

Title: How we created NMA elearning modules to enhance distance elearning courses and self-study

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Abstract

The goal of the nuclear material accounting (NMA) elearning modules is to deliver high quality learning objects to supplement the delivery of State System of Accounting for and Control of Nuclear Material (SSAC) courses. At the beginning of 2020 the SSAC course was moved completely on-line and this gave the IAEA trainees the opportunity to “think out of the box”. Instead of lectures and quizzes, the IAEA implemented the method of blended learning called flipped classroom¹, where the aim is to increase student engagement by having the students complete the readings and lectures at home, and work on live problem-solving during class time. Participants were asked to view the NMA lectures and elearning modules at home; during class time a brief introduction to NMA concepts was conducted and a question and answer session followed. In addition, participants broke out into smaller groups and together with experts, completed interactive on-line reports for the IAEA. The flipped classroom approach provides the traditional in-person benefit of working with safeguards experts, and provide the learners with on demand topic-based¹ learning where they are free to skip the portions of content they already know, and focus on the content that they do not know. Moreover, the on-line resources are available to the participants long after the course has been completed and are easily accessible to anyone with an account to the IAEA learning management system. This paper will describe how engaging elearning modules were created and implemented that provide topic based² learning for NMA concepts.

Introduction

There are many benefits of traditional in-person courses; for example: meeting with experts, meeting with other students, engaging in lively discussions during social time, travel to a different location, and hands on exercises. Obstacles to a traditional in-person course include; courses can be scheduled too far into the future and not frequent enough to meet the immediate need for training. Travel to the location of the course can be expensive, time consuming and students may be turned away when the course capacity is reached. These obstacles can leave many learners to figure things out for themselves, this situation is at best a good learning experience but at worst may lead to costly mistakes. One of the tools available to reach a wide audience is the use of the internet. The internet does not guarantee access to for everyone but it does widen the reach from the traditional in-person course. Courses conducted via the internet may also have attendee limits.

The effort to create Nuclear Material Accounting (NMA) elearning modules for the IAEA began before the COVID pandemic. The goal of the NMA modules is to provide on-demand learning materials with the objective of improving the quality of the NMA reports sent to the IAEA by the Member States. These elearning modules were supposed to be an addition to the in-person

Regional and international State System of Accounting for and Control of Nuclear Material (SSAC) courses. The SSAC course is a two-week in-person course that covers the basic concepts of Safeguards, the audience consisting of Member of States that have a legal obligation under Safeguard agreements and arrangements. Students usually travel to the location of the course and interact with each other and the instructors during the course. Due to the COVID pandemic, the 2020 regional SSAC course in Japan was moved 100% online. The pandemic and the need to conduct all classes virtually provided a unique opportunity to use the existing elearning modules and create new modules to assist in a blended learning approach called flipped classroom.

A flipped classroom has asynchronous and synchronous learning elements. The student is expected to complete assigned readings, videos, quizzes, and participate in discussions before the virtual synchronous session. The instructor guided virtual synchronous sessions to examine a more in-depth review of the material presented in the asynchronous elements. The range of topics covered in the synchronous session are guided by the students interests.

This paper will outline the efforts that were undertaken to provide a comprehensive SSAC course virtually through the use of the flipped classroom blended method. In addition, in this will outline the outcomes and future possibilities for virtual online courses.

Objective for elearning

We used the SMART³ method (Specific, Measurable/Observable, Attainable, Relevant, Targeted) to create meaningful learning objectives for Nuclear Material Accounting in Facilities, Location Outside Facilities (LOF), and Pre-34C reporting requirements. The audience for the elearning modules consists of Member States that have an obligation to report NMA to the IAEA. The objectives are as follows:

- List the documents containing the Safeguards Agreements and Arrangements pertaining to NMA
- Define Accountancy
- Describe Activities for Nuclear Material Accountancy
- Describe Nuclear Material Accounting concepts
- List the primary aspects of a Material Balance Area
- Define how Key Measurement Points are used for NMA
- List Nuclear Material Types under full Safeguards
- Give an example of a Nuclear Material Batch
- Describe the purpose of Code10
- List the Nuclear Material reports for the IAEA
- Compare Material Balance Report to a Physical Inventory Listing and an Inventory Change Report

Method

Online learning can provide learning for different levels of learners, a basics information level, interactive ‘try it’ exercises, in-depth information and source documents. In online learning students are required to be self-motivated and complete the required assignments before class. The instructor has less control as to what content the student actually reviews, this may make some instructors feel uncomfortable. In contrast to in-person learning students may feel more

pressure, because they may be required to complete their regular work responsibilities in addition to the assigned course work.

Due to the differences between online and in-person learning the design and delivery of a blended training approach must be different than the in-person course. A few days before the synchronous course began the students were given access to a Moodle⁴ website that contained the homework assignment and the instructor presentations. A virtual ‘ice breaker’ social was hosted so that students can meet each other virtually. The hands-on part of the SSAC NMA course was accomplished with interactive online exercises⁵.

The elearning modules were created using Articulate Storyline 360, the screencasts were created using Articulate Replay, interactive NMA reports exercises were storyboarded by the IAEA and created by an external contractor, and most presentations were created with Power Point.

How are the objectives accomplished in a virtual environment?

The SSAC course was structured so that students had no more than two hours of homework assignments (asynchronous) each day, reading, watching videos, completing elearning modules and finishing quizzes. The live video conference (synchronous) was conducted via the Zoom platform and was three hours long. The three hours of ‘live’ instruction was broken up with lectures, question and answers, knowledge checks, and workshops.

