Migrating Nondigital Learning Events for xAPI Data Collection

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ABSTRACT

An estimated 70% of learning occurs informally, often outside a digital environment (e.g., ad hoc, self-learning, just-in-time), and generates learner experiences not captured by an Experience Application Programming Interface (xAPI). As a result, some learner data are excluded from evaluation, thereby skewing interpretation of training effectiveness. Capturing nondigital learning event data allows educators to better understand the learner's needs.

This paper reports the results of migrating Ground Control Station (GCS) familiarization nondigital training events into a series of digital training events. Using the ADDIE method—Analyze, Design, Develop, Implement, Evaluate—the master training task list (MTTL) for a Remote Piloted Aircraft training program was analyzed along with required proficiency levels for each training task. Analysis data were used to identify levels of interactivity, instructional methods, and media training effectiveness. This analysis provided recommendations on training events that could be migrated from nondigital to digital training.

Limited by time and budget, the selected method and media were assigned to training objectives before developing our prototype. Reading materials, a pretest, and virtual instruction (prebrief, lesson content, and postbriefing in a VR environment) followed by a test, were used to run a sampling of learners through a GCS familiarization lesson. Data capture requirements were based on interviews with instructors, site managers, program managers, and instructional systems designers. A subset of the data collected for this study was compared with results from a Control Group that uses traditional nondigital training events. Study results suggest that testing and lesson times can be reduced without compromising learning.

This paper presents a pathway to migrating nondigital events to a digital environment with captured xAPI data. Further, it proposes a strategy for use of xAPI profiles in addition to metadata, resulting in increased efficiencies, better learner engagement, and more useful learner data to apply adaptive learning technologies.

ABOUT THE AUTHORS

Martin Bogan is a training solutions expert and multimedia design lead for CAE USA's Instructional Systems Group. Over the past 10 years, he has led several innovation projects in the areas of courseware design, virtual reality and use of xAPI. Martin has contributed to the xAPI standard with a recent submission of a new xAPI profile consisting of Department of Defense verbs and metadata for use in all military training.

Scott Bybee is a training leader with over 20 years of experience in the industry, including working as a learning technologist with a world-class learning and development team, one that has been recognized in Training Magazine's Hall of Fame for top performances across several years. Finding innovative ways to deploy training is a cornerstone of Scott's work in the industry.

Thomas O'Connell is a learning standards and technology consultant. He is a contributor to the xAPI specification and was previously with Rustici Software, where he was the lead investigator on research that led to significant policy updates included in the recently reissued Department of Defense Instruction 1322.26 *Distributed Learning (DL).*

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IDENTIFICATION OF PROBLEM

Organizations are faced constantly with critical training-related decisions (what to include, what delivery methods to use, when to provide remediation, etc.). Missing the mark can cause severe ramifications, especially in mission-critical functions. In many cases, lacking the ability to analyze solid data required to make these decisions stems from the inability to collect data. Much of the training is either nondigital in nature or not designed in a way that performance can be tracked easily. It is estimated that 70% of learning occurs informally (McCall, 1985) and often outside a digital environment (e.g., ad hoc, self-learning, lecture, just-in-time, etc.). In cases where digital content is used, learner data is not tracked unless launched from the Learning Management System (LMS) which still provides only very limited information, leaving educators guessing about best practices instead of relying on empirical data to guide them.

The Department of Defense (DoD) has acknowledged the problem and determined that a change in armed forces training philosophy is in order. In 2017, the U.S. Army Learning Concept for Training and Education (ALC-TE) outlined philosophy changes in how learners should be trained (Learning Concept, 2017; Training Concept, 2011). It describes an environment in which continuous, adaptive learning occurs and facilitates a career-long continuum of learning. The concept focuses on individual learning that is integrated seamlessly with unit training capabilities. The learning must be agile and adaptive, with the ability to respond quickly to identified gaps where and when needed. The new focus is on innovative personalized learning systems, where each person is responsible for their individual career-long learning pathways.

