organisation, the basic scenario, and a description of the road to crisis. The courses were divided into three levels of importance: Level 1 (Mandatory); Level 2 (Recommended for specific parts of exercise); and Level 3 (Repository available to all participants). Exercise participants had access to all the courses for one month prior to the exercise and could refer to them during the execution for just-in-time learning. The courses remained available through the end of 2018 for further use and reference. An ADL lab at the main site in Enköping, Sweden, also was open to the participants during exercise execution. Courses were delivered through a separate instance of the existing SAF Learning Management System (LMS), enabling the eLearning team to separate the VIKING participants from the existing users on the LMS, which supported better cyber security and information assurance.

Learning Analytics

The Experience Application Programming Interface (xAPI) played an important role in VIKING 18. xAPI is a technical specification that lets learning technologies better record, aggregate, and analyse learning performance data, particularly across different learning experiences. Given that the legacy courses generally did not use the xAPI specification, the eLearning team devised technical solutions to collect and aggregate the relevant data regardless of the technical specification used. The eLearning developers created a web-based data visualisation dashboard that analysed both xAPI and non-xAPI data from the exercise's management system. With the dashboard, exercise organisers and other stakeholders could trace trainee performance across different times and technologies, correlating eLearning activities with performance in the exercise scenario and unlocking the potential for deeper insights into the exercise training outcomes.

Figure 4-2. VIKING 18 eLearning visualisation dashboard.

Participant Feedback

At the end of the exercise, participants completed a digital survey which included two questions related to eLearning. The first asked, "Were the eLearning courses you took relevant and useful?" It used a scale from 1 (No, not at all) to 6 (Very useful). It included an option of indicating that they had not taken any eLearning courses, and 32.7% of respondents said they had not. Of those who used eLearning, 59% responded that it was useful (rating it a 4, 5, or 6). The second question asked, "Did you receive information about the mandatory eLearning courses?" and 38% of respondents said they had not. Participants who used the ADL content said that dividing it into levels of importance helped them prioritise their pre-training time.

In addition to the digital surveys of all participants, the eLearning team conducted short interviews with 30 participants at the exercise. Half of them said they had not received information about the eLearning options. Among those who did access the ADL material, most said that they found the courses relevant and useful, though it varied by the respondent's role in the exercise. For example, more of the content was relevant for participants with EXCON functions than for participants representing the UN mission in the exercise. In addition, some said that they chose not to take courses that were overly long and contained too much different information. Interviewees also reported some ADL access problems because they were required to have separate accounts for the PLANEX portal and the VIKING LMS.

Conclusions

In total, over 700 course completions were registered, and an additional 1,000 courses were initiated but not completed. The *Introduction to VIKING* course was by far the most popular, with 588 initiations, 369 completions overall, and 342 completions before the exercise began. Given the participation level and positive user assessments, the exercise's eLearning component was a success.

Still, using ADL in VIKING 18 was in part an afterthought. The ADL WG was formed after the initial planning conferences and meetings. Not being part of the planning in the early stages had several consequences, including difficulty in securing sufficient funds for ADL, problems with producing and updating courses, and complications with automating the LMS system due to manning list shortcomings that would have been discovered earlier had the ADL WG been part of the process from the beginning. Failure to adequately inform participants about eLearning throughout the entire planning and pre-training process led to a lower-than-expected use of ADL resources. The EXEVAL team concluded in the First Impressions Report:

> *The lack of clearly understood minimum requirements of the pre-training and WUST also led to some elements of the pre-training material being developed explicitly for the exercise not being used to its full potential. For example, the use of the e-learning modules was very low.*

Because the ADL courses used in VIKING 18 were mostly legacy courses from multiple sources, they covered only part of the specific exercise themes and training objectives. ADL courses are more useful if their content is tailored to match an exercise's particular training objectives, and their scope and length are limited to focus on information clearly of interest and value to the learners in the exercise.

Recommendations

Formalisation:

- Integrate ADL into all exercise phases (pre-training, WUST, execution, evaluation, POSTEX).
- Make ADL part of the CPT.
- Form a CPT-mandated ADL WG in the planning process.

Communication:

- Improve strategic communication about ADL to leaders, trainers, and trainees.
- Make sure Exercise Guidance, calling messages, and the Exercise Plan (EXPLAN) clearly state that participants are required to do mandatory eLearning content before the exercise.
- Plan how to reach out to partner heads and their participants, and make sure partners are properly mandated to do pre-training.

