WHITE PAPER

xAPI: Beyond the Hype

Contents

Introduction

Every professional has tools that are unique to their trade. Farmers use tractors, doctors use stethoscopes, and accountants use spreadsheets. The tools we use not only shape the work we do, but also affect the way we think about the work we do. They change the way we solve problems in our particular field.

A relatively new tool has emerged within the field of instructional design. Experience API (otherwise known as “Tin Can” or xAPI) is a technical specification for learning technology that allows instructional designers to collect data from various sources about their learners into a single location. From there, instructional designers can work with data analysts to figure out what works best for their learners and redevelop their curricula in a way that takes into account the needs of their learners. This iterative, data-driven approach to instructional design results in a better learning experience for users.

In this white paper, we define the basic terminology, history, and functionality of xAPI from an instructional design perspective. We also explore four case studies which highlight the usefulness of xAPI in instructional design and provide a number of potential use cases for various stakeholders.

xAPI Overview

SCORM has become a foundational component of the eLearning community since its inception in 2000. Although it has been updated since then with the release of SCORM 2004, some educational technologists argue that SCORM is outdated and that a new set of standards need to be set in place. This is because SCORM is relatively limited in the data it can collect about its learners. It can track completion data, whether the learner passed or failed, and report a single score for each learner, and (when both the SCORM authoring software and the LMS behave) responses to checks on learning, but in practice that's about it. Instructional designers are no longer finding these metrics about their learners to be sufficient. They want to know more about their learners and their learning environments.

Enter xAPI. Many instructional designers believe that xAPI will be the next generation of SCORM. SCORM currently tracks the learning that takes place inside of an LMS without considering the learning that takes place outside of the LMS such as informal learning, classroom learning, or on-the-job learning. xAPI is useful in that it allows instructional designers to collect data about their learners that they otherwise wouldn't be able to collect with SCORM.

For example, we know that the majority of learning takes place outside of formal learning contexts (Cross, n.d.). People tend to prefer what's known as informal learning, or learning that does not involve an explicit curriculum and takes place in context. Informal learning might take the form of participating in a relevant social media group, watching informative videos on YouTube, or working through an app on a mobile device. These are noteworthy ways that people learn, but under the current SCORM framework, we are not able to capture how people are learning in those environments. This is the problem xAPI aims to address.

xAPI captures learning data which is transmitted and stored as statements about activities in which learners have engaged. Statements include an actor, verb, and object. For example, if Jane read a book on instructional design, that information would be stated as Jane (actor) read (verb) Introduction to Instructional Design (object). That statement would be transmitted to what's known as a Learning Record Store (LRS), where it would be stored. This method of data collection can be as granular as the instructional designer would like it to be. xAPI could track whether Jane finished a chapter of her book rather than whether she read the entire book (or both.)

These activity statements are saved to the LRS. An LRS is a database that receives, stores, and returns activity statements. The LRS is a necessary component of implementing a project with xAPI; otherwise, the xAPI activity statements will not be stored. The LRS stores xAPI statements in ways that make the data easy to analyze (e.g., which students watched the assigned video to completion? On average, how much time did the students spend watching the video?) Many LRSs have data analysis tools built into them, making data analysis easier for the instructional designer. Some LRSs even have data visualization tools.

According to Rustici Software (2016), there are three main types of LRSs:

- Learning Analytics Platforms pull in learning and performance data from a range of sources to be compared and analyzed to provide actionable insights.
- OEM LRSs are designed to sit behind another product such as an LMS or authoring tool to provide LRS functionality. They are less fully featured than a Learning Analytics Platform, as it's expected that the system it's integrated in will provide those features. (OEM stands for "original equipment manufacturer". In software terms, that means code that's integrated inside another product.)
- Testing and Development LRSs give detailed debugging information for developers working with Tin Can.