The IAEA website (asynchronous) for the learning management system (LMS) used a Moodle platform. Elearning modules were designed to be short and cover single topics. Each module contains the following information; time to complete, date when the module was last updated, and a printable version of the module (PDF). The interactive exercises were designed to provide hints and the correct answers for the students. For the interactive exercises the student is expected to learn by making mistakes. Screencasts of the completed exercises are also available. For those students wanting to learn more in-depth there are supplemental interactive exercises with scenarios.

Workshops (synchronous) were conducted with groups of 4 students and a facilitator. The break out room feature in Zoom was used to divide the students into groups of four students each facilitated by an IAEA State Declarations analyst. Each group was expected to complete at least one Inventory Change Report, Physical Inventory Listing, and Material Balance Report. The subject matter expert facilitator chose their own method on how to guide each workshop.

Outcome

This was our first experience producing and delivering a blended online training course for the SSAC. The feedback from students indicated that they appreciated the elearning modules and overall the student feedback was good.

Some of the Student Comments have been copied below:

- *However, the study online requires more self-motivation and time management skills. IT is self-paced learning which you can start completing the targets at any time. Reference videos, course materials, and examination scores are saved and can be viewed multiple times, with no limit. Online courses are extremely cost-effective and can be utilized efficiently.*
- *I think having a break between each session is a very good strategy as I think people cannot*

keep concentrate in front of the screen for a long time. Breaking for 10 minutes every 30-40 minutes is a good choice and make the course more effective.

- *This Course is too comprehensive; hence, the course period needs to be reconsidered. There were too many interesting topics to cover with a very limited time apportioned.*
- *These elearning materials help me to understand ICRs, PILs, MBRs [Inventory Change Reports, Physical Inventory Listing, Material Balance Reports].*
- *All of the E-learning materials are well designed and resourceful.*

Students and the instructors had difficulties with using the technology needed for the course. Video, audio and connection problems were some of the difficulties. Unforeseen circumstances such a tropical storms, unreliable internet and workplace limits on web conferencing software, provided obstacles for all. Instructors and coordinating staff had to quickly learn and decide on what kinds of tools and platforms would be used for the courses. This at times meant that there were more support staff than students for the course.

Teaching in a flipped classroom is very different from the traditional in-person courses. A flipped classroom requires more work from both students and instructors. The emphasis is not on passive learning, but rather discussions, and though-provoking exercises. The students are expected to complete the required homework. It was found that in some instances the student had to perform most of their work duties in addition to attending the course. This created some stress for the student and therefore hindered the learning process.

The instructors reworked their presentations, making them interactive. But what does interactive mean? We had to invent what an interactive presentation looked like. We decided to turn our objectives into questions and ask these questions during the class. We used annotation tools, reaction emojis, chat messages and voice to allow students to interact. If the students didn't participate then the course would feel flat and uninteresting. In many ways our instructors needed to be entertainers as well as teachers.

Time management was a challenge. Some lectures required more time than allotted, hence we shortened some of the breaks. This was not liked by most students as they needed their breaks. For some students 3 hours of screen time was too long while some wanted more. Some students wanted to have the unscripted time that happens at the water/coffee stations, or the discussions over breakfast or dinner as is typical in an in-person course.

Lessons Learned

The flipped classroom model is not a passive learning method, it requires that a student do the pre-work and be actively engaged during the 'live' course. The student's had connectivity issues, and technology restrictions from their employers. Instructors were expected to learn new technology and had to teach and manage shared resources, chats, video, onscreen annotations, and figure out how to engage with non-participating students. The outcome of the SSAC course was overall good but there is room for improvements.

We need to better define what an interactive virtual course looks like. Is it simply the correct answers on a poll? Are we asking the students to internalize the facts and come to class prepared to debate, discuss and create? Students are expected to finish all the required pre-work; how do we encourage employers to provide the students with the time to do homework? How do we create virtual water/coffee breaks or other breaks to create non-scripted student interactions? We need have a better plan on what happens if the group is not interactive, or don't work well

together. How do we provide a safe space for those who are too shy to participate? These are questions that each organization has to answer for themselves.

Does a flipped classroom approach have the possibility to truly engage the students? The flipped classroom model has been researched mostly for K to 12 and university students, these are populations that can be called professional learners. A professional learner is a person whose main task is learning, for example in school or university, in many ways a professional learner has mastered the skill of learning. Professional learners may be more comfortable with listening to lectures and have practice taking notes and formulating questions. The skill of learning is better polished in those who are active in learning every day, perhaps without many other distractions.

The elearning approach for corporate learners has not been researched as thoroughly as it has for professional learners. Corporate learners are persons who are engaged in a course in order to learn a new skill and produce something for their employer. They do not have learning as their sole focus. A corporate learner may be juggling the training course with a deadline at work along with other work-related tasks. Their focus is not on practicing the skill of being a student, so this skill may dull. Corporate learners have a different set of obstacles than professional learners and these learners would benefit from more in-depth study.

There are benefits in using the flipped learning approach for corporate learners. These benefits include: giving the students access to all learning resources weeks before the start of the course, the ability to conduct shorter but very focused discussion groups, allowing days long open conversations on a topic, and providing access to experts located anywhere in the world. There is room for more research on the efficacy of the virtual flipped classroom model for corporate learners.

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