The U.S. Navy has a similar program, known as Sailor 2025, which describes a career learning continuum called "ready, relevant learning, and career readiness" (Sailor 2025, 2017). In this initiative, one of the core components replaces one-and-done classroom training events with career continuums supported by a mix of classroom instruction with modern training methods tailored to the unique requirements of each career path.

Experience Application Programming Interface (xAPI) is a mechanism for tracking granular details about learner experiences. We can use xAPI to provide immediate feedback both to the learner and to the instructor, thereby remediating at the time of need as opposed to waiting for a final test score. Because xAPI provides a greater level of training-related details, more extensive trend analysis is also possible, exposing both strong and weak areas in a training curriculum while empowering more effective and immediate adaptive and predictive learning.

This paper reports the results of CAE USA's research and development study utilizing a strategy to migrate nondigital (both informal and formal) training events into digital content with xAPI data collection standards applied. To broaden our understanding, we chose to utilize as many content source types as our lesson content would allow.

DEFINITIONS

The "working" definitions in this section are here to facilitate a common understanding.

Digital Training: any formal or informal training where the learning environment allows for digital capture of the learner experience; for example, reading a digital textbook, viewing a computer-based lesson, or engaging in a virtual simulation session.

Formal Learning: any type of learning program in which goals and objectives are defined by the training and education department, the instructional designer, or the instructor.

Informal Learning: any type of learning that occurs outside a structured or planned training environment. Informal learning can occur as a natural part of another activity and usually is guided by the learner's own self-interests.

LMS (Learning Management System): a software application for the administration, documentation, tracking, reporting and delivery of e-learning educational courses or training programs.

LRS (Learning Record Store): a cloud-based data storage and retrieval system serving as a repository for learning records collected from connected systems where learning activities are conducted (Berking, 2016). It is an essential component when using xAPI.

Nondigital Training: any formal or informal training where the learning content is not in a digital format and the environment does not allow for digital capture of the learner experience; for example, reading a textbook and listening to a lecture.

SCORM (Shareable Content Object Reference Model): a collection of standards and specifications for web-based e-learning. The standard defines communications between client-side content and a host system called "the run-time environment," which is commonly supported by a learning management system. SCORM also defines how content may be packaged into a transferable ZIP file called "Package Interchange Format."

xAPI (Experience Application Programming Interface): an e-learning software specification that allows learning content and learning systems to speak to each other in a way that records and tracks all types of learning experiences. This enables nearly dynamic tracking of activities from any platform or software system—from traditional Learning Management Systems (LMSs) to mobile devices, simulations, wearables, physical beacons, and more.

DESCRIPTION OF THE R&D PLAN AND METHODS

The study was part of a larger R&D plan designed to advance xAPI knowledge and strategic use within aviation training programs. The plan was broken into three main objectives:

- Objective 1 Categories of Data to Collect
- Objective 2 xAPI Strategy
- Objective 3 Migrating Nondigital Content for xAPI Data Collection

Objective 1 (Categories of Data to Collect) started July, 2017, with the goal of determining data collection and reporting requirements. We conducted brainstorming sessions and interviews with Instructional System Design (ISD) experts, former aircrew members, managers, and aircrew instructors to collect what data types each group would find valuable in making decisions on how to improve training for their learners. Results were documented and organized into data categories such as aircraft flight data, simulator flight data, performance validation, instructional material validation, personal experience, and SCORM data.

Objective 2 (xAPI Strategy) started August, 2017, with the goal of establishing an xAPI profile and strategy for use in military aviation courseware. We selected a data type with the biggest impact in enabling performance analysis and adaptive learning. We created an xAPI-compliant profile for capturing over 400 learner actions (verbs), verb definitions, verb categories, level of interactivity, and learning types to create the first military-focused xAPI profile (*Development of Interactive Multimedia Instruction*, Tables 23–25, 2001). The new DOD ISD Profile was listed as an xAPI conformant profile by the Advanced Distributed Learning (ADL) Initiative in February, 2018.