The following table is a comparison of each type of LRS:

	Learning Analytics Platform	OEM LRS	Testing and Development LRS
Powerful reporting and analytics built in	Yes	No	No
Detailed error messages and debugging information	No	Yes, but specific to the LRS	Yes
Designed for production use	Yes	Yes	No
Learner interface	May have limited learner facing features	No	No
Power user (admin, analyst) interface	Yes	May have a limited interface	Yes
Developer interface directly explore raw LRS data	No	May have a limited interface	Yes
Useful to organizations	Yes, to provide actionable insights from training and performance data.	Yes, to add LRS functionality to an existing product.	If developing in-house.
Useful to activity provider vendors	In later stages of development to test compatibility with reports. Could also be used to prove the value of their product to customers.	If an LRS is required as part of the product.	Yes, to test and confirm interoperability.
Useful to LMS vendors	Potential to integrate a Learning Analytics Platform into the LMS	Yes, to incorporate an LRS in the LMS	Yes, to test and confirm interoperability.

Key Takeaway

Although SCORM has been a mainstay in the field of instructional design, it doesn't provide the rich data that instructional designers need to inform their curriculum design. xAPI captures data from various sources and stores all the data in a single Learning Record Store. Once the data has been stored, instructional designers can use built-in data analysis tools to answer questions they have about their learners.

History and State of xAPI

In 2008, Learning Education Training Systems Interoperability (LETSI) was formed in order to create an updated version of SCORM (Advanced Distributed Learning, 2015). LETSI asked for the e-learning community's ideas. This resulted in over 100 white papers about possible directions for and beyond SCORM. In 2010, Advanced Distributed Learning (ADL) awarded a Broad Agency Announcement to Rustici Software to conduct research and community interviews to begin the creation of the next generation of SCORM. The first version of xAPI was officially released in April of 2013. It has been updated with some frequency since then.
There are currently over 160 known adopters of xAPI (Rustici Software, 2016). However, SCORM is still prominent within the e-learning community. There are a few reasons for that:

1. xAPI is still fairly new from a technological perspective. It takes time for standards to be adopted and implemented within the e-learning community. However, fewer and fewer people within the e-learning community have never heard of xAPI.

2. There is generally some confusion around the names used to describe the standard. It is known as "Tin Can", "Experience API", and "xAPI". Instructional designers can easily assume that these refer to three different standards when they actually all refer to the same standard.

3. It requires the implementation of an LRS. It is not possible to implement xAPI without having an LRS. This becomes a chicken and egg problem: companies are reluctant to spend the time and effort to run an LRS until they have a good use case for xAPI, but they can't use xAPI until they have an LRS.

4. xAPI requires tools or coding capability to build the "experiences" that make xAPI statements to the LRS. In other words, most programs don't natively generate xAPI statements.

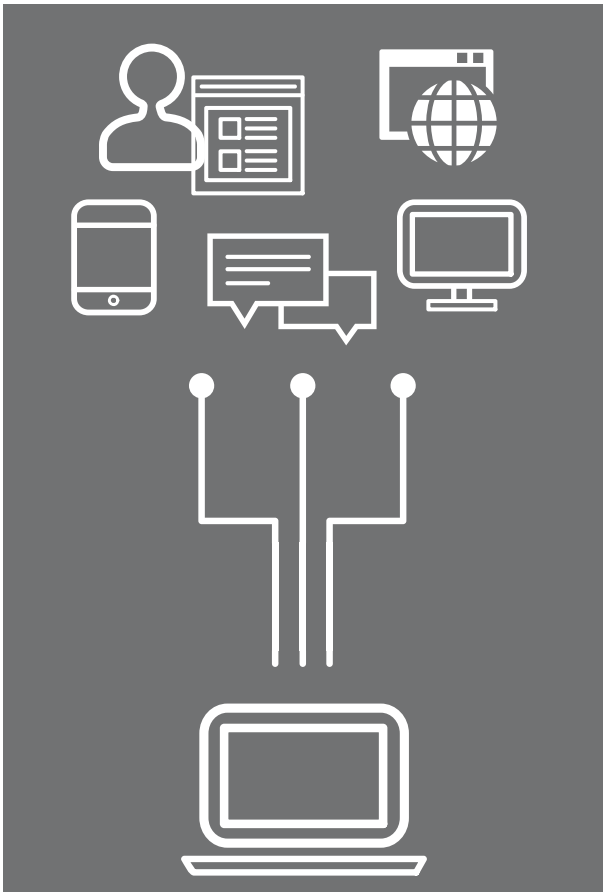
Members of the e-learning community are optimistic about the widespread adoption of xAPI. xAPI is being used by instructional designers all across the globe. The hope is that the adoption of xAPI will reach a critical mass and will become a standard tool in instructional designers' toolkits.