Learning resources:

- Tailor key content to the exercise and align it with the training objectives and exercise themes.
- Recommend content for different elements in the exercise.

- Make ADL courses modular and as short as possible. (Content quality is more important than content quantity.)

Access:

- Provide internet access as close to the participants' workstations as possible.
- Use microlearning to support anywhere/anytime ADL access (e.g., at home, travelling to the exercise, in the exercise site hotel room or barracks, within the exercise execution area) and to promote just-in-time learning during the exercise.
- Ensure ADL system usability.

Evaluation:

- Make sure ADL is a part of the EXEVAL effort.
- Give the EXEVAL team full and immediate access to the exercise learning analytics dashboard.

4.2 NATO Standards Exercise, Ukraine

Background

Even as the field of learning analytics becomes increasingly sophisticated, many nations/partners currently lack the capability to produce high-fidelity determinations of how military exercises have specifically improved personnel readiness. This challenge is magnified in multinational environments, due to a lack of standardised measures. The NATO Standards exercise in Ukraine was conducted 17-22 June 2020 with 81 participants at the National Defence University of Ukraine (NDUU).

The exercise aim was to develop Military Staff Officers' professional competencies in planning and conducting combat actions of military units and inter-service operations of troops according to NATO standards.

The exercise was supported by the U.S. ADL Initiative's Maturing ADL in Exercises (MADLx) project. MADLx aims to build the foundations for measuring learning effectiveness in mission rehearsals to help management make better decisions about the best ways to use different learning approaches in multinational exercises. The goal of this research study is to develop and field test measurement standards with analytics-enhanced learning content in exercises, and to visually represent those analytics in a dashboard.

ADL Content

The ADL pre-training component covered the theoretical foundations of the operational planning procedures and work of a joint headquarters. ADL pre-training also addressed the development of operational documents in accordance with NATO standard STANAG 2014. The NDUU randomly assigned 11 participants to serve as a control group and the remaining 70 participants to two treatment groups. The treatment groups had access to the ADL content, while the control group was provided the same material in traditional paper form. Data on the participants' relative success at meeting the mission rehearsal objectives was anonymously collected from student learning on the online platform and within the exercise itself. The xAPI-compliant ADL performance data fed the exercise dashboard in real time. The observer data remained non-standardized and was presented to MADLx during the exercise. This was the first time that NDUU had used native xAPI standardised courses.

Participant Feedback

All participants completed a post-event survey, which included a question on how they felt the ADL pre-training courses had affected their exercise performance. Nearly all noted some kind of positive effect, with 63% saying the ADL content provided them with new interesting knowledge. (Figure 4-3)

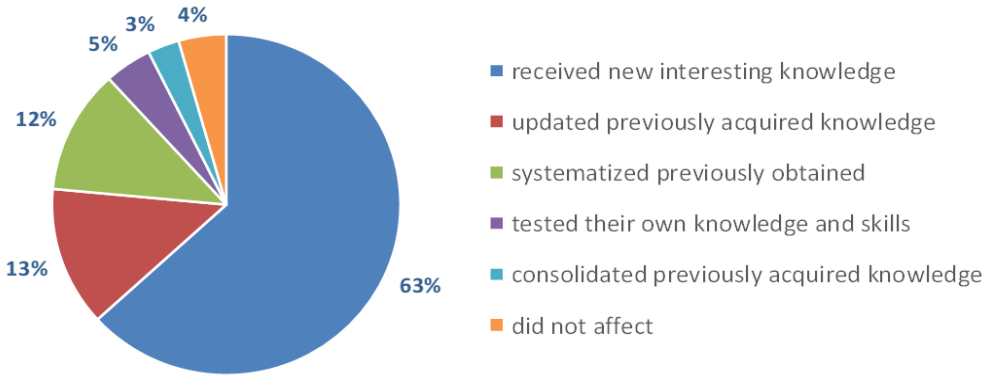

Figure 4-3. NATO Standards participant survey on ADL content.

ADL and Performance

The two treatment groups were provided with the ADL materials as recommended pre-training and an integral part of the exercise, and their results dominated overall performance results (Figure 4-4). The treatment groups achieved an average of 8.11% higher results for all exercise objectives and team averages over the control group, which had received traditional paper-based pre-training.