Objective 3 (Migrating Nondigital Content for xAPI Data Collection) started December, 2017, with the goal of using xAPI to track the learner experiences in a training program where almost all class-related activities were traditionally nondigital. Once content was in a digital environment, we would be able to track learner experiences and use the same data to create an adaptive learning environment during the training.

The content selected was from a U.S. Air Force Remotely Piloted Aircraft (RPA) training program. We migrated four hours of introductory and familiarization learning events for the Ground Control Station (GCS) device that pilots use to control the aircraft. Traditionally, instructors guide students on a tour of the device, introducing them to the various components and preparing them for more interactive simulation training. Because this introductory lesson is nondigital, student attendance was the only data captured historically. This lack of robust data capture failed to document learner engagement or retention prior to subsequent training events. Instructors commonly complained about how unprepared learners were prior to a high cost presentation in the GCS simulator. Instructor briefings provided opportunities for feedback, but chances for meaningful remediation were late to need, subjective in nature due to memory loss, and expensive. This program was suffering from deficiencies in data tracking and had the most potential to benefit from collecting xAPI learner experience data.

DESCRIPTION OF THE STUDY

Once we had selected a training program for migration to a digital environment, we ran two groups through a study to determine effectiveness of the training. The Control Group completed a series of learning events similar to those completed by traditional learners. However, we did not have access to the actual GCS device, so we replaced that portion of the lesson with a virtual reality-based device. In effect, this gave the Control Group the equivalent of a traditional instructor tour of the device. We opted not to collect any learning data on the Control Group until a final scored test. This approach replicated the lack of information available to a traditional instructor and program administration.

The Test Group accomplished all of their training events in a digital format. xAPI statements (including our conformant xAPI profile) were added to the content. Our LRS stored all training data. During the virtual reality GCS device lesson, the software retrieved data from the LRS to provide branching opportunities to the learner. Our ISD team used the data again to produce reports for overall learner performance analysis.

Figure 1 illustrates the training events and how data were passed to and from the LRS. The test used an LMS for authentication and content launch purposes only. Our test events produced both SCORM and xAPI data, but only the LRS data were needed for analysis.