Key Takeaway

xAPI was developed as a response to the e-learning community's desire for an updated version of SCORM. It was initially released in April 2013. Although there are a few reasons why xAPI hasn't been widely adopted yet, xAPI supporters are hopeful that it will see wide adoption by instructional designers.

Data Sources

xAPI allows instructional designers to gather data from various sources without being constrained by an LMS. These sources may include sensors, YouTube videos, and blogs, among many others. But these various sources pose a problem for instructional designers: how do you get these data sources to generate xAPI statements? This is not a problem with a simple solution. Some educational programs have already started to give users the option to generate xAPI statements. Additionally, various companies have been developing middleware that take data from data sources and translate that data into xAPI statements that can be stored into an LRS. The following table lists a number of programs that generate xAPI statements. This table was derived from a list of certified data sources from Watershed LRS (2016), one of the leading companies of LRSs.



Traditional LMS	Traditional SCORM Authoring	Specialized Authoring Tool	CMS	Middleware
Moodle	Storyline	OpenLabyrinth	WordPress (GrassBlade xAPI companion)	Zapier
RISC VTA	Lectora	H5P		xapiapps
DigitalChalk	dominKnow	SurveyGizmo		SCORM Cloud
Opigno	iSpring			

In what follows, we describe three case studies that have successfully implemented xAPI into their curricula. We describe the context in which xAPI was implemented, the curricula, and the results and impact of the xAPI implementation.

MedStar Health: Code Blue

xAPI can be used in ways that can literally save lives. Consider MedStar Health's Code Blue simulation (Bauer, 2016). In medicine, a "code blue" is when a patient requires resuscitation or is in need of immediate medical attention, most often as the result of a respiratory arrest or cardiac arrest. The speed at which the staff responds, as well as the ability of the team to effectively communicate what everybody's roles should be, have a significant impact on whether the patient lives or dies. Medical staff need to be well trained in order to respond with the speed and communication skills necessary to save the patient.

MedStar Health tackled this particular problem by developing a curriculum that incorporated xAPI all throughout. Like many educational programs, they took a multifaceted approach. Staff members completed courses on the topic, which were either online or in person. Next, staff members completed a simulation in the form of an app. It is a mobile defibrillator app that teaches staff members how to use the equipment and about the steps in the procedure of running a code. The app is available on iPad and through MedStar Health's learning management system. Finally, staff members completed what is known as a "mock code". A mock code is when staff members practice responding to a code blue on a mannequin. Mock codes happen in the hospital and ideally are not known by the staff ahead of time, so staff come into the unit thinking it's a real code. They've been coached to treat it as if it were a real code blue.

xAPI recorded the data from these different curriculum components. Course completion data was submitted to the LRS for the online and in-person courses. The app recorded each of the learners' steps throughout the simulation and whether the learners passed or failed the simulation. Finally, an observer recorded data as medical staff completed the mock codes. There are three key performance indicators that are collected from the mock codes that also applies to a real code as well: the time to start CPR, the time to defibrillation (the first shock that is delivered), and the time before the first dose of epinephrine is administered. Those three are known national benchmarks for successful resuscitation. Additionally, the observer records how effective the communication was between the staff members, whether the defibrillator pads were placed correctly, and whether the proper equipment was in the unit.

"The speed at which the staff responds, as well as the ability of the team to effectively communicate what everybody's roles should be, have a significant impact on whether the patient lives or dies. Medical staff need to be well trained in order to respond with the speed and communication skills necessary to save the patient."