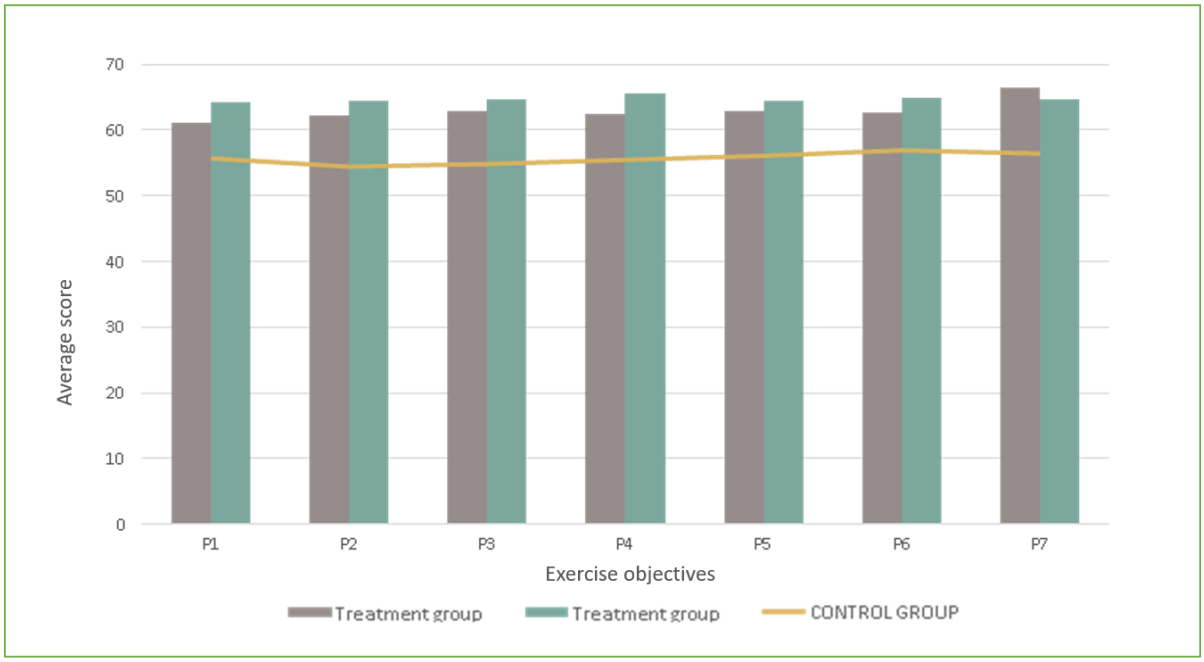

Figure 4-4. NATO Standards exercise performance by objective.

Conclusions

The exercise successfully measured and visualised improved operations effectiveness by participants who utilised ADL content. The MADLx project/exercise executed a solution that was fully integrated into the planning and operations environment of the existing exercise. The exercise learning analytics revealed gaps in participant readiness and highlighted the need for improved pre-training in the next iteration of the event. The xAPI-compliant ADL solution sustained no intrusions into the Learning Management System (LMS), Learning Record Store (LRS), or Learning Analytics Dashboard (LAD) in an active hostile security environment. The exercise met all standards, measured a meaningful, actionable result relative to the training objectives, and represented this measurement in an intelligible real-time dashboard.

Recommendations

- Integrating ADL early into exercise planning can achieve an exceptional match between the learning objectives of eLearning courses and the exercise training objectives.
- ADL performance can be monitored live during pre-training on a dashboard with more than 15 data visualisations showing performance, comparisons, and behaviour of the training audience.
- Exercise stakeholders should receive basic xAPI implementation training.
- Analytics can inform and enable midstream corrections to pre-training.

4.3 Bold Quest

Background

The Coalition Capability Demonstration and Assessment series, known as Bold Quest, fosters Joint and Coalition resource pooling, collaborative data collection, and data analysis to inform capability development on a Joint and Coalition scale. The purpose of the Bold Quest series of events is to improve interoperability across systems, services and nations. It fosters rapid and accurate information exchange, providing the warfighter with battlefield situational awareness to support decision making against modern and traditional opponents and increasing lethality among joint and coalition operations.

Bold Quest was originally conceived in 2001 as an Advanced Concept Technology Demonstration (ACTD), with the first operational demonstration in 2003. The ACTD was extended twice at the request of the participant nations and services to accommodate an expanding scope of work. Bold Quest then transitioned from an ACTD to a recurring cycle of collaborative capability demonstrations and analysis.