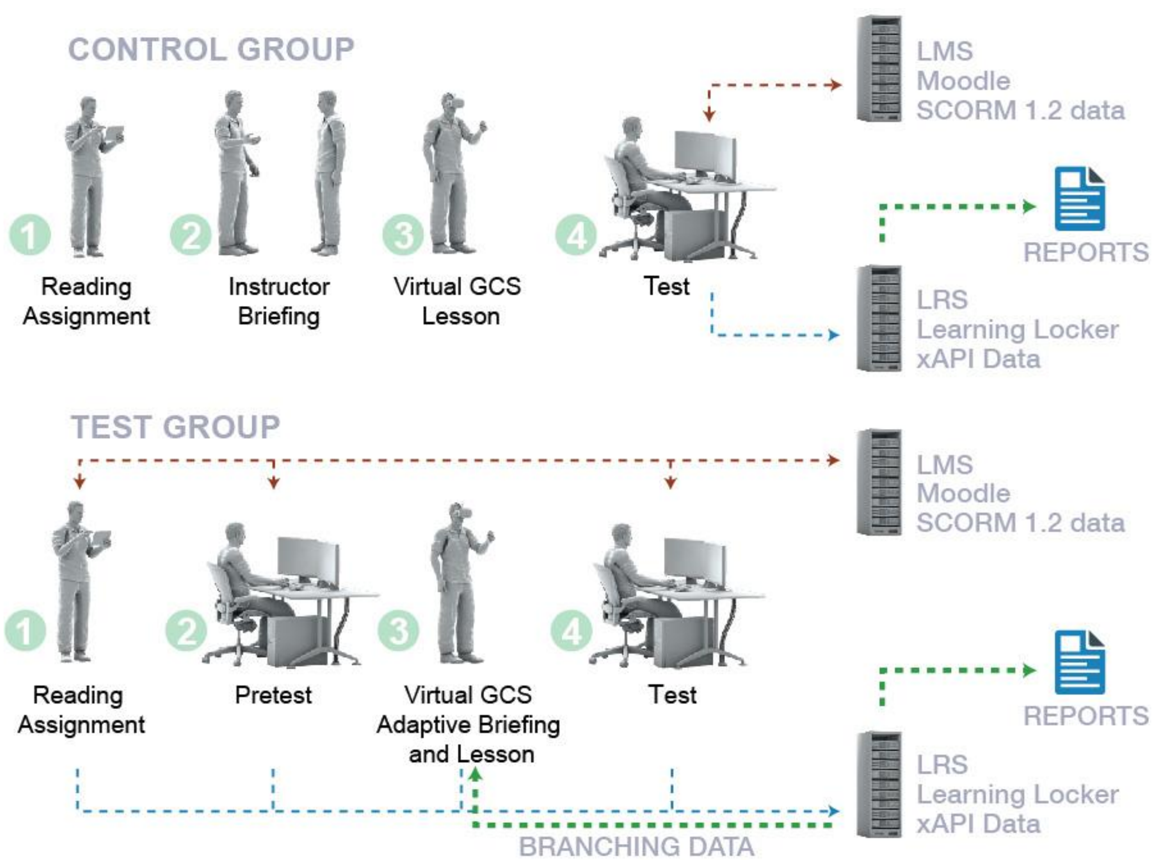

Figure 1. Proof of Concept

Final test results indicated that the Test Group had shorter test and virtual sim durations, along with improved test scores compared to the Control Group. The sample of learners was not sizable enough to make definitive conclusions; however, the results provided valuable insights that should be explored further with larger samples.

Table 1. Results Summary

Learner Groups	Avg. Virtual Sim Time	Avg. Posttest Time	Avg. Posttest Score
Control Group	20 min	4 min 21 sec	66.93
Test Group	3 min 50 sec	3 min 2 sec	77.26

Test Groups and Control Groups

Sample groups were selected from CAE USA staff and organized into small groups of six. Each group contained a balanced mix of age, gender, and background. All learners were U.S. citizens with English as their primary language. Some individuals were former military aircrew members. None of the learners were experts in the subject matter.

Data Collection

The follow data categories were collected from the Test Group xAPI statements: event completion, objective completion, time spent, and score. Event completion, time spent, and scores were collected for Control Group learners. xAPI data were transmitted to a LRS set up specifically for this study. SCORM 1.2 data were delivered to the LMS to mark event launch, progress, completion and scores. Data were retrieved only from the LRS for analysis at the completion of the study.

Communication

Learners in each group received independent emails daily with instructions and training tasks. Each email advised the learner not to discuss study details until all testing was complete.

Table 2. Training Event Schedule

Group	Day 1	Day 2	Day 3	Day 4
Test	Reading Assignment	Pretest	Virtual Simulation Session	Posttest
Control	Reading Assignment	Virtual Simulation Session with Prebriefs and Postbriefings	Posttest	N/A

Reading Assignment

Flight manual documents comprised the reading materials. Learners were given a one-hour limit, with no guidance on which sections to place focus.

The Control Group’s reading materials were provided in PDF format via a server link for convenience of delivery and paper conservation with no digital tracking added.

The Test Group’s reading materials were broken into smaller PDF files. PDFs do not natively support xAPI, so they were embedded and presented within hyperlinked web pages, where xAPI calls could be added and controlled. The web pages were accessed in the LMS to provide learner authentication to the LRS. xAPI code was added to collect learner data by each section.

Pretest and Posttest

Randomized multiple-choice test questions related to the reading materials and the training objectives were developed and administered through the LMS. Only the Test Group received a pretest to enable content branching during the main lesson. xAPI statements covering test launch, time in test, questions answered, and score were sent to the LRS. Duplicate data were sent simultaneously to the LMS using SCORM 1.2 standards. The main purpose of the LMS launch was to provide learner authentication to the LRS.