By collecting data from these various sources, MedStar Health was able to draw a few conclusions about the effectiveness of their curriculum. For example, on the app, they noticed immediately that people were failing a specific step: placing the pads on the patient. This was unexpected to them, so they went to the American Heart Association coordinator who runs the program. She indicated that they generally don't see learners failing that step either in the mock codes or in the classroom. MedStar Health went back to the app and noticed that this step required the user to hit a button that was out of view, so they changed their user interface design. Additionally, the data indicated that the medical staff weren't using a backing board for CPR, which is one of the steps of responding to a code blue. Finally, MedStar Health noticed that there were communication issues between the staff members, specifically around identifying team member roles. They were able to use this data to inform instructors of common issues surrounding code blue so that the instructors could update their curricula.

SIDEBAR: Interview with Andrew Downes

Andrew Downes is an author of the xAPI specification and much of experienceapi.com. As a recognized xAPI expert, Andrew maintains a number of open source code projects, including two xAPI-related Moodle plugins. He's also a contributor to several other open source projects, including the Learning Locker LRS.

We've heard that creating xAPI-compliant experiences that go beyond "what you can do in SCORM" effectively still requires software development. Do you think this is true, and when do you think this might change?

"No, I don't think this is true. We're seeing increasing numbers of new products and classes of product appearing that aren't tied down by the SCORM legacy, or products that never fitted the SCORM paradigm (like survey tools) adopting xAPI. You can use these to go beyond SCORM without having custom software development.

There's more truth to this if we're just thinking about originally SCORM based e-learning authoring tools...The problem is that these authoring tools work on a 'build it once, publish to SCORM or xAPI' philosophy. That sounds really good, but actually it just means that they can't give you any functionality that won't work in SCORM. I was speaking to another vendor at DevLearn who told me they're planning on incorporating xAPI-only interactions, which is where I think we'll see these tools moving beyond what's possible with SCORM."

Key Takeaway

MedStar Health showed that xAPI can be used both to improve the design of high-fidelity medical simulations, and to better evaluate the results of the simulations. MedStar Health used xAPI to gather data from a various number of sources within a medical curriculum. The results indicated that the app's interface design was confusing users and that medical staff responding to a code blue tended to not use backing boards for CPR and had communication issues. MedStar Health was able to use this data to update both its educational app and its curriculum in order to create a better learning experience for medical staff.

SIDEBAR: Interview with Nick Washburn

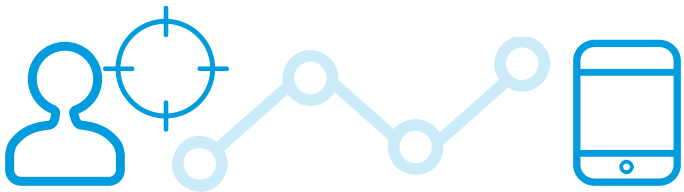
Nick Washburn is the lead of the Riptide Software Learning Division, with large scale clients in the commercial, Department of Defense and government, and higher education sectors, bringing Riptide Elements enterprise learning products to the web/mobile international market.

"One of the great things about xAPI is it's not just for distance learning so you can literally use xAPI on any type of training project or learning project that involves technology. We're using it to create listening events, to train people how to use software as an overlay on software training; we're using it to do the same thing when we're trying to prove competency, that the person actually learned the software. So we're listening to the right events and tracking what they do using xAPI and doing competency based assessments…If it involves training and there's some technology involved, you can use xAPI to understand what the person did, that act or verb object, I did this, and the series of things that they did in order to have some kind of outcome. It's really, really flexible in that respect."

Ann Arbor Hands-On Museum's Personalized Interactive Exhibits: DEEP

The Digitally Enhanced Exhibit Program (DEEP) works with the Ann Arbor Hands-On Museum in order to provide an interactive, informal learning experience for students (RipTide, n.d.). The Ann Arbor Hands-On Museum boasts over 250 exhibits in 40,000 square feet of Museum floor, as well as classroom, outreach, and distance learning programs. The goal of this particular project was to 1. address the disconnect between students' experiences during a field trip and the reports on student learning and 2. tie learning activities to state curriculum standards. The result was a more personalized learning experience for students and better reporting for teachers.