The Bold Quest 20:2 live exercise was held from 24-30 October 2020 at Camp Atterbury, Indiana, with 54 participants (down from the initially planned 108, due to pandemic-related cancellations).

ADL Content

The planning process included the preparation of an ADL online pre-training course on the use of the Android Team Awareness Kit (ATAK) system. This was the first time that the exercise organiser used an alternative xAPI standardised course. MADLx created a native xAPI course and enrolled all participants in an independent Learning Management System (LMS) for access. However, only 12 international (Belgian) participants and U.S. Subject Matter Experts (SMEs) attended the virtual learning environment for pre-training. Their interaction was modest and collected 4,164 xAPI statements. The LMS was the only source of xAPI data. With the Belgian participants' withdrawal from the exercise because of the pandemic, their statements could not be compared to the live exercise data.

Data Collection

Unlike many other exercises, data collection activities represented an integral part of the Bold Quest exercise, albeit with essentially no usable data from the ADL content. The collection methods included the following data procedures at the live exercise:

- A designated Learning Record Store (LRS) collected data on participants who attended the online pre-training.

- Participants were asked upon arrival to complete informed consent, demographics, and additional knowledge and self-assessments, if designated.
- Participants completed a mission-related survey upon commencement of training activities.
- Researchers observed participant performance on meaningful activities tied to the training curriculum.
- System instrumentation and audio collections occurred during virtual or live scenario performance.
- Upon completion of each day's activities, participants completed the Mission Awareness Rating Scale (MARS), a reaction survey, and additional self-assessments.
- Participants completed an overall reactions survey and additional self-assessments at the end of the exercise.
- Researchers asked individual participants a series of questions in the form of semi-structured interviews.

Based on the self-assessments of the participants, MADLx reconstructed their opinions on exercise performance and overall mission success. Opinions were organised into Squad (SQUAD) group, Leaders (LDR), Anonymous (ANON), and Exercise Control (EXCON). Participants rated both the mission's success from their perspective and their own performance, ranked on a scale of 1 (Not at all Successful) to 10 (Very Successful). The aggregated average results showed that EXCON performance matched the mission achievements at a very high rate. SQUAD average opinions were rated lower for both their performance and mission achievements. Similarly, the LDR group rated the achievements lower, but with less of a difference between the mission success and their performance. The ANON group (those participants might belong to any said group) rated the mission success highly but noted discrepancies with performance.

Conclusions

We were not able to measure and visualise improved operations effectiveness by participants who utilise ADL content because the pandemic undermined the ADL effort by eliminating international participation. We also were not able to utilise the ROI dashboard or give actionable analytics on the training environment to maximise performance success and improve the learning environment. Furthermore, last-minute shifts in participants and support personnel resulted in U.S. exercise participants failing to utilise the online training assets, and institutional inertia behind a heavy reliance on paper reporting resulted in limited use of the online self-evaluation survey instrument. Targeted sensor data from the exercise ultimately was unavailable to MADLx for analysis, demonstrating that data which can land in the Secret Internet Protocol Router (SIPR) is highly vulnerable to breakdown in coordination.

However, ADL demonstrated the capability to be integrated into and support even a highly disrupted exercise event. We executed a solution that was fully integrated within the planning and operations environment of the existing exercise with a continuous supporting role. With early integration of ADL into exercise planning, we matched the eLearning courses to the training objectives. Processing and delivery of analytics with useful visualisations was accelerated, especially for legacy analog paper-based reporting, and multiple data streams on exercise participant performance offered resilience to

analytics delivery, even as the primary performance data was made unavailable. In addition, there were no security issues for the LMS, LRS, or Learning Analytics Dashboard (LAD).

Recommendations

- Assure ADL involvement in planning from an early stage, and directly link ADL with shortening the preparation time at the live event and consequent savings. (For example, make online preparation mandatory, and dedicate in-person time for other elements of mission preparation.)
- Establish protocols for U.S. military personnel to access online resources which reside internationally.
- Establish protocols for live-streaming non-classified data into the MADLx ROI dashboard, instead of relying on a totally paper-based collecting process, with its subsequent wait for the data. (For example, establish the role of the ROI dashboard in expansive analytical research done by other researchers in the Bold Quest exercise series.)