Prebriefs and Postbriefings

Control Group briefings were provided by a live instructor in a nondigital environment. All Control Group learners received the same prebrief and postbriefing. The objective of the prebrief was to prepare the learner for the virtual simulation session and provide guidance on learning objectives. The postbriefing was provided to allow the learner to give feedback to the instructor and get clarification on information provided during the virtual simulation session. Data were not collected for these events.

Test Group briefings were migrated from a nondigital experience to digital by developing a virtual instructor within the simulation session. Learners were required to enter an authentication ID to initiate the session. Simple artificial intelligence (AI) in the form of branching was added to the code, allowing the virtual instructor to adapt the briefing message to each learner. This was accomplished by building a query to the LRS from inside the android VR application. Cross-checking the learner ID with pretest scores allowed the AI to branch content. Low pretest scores resulted in a longer prebriefing and lesson in the sim. High pretest scores allowed for bypassing lesson content, at the learner's option. A postbriefing was in the form of a self-check, which provided the learner with remediation recommendations prior to the posttest. xAPI data were collected on all self-check learner actions, scores, and times.

Ground Control Station VR or Virtual Simulation Session

The Ground Control Station familiarization lesson was converted from an instructor-led lesson into a virtual reality simulation session. Learners were scheduled for individual sessions in a virtual reality lab. They were greeted by an instructor who assisted with the virtual headset and monitor for safety. All learners were authenticated on login.

Control Group learners were provided the full 20-minute session. Launch, completion, and time-in-session xAPI data were sent to the LRS.

Test Group learners were branched to a full 20-minute session or a partial session based on their xAPI pretest score data, which the application requested from the LRS. This adaptive approach allowed advanced learners to bypass up to 15 minutes of training, if desired, and move directly to the self-check and postbriefing.

Hardware and Software

Reading materials and tests were deployed to standard HP systems, ranging from 420 to 620 CPUs with Windows 10 OS using Google Chrome or IE 11 web browsers via a Moodle© SCORM 1.2-compliant LMS. Reading materials for the Control Group were accessed via LAN since xAPI tracking was not required. The virtual simulation session was deployed to an Android "Oreo" Google Pixel Phone as an android VR application. xAPI data was sent to the LRS via WIFI with internet access. Cellular data service also allowed communication. Adobe Acrobat Pro®, Adobe Dreamweaver®, and Microsoft Visual Studio® were used to create the final reading media.

Tests were created using IBM LCMS software published to a custom viewer with SCORM 1.2 compliancy. A series of post publish edits added xAPI calls and an xAPI wrapper. Tests were scheduled and delivered through Moodle 3.3.

The virtual simulation session was a VR application developed with Unity 3D®, Microsoft Visual Studio®. Programming code was managed in GitHub. 3D models were built using Cinema 4D® and Autodesk 3DS Max® software. Adobe CC Auditions® was used to develop audio components of the virtual instructor.

xAPI data were stored on Learning Locker® 1.17.0 LRS hosted on Amazon Web Services® (AWS).

XAPI CAPTURE PLAN AND METHOD

The xAPI capture plan was to gather consistent learning experience data throughout each training event. Table 3 describes the data captured by xAPI statement calls across the various methods and media. The decisions of verbs to capture were based on anticipated reporting needs and training objectives prescribed by the lesson.

Table 3. Course Components and Associated Data Collected

DATA COLLECTED	COMPONENT 1: Reading Assignment	COMPONENT 2: Pretest/Posttest	COMPONENT 3: Virtual Simulation Session
Content Launch	X	X	X
Selection Read	X		
Length of Time (per unit and whole)	X	X	X
Overall Score		X	X
Each Question Answered (question, choice, and score)		X	X
Objective Verb Experienced (SKA, interactive level, verb category)	X	X	X
Completion	X	X	X

Because xAPI provides a more granular tracking capability, we needed to document exactly what should be tracked, then map each xAPI-tracked event back to course objectives and tasks being taught.