The DEEP program provided students with name tags that included a beacon with a unique identifier. Beacons are small wireless transmitters that emit a signal recognized by Bluetooth-enabled devices within range. These beacons interacted with tablets that were mounted on the wall next to the exhibits. The tablets would then display relevant, grade-appropriate curricula to the students. For example, if a fifth grade student approached the tablet, the tablet would display fifth grade level content, but if a third grade student approached the tablet, it would display third grade level content. Using xAPI, the tablet recorded the students' responses to various questions and activities, the amount of time spent on the questions, who was there at the time, and each of the questions' corresponding curriculum standards. This all occurred without the students having to log into any program as they would have to with a SCORM.



Typically, when students visit a museum, there is little tracking of their learning experiences. Sometimes a teacher will assign a worksheet for the students to fill out, but that's about it. With xAPI, DEEP was able to track each individual student's responses to the questions about the exhibit. This allowed the museum to print out individualized reports of each student's learning experiences and the details of their day at the museum. This also allowed the museum to collect data on how well the students were responding to the questions and interacting with the exhibits so that they could better prepare their exhibits in the future. DEEP also provided reports to teachers who could see how their students were meeting state curriculum standards during their museum visit.

Key Takeaway

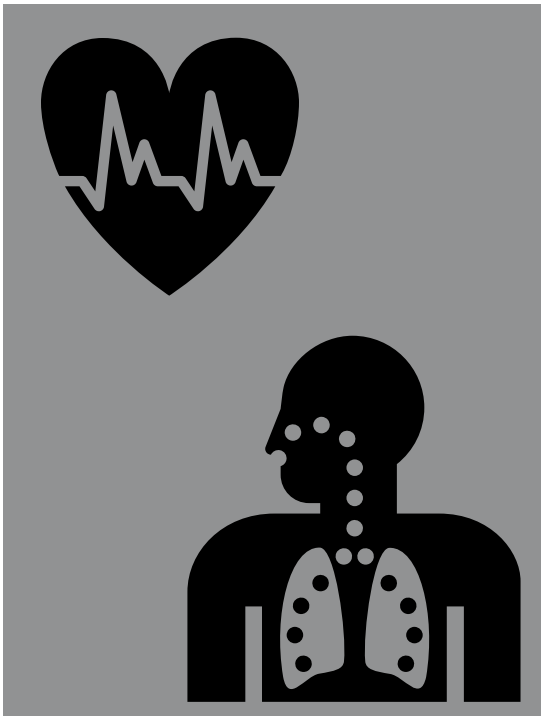
Using xAPI, DEEP was able to provide individualized learning experiences to the students visiting the museum. Using beacon technology, the tablets could detect the students' grade levels and provided individualized curricula to the students. The LRS used the data collected through xAPI to produce reports to the students, teachers, and museums that could enhance the museum learning experience.

CHEST Simulation

The American College of Chest Physicians (CHEST) works to improve patient outcomes through innovative chest medicine education, clinical research, and team-based care (American College of Chest Physicians, 2016). Their mission is to champion the prevention, diagnosis, and treatment of chest diseases through education, communication, and research. They are the first medical association with a clinical simulation program accredited by the Society for Simulation in Healthcare. In addition, CHEST also provides hands-on training through innovative simulation education.

CHEST partnered with Web Courseworks to use their Learning Management System (LMS), CourseStage, and xAPI, in order to track data from medical simulators for some of their live courses.

One of these courses, a four-day course called Difficult Airway Management, was the pilot for CourseStage LMS and xAPI. During the course, a medical simulator tracked data, such as time between drug administration and intubation, as the physician-learner worked on a high-fidelity mannequin. Previously, the internal reports were unable to be recorded in CourseStage. A CHEST physician-instructor would observe the learner as they performed the procedures, and utilized a checklist on an iPad to mark if the procedure was performed correctly. The iPad was connected to CourseStage, in order to record the observer's data into the learner's transcript. However, this was only qualitative data, limiting how much feedback the instructor could give the learner. To connect the missing data from the mannequin to the learner's transcript, Web Courseworks built a translator to take data and send it, via xAPI, to a Learning Record Store (LRS). The LRS connects to CourseStage, allowing the data from the simulator to be recorded in the learner's transcript, in addition to the checklist data. The use of xAPI to retrieve the mannequin's data allows for quantitative data, in addition to the qualitative data, to be recorded in CourseStage. This helps CHEST's faculty and instructional designers better evaluate the learning activity and performance of the learner.



John Ehringer, Director of Technology at Web Courseworks stated, "We're really excited about xAPI. Primarily because we can collect data from sources we weren't previously able to in a standard way.... [We can] correlate [data] and aggregate [it] in a standard way to identify new pieces of information we didn't previously have access to."

SIDEBAR: xAPI and Caliper

xAPI, developed by ADL, works on what is known as an "activity streams" framework (Griffiths & Hoel, 2016). This was a framework developed by IBM, Google, Microsoft, MySpace, Facebook, VMware and others in order to create an interoperable format for exchanging and syndicating information about activities from social media. Activity streams consist of an actor, a verb, and a target.

Caliper, another learning analytics specification developed by IMS, also uses that same basic structure. Caliper users include: Blackboard, D2L, Elsevier, Intellify Learning, Kaltura, Learning Objects, McGraw-Hill Education, University of Michigan and VitalSource Technologies. The main differences between xAPI and Caliper are:

1. Licensing. Caliper users are not allowed to create modifications or derivatives of IMS documents unless they are granted permission to do so. This is done to ensure the quality of the programs running Caliper. xAPI users are granted permission by ADL to create and distribute modifications of the specification as they see fit for their community. This allows xAPI users to manipulate xAPI in ways that work best for their particular projects.

2. Vocabulary. Caliper provides a "metric profile" which predefines a format for learner activity for data collection. xAPI expects communities of practice to come together to define their own statements and activities.

3. Context. Caliper tends to be a standard solution for enterprise sized LMSs and large scale applications that communicate with LMSs. xAPI tends to be implemented in professional learning contexts in order to capture learning events that occur outside of the LMS.

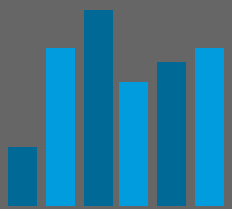
Members of the xAPI community and the Caliper community hope to find ways to align the two specifications in the future.

Using xAPI in this way has various benefits for the physician-learners and the physician-instructors. Previously, instructors had no way to access the data that was saved from the mannequin. Although running through the simulation was certainly useful for the learners, having the data for the exact moment drug administration and intubation occurred allows the instructors to provide more detailed feedback regarding the learners' performance. The instructors can also track learners' improvement from before completing the course to after completing the course. This study will ultimately help CHEST set benchmarks and demonstrate physician-learner improvement in these live courses.

One instructor from CHEST commented, "[xAPI] could actually give us some metrics to assess what happens at what point for each learner, or across all the learners… a lot of the benchmarks and data points we find are after the fact; not necessarily things that we look for specifically… We can go back and look for different benchmarks that we weren't initially evaluating, or we may find new data points that may be significant as well."

Key Takeaway

CHEST used xAPI to gather data from a high fidelity mannequin and from an observer in the room in order to provide detailed feedback for physicians who were trying to learn how to properly intubate difficult airway patients. The data extracted from the mannequin allowed instructors to evaluate pre to post learning outcomes in the LMS as well as begin to set benchmarks for physicians nationwide.