Table 4 shows the report requirements that we determined were needed for analysis.

Table 4. Report Requirements by Media

MEDIA	REPORT REQUIREMENTS
Reading Assignment	Number of document visits
	Time spent in document
	Training objectives experienced
Pretest (and Posttest)	Time spent at the question level
	Scores at the question level
	Completion status
	Overall time in test
	Overall score
	Comparisons between pretest performance and posttest performance.
Virtual Simulation Session	Prescribed lesson remediation sequence (based on pretest)
	Amount of time spent on each task
	Amount of time spent in sim overall
	Learner errors at the task level
	Time spent in each lesson
	Total number of errors overall
	Training objectives experienced

In addition to the report types, we also needed to determine performance data that would be used for adaptive learning. The ISD team provided learning path branches to the developers. Figure 2 shows how our branching path was communicated. This level of detail goes beyond what is normally provided in a handoff, but was an essential extension of required tasks.

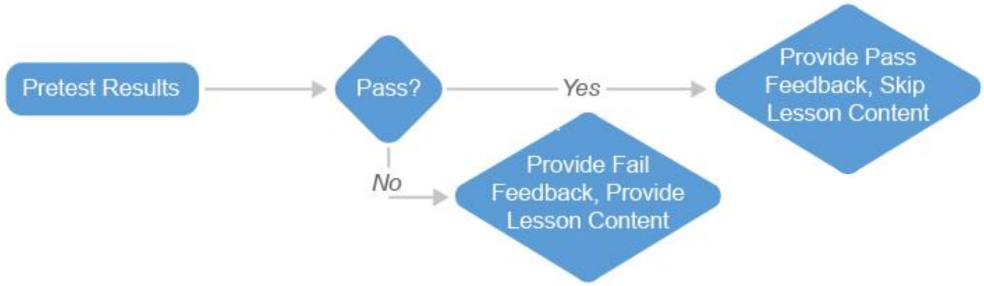

Figure 2. Learning Path Branches

ASSESSMENTS/ANALYSIS

In this study, assessments were used both for formative and for summative evaluation. In addition to the normal end-of-test feedback provided to the learner, we also leveraged the LRS for real-time branching decisions. As the learner entered the virtual reality GCS simulation session, a call was made to the LRS to retrieve the pretest results for the learner. These data were used to provide an adaptive branch within the simulation itself. If the learner passed the pretest, then the learner was allowed to bypass the embedded lesson. Based on post-study interviews, novelty of the simulation experience and individual curiosity were some of the reasons provided for choosing the full path, even if not required.

Analysis was performed using Excel pivot tables, based on the data exported from the LRS. While it is important to determine the types of Reporting and Analytics prior to the Design phase, the small sample size limited the types of reports produced for this effort.

LESSONS LEARNED

xAPI Statement Complexity

One of the big lessons learned is how much thought must go into statement generation. While the xAPI specification requires only the Actor/Verb/Object fields, the reality is that additional information is required in order to provide effective reporting. Context can provide data regarding the hierarchical structure of the experience. For example, it can be used to denote that an activity is part of a class, which is part of a curriculum, which is part of a program. It can also be used to specify the instructor who taught the activity.

The Results field provides more granular data regarding scores at the test and question-item levels. Without results, we would only be able to see overall completion at the test level. Extensions provide extra details, which offer more insight to the analyst. For example, specifying that the activity took place in windy conditions. However, extensions should be used with caution; consider that "windy" should be operationally defined and could mean different things to different people. The same is true for verb statements, which is the reason we added descriptive definitions for each verb as part of the standard in our DoD ISD profile.