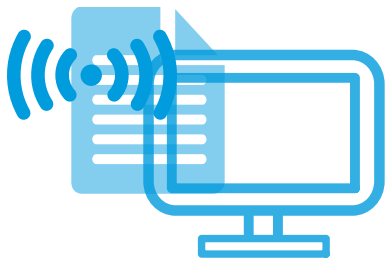


MedBiquitous Learning Experience Working Group

MedBiquitous is an accredited developer of IT standards for healthcare education (MedBiquitous, 2015). They aim to improve patient care and reduce administrative work through educational technological solutions. In addition, they provide a neutral forum for educators and industry leaders to exchange ideas about the ways in which technology can be used to improve healthcare education. In order to address problems about collecting learner performance data, MedBiquitous established what is known as the Learning Experience Working Group. The Learning Experience Working Group's mission is to develop a set of xAPI profiles for collecting data from: simulations, mannequins, virtual worlds, games, and clinical training activities and experiences.

One group presenting at the MedBiquitous annual meeting was interested in exploring what biometric data could be captured and correlated with to learning data using xAPI on a relatively small budget (Topps et al., 2016). In particular, they were interested in exploring what could be done with cheap sensors and simple computing cores available on the Arduino platform, which is designed for hobbyist use and very low budgets. They decided to develop a stress test using a combination of heart rate and galvanic skin response sensors. This stress test measured their participants' responses to high pressure, timed virtual patient cases.

There was no pre-existing infrastructure for the Arduino sensors to send the sensor data to the LRS. Rather, they had to develop the middleware themselves. They hired a computer science student for course credit to figure out how to convert the sensor data to a format that could generate xAPI statements. In doing so, they were able to track activity data from a variety of sources simultaneously, including: heart rate, galvanic skin response, click stream data, decision tree responses in a virtual patient simulation, and question responses. They then visualized their data using the data visualization tools available in LRSs such as GrassBlade and Watershed.



Key Takeaway

The researchers presenting at MedBiquitous used Arduino sensors, among other sources, to demonstrate that it is possible to capture interesting data streams using inexpensive equipment and xAPI programs. Because there was no pre-existing software to generate xAPI statements from the sensor, they had to develop the middleware themselves. As a result, they were able to collect data from a variety of sources simultaneously and then visualize that data using built-in LRS tools.

Use Cases

In the previous section, we reviewed four different ways that xAPI has been used. We will now explore different ways in which xAPI could be used. This table is the result of our own brainstorming; we look forward to seeing the innovative ideas our fellow instructional designers develop.

Stakeholder	Goal	User Experience	Technology Tracking	Reporting
Training Manager	Measure the mentoring between senior and junior employees	Sending messages on Slack	Custom middleware	Frequency of chats
Instructional Designer	Track which employees are accessing job aids	Accessing job aids on the company's WordPress webiste	GrassBlade xAPI companion on WordPress site	Reporting views by job aid, by individual, and by department
Instructional Designer	Track which videos employees are watching	Watching a video on YouTube	Rustici's xAPI YouTube Software	Track whether employees complete watching videos (or, if not, when employees stop watching them) by video and by department
Instructional Designer	Measure how much participants enjoyed a conference session	Completing a survey about the conference session on the conference app	Custom middleware	Calculate an overall average enjoyment score and then break it down item by item
Instructor	Report data collected by students back to the students	Collecting water samples from a creek and running chemical tests on them	Custom middleware	Generate a report with the students' findings about the water samples
Chief Technology Officer	Create an integrated view of learning data with other applications	Interacting with each component of the learning system: the LMS, HRIS, CRM, mobile app etc.	Custom middleware	Collect all data from various components of the learning system into a single LRS

Conclusion

xAPI is a relatively new standard that allows instructional designers to make informed decisions about their curricula. It allows instructional designers to collect data from various sources into a single repository where instructional designers can get answers to the questions that they have about their learners and their learning environments. Using xAPI grants instructional designers the freedom to use resources beyond the realm of SCORMs while still being able to gather important information about learners. xAPI has the potential to be a powerful new way to solve problems within instructional design.

For More Information

Web Courseworks

www.webcourseworks.com

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