Other statement fields include duration, timestamp, authority (who is making the statement), and void – which tells the LRS to void a previously made statement. One issue we encountered concerned the timestamp. ISO 8601 specifies the format of the timestamp, which xAPI references (Downes, 2014). However, even with ISO compliance, timestamp formatting can differ, depending on the programming language (and library) used to create the content. When multiple languages and authoring tools are used to build the content, the development team must be cognizant of the potential discrepancies that could exist and address this early in the design process. Table 5 contains the full list of xAPI statement fields.

Table 5. xAPI Statement Anatomy

STATEMENT FIELD	REQUIRED/ OPTIONAL	STATEMENT FIELD DESCRIPTION
Actor	Required	Person (agent) or group. This denotes the person performing the activity.
Verb	Required	Identifies the action of the actor. Verbs require unique identifiers. There are Communities of Practice that are defining xAPI vocabularies. Test: DOD ISD Profile
Object (Activity)	Required	The thing on which the Actor took action. It could be an activity, another agent or group, or a sub-statement. Activities also require unique identifiers.
Context	Optional	Defines associations between activities and other important information (instructor, class, location, revision, etc.)
Result	Optional	Details related to a score or duration, completion status, etc.
Extensions	Optional	Extended details related to the statement. Test: mastery score required for completion.
Other Statement Fields	Optional	Test: duration, timestamp, authority, void, etc.

When dealing with large training classes that encompass several weeks or more, the complexity of the statements increases. Some best practices to help overcome these challenges include the use of Verb Profiles and the development of an Activity ID Registry. This ensures that we provide consistent statements to the LRS. Any changes to courseware should use the context attribute to denote the revision number, while keeping the original Activity ID intact.

Agile Project Management

Clearly conveying the expected experience to the development team became evident early in the design/development of our prototype. Flowcharts depicting branching events are imperative to ensure developers build out the events in the intended sequence. Storyboards ensure learner actions are performed in the correct manner.

Due to the ever-evolving changes in technology (gamification, augmented and virtual reality), media choices that were most optimal a few months ago may no longer be the best choices. It is imperative that the Design and Development teams stay connected throughout the process. The traditional waterfall approach to project management, with each team passing their outputs on to the next team, might not be the best approach to managing these type of projects. Small collaborative teams with representations from all parties involved at all stages is paramount to success. The agile methodology of iterative sprints works well with this type of project.

Learning Analytics and Reporting

xAPI totally changes the landscape of learning analytics and reporting. Due to the immediate availability of performance data, new opportunities exist in formative evaluation. We have the ability to provide feedback to the learner and the instructor (if present). How and when this feedback should be presented is something we must consider, while also securing that data. In addition, reporting can provide metrics for branching decisions, allowing for remediation where appropriate. Due to the vast amounts of data sources never before available, summative evaluation is also changing. Trend analysis reports that show correlations between past/future performance are more readily available. We must ensure we understand the reporting requirements in advance of design. Otherwise, we might be capturing data that are not necessary or not enough to meet the reporting requirements.

MIGRATION METHODS

Many training programs are primarily classroom-based and nondigital. Learners receive printed copies of student manuals, and lessons are primarily lecture-based. xAPI requires some form of migration to a digital format. If we are unable to migrate the event itself, then providing a means to capture the memory of the experience in a digital format is essential. Possible examples and remediations are described in the following sections.

Reading Material

It is likely that a digital source file already exists, so most reading material will not require migration. The digital file provides a convenient mechanism for viewing the content from an electronic device. However, getting user-experience details to the LRS requires additional effort. For this study, we found that the PDF/DOC file format does not lend itself to embedding xAPI statement calls. Sectioning reading materials into small PDFs, then embedding them into web pages enabled us to build “wrappers” around the content that could send/retrieve statements from the LRS. Once the wrappers in are in place, the design team can easily determine the level of tracking granularity needed. Our approach was to connect content read to the lesson objectives and track the time spent reading.

Instructor Briefings/Lectures

In many cases, these activities have sources that are digital (e.g., instructor manuals); however the delivery and tracking of performance is nondigital. Tracking is usually on a printed form that requires manual input into a database. There are a couple of ways this can be addressed:

- Electronic Gradebook – this is probably the simplest mechanism. Learners authenticate their credentials when entering the lecture/briefing. This can be done using a QR code from a phone, a CAC card, or other digital means of acknowledging attendance. The instructor would enter learner performance details using a predetermined checklist, which would capture activities in the form of xAPI verbs matching the training objectives.

- Virtual Digital Instructor – converting the lecture/briefings to a digital self-paced lesson. There are potential drawbacks in that AI must be built into a lesson so we can provide the appropriate level of content. For lessons that are familiarizations, this is more of a possibility. Using xAPI, we can track learner performance throughout the lesson and even combine that with tracking that occurred in previous activities. In our study, we built a virtual instructor into the simulation. The content taught in the lesson was based on performance in the pretest. In future research, we plan to build this out into more extensive branching. Another drawback to virtual digital instruction is determining how to provide responses to learner questions that arise during the training. There are a couple of ways this can be addressed: one way is to provide a chat box that allows learners to enter their questions to a facilitator that is available during the instruction; another way would be to provide listening devices that are AI-based, such as Alexa/Google Home. Over time, these would continue to evolve and increase in capability.

Informal Learning Events

Informal event transactions include conversations held with peers/coworkers, online research, reading printed literature, watching a performance, attending a conference, etc. Even if the event is nondigital, in most cases there is a method in which these can be tracked in a digital format. It might take the form of a self-acknowledgement or an entry into a blog or online discussion.

XAPI STRATEGY

Because xAPI statements are used to convey “experiences” that an agent interacts with, they are very open in nature. If we don’t consistently apply xAPI statements, we get a data set that has many loose ends and is difficult to analyze. xAPI profiles and templates are a reusable and referenceable strategy to help systems use the data in xAPI statements more effectively. ADL’s profile specification serves as a companion to the core API specification. Official profiles are curated by ADL in their xAPI repository.

Our strategy was to establish data standards specific to military training (*Development of Interactive Multimedia Instruction*, Part 3 of 5, 2001). We developed the DoD ISD profile capturing over 400 verbs that correlate to military-oriented training objectives. The profile includes metadata identifying each verb’s relationship to a skill, knowledge, or attitude (SKA), verb category, and the level of interactivity used (AFH 36-2235, V3, 2002). We expect that consistent use of this profile (as learners progress from knowledge to skill training) will allow us to accurately measure how they develop as individuals and as a collective across many training programs over time.

CONCLUSION

xAPI is still in its infancy, and many of the building blocks are still a work in progress. Regardless, the need for change is great, and the stakes are high. As mentioned in the introduction, the Department of Defense acknowledges that we must find better ways to train if we are going to keep up with our adversaries. Much of this begins with the digitization of training content traditionally delivered in a nondigital format, and the inclusion of xAPI statement calls to collect data on a learner's interactions. Due to the high percentage of informal learning, these types of experiences must also be included in our data collection methodology.

This study demonstrates that xAPI allows for greater insights into learner engagements compared to traditional tracking mechanisms. It shows that xAPI enables training to adapt immediately to the learner's needs, thereby personalizing the training paths taken. Further studies are required to determine the overall impact this will have on required training times and subsequent job performance.

There are implications with this new technology as well. The need to maintain privacy and keep high levels of authentication security are issues that all companies must address. In addition, standardization of xAPI statements and profiles are paramount to successful implementation. As training providers, we must work together to ensure our products align with each other, otherwise the customer will have conflicting data that can't be used in a meaningful way. Our study was meant to focus on xAPI/LRS data collection in general. Future studies will include research into the issues mentioned here. Joining a Community of Practice will help ensure that we are embracing the standardization of this technology. We encourage everyone who is embarking on this journey to seek those out as much as possible.

ACKNOWLEDGEMENTS

This work would not be possible without the significant development of xAPI provided by the ADL Initiative. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing official policies, either expressed or implied, of the ADL Initiative, U.S. Department of Defense, or U.S. Government.

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